AI AND ML
POWERING THE AGENTS
OF AUTOMATION

Demystifying, IOT, Robots, ChatBots, RPA, Drones & Autonomous Cars-The new workforce led Digital Reinvention facilitated by AI & ML and secured through Blockchain

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by

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About the Author

DEEPIKA M

http://linkedin.com/in/deepika2019

Deepika is CCNA/CCNP/CCIE certified Computer Engineering graduate and a Cybersecurity professional with over four years' of experience in Networking and Cybersecurity from Cisco. She has completed her MBA in General Management with specialization in Finance, Marketing and Analytics (Trained in R and Python) from Asia School of Business, Kuala Lumpur, in collaboration with the MIT Sloan School of Management. She is a R3 Corda certified Blockchain and Distributed Ledger Technology Evangelist. She received a scholarship at Stanford Ignite 2017 for her Entrepreneurial Development Program.

SRINIVAS MAHANKALI

http://linkedin.com/in/srini-ults

Srinivas Mahankali is an alumnus of IIT Madras and IIM Bangalore and heads the Blockchain Center of Excellence at ULTS (ULCCS Group, Calicut, Kerala). He is certified in Lean Six Sigma, NCFM Level 2, Capital Markets and R3 Corda. He is the author of the book Blockchain–The Untold Story and also co-authored, Successful Organizations in Action. Blockchain–The Untold Story is deemed to be the first book to be translated from English into Chinese by Artificial Engineering Bots.

VIJAY K. CUDDAPAH

http://linkedin.com/in/vijay-kumar-0706858

With a Masters degree in Business Management and a B.Sc. degree in Computer Science, Vijay is responsible towards Technology/Functional Development and Strategic Planning in IOT, AI and Analytics organizations. He has 10 years' of experience in project development, deployment and delivery. He has experience in multiple areas such as Analytics, Machine Learning, Information Technology and Consultancy-related Services. He is passionate about drones and diverse technologies ranging from Analytics, Machine Learning, Simulation, Automation, Tools development, and Application Development across different verticals. He has significant experience in research methodology, design and conducting large-scale surveys and analysis.

AMITENDRA SRIVASTAVA

http://linkedin.com/in/amitendra-srivastava-a5007844

Amitendra holds a post graduate diploma in Business Administration from ISCS, Pune. He has more than 14 years of rich corporate experience in training delivery and analytics product development. He has worked with HDFC Bank, Redwood Associates and Analytics Training Institute. He is extremely passionate about Analytics, Statistical concepts, Deep Learning and AI, Predictive modeling, Video Analytics and Autonomous Vehicle Technology.

Acknowledgements

Preface

We live in an autonomous world. Billions of people and many more trillions of living organisms are using the resources of the universe which are apparently not made by living organisms but by the laws of nature.

The sun, moon, stars and the forces of nature are going about their paths in a routine manner for billions of years giving us seasons and all the great experiences.

The human being's quest for unearthing 'God' or emulating Him by any means is manifesting in a number of ways, including the launch of autonomous devices and humanoids, that one day they may be more ubiquitous than the human beings.

Unmanned spacecrafts that hit their targets precisely on another planet are indeed a wonder to many.

The same autonomy is deemed to be transplanted into many more aspects of our modern life.

Chatbots, voice assistants, drones, AI-enabled robots and autonomous cars are now being 'employed' increasingly.

On the other hand, we have seen the launch of Bitcoin Cryptocurrency which has become the largest unmanned, unowned and unmanaged peer-to-peer network running on its own as a 'Decentralized Autonomous Organization' without any interference for over 10 years. We are witnessing an increasing trend towards autonomy, decentralized approach, open source, and pay-as-you-go approaches.

Where this all will lead to is anyone's guess or a calculated forecast.

But it is imperative for us to take a close look at these developments, understand their dynamics and be prepared for the future.

We should be knowledgeable enough to foresee and leverage the forces of disruption and stay ahead of the rest. Only then our survival is assured, lest we would be blown away by these powerful waves of disruption. This book 'Agents of Automation' takes a close look at the

various disruptive technologies that are shaping our world and enables everyone to take a pragmatic view to leverage them to 'Augment' our performance by making them our 'Agents' too.

Further, the power and utility of Blockchain is well examined as a tool to de-risk the growing threat of malware attacks and cybercriminals that could not only be a spoil sport but also provide dangerous twists along the way.

Blockchain allows us to scale our automation by striking the threats of data breaches and cyberattacks at their very roots, thus making the scaling through automation a delightful reality that improves the quality of life of all concerned. The readers are sure to enjoy this journey into the future!

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Introduction to Automated Personal Assistants: Past, Present and Future

Automatic teller machines, automatic vending machines, automatic ticket vending machines, automated check-in counters, automated baggage check-ins at airports, and automated immigration counters at international airports are some of the machines we see in our day-to-day life. The various places where we use automated machines is shown in the following image:

Automatic Ticket Vending & Bank Teller Machines Automatic Vending Machines   Self Check-in & Automatic Baggage Check-in, Immigration counters and Boarding gates

Fig. 1.1: Automatic machines for tickets, cash and products and at airports for check-in, baggage, and immigration

Completely automated retail counters (e.g. Amazon GO), hotels and restaurants, personal assistants such as Apple Siri, Google Home, Amazon Echo are the manifestations of automation enabled by advanced technologies like Artificial Intelligence and Machine learning that we are experiencing more and more.

The complete transformation that a retail store undergoes with automation is depicted in the following image:

Fig. 1.2: Amazon Go: Advanced technologies to fully automate the retail experience

(Figure courtesy: https://www.amazon.com/)

From ATMs of the yesteryears to the advanced voice activated personal assistants that understand our needs and moods to respond are replacing many jobs that were hitherto being done by human beings. This is a growing and irreversible trend of these manifestations of automation.

It is possible that in the future that when you pass by an ATM in a bank, it identifies you by name, recognizes your need for a loan and offers you attractive terms on the spot while enticing you to its location using a voice activated and geolocation targeted message. This then would be the foreseeable future of the banking as we know. The same can be true for any area as the power of AI is considerably enhanced with the confluence of Big data, Cloud and Machine learning technologies.

Welcome to the world of humanoids and autonomous machines.

Figure.1.3: It is going to be difficult in future to identify
whether you are dealing with a man or a machine!

We will take a close look at these agents of automation in the coming chapter as we analyze the anatomy of these machines and track their journey into the future.

CHAPTER 2

Disruptive Models Led By Digitization

Introduction:

Home automation, factory automation, AI and ML led analytics are making deep rooted and disruptive impact on various aspects of our lives.

We now know that drones can fly, robots can jump, and bots can listen, talk, think, crawl, attack and beat the world's best in thinking games. Guess what would happen if all this combines into one unit or a body!

This is the power of Artificial Intelligence powered with the boosting characteristics of Machine learning and Deep learning! 2019 in many ways is seeing the convergence of a number of advancements in the adoption of cutting-edge technologies. It is now clear in no uncertain terms that the future is getting increasingly 'Autonomous'. Artificial Intelligence and Machine learning are combining together for a rapid adoption of automation across the spheres of our personal and corporate lives.

The organizations that are winning the race for market supremacy in every field are the biggest exponents of these powerful technologies. With the increasing trends of digitization, decentralization, and automation, adoption of cloud and open source technologies is resulting in a manifold increase in data generation, analysis and consumption. The Big Data technologies are increasingly adopted and this has resulted in the rapid adoption of Artificial intelligence-led analytics, bolstered by the productive utilization of Machine learning algorithms effectively.

The organizations that are able to create a strong foundation of data-based technologies and exponents of data analytics are reaping rewards of their investments in such areas. According to the consultancy firm, Accenture, 'automation, minibots, machine learning and adaptive intelligence are becoming part of the finance team at lightning speed'.

STRUCTURE:

- Changing face of the new workforce
- Fair and sustainable practices

OBJECTIVES:

In this chapter, we will briefly look at the different manifestations of the digitization and automation that are making an impact on various aspects of our environment and working life. We shall also look at some of the organizations that are working in the various aspects of digitization and automation. We will also see how Blockchain can help in the process of securing the automated world of the future.

Companies like Google, Amazon, Netflix, and Facebook have taken the usage of analytics and marketing automation to a totally different level which has further strengthened their market dominance in their respective areas. The term 'Data is the new Oil' has never been more true.

The current situation can be summarized in the following joke:

It may be a joke, but quite possible with today's technology of Big Data, AI, Predictive Analytics, Social Applications, Recommendation Engines, Next Best Action, etc., all coming together.

Hello! Is this Gordon's Pizza?

No sir, it's Google's Pizza.
Did I dial the wrong number?
No sir, Google bought the pizza store.
Oh, alright then I'd like to place an order please.
Okay sir, do you want the usual?
The usual? You know what my usual is?
According to the caller ID, the last 15 times you've ordered a 12-slice

with double-cheese, sausage, and thick crust.

Okay that's what I want this time too.

May I suggest that this time you order an 8-slice with ricotta, arugula, and tomato instead?

No, I hate vegetables.

But your cholesterol is not good.

How do you know?

Through the subscriber's guide. We have the results of your blood tests for the last 7 years.

Maybe so, but I don't want the pizza you suggest. I already take medicine for high cholesterol.

But you haven't taken the medicine regularly. 4 months ago you purchased from Drug sale Network a box of only 30 tablets.

I bought more from another drugstore.

It's not showing on your credit card sir.

I paid in cash.

But according to your bank statement you did not withdraw that much cash.

I have another source of cash.

This is not showing on your last tax form, unless you got it from an undeclared income source.

To HELL with your pizza..!!

ENOUGH!!

I'm sick of Google, Facebook, Twitter, and WhatsApp. I'm going to an island without internet, where there's no mobile phone line, and no one to spy on me

I understand sir, but you'll need to renew your passport. It expired 5 weeks ago.

CHANGING FACE OF THE NEW WORKFORCE: WELCOME TO ROBOTS, CHATBOTS, IOT DEVICES, CONNECTED CARS, RPA and FLYING DRONES

I had 1,000 employees last year. Next year, I am targeting 800 humans, 25 robots, 10 chatbots, and 1,000 connected things. Could well be the outlook of a 'Human Resource Head' in a thriving company of the future!

It is not just the organizations. The 'Bot' revolution is going to permeate every segment of our infrastructure. If the vision of global leaders like #Cisco has to be noted, connected devices are a part and parcel of every piece of our future landscape cutting across organizations, cities,

functional areas and services, which is why Cisco calls it IOE or Internet of Everything! Source (#Cisco PR).

#Cisco filed US patent application 20170302663, an invention that it terms Blockchain-based #IoT [Internet of Things] Device Identity Verification and Anomaly Detection" that enables a #Blockchain-based system record changes to the conditions affected and captured by sensors (i.e., smart objects) in a network and instrumentalize network relationships and the data that the network generates in order to exercise control over those nodes is one of the many patents filed to integrate IOT devices into the Blockchain ecosystem. The need of the hour as we employ edge-enabled devices for computing to empower the once dumb IOT devices to do what they are supposed to do and not something dangerous!
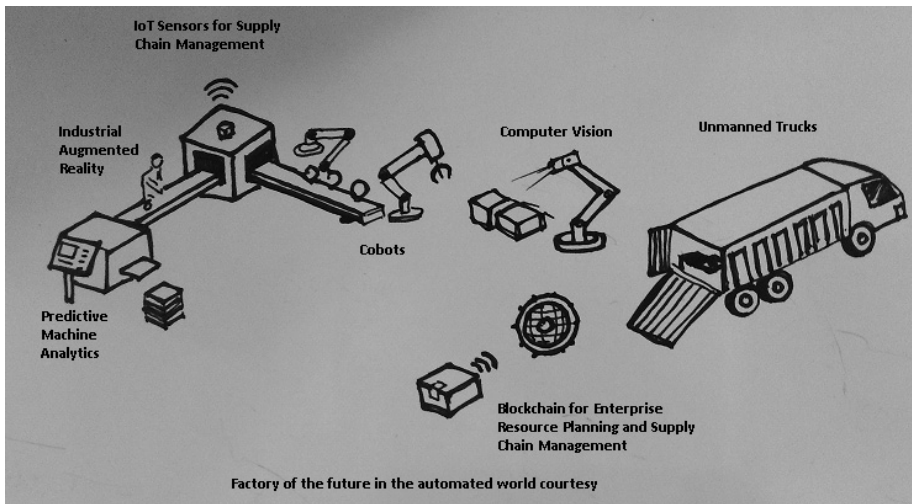
Fig 2.1: Automaton across factories of tomorrow

In future, it is possible that organizations will be employing high levels of automation of manual and repetitive tasks across the length and breadth of their operations to interact with customers, employees, vendors, channel partners at various locations. These could be through self-servicing queries for information retrieved within the organizations or queries handled through external party API integrations.

There could be different bots and robots such as:

a) Front office bot that greets and directs the visitors to their respective destinations and also handles routine queries (Ex: Reception bot employed by Kerala state police headquarters)

b) HR bots engaging with the employees to answer routine queries or conduct environmental surveys.

c) Customer engagement bots on online outposts and for service-related queries.

d) Financial and accounting management bots that are a part of the RPA ecosystem that conduct expense management, accounts, finance and audit-related tasks.

RPA or Robotic Process Management that involves streamlining the workflows with AI and Machine learning techniques as big data processing is already making its presence felt in a number of areas, which are as follows:

i. Invoice management

ii. Partner and vendor management by verifying credentials of the new partners through 360 degree authentication and procurement process automation

iii. Auditing and reconciliations in a speedy and secure manner to generate

iv. Expenses tracking across various heads versus budgets and reporting abnormalities

v. Financial reports instantaneously instead of days and months after book closures

While some of them would be maintained on premise, a number of them could be maintained on Cloud-based platforms. To manage these different types of bots, which form a part of the bot-farm in the company, the organizations need to employ Robot controllers to manage different sub groups of bots across organizations. Planning, developing or deploying these different types of automation projects calls for different skill sets and facilities ranging from workflow designing, API integration and management, analytics and analysis of business across different functional areas to ensure the right types of reports and dashboards are

created and made available to the concerned officials for live tracking of business processes and results these automation projects are designed to produce.

FAIR AND SUSTAINABLE PRACTICES–THE NEED OF THE HOUR FOR NEW AGE COMPANIES:

While machines permeate every aspect of our work environment, there are bound to be a lot of issues surrounding energy consumption, employee privacy and customer data privacy, etc. It is imperative that organizations follow green practices for energy conservation, give precedence to openness against spying with CCTV cameras and data warehouses, and high powered analytics-based targeting of customers intruding into their privacy.

The various tools of automation leveraging Artificial intelligence and Machine learning should leave behind a highly productive world with performance that is vastly augmented and menial tasks automated. This will enable all the citizens of the world improve their quality of life substantially and reaping the full benefits of technological advancements.

The increasing dependence on digitization and data-driven technologies facilitated by the IOT led automation reminds us of different types of possible threats as well. Data breaches and cyberattacks have been rated as the most dangerous threats to the human mankind in the recent past.

It is said that the next world war is going to be fought in the cyberspace and not on the ground.

The October 2016 Mirai bot attack that infected unsecured Internet of Things (IoT) devices like DVRs and IP cameras exposed the increased vulnerability of the #centralized corporations depending more on the burgeoning number of Internet of Things. If the changing landscape of the workforce composition in today's companies, it is imperative to think that Blockchain as one of the important paradigms to be embedded to secure your future!

The Boeing 737 Max crash of October 2018 and March 2019 claiming more than 600 lives were apparently caused by the failure of automated pin board programs.

The unauthorized and unwelcome citing of drones flying over various vital installations in Kerala in March 2019 raises the spectra of misaligned pilots rehearsing before sinister attacks.

IBM and Samsung's ADEPT platform (Autonomous Decentralized Platform for Telemetry) is one of the landmark initiatives for securing the growing population of the IOT devices which is supposed to cross 10 times of the connected human beings in the next 2-3 years!

Blockchain's removal of the single point of failure, shared and distributed ledger, secure authentication of identity with appropriate permissions and authorizations in place to interact and end-to-end encryption of transactions, apart from many other advantages, fortifies the IOT devices against any Malware attack, dis-incentivizing them and de-risking the entire ecosystem.

CONCLUSION

In this chapter, we looked at the various aspects of a digitized world that is witnessing the increasing level of automation. Industry 4.0, led by IIOT, and RPA led back office automation and the employment of bots across various areas of organizational working is changing the face of the Talent Management department, which is calling for new skills and new approaches to keep the workforce engaged and managed. The increased ubiquitous digitization is offering enormous pools of data that is strengthening the muscles of the organizations who are experts in data analytics. The security and privacy requirements of organizations and the users of their products and services are becoming a major concern. Blockchain is offering an effective tool to scale automation in a secure and acceptable to all.

CHAPTER 3

Machine Learning and Artificial Intelligence

INTRODUCTION

Artificial intelligence refers to the ability of computers to think and decide like humans. The advent of machine learning facilitated by the tremendous ability of e-commerce and social media organization to collect enormous amount of data of their customers and their preferences across various data points. This enabled these data exponents to continuously learn from their experience, thus refining their methods and methodologies to accurately target, cross-sell and upsell to their customers.

The exponents of AI and ML are able to corner a specialized segment of the consumer market by attracting customers in a number of ways. Companies like Amazon, Facebook, Netflix, Google, and Apple have excelled in leveraging AI and ML to the hilt. In this chapter, we will look at the utility of Artificial Intelligence and Machine Learning for various activities. We will discuss the utility of these technologies to various activities and see how they augment the productivity and capability of their exponents.

STRUCTURE:

- Market potential indicators of the agents of automation
- The rise of machine learning
- Case study: The Intel® openVINO™ toolkit for advanced industry 4.0 applications

OBJECTIVES:

The objective of this chapter is to provide an understanding of the essential technologies that are powering the automated world. An understanding of the various applications, the types of algorithms and their utility across different actions to be performed to augment or mimic the human beings' efforts will enable the readers to appreciate the 'Agents of Automation' in a detailed manner. This will help leverage them to enhance their quality of life and the productivity in future.

Amazon leveraged the power of its brand it cultivated to provide a phenomenal platform to buyers and sellers with no brand equity by extending them the benefits of its platform for listing fees and storage charges. For powerful and sought after brands, it offered an excellent platform and marketing opportunities with fine-tuned targeting strategies that maximized their sales through customized offerings. It milked the customer base and drastically improved its customer throughput and lifetime value by weaning away from competitors and also making their customers spend much more than they imagined.

Companies like Facebook, Google, and Apple offered new conveniences through value-added platforms like Chatbots, voice assistants and messenger bots to get their audience glued to their channels with unflinching loyalty, thus increasing their advertising revenue. Netflix on the other hand created phenomenal content that resonated with the audience taste, giving them an unprecedented edge in the media space.

The e-commerce boom in the early part of 2000 created a totally new industry with retailers like Amazon dominating the online retail market. Over a period, many industries such as banking, ticketing, airlines, and social media went full hog into online management of their customers and participants giving rise to the digital marketing revolution. This forced the leading offline brick and motor companies, who had a number of advantages like physical proximity and associated trust, like Walmart to venture into online sales both, organically and through acquisitions as well. There are a number of strategies that are adopted by these behemoths to maximize their sales and customer throughputs through repeat purchases, cross selling and upselling.

The Omni channel retail strategy that helped the retailers to target the customers in places like online hangouts, social media outposts, offline stores, popular hotspots, and high footfall malls are the favourite hunting grounds, apart from the large format stores and killer application powered websites garnering the maximum eyeballs. Targeting potential customers and converting them into lifelong customers that started off as a specialized skill and a product of the creative outburst of exceptional digital marketing professionals has become a full blown industry that leverages advanced technologies like Artificial Intelligence and Machine learning powered analytics and marketing automation tactics.

Inbound and Outbound marketing activities became a part of well-knit integrated marketing approaches with companies like HubSpot taking the lead. Some of the strategies adopted by the Omni channel blockbuster companies are described below:

- **GUIDED SELLING:** The customer's data is used to target him or her repeatedly using recommendation engines to guide him/ her to selected web pages for conversions with live chat. Mobile applications are now the order of the day for instant offers and loyalty management. Loyalty management that maximizes the lifetime value of the customers is now thriving big time.

- **DYNAMIC PRICING AND INSTANT CONVERSIONS:** The customer is offered a dynamic pricing depending on the stock availability, specific fine-tuned promotion for upselling and cross-selling to ensure that the customer does not slip away without purchasing the product.

- **FORECASTING AND STOCK MANAGEMENT:** Advanced analytical techniques are used to predict and make available the right stock at the right time to ensure that the loss due to stock outs and the excess resources locked in over stocked inventory is minimized, thus vastly improving the efficiency of the organization and giving more flexibility for marketing and increased value.

The insights obtained by mining the data are leveraged to accurately target the customers through digital marketing and remarketing efforts to ensure high levels of click through rates and associated sales. Companies like Amazon also started stores that offered Walk in Walk out facilities that enabled customers to check out without wasting time at billing counters; an amazing level of automation. Retail giants like Alibaba enabled small neighborhood stores to leverage advanced analytics and economies of scale in procurement by congregating and facilitating them with necessary technology, hardware and software.

- **BOT LED MARKETING & CUSTOMER SERVICE EFFORTS:** Chat bots and voice agents that offer round the clock service providing necessary information to customers, handling sales and service requests and queries, recording and responding to the customers' irrespective of the languages has now become common and offer unlimited productivity to the leading online marketers and large B2B and B2C organizations.

MARKET POTENTIAL INDICATORS OF THE AGENTS OF AUTOMATION – SOME INDICATORS:

The following figure displays some trends expected across the areas influenced by AI led automation in the coming future.
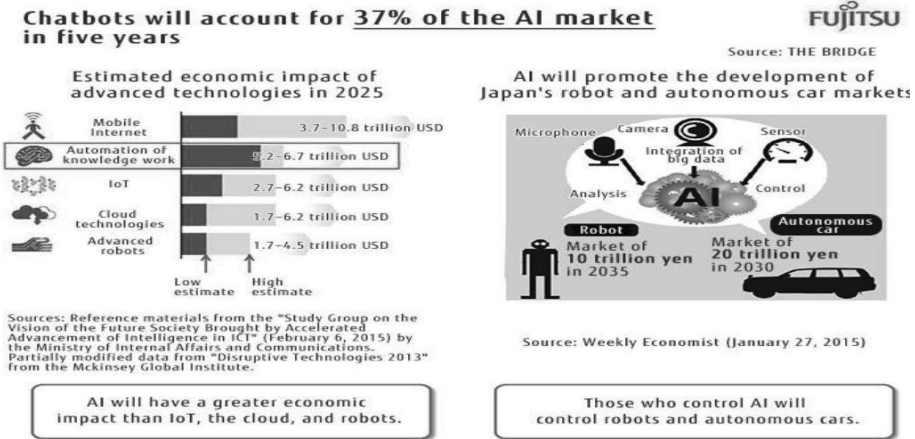
Fig 3.1: Economic impact of advanced technologies and the expected proliferation of Agents of Automation

As we dwell deeper into the world of the agents of automation, we need to understand the basics behind Artificial Intelligence and Machine learning the buzzwords of the 21st century.

Artificial Intelligence is a branch of computer science that deals with the simulation of intelligent behavior in computers and aims to improve their functions related to human knowledge such as reasoning, planning, learning, natural language processing, perception, decision making, and the ability to move and manipulate objects (Robotics).

Artificial intelligence that has been touted for long as the killer application that will enable machines to think like human beings resulting in unbelievable productivity had many unsuccessful stints after a number of starts and stops in the past.

The activity in Artificial intelligence, a term adopted at Dartmouth in 1956, experienced many periods of disinterest and disinvestment, especially during 1974-1980 and 1987-1993 due to the inability to generate impressionable results leading to frustration of the investors.

The advances in numerous technologies like Big Data, Cloud, New generation Programming knowledge, development of Business Intelligence tools and the Yeoman Work of companies like Microsoft, IBM and Google along with open source tools like Hadoop, Golang, Python, R, etc. have now given a huge boost to the Algorithm led movement of Artificial intelligence coupled with Machine learning. At its core, Machine learning is simply a way of achieving AI.

The availability of large amount of data through various initiatives discussed earlier and with a vast amount of data generated by the users while interacting with the various portals has offered the companies the opportunity for training machine learning models to rapidly simulate discovered patterns and predict the human behavior using appropriate mathematical models. Techniques like Alternate Least Squares and Matrix reduction models enable analysis of large amount of data and create appropriate models that close the gaps with actual observations leading to accurate predictions for the future.

The marketers now have the data not only of the behavior of their subjects, their likes, dislikes and online search patterns, but also have the mapping of behavior with others with similar demographics and psychographics. By correlating them, they are able to predict the behaviors of any of their

observed subjects well in future. Thus, AI/ML has been instrumental in assisting and augmenting the efforts of humans in their activities and also in automating a large number of repetitive tasks and freeing up human time for more strategic pursuits.

SOME OF THE NOTABLE EXPONENTS OF AI/ML ARE GIVEN BELOW:

• Google's DeepMind (ML system) and RankBrain (AI system) are used to accurately predict the human behavior while searching online and also process the search results. Google uses Deepmind AI algorithms to dramatically improve energy efficiency of its operations.

• Fluid AI uses AI/ML powered customer service bots to make banking fun for customers by mimicking human interactions with customers, thus reducing operational costs.

• Niki, an AI/ML company, offers Chatbots that use Natural Language User interfaces that offer their customers to interact in their natural language.

• ShopR360 offers AI/ML powered solutions to malls and large retailers to differentiate between their customers and employees, etc. by integrating with the CCTV infrastructure.

• Baidu, the Chinese search engine giant, uses AI/ML for image processing, speech recognition, natural language processing, deep learning and high-performance computing.

• IBM offers Robotic Process Automation Solutions to reduce operational costs and eliminate menial labor performing repetitive tasks.

THE RISE OF MACHINE LEARNING

A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P if its performance at tasks in T, as measured by P, improves with experience E. - Tom Mitchell (1998).

Machine learning involves modeling real-life behavior using computational algorithms that have evolved as a part of the work in Artificial Intelligence over a number of decades.

Machine learning algorithms such as SVM (Support Vector Machine), Random Forest, Naïve Bayes classifier,

KNN (K nearest neighbour), etc. are used to discover patterns present in data which cannot be found by humans in normal course.

The tools enable the system to iteratively evolve the most appropriate combination of dependent variables by going through multiple steps that are implemented over large test data. Once the most appropriate models that explain the patterns found in test data has been evolved. The next step is to reduce the dimensionality of the data drastically to discover and weed out unconnected variables. This process is then repeated for a further refined model that closely explains the behavior of the subject being explored.

Thus, machine learning enables continuous improvisation in performance of systems that evolve with time and experience with the availability of more data sets describing the process.

MACHINE LEARNING HAS FOUND APPLICATION IN SEVERAL AREAS:

- Analysis of consumer behavior.

- Fraud detection in financial products and services consumption.

- Recommendation engines in media and e-commerce.

- Stock market trading to predict the movement of share prices.

- In the field of digital marketing: Email, social media and search engines for automatic response generation, targeted promotions, and advertisements.

- Social media such as Facebook and LinkedIn for accurate feeds, facial recognition, etc.

- Healthcare (for example, cancer cell discovery).

- Gene discovery and their classification and numerous other applications in researching and analyzing consumer behavior.

The various aspects of machine learning are depicted in the following figure in a simple manner.
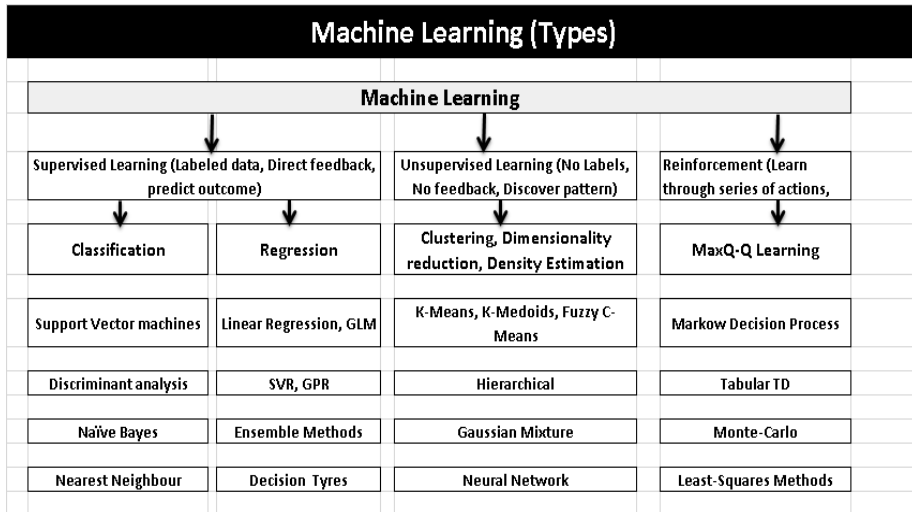
Fig 3.2- Various types of Machine Learning Algorithms

While traditional analytics is more inclined towards statistics and data analysis, machine learning involves an overlay of many dimensions of human behavior like Philosophy, Biology, Psychology, Neuroscience and Analytical behavior expressed through the field of Probability and Statistics.

This is expected to lead the march towards the approximation of human faculties in behavior and thinking.

Thus, machine learning is a branch of artificial intelligence which catalyses this approximation through an iterative and automated process. Machine learning consists of various phases that involve data collection and cleansing, organizing data, building training sets for continuous improvement of performance, mining the data, refining the model, feeding the results obtained for comparison with actual results and further refinement of the model with a recursive approach.

Machine learning involves extensive use of algorithms to re-engineer business processes across various domains of an organization, including Sales and Marketing, Finance, HR, Manufacturing, Customer Service and so on.

The iterative nature of the algorithms refers to probing, learning and continuously improving after learning from every error and a previous iteration, thus enabling them to correct themselves. Thus, moving closer to reality and expected outcomes. The various steps involved in this process happen in a fraction of a second, enabling the decision making process to be efficient, objective, accurate, and predictive.

Machine learning makes it easier to devise sophisticated software systems without much human effort. Instead of spending years coding features or fine tuning a system with a lot of parameters, we can use machine learning to get things done in a much shorter time span. Don't be surprised if you soon begin to see and use technology and gadgets, which are currently seen in science fiction movies.

Machine learning flourishes in the environment in which large data sets are continuously available to train and improve the outcome of the algorithms to real life. The advent of Big Data technology thus provided the necessary fillip to the machine learning outcomes, which further gave a boost to the movement of Artificial Intelligence.
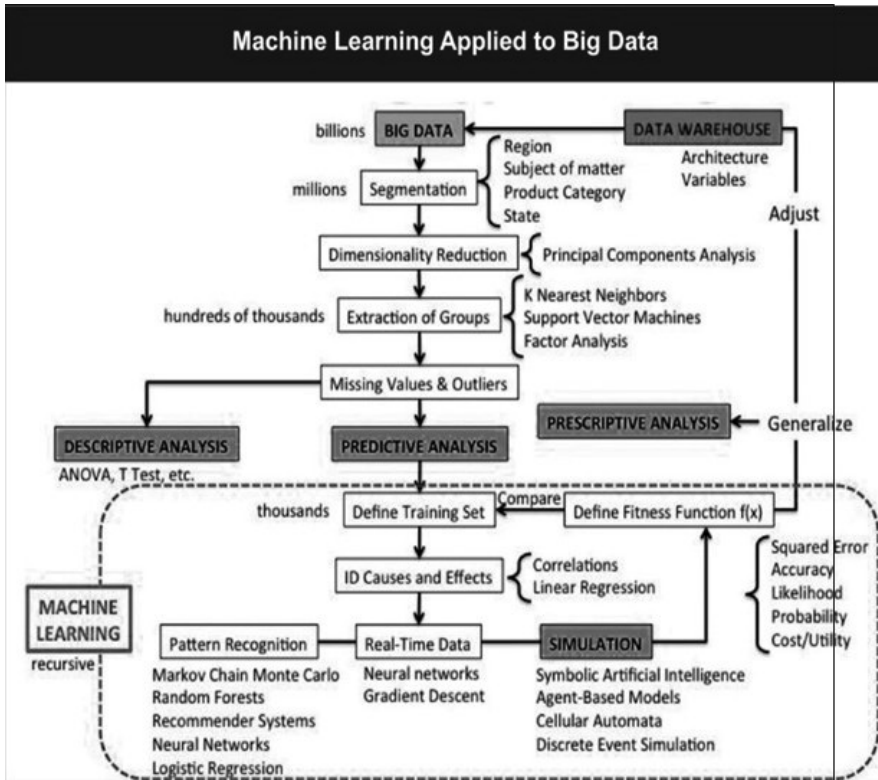
Fig 3.3: Big Data enabling Machine learning
powered AI in advanced analytics applications

Artificial Intelligence with machine learning and deep learning has now made possible a number of tasks, considering the time and effort consumed by mankind. The ability to perform tasks such as data extraction, classification and translation enables bots and machines connected to natural language processing (NLP) systems and speech capabilities like text to speech and speech to text conversions enable machines and bots to converse in hundreds of languages.

Pattern recognition enables machines to recognize images and objects in 3D mode to help robots and autonomous cars move and also help police and finance professionals to identify fraudsters and criminals.

Python, which is an open source and preferred language for implementing artificial intelligence and machine learning algorithms and applications, offers a variety of libraries to conveniently implement these activities.

Some of the popular open source libraries are mentioned as follows (Ref, Altoros- ML Cheat sheets for Python).

End-to-End Negotiation, DeepPavlov and awesome bots are some superb Python and other open source libraries to enable train Chatbots to conduct human-like conversations and negotiations.

COMPUTER VISION:

Scikit-image helps image processing through segmentation, geometric transformation, color space manipulation, analysis, filtering, morphology, feature detection, etc. Open CV and Simple CV help detect landmines and advanced autonomous applications. OpenFace helps detect faces using a deep neural network.

DATA ANALYSIS AND DATA VISUALIZATION:

NumPy, SciPy, Pandas, PyMC, Statsmodels, MatplotLib, Ggplot, and scikit-plot enable a variety of data crunching, data mining, data analysis and plotting for visualization.

GENERAL PURPOSE ML:

Auto_ml, machine learning, XSBoost, scikit-learn, Single-AI, Theano, TensorFlow, Keras, Caffe, PyTorch, CatBoost, etc. are a variety of frameworks and libraries used to undertake and implement a variety of machine learning processes easily.

NATURAL LANGUAGE PROCESSING:

NLTx, TextBlob, PyNLP1, Polyglot, Fuzzy Wuzzy, and Jellyfish are various Python libraries that allow text mining, classification, speech tagging, grammatical anointment and figure of speech extraction, sentiment analysis, sequencing and string matching.

TOPIC MODELLING:

BigART, gensis and Topik support topic modeling, document indexing, similarity retrieval and a variety of applications in topic modeling and document management. In Python every idea can be quickly validated through 20 to 30 lines of code that helps in fast prototyping. Hence,

it is imperative for all those wanting a career in AI and ML-related programming areas to learn Python and execute programs by leveraging its versatile libraries and features.

As per a PWC report, machine learning has a great potential impact across various industries as shown in the following table on Popular Machine Learning Algorithms and applications. A more detailed analysis of AI and Analytics and their impact across organizations and contexts can be found in the book, AI and Analytics by Sameer Dhanrajani.

RESOURCES FOR LEARNING DATA SCIENCE

https://www.edx.org/professional-certificate/berkeleyx-foundations-of-datascience#courses.

POPULAR MACHINE LEARNING ALGORITHMS AND APPLICATIONS		
S. No	Machine learning Algorithm	Popular applications
1	Decision Trees	Rule-based credit risk assessment
		Horse race bets
2	SVM(Support Vector Machines)	News categorization
		Handwriting recognition
3	Regression	Traffic flow analysis
		Email filtering
		Share price predictions
4	Naïve Bayes	Sentiment analysis
		Customer segmentation
5	Hidden Markov Methods	Facial expression analysis
		Weather prediction

6	Random Forest Method	Customer churn analysis
		Risk assessment
7	RNN (Recurrent Neural Networks)	Image classification and captioning
		Political sentiment analysis
8	LSTM	NLP and translation
9	CNN(Convolutional Neural Networks)	Image recognition and text to speech
		Drug discovery
10	Deep Learning	Intensive and multi-layered approach
	Banking	Images footage analysis for fraud prevention
	Insurance	Accident analysis and claim process
	Healthcare	Identification of medical reports
	Government	Cyber threat prevention
	Autonomous cars	Identification of vehicles on road

Fig 3.4: Applications of AI, ML and Deep learning algorithms in different domains

CASE STUDY: INTEL® OPENVINO™ TOOLKIT FOR ADVANCED INDUSTRY 4.0 APPLICATIONS

(Source:https://software.intel.com/en-us/articles/sdp-case-studies#OpenVINO)

Intel is one of the leaders in enabling cutting edge technology champion organizations through its wide range of solutions deploying Artificial Intelligence, Machine Learning and Deep learning algorithms. Intel's distribution of the Open VINO platform offers easy deployment of advanced AI-based robot development and deployment solutions to solve automation problems.

The OpenVINO™ toolkit, short form of Open Visual Inference and Neural Network Optimization toolkit, provides developers with improved neural network performance on a variety of Intel® processors and helps them further unlock cost effective, real-time vision applications. The toolkit enables deep learning inference and easy heterogeneous execution across multiple Intel® platforms (CPU, Intel® Processor Graphics) providing implementation across cloud architectures to edge devices. This open source distribution provides flexibility and availability to the developer community to innovate deep learning and AI solutions.

OPENVINO™ TOOLKIT CONTAINS:

- Deep Learning Deployment Toolkit

This toolkit allows developers to deploy pre-trained deep learning models through a high-level C++ Inference Engine API integrated with application logic.

This open source version includes two components, Model Optimizer and Inference Engine, as well as CPU, GPU and heterogeneous plugins to accelerate deep learning inferencing on Intel(R) CPUs and Intel(R) Processor Graphics. It supports pre-trained models from <u>Open Model Zoo</u> along with 100+ open source and public models in popular formats such as Caffe*, Tensorflow*, MXNet*, and ONNX*.

- Open Model Zoo

This repository includes optimized deep learning models and a set of demos to expedite development of high-performance deep learning inference applications. This repository uses these free pre-trained models instead of training your own models to speed up the development and production deployment process.

Some of the top applications of the INTEL OpenVINO toolkit are mentioned below:

- ADLINK and Touch Cloudo optimized by the Intel® Distribution of OpenVINO™ toolkit provides a turnkey AI engine to assist in data analytics, detection, classification, and prediction for a wide range of use cases.

- Advantech deploys a combination of hardware and software, including cameras, AI deep learning, and video analysis technology optimized by Intel® Distribution of OpenVINO™ toolkit for cutting-edge solutions for retail organizations.

- Agent VI delivers cutting-edge Digital Security and Surveillance Solutions using Intel Distribution of OpenVINO toolkits Computer vision applications.

- GeoVision Turbo-Charges its 24x deep learning facial recognition solution using Intel® System Studio and the OpenVINO™ toolkit.

- GE Healthcare improved inference performance by 14x running with Intel® Xeon® processors and the Intel® Distribution of OpenVINO™ toolkit. The Deep Learning Deployment Toolkit from Intel helped GE with the power of AI to clinical diagnostic scanning and other healthcare workflows.

- Gorilla Technology used the Intel® Distribution of OpenVINO™ toolkit and Intel® System Studio to optimize the efficiency of its IVAR* intelligent video analytics recorder by 1.5 times.

- Honeywell accelerated video processing time and increased the number of cameras streaming in real-time through a single device to enhance its portfolio of Security and Surveillance solutions with the help of Intel's robust portfolio of vision products like Intel's OpenVINO toolkit.

- IOmniscient IronYun's advanced video analytics and AI video search use Intel® Distribution of OpenVINO™ toolkit to accelerate AI model training and deep learning inference to deliver cutting edge AI-based Multisensory and Smart Surveillance Analytics.

- Powered by a robust, high-performance Intel® architecture, are helping to make cities safer and organizations more efficient.

- Intel® Vision Products help ISS deliver advanced visual deep learning neural networks for Video Surveillance.

- Mindtree's smart digital vision analytics system enhances security and reduces shrinkage with the Intel® Distribution of OpenVINO toolkit.

- NexCOBOT, a NEXCOM company, offers a flexible, modular robotics solution integrating artificial intelligence (AI) with machine vision, powered by Intel® Vision Accelerator Design products and optimized by the Intel® Distribution of OpenVINO™ toolkit.

- Outdu's devices use Intel® technologies to analyze videos at the edge and give retail and other high-footfall environments immediate, actionable insights.

- Philips demonstrates a breakthrough performance for AI inferencing of healthcare workloads run on servers powered by Intel® Xeon® Scalable processors and optimized with the OpenVINO™ toolkit.

- QNAP/IEI partnered with INTEL to offer developers, data scientists, medical researchers, and students a quick-to-deploy computer vision system combining a workstation, deep learning software development kit (Intel® Distribution of OpenVINO™ toolkit), and powerful NAS (network attached storage).

CONCLUSION

Machine learning has given a new life and wings to the Artificial Intelligence paradigm. The advent of Big Data, Cloud computing and Machine Learning together with Artificial Intelligence are shaping our new world of automation. The 'Agents of Automation' of tomorrow are going to use every weapon in the armour provided by these technologies to take us into an unimaginable world that has got the capacity to augment and enhance our productivity and quality of lives. We have seen how different types of AI and ML algorithms work and provide customized rendering to different applications. All these are going to be used in some form or the other if not in combination to power the workforce of autonomous objects that we will discuss in the coming chapters.

CHAPTER 4

Internet of Things, Industry 4.0 and Factories of Tomorrow

INTRODUCTION:

The advent of big data synchronized with the proliferation and another important aspect of technology, namely, Internet of Things (IoT). While the birth history of Internet can be traced back to 1969, 1990 marked the official birth year of the Internet of Things (IoT). IoT facilitated connection of things other than human beings through embedded sensors that could be connected to the internet and communicated over the internet with other machines, things and human beings.

Machine-generated data derived from the phenomenal growth in the number of sensors and machines used to measure and record the events and situations in the physical world. The output of these sensors is machine-generated data, and from simple sensor records to complex computer logs, it is well structured. As sensors proliferate and data volumes grow, it is becoming an increasingly important component of the information stored and processed by many businesses. Its well-structured nature is suitable for computer processing, but its size and speed are beyond traditional approaches.

In this chapter, we will take a look at the various aspects of IOT, Big Data, AI and ML and their impact on the factories of tomorrow.

STRUCTURE:

- Variety of sensors
- Major components of IoT
- Major IoT protocols at various layers
- Smart factories of tomorrow and the Industrial Internet of Things

OBJECTIVE:

The objective of this chapter is to understand the anatomy of IOT systems, evaluate their key roles in automation with respect to factories, homes and smart cities. IOT or Internet of Everything, as it is sometimes referred to, is the fundamental aspect of the connected systems which enables us to connect, collect information and manipulate in order to achieve the desired objectives. Hence, it is desirable to have a good understanding of the way they function, the potential they promise, the opportunities they offer and the issues that need to be addressed to keep them secure.

The year 2010 marked a new milestone in the field of Internet Of Things with the announcement of connected cars by Google.

UNECE (United Nations Economic commission for Europe) has declared IoT generated data as one of the key sources of Big Data. (https://statswiki.unece.org/display/bigdata/Classification+of+Types+of+Big+Data)

Creating an M2M protocol, Andy Stanford-Clark of IBM and Arlen Nipper of Arcom (now Eurotech) introduced the first machine-to-machine protocol for connected devices such as MQ Telemetry Transport (MQTT).

Data is generated from a variety of sensors used in various applications. Some of them are listed below in the following two categories:

A. FIXED SENSORS

- Home automation
- Weather/pollution sensors
- Traffic sensors/webcam

- Scientific sensors

- Security/surveillance videos/images B. Mobile sensors (tracking)

- Mobile phone location

- Cars

- Satellite images

B. DATA FROM COMPUTER SYSTEMS

- Logs

- Web logs

The amount of data transacted through the internet grows manifold as the communication between the devices and their principals does.

Starting with RFID (Radio-frequency identification) chips in the year 2000, the advances in the field of Internet Of Things is expected to permeate to the entire world connecting humongous number of devices with sensors that are then hooked up to the internet through advanced communication platforms and technologies. By 2020, the number of interconnected devices and the associated business opportunities is expected to grow manifold to over 30 billion connected objects and 50 trillion US dollars in market opportunities.

By 2020, the IoT business with the help of cost-effective sensors, which is made possible due to the increased economies of scale and also the cumulative advances in all the interconnected technologies of hardware, middleware, software and storage technologies, would be in a position to create a humongous value of over 50 trillion US dollars as per current estimates. The collective intelligence and processing power of all these devices offer enormous benefits to mankind, but not without the associated threats due to the increased dependence and the corresponding tilt of incentive in favor of cyber attackers and terrorists.

Source:https://gigaom.com/2016/07/15/review-smartdraw-helps-to-tamewild-iot-networks/
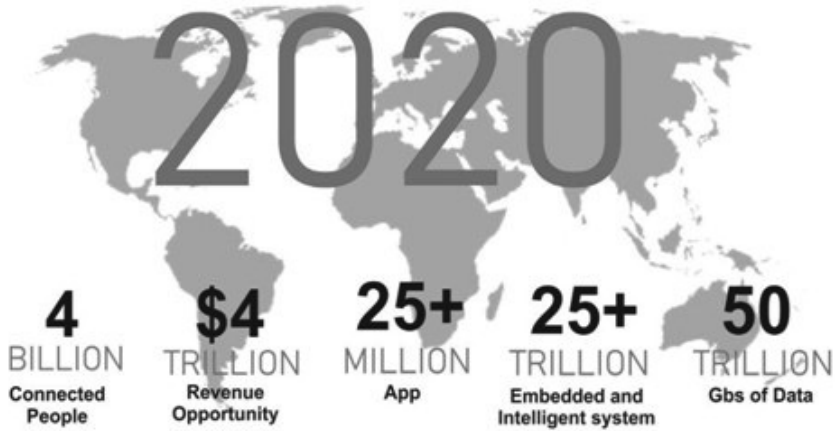
By 2020, the Internet of Things will have achieved "critical mass". Linking enormous intelligence in the cloud to billions of mobile devices and extremely inexpensive sensor and logs embedded in and on everything, will deliver and enormous amount of new value to almost every human being. The full benefits - in terms of health, safety and convenience-will be enormous.

Fig 4.1: Scale of complexity and business opportunity due to IOT penetration by 2020

What is IOT?

The first Internet-connected appliance was a modified Coke vending machine at Carnegie Mellon University. The concept of 'Ubiquitous computing' was extensively discussed in a paper by Mark Weiser in 1991.

First proposed by Kevin Ashton of Procter & Gamble in 1999, the term IoT or Internet of Things, became popular at Auto ID Center, MIT. It was originally envisaged that, RFID will be the essential component of IOT connectivity.

As per Wikipedia, The **Internet of things** (**IoT**) is the extension of Internet connectivity into physical devices and everyday objects. Embedded with electronics, Internet connectivity, and other forms of hardware (such as sensors), these devices can communicate and interact with others over the Internet, and they can be remotely monitored and controlled.

The definition of the Internet of things has evolved due to convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems.[5] Traditional

fields of embedded systems, <u>wireless sensor networks</u>, <u>control systems</u>, <u>automation</u> (including <u>home</u> and <u>building automation</u>), and others all contribute to enabling the Internet of things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "smart home", covering devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as <u>smartphones</u> and <u>smart speakers</u>.

Let's examine the major components of IoT:
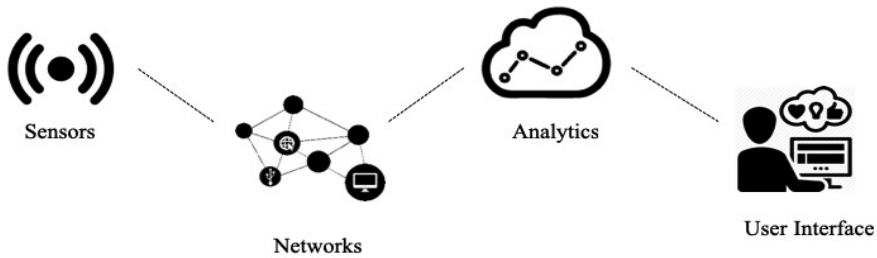
Figure 4.2 Major components of IoT

1. **SENSORS AND SMART DEVICES**

   According to IEEE, a sensor is an electronic device that produces electrical, optical, or digital data derived from a physical condition or event. Smart devices are devices with one or more sensors that can bundle together to do more than just sense things. E.g. Smart phones have multiple sensors such as GPS, accelerometer, and camera.

   These sensors or smart devices are used to pick and collect data from the environment which is the most rudimentary step in IoT implementation.

2. **NETWORKS**

   Networks are the components which enable connectivity in the IoT system. The second step of the implementation is to transmit the signals collected by the sensors through one of the various mediums of communications such as cellular networks,

Wi-Fi, Bluetooth, Low Power Wi-Fi , Wi-Max, regular Ethernet, etc. to all the components of the network. Low power and low cost wireless transmitting devices are preferred due to their long battery life and efficiency.

Since Internet of things creates a huge amount of data from devices, the cloud infrastructure is leveraged upon to process, manage and store data in real time. Cloud system integrates billions of devices, sensors, gateways, protocols, data storage and provides predictive analytics, and that brings us to the next component – Data processing and analytics.

3. ANALYTICS

The third step in IoT implementation is extracting insights from data for analysis. The analysis can range from something very simple, such as checking if the temperature reading on devices such as AC or heaters is within an acceptable range to something complex such as identifying objects using computer vision in videos. Information is very significant in any business model and predictive analysis ensures success in concerned area of business line.

4. APPLICATIONS AND USER INTERFACE

Applications refer to the various activities performed using the IoT networks and they are activated through a user interface. The application layer is a user-centric layer which executes various tasks for the users. There exist diverse IoT applications, which include smart transportation, smart home, personal care, healthcare, etc.

Consider a scenario in which the analysis from the previous step has shown that there is an intruder in the house. So, what next? This information has to be made available to the user in some way by triggering alarms or through notifications via phone, text or email.

Also, an interface may be required to enable users to actively monitor the status of their IoT system. Ideally, the user interface is well designed to support minimum effort for users and encourage more interactions.

The sensor management systems of several devices can be controlled from one common platform (a hub or smartphone). Unlike other systems, Samsung SmartThings offers a capability-based sensor management system. With SmartThings, applications interact with smart devices based on their capabilities. So, once the capabilities that are needed by a SmartApp are specified and once the capabilities that are provided by an IoT device are identified, the devices based on the device's declared capabilities are selected for use within a specific SmartApp.
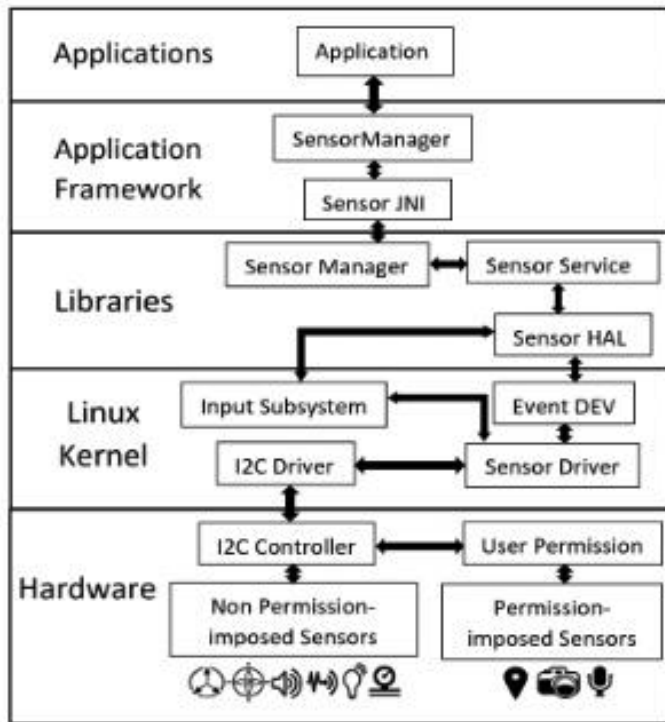
Fig. 4.3: An example of the sensor management system for Android.

(Source: https://www.researchgate.net/publication/322975901_A_Survey_on_Sensor-based_Threats_to_Internet-of-Things_IoT_Devices_and_Applications)

Cisco, the industry leader in IoT platforms, offers an integrated solution for the management of IoT devices. The Cisco IoT/M2M architecture is composed of four layers; some are similar to those described in the conventional Cisco network architecture.
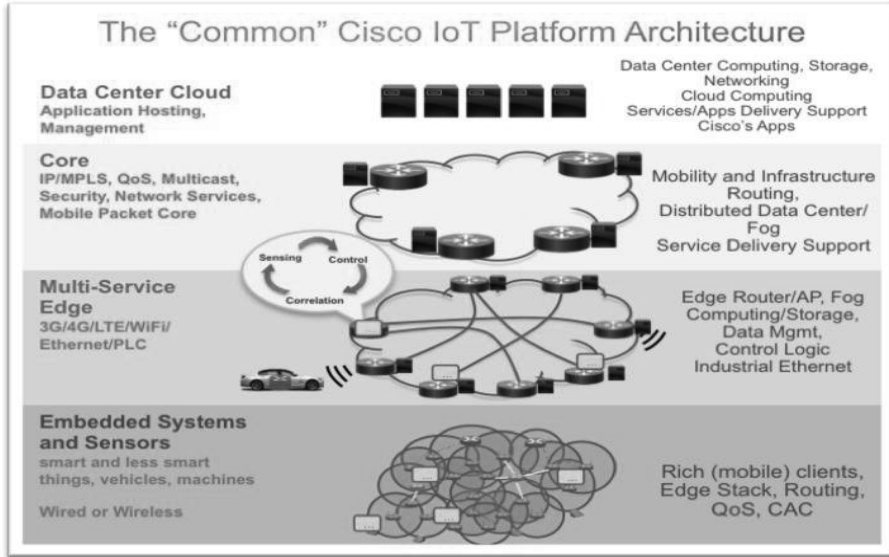
Figure 4.4: IoT/M2M network architecture layers

Source: https://www.cisco.com/c/en/us/about/security-center/secure-iot-proposed-framework.html

The Internet of Things covers a wide range of industries and use cases across cross-platform deployments and cloud systems in real-time. Hence, there exist certain standards and protocols to allow the communication between the devices and servers in more interconnected ways. The major IoT protocols at various layers in the IoT architecture stack are displayed in the following figure (Source: Simon Ford - Director of IoT Platforms ARM):
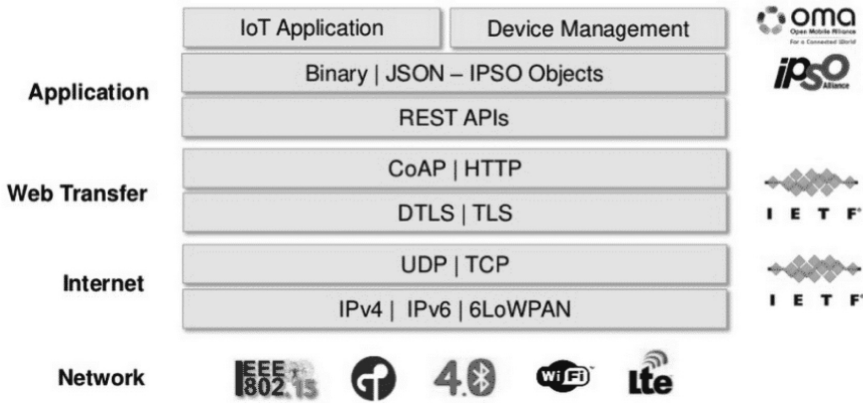
Fig 4.5: Major IoT protocols at various layers

Many communication technologies such as Wi-Fi, Bluetooth, Zigbee and cellular are well known, but there are also several new emerging networking options such as Thread used as an alternative for home automation applications, and Whitespace TV technologies being implemented in major cities for wide area IoT-based use cases.

1. WI-FI

Wi-Fi is the choice for many developers because of its wide existing infrastructure as well as its ability to handle high quantities of data with rapid data transfer.

2. BLUETOOTH

Bluetooth, a short-range communication technology is expected to be the key for wearable products in particular, connecting to the IoT via a smartphone in most of the cases. The new Bluetooth Low Energy (BLE) or Bluetooth Smart is a significant protocol for IoT applications as it offers significantly reduced power consumption.

3. ZIGBEE

Zigbee, like Bluetooth, has a large installed base of operation, more in industrial settings. Zigbee/RF4CE offers low-power operation, high security, robustness and high scalability with high node counts and is well positioned to take advantage of wireless control and sensor networks in M2M and IoT applications.

4. CELLULAR

IoT applications requiring operations over longer distances can leverage GSM/3G/4G cellular communication capabilities. Cellular is capable of sending high quantities of data, especially for 4G; however, the expense and power consumption is deemed to be high for many applications. Cellular can be ideal for sensor-based low-bandwidth-data projects that will send very low amount of data over the Internet.

5. LOWPAN

6LowPAN (IPv6 Low-power wireless Personal Area Network) is a network protocol that defines encapsulation and header compression mechanisms.

6. Thread

Thread is a relatively new IP-based IPv6 networking protocol aimed at the home automation environment. It is primarily designed as a complement to Wi-Fi as it recognizes that while Wi-Fi is good for many consumer devices that it has limitations for use in a home automation setup.

7. LoRaWAN

LoRaWAN targets wide-area network (WAN) applications and is designed to provide low-power WANs with features specifically needed to support low-cost mobile secure bi-directional communication in IoT, M2M and smart city and industrial applications. LoRaWAN is optimized for low-power consumption and can support large networks with millions and millions of devices.

Proto-col	Standard	Frequency	Range	Data Rates
Wi-Fi	802.11n	2.4GHz and 5GHz	Ap-proxi-mately 50m	600 Mbps maximum, but 150-200 Mbps is more typi-cal
Blu-etooth	Bluetooth 4.2 core specifi-cation	2.4GHz (ISM)	50-150m (Smart/BLE)	1Mbps (Smart/BLE)
ZigBee	ZigBee 3.0 based on IEEE802.15.4	2.4GHz	10-100m	250kbps
Cellu-lar	GSM/GPRS/EDGE (2G), UMTS/HSPA (3G), LTE (4G)	900/1800/1900/2100MHz	35km max for GSM; 200km max for HSPA	35-170kps (GPRS), 120-384kbps (EDGE), 384Kbps-2Mbps (UMTS), 600kbps-10Mbps (HSPA), 3-10Mbps (LTE)

Proto-col	Standard	Frequency	Range	Data Rates
6 Low-PAN	RFC6282	Used over a variety of networking media, including Bluetooth Smart (2.4GHz) or Zigbee or low-power RF (sub-1-GHz)	N/A	N/A
Thread	Thread, based on IEEE802.15.4 and 6Low-PAN	2.4GHz (ISM)	N/A	N/A
LoRa WAN	LoRaWAN	Various	2-5km (urban environment), 15km (suburban environment)	0.3-50 kbps

Fig 4.7: Different IOT protocols and their parameters

IoT will impact all areas cutting across consumer and industrial usage. While smart home, wearables and personal trackers are good use cases for consumers, IoT can be leveraged across all areas of design, manufacturing, storage, transportation, maintenance and live performance tracking

through the value addition cycle of products and services to dramatically enhance the productivity and profitability of organizations.

The different prominent application domains in Industrial and Consumer IoT applications are summarized in the following image:
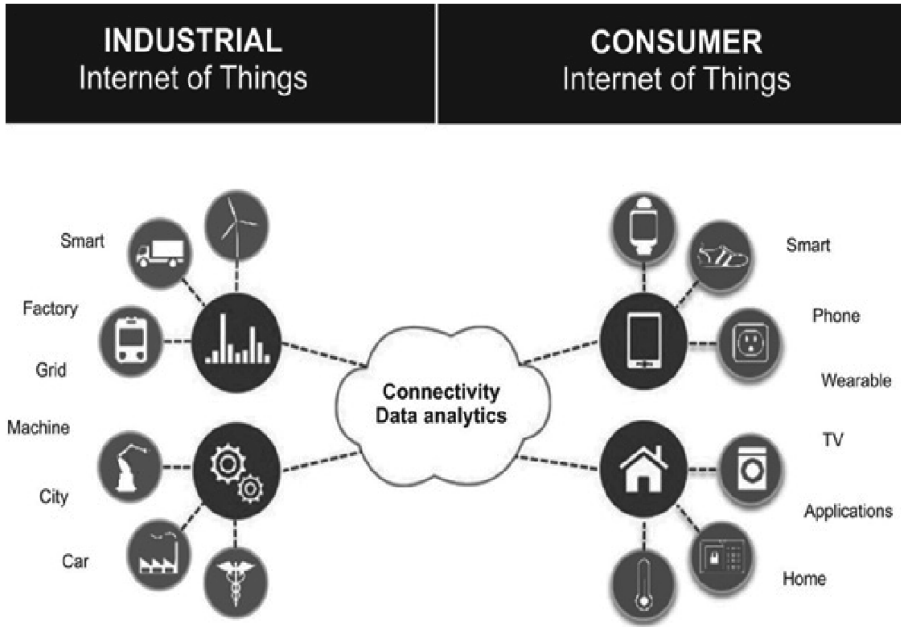
Fig 4.8: IOT classifications and use cases

As of now, IoT is extensively used in the following areas:

- Tagging and monitoring the movements and performance parameters of automobiles, animals, accessories, and dependents.

- Information collection and dissemination for optimum agricultural output.

- Automatic meter reading and energy utilization management for all electrical devices.

- Security and surveillance systems for a wide variety of establishments and connected homes.

- Building automation and maintenance services.

- Machine to Machine connectivity offering communication,

ecommerce and collaboration opportunity through high levels of automation.

- Smart cities to effectively manage delivery of efficient products and service across every area that touches a citizen's life.

- Telemedicine and healthcare for remotely measuring and tracking the health parameters to offer quick resolution to patients in remote areas.

The key steps for implementing IIOT projects are displayed in the following image:

5 Steps to start and optimize IIOT Projects
Build partnerships
Clarity business outcomes and ROI
Start small
Security first
Architect for analytics

Fig 4.9: Steps to implement IIOT projects

The paper, Blockchain Technologies for the Internet of Things: Research issues and challenges, Mohamed Amine Ferrag, Makhlouf Derdour, Mithun Mukherjee, Member, IEEE, Abdelouahid Derhab, Leandros Maglaras, Senior Member, IEEE, Helge Janicke highlight the various studies undertaken across a number of IoT related domains that are impacted by the blockchain implementation.

Centralized platforms can offer innumerable services through cloud-based platforms by converting every dumb object into intelligent and communicable systems. Governments across the world have realized the potential of IoT and are implementing various projects under the category of 'Smart Cities', while service, technology and infrastructure providers are leveraging advanced technologies and innovation to dramatically optimize and enhance the capability and productivity of systems across every field we can think of.
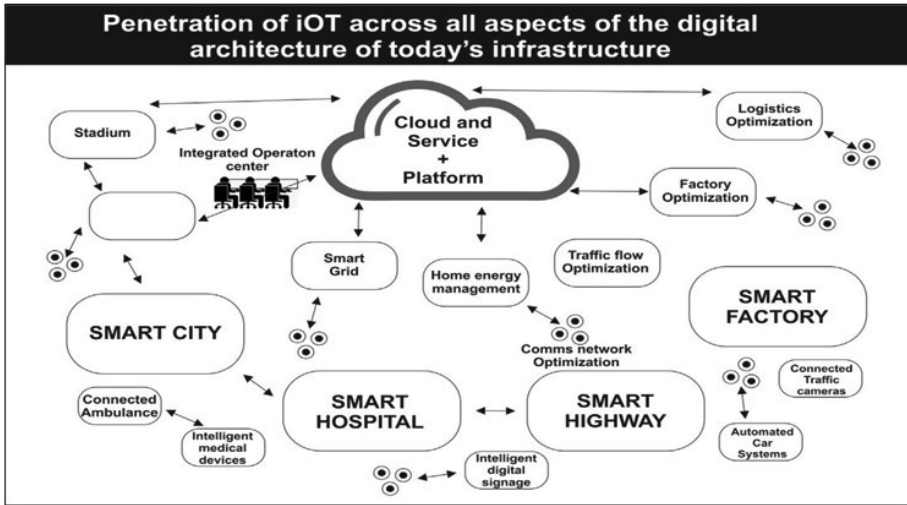
Fig 4.10: IoT architecture and use cases across SMART cities and connected facilities

The Internet of Things is a new paradigm that is expected to make life much more convenient for citizens across the world. With things connected to the internet, their users can access and control it from anywhere. This dramatically increases the productivity of human beings while creating huge opportunities for data collection, analysis, monitoring, track ability, market opportunity.

Thereby, IoT can create value for proactive organizations by giving them a huge competitive advantage. This could also be a source of risk due to the vulnerability of these devices to malicious attacks by cyber terrorists.

Big Data technologies play a crucial role in managing the humongous amount of information generated by the sensors deployed on all things that need to be monitored and managed.

Companies like General Electric, Rolls Royce, Shell and many more are proactively using the IoT technology to dramatically improve their efficiency as well as reduce the chances of failures and defects by combining the technology with cutting edge tools facilitated by Analytics.

As we take advantage of the connectivity revolution, we are also exposing ourselves to the unforeseen attacks on the IoT systems across

the world through cyber-attacks like the October 2016, DDOS attack that paralyzed systems across the world (https://www.cnbc.com/2016/10/22/ ddos-attack-sophisticated-highly-   distributed-involved-millions-of-ip- addresses-dyn.html).

Massive cyber-attack 'sophisticated, highly distributed', involving millions of IP addresses Javier E. David | @TeflonGeek Published 5:12 PM ET Sat, 22 Oct 2016 Updated 8:45 AM ET Mon, 24 Oct 2016CNBC. com we will address this issue later.

Smart Factories of Tomorrow and the Industrial Internet of Things (IIOT)

With the cutting-edge advances in robotics and automation, the way we work and live is expected to change. And although, the factory floor may seem like an improbably setting for cutting-edge technological innovation, as per historical trends, manufacturers have always been early-adopters of new technologies. They were among the first to recognize the value of automation, and we have all seen how automated systems have radically transformed our modern factories.

In the coming years, manufacturing is expected to benefit vastly from IoT solutions. As per projections made by Cisco, the number of Machine-to-Machine connections is expected to grow to 3.3 billion worldwide by 2021 (Source: Statista).

After investing heavily in building strong supply chain networks, now in conjunction with steadily falling costs of manufacturing, connected IoT ecosystems are the next logical steps in the evolution of modern manufacturing. As per another study by NASSCOM, 57% of the global IoT manufacturing spending is going to be on field devices, followed by 21.8% on construction vehicles and 11.7% on robots in 2020 (Source: Statista). Automobile and few other factories have already started adapting collaborative robots, robotics arms and the Internet of Things coupled with AI to produce large parts of the automobile chassis, power trains and other components, thus increasing industrial productivity.

Although much of the robotics technology such as AI or IoT is in the nascent stage, the automation market has been growing at a consistent pace with time, and robots are able to handle even the most complex manufacturing tasks faster than human workers with more precision.

Now, let's explore some of the advanced automation technologies that will be used in the factories of tomorrow:

- **MACHINE VISION (MV)**

  Machine vision is the technology used to provide imaging-based automated machine inspection method for applications such as automatic inspection, process control, and robot guidance. This technology works as the eye of the advanced production process using imaging processes, including conventional imaging, hyper-spectral imaging, infrared imaging, line scan imaging, 3D imaging of surfaces, and X-ray imaging.

  Smart camera or smart sensors with frame grabbers are used along with interfaces such as Camera Link or CoaXPress (or custom interface) to record or capture images of the surface to be inspected. And these images are then analyzed and processed by specialized analysis software, which mostly use the principle of Finite Element Analysis in their working. MV helps automakers save money, justify price points and emerge as strong competitors.

  National Instruments, Microscans Cognex, Datalogic, Optotune and ViDi Systems are some of the topmost companies whose machine vision systems are preferred by large manufacturers. As per the latest market research reports, Industrial Machine Vision System market is projected to amplify during 2019-2025.

- **COLLABORATIVE ROBOTS (COBOTS)**

  Also known as cobots, these are robots designed to operate autonomously or with limited guidance. A cobot uses machine learning to pause all its operations when a human worker enters its space.

  According to Dan Grieshaber, Global Director of manufacturing engineering integration at General Motors, Collaborative robots (cobots) have become a 'fundamental game changer' on the automotive factory floor. Because cobots will stop safely if they come in contact with a human, this opens up several applications for use as an assistant directly on an assembly line, Grieshaber commented.

As per ISO 10218, there are four types of cobots that incorporate the following functionalities: Safety Monitored Stop, Hand Guiding, Speed and Separation Monitoring, and Power and Force Limiting robots.

- **ARTIFICIAL INTELLIGENCE (AI)**

Artificial Intelligence system is defined as any system that perceives its environment and takes actions that maximize its chance of successfully achieving its goals.

The smart factories of tomorrow will use the AI support to automate processes and machinery to respond to unfamiliar or unexpected situations by making smart decisions in contrast to the traditional rules-based approach. Under a rules-based approach, a robot cannot identify and select the needed parts from a bin of unsorted parts because of the lack of detailed programming required to deal with the numerous possibilities in the orientation of parts. Whereas, an AI supported robot can pick the desired parts from an unsorted mass, regardless of their orientation. As a result, technical systems will be more flexible and adaptable.

- **COGNITIVE COMPUTING (CC)**

Cognitive Computing (CC) refers to technology platforms based on artificial intelligence and signal processing. These platforms encompass and use machine learning, reasoning, human language processing, speech and object, human–computer interaction, dialog and narrative generation to simulate human thought process in a computerized model.

Cognitive computing platforms are being used by leading automobile manufacturers such as BMW; for instance, to learn about how drivers and their cars' systems can interact more comfortably and naturally. BMW strongly believes that cars of the near future will pilot themselves, rather than relying on human drivers and it aims for its vehicles to achieve full 'level 5' [1] autonomy by 2021 with the help of these cutting-edge technologies. Boston Consulting Group estimates that the market for comprehensive vehicle connectivity will be 159 billion USD by 2020.

[1] – *Level 5 autonomy tops the scale defined by the US Department of Transport as it made preliminary investigations for how legislation for autonomous vehicles would work. It indicates that the car will be capable of driving with no human input or supervision and operate at least as effective as a human driver in any conditions and on any road.*

- **3D PRINTING**

  3D printing for manufacturing comes with a number of exciting and unique advantages when compared to traditional manufacturing. Using 3D printing enables manufacturers to produce parts and composites from different materials with unique mechanical and physical properties in one single process. Advancements in the 3D printing technology, equipment and materials have lowered the costs, making it a more feasible option for the manufacturing industry.

  We can see the applications of 3D printing across various industries, including garment manufacturing. For instance, Ministry of Supply, a clothing startup founded by MIT grads uses 3D printing to make better and more sustainable clothes. Merging 3D printing with IoT data collection can drive lean manufacturing and provide a competitive edge to the manufacturers.

- **DRONES**

  A drone is a flying robot that can be remotely controlled or fly autonomously based on software-programmed flight plans. It's also known as 'unmanned aerial vehicle' (UAV). In manufacturing, drones are incredibly useful in inventory control and warehouse management.

  Companies such as General Motors (GM) are using drones to inspect sand delivery pipes inside the company's casting plants.

  Dan Grieshaber, the global director of manufacturing engineering integration at GM said that towering high above the factory floor, pipe inspection is inherently dangerous. Instead, a drone flies around inside a cage, tracks the pipe, and can spot potential problem areas like cracks. We send the drone in, have it capture the environment, identify what work needs to get done, and then we'll send in an operator with a specific job to do. This

significantly cuts down on the amount of time a human must spend in that and other dangerous environments. The person is only working where they need to work.

- **EXOSKELETONS**

Exoskeletons are essentially wearable robots that find prominent applications in repetitive operations in manufacturing. Typically, in car manufacturing, a worker might need to perform a task within 45 seconds before the next car comes along. An exoskeleton can actually support the human body and distribute the load. It helps the worker stay safer and also helps perform the job in an easier way.

The robotic glove technology developed by General Motors (GM) along with NASA would also be an example of Exoskeleton. At GM, workers use the RoboGlove to add strength and grip to the human hand. As you grip, the glove aids you with more assistance. It greatly reduces fatigue and protects the workers from injuries.

As per the McKinsey report, by 2025 Internet of Things (IoT) applications will have an economic impact of 900 billion USD to 2.3 trillion USD in manufacturing alone. This estimate is based on potential savings on 2.5 to 5 percent in operating costs, integration of IoT in the power grid and its applications in public sector services like waste, heating and water systems. However, with all the exciting possibilities that come with connecting our things to the internet, we also need to make sure that security is built into the design of these systems right from the beginning.

There is no single smart factory configuration; there is likely no single path to successfully achieve a smart factory solution. The smart factory journey requires more than just a set of connected assets. People are expected to still be the key to operations. As a lot of roles can be replaced by robots, automation and AI, there will need to be realignment of roles and emergence of new unfamiliar roles. Companies need the right talent to drive the journey and the right processes in place. Managing changes to people and processes will require an agile, adaptive change management plan.

Despite the differences in factory configurations, the components needed to enable a successful smart factory remain universal, all of which are equally important: Data, Technology, Process, People, and Security.

DATA MANAGEMENT IN A TYPICAL ENTERPRISE AND THE THREAT OF SINGLE POINT OF FAILURE:

The increasing competition and the need for outsmarting the competitors are forcing the organizations to rethink and modify their approaches to data management. This scenario is witnessed even in small organizations.

The typical schema in an organization that spans multiple functions and activities is given below:
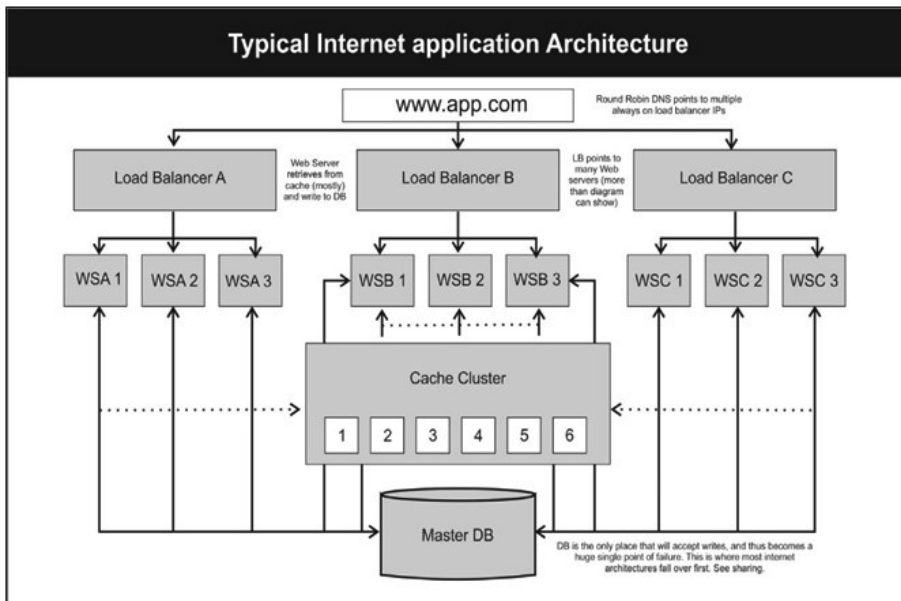
Fig 4.11: Typical technology framework in a centralized architecture

However, in organizations that have advanced data measurement practices due to the availability of large amount of data, as these organizations are higher up in the evolution of data management practices as they use a

combination of structured and unstructured databases as shown in the following figure:

While large companies have the resources to invest in Data Lakes, smaller companies can still combine their data storage, data processing and analytical activities to an integrated or unified Data Management Platform (DMP). A high-end DMP is an integrated software suite that combines data storage, processing and analytics and offers an intuitive and easy-to-navigate executive dashboard. The role of a DMP is to:

• Collect structured and unstructured data from all sources: internal and external, covering an organization's own applications, systems, websites and products, data from partners and other associates and any other third-party data used by the company.

• Integrate and store all the data collected.

• Apply analytical tools and provide appropriate insights to the top management and all the other data driven parts of business.

Some of the key DMP offerings include Adform DMP, Adobe Audience Manager, KBM Group's Zipline, Lotame, MediaMath DMP, Neustar Identity DMP, Nielsen exelate, Oracle BlueKai, Salesforce DMP (formerly Krux) and Turn Digital Hub for Marketers. Platforms like IBM Insights and SAS Data Management offer the capability to access data on legacy systems and Hadoop. These platforms offer enterprise capabilities to enable, manage and analyze large volumes of structured and unstructured data by performing activities to integrate, cleanse, transform and govern data on premises and in the cloud.

With the proliferation of Internet of Things, the amount of data that needs to be handled across all segments of an organization in private, public and government domains is huge. Use of DMPs also allows an organization to leverage technologies like Artificial Intelligence and Machine Learning for significant competitive advantage. DMPs can also offer the organizations to manage the regime of GDPR in a comprehensive manner. However, in all these cases, there is a risk of failure of varying stages due to probability of failure at a single point.

CONCLUSION

With every human being on the planet Earth expected to be connected to over five devices on an average in the next five years, the number of connected things communicated and controlled through the internet and the amount of data that will be exchanged through these systems is mind boggling to say the least. More data and connections not only generate huge values and opportunities, but also bring forth, many challenges and risks as well.

In this chapter, we examined how AI and ML technologies can be combined with IOT, Cloud and Big Data to create the factories of tomorrow. It is indeed important to protect these devices from the ever increasing threat of malware attackers and cybercriminals.

CHAPTER 5
Robots

INTRODUCTION:

Robots can perform complex tasks easily by performing complex operations to build houses using 3D printing with utmost precision. They have the ability to move about in the environment and take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior, or cognition.

With the help of sensors, robots can manage to avoid obstacles on their paths and achieve their goals with or without prior planning, depending on the complexity of their implemented program.

Robots operations are characterized by sense (perception), process (interpretation and planning), and action (movement of some kind).

Artificial Intelligence and Machine learning have resulted in a manifold improvement in the capabilities of the robots of today and this is discussed in this chapter.

STRUCTURE:

- Skills of a robot
- Advantages and disadvantages of robots
- Laws of robotics
- Systems in a robot
- Components of a robot
- Building a good robot

- Evolution of robots and their increased utility with the advent of AI and ML

OBJECTIVE:

The objective of this chapter is to track the evolution of robots from a mere physical labor supplements to the sophisticated robots of today that we see in the form of Sophia, the accredited citizen of the Kingdom of Saudi Arabia, the first such honor conferred on a non-living being. The complete hardware, AI led applications and the way they work in tandem are sought to be explained to the readers. This will enable them to look at robots as tools to augment their performance and enhance the quality of our lives, rather than as threats as they are made out to be in most references.

What is a robot?

A robot is reprogrammable, multi-functional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks (Robotics Institute of America).

A robot is an electro-mechanical machine that is guided and controlled by computer code. It can be considered as an electro mechanical agent that can perform a number of actions in a sequential manner automatically with the complexity as envisaged in the program. Robotics deals with the design, construction, operation, and application of robots as well as computer systems for their control, sensory feedback, and information processing .

A BRIEF HISTORY: The term comes from a Czech word robota, which means 'forced labor'. The word 'robot' was first used to denote a fictional humanoid in a 1920 play R.U.R. (Rossumovi Univerzální Roboti - Rossum's Universal Robots) by the Czech writer Karel Čapek, but it was Karel's brother Josef Čapek who was the word's true inventor.

The world's first electronic autonomous robots was created by William Grey Walter in Bristol, England in 1948 as well as Computer Numerical Control (CNC) machine tools in the late 1940s by John T. Parsons and Frank L. Stulen.

The first commercial robot 'Unimate' was built by George Devol in 1954 and sold to General Motors in 1961 where it was used to lift pieces of hot metal from die casting machines at the Inland Fisher Guide Plant in the West Trenton section of Ewing Township, New Jersey.

Robots can be autonomous or semi-autonomous and range from humanoids such as Honda's Advanced Step in Innovative Mobility (ASIMO) and TOSY's TOSY Ping Pong Playing Robot (TOPIO) to industrial robots, medical operating robots, patient assist robots, dog therapy robots, collectively programmed swarm robots, UAV drones such as General Atomics MQ-1 Predator, and even microscopic nano robots. By mimicking a life-like appearance or automating movements, a robot can convey a sense of intelligence or thought of its own. Autonomous things are expected to proliferate in the coming decade with home robotics and the autonomous car as some of the main drivers. (Source Wikipedia)

IMPORTANT SKILLS OF A ROBOT:

Robots are adept at a number of skills. Some of the important skills are mentioned below:

- Search, procure, collate and analyze data from the web or from a database.

- Record and transmit information and data.

- Calculate locations, positions about their current location, targeting locations for movement or any action and decide a course of action as per the programmatic instructions.

- Engage in written and voice-based communication with external actors.

- Carry out activities in a synchronized and pre-determined fashion with precision any number of times or as per a sequence.

- Monitor, identify and report performance measures.

- Learn and continuously improve their performance to identify and predict future from examined patterns based on data mining.

- Able to lift huge weights and position them with precision in a targeted place with pin point accuracy using appropriate sized arms.

ADVANTAGES AND DISADVANTAGES OF ROBOTS

The following are the advantages of robots:

- Ability to work in any type of environment, including hazardous and difficult terrains. They can execute jobs such as bomb and landmine diffusion, which are considered to be human life threatening jobs.

- Exhibit repeatable pin pointed accuracy and precision without any fatigue or boredom forever.

- Conduct robotic surgeries, build 3D manufactured components and buildings that can lift large weights effortlessly as programmed.

- Their cost continuously comes down over time, while the wages of human beings increases with time and hence their productivity, efficiency and return on investment increase over time.

- Do not participate in politics and frivolous activities and focus on increasing their performance at work and are immune to working conditions except for certain environmental factors like temperature and terrain, etc.

- Modular constructed robots offer the flexibility of multi-tasking and the same forms can be used to undertake jobs that require different skill sets by modifying the programs.

- Robots are objective and not sentimentally effected like the humans, thus leading to their dependability and predictability at all times.

The following are the disadvantages due to employment of robots:

- Prior to the advent of machine learning, there were many disadvantages associated with robots corresponding to the inability to improve and adapt to the circumstances. But machine learning combined with artificial intelligence has enabled robots

to continuously improve and get better and better.

- However, robots require high initial investments, prone to technical breakdowns, high energy consumption and high maintenance cost apart from a bit of technical savvy management.

- Robots can also be corrupted by cybercriminals and this can lead to shutdowns and failures or performance variations. Hence, they need to be properly secured through very high level of interaction authentication and cryptographic protocols by leveraging the blockchain technology.

LAWS OF ROBOTICS:

The best known sets of laws are Isaac Asimov's 'Three Laws of Robotics'. These laws were introduced in the 1942 short story 'Runaround', although they were foreshadowed in a few earlier stories. The three laws are as follows:

- A robot may not injure a human being, through inaction, or cause any harm to a human being.

- A robot must obey the orders given by human beings except orders that could conflict with the first law.

- A robot must protect its own existence as long as the protection does not conflict with the first or second law.

At the end of his book, *Foundation and Earth*, a zeroth law was introduced: A robot may not injure humanity or by inaction, allow humanity to come to harm.

In 2011, the Engineering and Physical Sciences Research Council (EPSRC) and the Arts and Humanities Research Council (AHRC) of Great Britain jointly published a set of five ethical 'principles for designers, builders and users of robots in the real world, along with seven 'high-level messages' intended to be conveyed based on the September 2010 research workshop. They are as follows:

- Robots should not be designed solely or primarily to kill or harm humans.

- Humans, not robots, are responsible agents. Robots are tools designed to achieve human goals.

- Robots should be designed in ways that assure their safety and security.

- Robots are artifacts; they should not be designed to exploit vulnerable users by evoking an emotional response or dependency. It should always be possible to tell a robot from a human.

- It should always be possible to find out who is legally responsible for a robot.

AI and ML are now working in tandem and the prospect of an all powerful robot that can run, crawl, swim, climb, fly and out-think and outmanoeuvre the human seems plausible. It is worthwhile to recount the laws of Artificial Intelligence listed by Satya Nadella, the CEO of Microsoft Corporation, in June 2016 in an interview with the *Slate* magazine and roughly sketched five rules for artificial intelligences to be observed by their designers.

- 'A.I. must be designed to assist humanity' which means human autonomy needs to be respected.

- 'A.I. must be transparent which mean that humans should know and be able to understand how they work.

- A.I. must maximize efficiencies without destroying the dignity of people'.

- 'A.I. must be designed for intelligent privacy' which means that it earns trust through guarding their information.

- 'A.I. must have algorithmic accountability so that humans can undo unintended harm'.

- A.I. must guard against bias so that they cannot discriminate against people.

SYSTEMS IN A ROBOT:

The main actions representing a robot's spectrum of activities fall under 'Sensing and Actuation'. Sensing involves the perception of the external environment to be processed by the relevant internal mechanisms, both electronic. The response is initiated in the form of a decision passed on

to the respective component or part, resulting in an action. This process is called 'Actuation'.

- Robotics involves integration of computers and controlled mechanisms to make devices re-programmable and versatile. A variety of mathematic representations are used to plan robotic tasks and integrate sensors into the task planning. The tasks are the goals to be achieved; for example, go from point A to point B.

- A number of supporting technologies go into the building of the robots such as Vision systems, End-of-arm tooling, Compliance devices,·Manipulation devices,·Welding technologies,·Lasers, Proximity sensors, Wrist sensor (forces/torques), Control software/hardware,·Part delivery systems,·Application software,·Interface software, Operating systems, Programming languages, Communication systems I/O devices, etc.

COMPONENTS OF A ROBOT

A typical robot consists of the components such as electronic motors, sensors, power conversion unit, controller, actuators, piezo motors and ultrasonic motors, pneumatic muscle wires, manipulator linkage, base and a user interface, locomotion, and artificial intelligence. All these components along with cameras embedded in the place of the eyes and a CPU positioned like a brain enable the robots to undertake many complex operations.
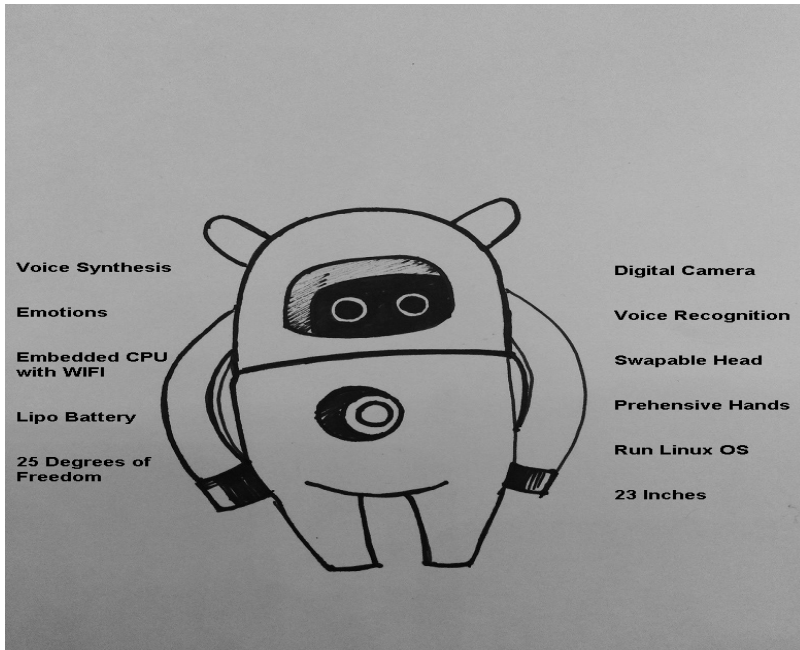
Fig 5.1

Robots are of the following types

- Wheeled
- Legged
- Climbing
- Flying or drones

Mobile robots that can move around like the *automated guided vehicle* or *automatic guided vehicle* (AGV follows markers or wires in the floor or uses vision or lasers).

These robots with manipulator arms are used in a variety of military, industrial and consumer applications. Domestic robots used for cleaning and maintenance are becoming common in developed countries like USA and Japan today.

Industrial robots usually consist of a jointed arm (multi-linked manipulator) and an end effector that is attached to a fixed surface. The International

Organization for Standardization defines a manipulating industrial robot in ISO 8373 as 'an automatically controlled, reprogrammable, multipurpose, manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications'.

Soft robots use soft computing approaches (e.g., fuzzy logic, neural networks). There are other types of robots like Mimicking robots (robots that learn by mimicking), Softbots (software agents that can communicate over networks) and Nanobots which wander in an environment to investigate or make changes.

The industries where the robots can be extensively used are summarized below:

- **MANUFACTURING:** Factories use robots extensively for a variety of purposes to assist the workers and for automating repetitive and manually difficult jobs and as cobots to assist workers in complicated tasks.

- **3D PRINTING:** Robotic arms have proven their ability in printing buildings at a rapid pace using the additive manufacturing technology.

- **LOGISTICS AND SUPPLY CHAIN:** Robots are extensively used in material handling in warehouses and drones are now being used for delivering consignments to customers of big supermarkets and e-commerce companies.

- **SECURITY AND SURVEILLANCE:** Robots are used for patrolling and surveillance in the form of drones and in assisting military to maintain law and order and target military hideouts. Robots also can assist in defusing bombs.

- **FOOD AND AGRICULTURE**: Robots are used to assist farmers in farming and help pick up fruits and vegetables during harvest time to reduce pressure on manpower intensive jobs.

- **HEALTHCARE:** Robots are experts at undertaking high precision surgeries using robotic arms with terrific accuracy in a dependable manner to reduce mishaps.

- **OIL AND GAS**: Oil companies use robots for pipe cleaning and drones for aerial surveys for supervising installations for any untoward incidents and thefts.

Modular robots with high degree of freedom with the ability to do a single task or also combine forces with other modules to undertake many more tasks are currently being used in hybrid transportation, industrial automation, duct cleaning and handling. Collaborative robots or *cobot*s are robots that can safely and effectively interact with human workers while performing simple industrial tasks.

THE ARCHITECTURE OF AN OBJECT RECOGNIZING a ROBOT:

Traditionally, the robot is modeled with a CPU running a central process is responsible for planning and other processors to control motions and interpret sensor values, passing the interpreted results back to the central processor. A central reasoning mechanism with a pre-specified representation must be implemented.

Advanced robots that are powered by complex algorithms and very high processing powered CPUs are now packaged in a human-like form and functionality. The most famous humanoid robot, Sophia, has been found to be able to communicate with fellow humans in such a way that it is almost impossible to differentiate her from the fellow human. http://www.robots-and-androids.com/build-a-robot.html Building a robot involves electronics, computer programming, mechanics, and fabrication.

THE FOLLOWING ARE THE IMPORTANT STEPS AND CONSIDERATIONS FOR BUILDING A GOOD ROBOT:

Building a robot for a given application and requirement follows the standard steps like any other hardware and software integrated application with a layer of communication built in. The steps can be broadly defined as follows:

1. Identify the problem to be solved and the goals aimed to be met and also establish a market opportunity or an internal buy-in from the concerned department and the top management.

2. Collect, identify and analyze options with respect the budget, time and resources available.

3. Build a prototype by gathering all the required components.

4. Identify the communication system for remote management and integrate the same into the hardware.

5. Establish the proof of concept and once it is achieved and demonstrated, build a small batch quantity to establish the relation between the stated objectives and achieved goals. Fine tune and make it perfect for a larger batch size production.

6. Test the robot against all the stated goals and ensure that all bugs are taken care before releasing the final product for large scale production. At this stage, you can also consider showcasing it to potential investors who can enable a quick ramp up.

PLANNING THE PROJECT:

- It is very important for the project plan to be well laid out in an objective manner.

- The plan should outline the various expectations and goals of the robot being built.

- Depending on the various tasks like talking, moving, responding to a voice or a sound, moving around on a smooth surface or an obstacle ridden path, the drawings of the robot should be laid out and parts need to be chosen with great attention to detail.

- The tools required and the various electronic, hardware and software products and applications should be identified, budgeted for and procured.

PROCURING THE COMPONENTS AND ASSEMBLIES:

While it is a great idea to build from scratch if you are capable of or having a team that can do it, it is always better and less time consuming to deploy as many parts as possible in the form of readymade assemblies. This can save enormous amount of time and budget as you can avoid a lot of testing and planning that goes with it. Also, assemblers offer a lower cost of products due to economies of large scale.

ROBOT MICROCONTROLLERS

Microcontrollers are the brains of robots which are programmed in C or basic language. They are used to control smaller robots that require energy efficient management. The bigger and more complex robots are controlled through PCs, tablets or laptops. Readymade microcontrollers can be explored for a quick and modular solution. Arduino C the most popular language to program the microcontrollers is very much similar to C and comes with a lot of readymade open source programs that can be easily modified to our requirements.

ROBOT SENSORS

Sensors enable robots to feel the environment like the five senses in humans. They enable the robot to hear, see, smell, feel and taste, thus sizing the environment around them to respond.

Different sensors depending on the need are used in the body, allowing the robot system to understand the question, feel the pressure, know the temperature or find the obstacle, identify the person talking and the direction of the sound, etc. This results in an appropriate response from the robot in the form of a reply or an evasive action or modifying its speed of movement and gesticulation, etc. A complete list of different types of sensors and other components of robot can be obtained from https://www.trossenrobotics.com/robot-parts.aspx.

ROBOT SERVOS

Servo motors with the help of a feedback loop enable the robot's components and arms to move precisely in the right direction and at the right speed.

ROBOT ARMS and LEGS:

Robot's arms which depend on the size and shape of the main structure and the strength required to undertake various activities and conduct movements enable the robots to interact with the outside world. The developments in the materials now enable to it to move like an animal at high speed with huge flexibility are facilitating the development of

humanoid robots that resemble the human beings and act like them in every manner. ASIMO that was built by Honda was the first humanoid robot to walk. Boston Engineering, a research organization, focused on developing robots in different shapes and sizes and demonstrated that robots can walk and run in varying speeds.

Robots pack a huge number of motors in their face, hands and legs that enable them to move, gesticulate, walk and show emotions.

ROS (ROBOT OPERATING SYSTEM)

As per Wikipedia, ROS (Robot Operating System) is a framework for robot software development, providing operating system-like functionality. ROS, Linux for computer programming, is a key tool for implementing the commonly used device functionality.

MICROSOFT ROBOTICS DEVELOPER STUDIO

As defined by Microsoft, Microsoft Robotics Developer Studio, a robotic software development environment, enables academic, hobbyist and commercial developers to easily create robotics applications across a wide variety of hardware.

Japan's HRP-4C, who. Her developers say that this 'cybernetic human' isn't ready to help with daily chores or work side by side with humans yet but she sure can entertain crowds with her numbers.

HRP-4C, who was developed by the National Institute of Advanced Industrial Science and Technology (AIST), can also sing and perform simple dance steps that make her a great crowd entertainer.

An android, or robot designed to resemble a human, can appear comforting to some people and disturbing to others[96]

Fig 5.2: A humanoid robot (courtesy: Wikipedia)

EVOLUTION OF ROBOTS and THEIR INCREASED UTILITY WITH THE ADVENT OF AI and ML:

Prior to the advent of machine learning powered AI, robots suffered from a number of disadvantages like not being creative enough, inability to think independently, inability to learn from mistakes and adapt to different surroundings quickly, etc.

Machine learning has enabled robotics to overcome many of these challenges to a great extent and continues to make rapid progress in many of these directions. However, they are still considered expensive in terms of cost and also for the maintenance with respect to the output produced and unable to multi task being able to deliver only the task they are programmed to undertake. There is always a raging debate regarding the job losses that are expected to be caused by the invasion of robots.

ROBOTS and AUTOMATION IN AIRPORTS:

We have heard of Artificial intelligence bots translating books across languages saving months of time to launch bestsellers across the world. Now, we are seeing robots that are replacing human beings in hotels, airports and many areas of hospitality industry and such services.

Singapore's Changi international airport, which has been voted as the best international airport many times, is planning to free almost all its human staff except for a few customs staff to check on passengers in exceptional circumstances. (https://www.bloomberg.com/news/features/2018-09-16/singapore-s-changi-airport-is-partly-run-by-robots).

Employing CCTV cameras, automated vehicles and laser guided aerobridge positions, the airport employs cutting edge AI and ML led pattern recognition and automation technologies to carry out most of its services. Dubai International airport employs an Android customs inspector who can scan a human body to detect the body language, thermal heat, as well as carry out facial recognition and track luggage. You will soon find Android robots in the arrival section of the airports that will greet travelers and will be able to detect faces of wanted criminals as well as report any suspicious person or activity, according to Khaleej Times.

SELF SERVICING CHECKIN AGENTS AT THE AIRPORTS:

We have already been used to generating our own boarding passes from the self-service kiosks at the airports. Now, the self-service kiosks have extended their functionality too:

A) Comprehensive check in, including cabin baggage.

B) Immigration for international travelers.

C) Ask me assistance booths and many more.

Airports are on their way to become completely human free zones with human intervention provided only for exceptional services.

ROBOTS AND AUTOMATION IN HOSPITALITY INDUSTRY:

Robots are being extensively employed for assisting humans and servicing the guests in boarding and lodging use cases. In Chennai, India, there is a restaurant called 'Robot Restaurant' where orders are taken and serviced by robots instead of waiters. A team of seven robots dressed in blue and white interact with the customers and service their orders with a few real human waiters assisting them in shadows. While long magnet strips on the floor guide the machines around the restaurant, a few waiters operate the robots and control their movements using an app. Restaurants are also using robot-assisted cooking to cook a variety of dishes rapidly to serve huge number of guests in a record time.
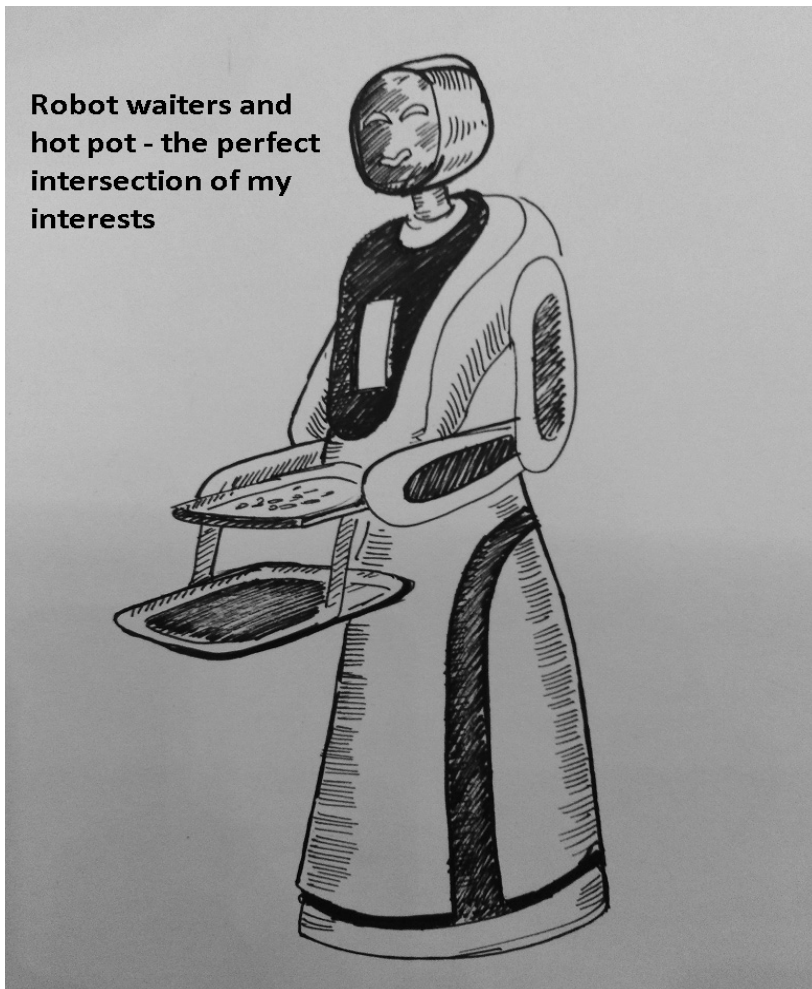
Fig 5.3: A server robot

A Bangalore-based company, Mechanical Chef, has built a wooden prototype about the size of a large gas hob with a rotating drum filled with spice canisters, three induction plates, and little robotic protrusions that wield spatulas and volumetric cups to prepare over 30 different vegetarian dishes like rice, dal (lentils), and a sabzi (any vegetable-based side dish) simultaneously.

The global ecommerce leader Alibaba has built robots that can be operated as hotel staff to transport and deliver amenities for hotel guests. At the futuristic 'FlyZoo' hotel, black disc-shaped robots deliver food and drop off fresh towels in the hotel rooms for guests. Smart LYZ in China has taken the use of robots beyond greeting guests and dropping things in rooms. It is the first 'Fully Automated Hotel'. This hotel in Chengdu, China, has almost no humans working in it. Smart LYZ employs minimal human resources, thus enabling its guests to contact in exceptional circumstances.

From the time of online booking to arrival at the hotel greeted and guided by the robots till checkout, the guests might never encounter a human being throughout their entire stay. This company plans to launch over 50 such hotels across the main cities of China in the coming few years. But not all is hunky dowry with the agents of automation replacing human activities. Robots break down frequently, are expensive to maintain and annoy guests at times looking for a human touch.

Japan's Henn-na Hotel chain employs a lot of robots as front-desk staff, cleaners, porters and in-room assistants. While replacing its existing robot manned jobs with human beings, the company is planning to develop a new generation of robot employees to open new properties across Japan. Advances in robotic technologies are now enabling the robots to mimic a lot of human and animal actions. Robots were barely able to walk properly a few years back. But now, pioneered by the works of organizations such as Boston Scientific, robots are able to jump steps and run fast like dogs and open latches.

Some of the bio-inspired robots are depicted in the following figure:
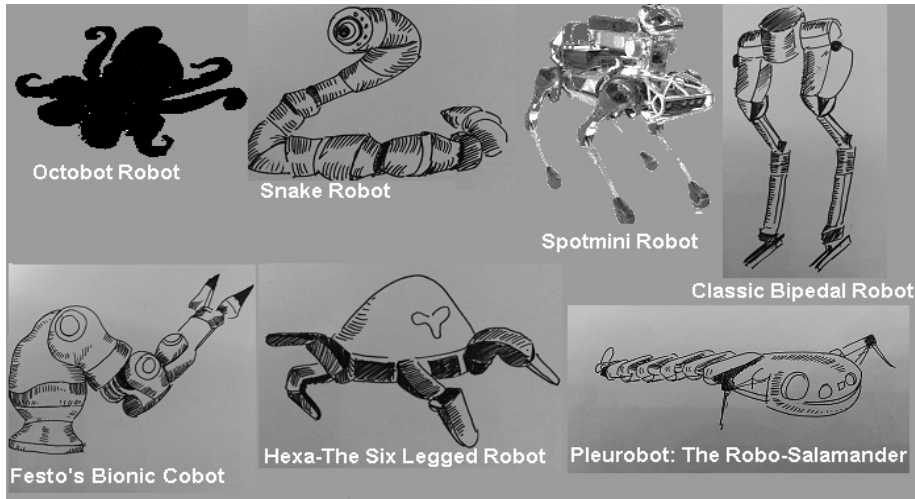
Fig 5.4: Bio inspired robots coming in animal shapes and sizes.

The bio-inspired robots are able to leverage the synthesis of different technologies in material, hardware and software to be able to undertake a number of activities, hitherto reserved for human beings such as enhanced mobility of parts and the whole that enables the robot's physical structure to run, jump across terrains, climb stairs, crawl, swim, dig and fly. These properties of robots are also now successfully used to create the drones of various shapes and sizes. The increased flexibility of the robotic body enables the robots and drones to be used in a number of applications such as environmental monitoring, geological exploration, structural inspection and maintenance, home assistance, social service and elder care, security and surveillance in human impossible and dangerous terrains and many more.

The International Research Institute for Nuclear Decommissioning in Tokyo unveiled a new robot in December 2015 that will help clean up and dismantle the crippled Fukushima nuclear power plant. The increased utility of robots and autonomous objects has also resulted in the need of advances in energy generation, storage and harvesting techniques.

The urgent need to explore how these devices can last longer with the available energy sources embedded in the body, while the cost of usage needs to drop and availability of recharging stations and options to

recharge need to be ubiquitous and convenient. The options for electrical sources of energy for robots include

i) Electrical batteries

ii) Solar cells

iii) Nuclear power

iv) Fuel cell technology

Fuel cells are different from most batteries in requiring a continuous source of fuel and oxygen (usually from air) to sustain the chemical reaction, whereas in a battery the chemical energy usually comes from metals and their ions or oxides that are commonly already present in the battery, except in flow batteries. Fuel cells can produce electricity continuously for as long as fuel and oxygen are supplied and are increasingly used for a variety of purposes.

In large robots, it is possible to fit a small nuclear reactor that uses a Stirling engine (heat engine that is operated by a cyclic compression and expansion of air or other gas and used for low power domestic applications) that generates electricity to power the robots.

A lot of countries are encouraging the setting up of charging stations for robots, autonomous cars and other self-driving vehicles to charge conveniently and keep going for ever. A lot of attention is also given to advance the energy storage density at an affordable cost that will enable their usage in autonomous cars and for domestic purposes. For example, the Lithium technology has been making rapid strides in increasing the density of battery storage by many folds over the lead acid battery. This has helped practical applications to bring electric cars and hybrids to the market. A continuous improvement will help in making the agents of autonomy more affordable and ubiquitous in future.

Conclusion

In this chapter, we explored the different aspects of robots from their evolution to their construction and management as intelligent agents of automation powered by Artificial Intelligence and Machine Learning. We explained the various applications of robots and the anatomy of the robots in detail.

The advantages offered by the employment of robots far outweigh the investments in a number of ways as robots can work tirelessly in extenuating circumstances and in dangerous and hazardous circumstances. They can undertake repetitive tasks that are hitherto considered a drudgery of sorts by humans. Once programmed, they can go about undertaking their work with utmost precision with a maximum predictability. This ability makes them most suitable for industrial applications, high precision medical surgeries and also 3D printing of houses.

With the increasing capabilities of the robots powered by advanced AI algorithms, it has become imperative to ensure the cyber security of these agents by programming through Blockchain-enabled ecosystem that not only ensure authentic communication with appropriate access controls but also allow deviations to be tracked and acted upon in a lively manner.

CHAPTER 6

Robotic Process Automation

INTRODUCTION:

Robotic Process Automation (RPA) aims to leverage technology in automating a number of repetitive jobs with the help of artificial intelligence, algorithms and machine learning tools. RPA offers enormous amount of benefits over human operations with high precision, consistency, scalability and flexibility. By being able to work 24 hours, RPA can help enormous amount of data crunching and manipulation by undertaking tasks in invoicing and accounting, expense management and auditing functions without fatigue and error across multiple languages and geographical locations. AI agents have proven themselves in language translations at break-neck speeds. In this chapter, we will explore RPA from a variety of angles in order to appreciate the potential of this new age paradigm of enhancing productivity and gaze into the future to project its future course in tandem with other internal and external applications and cutting edge technology paradigms.

STRUCTURE:

- Robotic process automation: Why, What, How, Where?
- Describe business process management
- Types of roles in a RPA projects
- RPA Vendors
- Examples of RPA applications and Implementations

OBJECTIVE:

The objective of this chapter is to understand Robotic Process Automation that has taken the world by storm since its introduction in 2012. Various tools and platforms are sought to be explored as the various steps in putting in place a complete project for the implementation of RPA in an organization along with the evaluation of its financial viability. The reader should have a clear understanding of the applications of RPA along with the steps needed to implement the same.

RPA-enabled processes offer tremendous transparency and complete audit trail. RPA allows integration and interoperability of digitized processes, thus enabling to fetch data as required and also update information anywhere through API management. The integration of all data-oriented applications can then pave way for leveraging data analytics to the maximum using artificial intelligence and machine learning-based algorithms and tools.

Reduced operational cost and higher throughputs with zero errors ensures high return on investments that only increases with time, being wage proof. It is estimated that a majority of the jobs in finance and accounting functions in the future will be eliminated due to the implementation of RPA and other applications of Artificial Intelligence (https://www.americanbanker.com/news/how-artificial-intelligence-is-reshaping-jobs-in-banking).

It is estimated by Autonomous Research, a premier body in AI and ML research, that over 1.2 million people working in the banking and other financial institutions will be replaced by artificial intelligence-related applications by 2030 globally. The jobs most affected will be the routine jobs like tellers accounting to over 30% of job losses. While a number of customer servicing and accounting jobs such as loan officers, customer service reps, loan interviewers and financial managers will be most affected as these jobs will wither by self-serviced customers or automated by bots or catered to by Chatbots.

WHAT IS RPA OR ROBOTIC PROCESS AUTOMATION?

RPA consists of the following three terms:

ROBOT: A robot refers to a piece of computer coded software that can mimic user interactions and routine manual activities with utmost precision across the areas of its deployment and could be rule-based or unstructured.

PROCESS: A process refers to an activity or a sequence of steps that is carried out on an input to result in an output in a regular and routine manner. This could be across various functional and non-functional areas of an organization and lends a method and a system of approach to any task in a professional organization, lending it dependability, accountability, repeatability and credibility.

AUTOMATION: Automation refers to the approach of carrying out the processes without a manual intervention by leveraging information technology tools and systems.

Thus RPA means automation of repetitive, rule-based processes across functional areas and different applications in an organization with robots that mimic the human activities, thus replicating the same.

Routine jobs like data entry tasks, accounting entries, invoicing, expense filing, auditing against a set rules, etc. can now be automated and integrated into the rest of the IT systems in the organization resulting in high precision, tremendous scalability and ease of reconciliation. RPA is very different from other automated routine processes performed by Chatbots, voice assistant and personal assistants. RPA are automation tools for rule-based processes mainly in financial and accounting domains controlled by business operation teams and managed by the IT department in the organization.

Implementation of RPA has proven to improve efficiency and increase speed of operations while reducing expenses, thus resulting in an all-round operational excellence and customer satisfaction in organizations.

LEVELS OF RPA:

Based on the capabilities of the RPA system, there are different types of RPA platforms available from simple to complex. At the basic level, RPA can be leveraged for automation of simple rule-based tasks like form filling, survey aggregation, etc. The bots that perform such functions are called Programmable RPA bots.

A typical RPA involves automation of invoicing and accounting activities that will encompass a number of routine processes leading to input transformations and output generation. For example, this can involve the creation of an invoice by updating a number of fields taken from a variety of other applications like CRM, ERP, etc. and posting the output to customers while updating the internal systems.

The bot finds its action based on inputs gathered from the other systems in the organization and produces outputs and performs various other actions to update and communicate with the external world through emails, report and dashboard generation, etc.

AI and ML powered RPA involves programming-based, UI-operable software robots with the ability to work with structured semi-structured and unstructured data as well. There are two types of AI powered bots:

- Self-learning solutions trained by observation of the various activities by the existing manual systems learn the same and start executing the tasks.

- Intelligent bots using advanced cognitive capabilities possess capabilities such as vision, Natural language Processing capabilities and pattern recognition, etc. and these can work on both structures and unstructured data as well.

RPA AND BPM (BUSINESS PROCESS MANAGEMENT):

In professional organizations, there is a lot of accent on Business Process Management (BPM). Business process management involves continuous evaluation and engineering of processes across the functional and non-functional areas to ensure a lean management, de-bottlenecking of

redundant processes, through optimal utilization and orchestration of organizational resources for enhanced productivity.

RPA complements the BPM activities by automating a number of manual and repetitive steps by leveraging cutting-edge technology tools and platforms, thus offering a high ROI (Return on Investment).

RPA is increasingly making its effectiveness felt across multiple large organizations who employ a number of staff for managing their business processes and operations. In many cases, there has been over 50% reduction in manpower and technology leaders offering RPA platforms that are providing outsourced services to these organizations by managing their operational and financial departments at much reduced monthly costs after leveraging RPA.

Mckinsey & Co. predicted that 45% of all human performed activities can be automated by leveraging advanced technologies available today; the predominant being AI and ML powered analytics, RPA and Blockchain.

As per NASSCOM, RPA has been found to reduce onshore process operations costs by 35-65% and offshore delivery costs by 10-30%, resulting in a recovery period of 6-9 months.

As per IRPAAI, an RPA bot agent costs less than one-third of the cost of an offshore full time employee and one-fifth of the price of an onshore worker.

The PREDOMINANTLY TYPES OF ROLES IN RPA PROJECTS:

PROCESS DEVELOPERS

The Robotic process automation project begins with the identification and assessment of processes that contain repetitive workflows that can be automated with minimal impact of manpower but maximum impact on productivity.

BUSINESS USERS

Business user segment consists of the members of different functional areas and their customers whose problems need to be solved through automation while resulting in improvement in efficiencies and improved customer satisfaction.

SOLUTION ARCHITECTS:

The solution architects analyze the various options and create the appropriate design and use cases with user stories and system design required to achieve the same.

TECHNICAL CONSULTANTS

- Very often, the technical consultants undertake the process of concept selling to the management of clients of the RPA program.

- They then undertake an extensive review of the existing systems, identify the processes that need intervention and offer substantial scope for efficiency improvements.

- The various business processes are redesigned and optimized and the KPIs and metrics are defined as per the standard SLAs benchmarked with the best in the industry.

- The repetitive processes that are amenable for automation are passed on to the RPA development team and the IT experts in the organization.

- A proof of concept is initiated and upon successful implementation of the proof of concept, the business case for a large-scale implementation along with the success metrics to be achieved is drawn out.

- The technology team evaluates various options by assessing the solutions and options available from various vendors and the decision is taken with respect to the best fit and the options that can yield the maximum ROI or return on investment.

DEVELOPERS and PROJECT MANAGERS:

The technology team is tasked with the creation and scaling up of the RPA bot project. While the project management team works on a comprehensive step-by-step plan with deliverables on time and resource developers work on an evolving the necessary front end, backend, middleware and integration activities required for the execution of the project.

RPA Vendors (top platform providers):

The top vendors of RPA are mentioned below:

BLUEPRISM:

UK-based Blue Prism group is a global leader in the RPA market and enables a number of organizations to reduce manual data entry jobs that are repetitive and prone to human errors.

Based on the robust Microsoft dot net framework, Blue prism offers high speed operation capability coupled with user-friendly features. It is available for web, desktop and Citrix environments. Blue Prism offers reusable frameworks and is known for high reliability.

High level of security through internal and external decryption and encryption keys and analytics dashboards, ability to work with any types of platform and application, Blue prism's digital bots and the framework has the ability to understand visual and written messages from disparate digital data sets across the organization. Using pattern recognition and advanced cognitive capabilities, they can extract the relevant information, process and report the same in an integrated manner across the organization's internal processes and systems.

UIPATH:

New York-based UiPath's UiPath tool offers user-friendly architecture to automate and manage the repeatable business processes using bots. The UiPath tool is based on the Microsoft SharePoint workflow and Kibana elastic search. It offers mobile and browser accessibility, on-premise and cloud deployment methods with a cloud-based orchestrator. It has convenient user interfaces and offers desktop contribution and Citrix environment. BPOs are a strong focus area for UiPath and are found

to be more suitable for large-scale applications than medium-scale implementation.

KOFAX KAPOW

California, USA-based Kofax Kapow offers process management, RPA, e-signature, mobility and customer communication services. Its stateless multithread architecture and ability to no-coding-based solution that can integrate with any application and data source or enterprise system offers excellent user-friendliness and scalability, which are the key features that any user looks for. The ability to work with websites, portals, enterprise systems, and legacy applications, Excel, Email, XML, JSON, CSV, and SQL makes it a preferred choice for web automation and file handling. It can easily integrate with robotic processes from external and internal environments.

AUTOMATION ANYWHERE

California, USA-based Automation Anywhere offers a robust Microsoft-based platform. It can help to automate end-to-end business processes and can be deployed in cloud, data center, desktop, or in any other environment. Automation anywhere is more suitable for low and medium sized operations with a limited number of bots usages.

NICE:

Israel-based Neptune Intelligence Computer Engineering (NICE), a leader in large-scale deployments, offers enterprises RPA solutions to operationalize Big Data. Based on Visual Basic and Microsoft dot net technology, NICE offers a seamless, fast, highly scalable bot architecture that enables operations with a lower level of cognitive requirement to automate and achieve high levels of productivity. Any third-party or home system, including CRM, billing, MS Office, virtualization, and networking can be integrated into a NICE-based application.

Once the successful vendor is selected, the organization works closely with the vendor and outlines the targeted SLAs and also presents a business case internally with ROI expected and the delivery timelines for the project.

BOTS:

The bots are then developed and put into action to arrive at an automation of various activities as planned.

The automated process is then tested thoroughly and user acceptance testing, integration testing, etc. are undertaken to identify any potential bugs that have been missed out in earlier stages. All the bugs are rectified in a limited production scenario and once completed, a large scale roll out is executed across the potential areas of bot applications to realize the full potential of the project through expected savings. This stage also involves the integration of the RPA with the various internal systems that are positively impacted.

For extending the RPA across the organization, it is imperative that a proper transition plan is created and implemented by addressing the misgivings from the staff if any while securing the organizational goals of lean operation, high productivity and return on investment.

Robot controllers assign the jobs to various bots and monitor their performance with respect to the metrics laid out**.**

CONSIDERATIONS FOR RPA INVESTMENTS:

RPA involves replacement of a lot of human resources across a variety functions, mostly related to finance and accounting with programs that can be termed as bots. Management of the affected employees and re-skilling them for other activities or placing them in other organizations etc. is a challenge that gripe the human resources and talent management of an organization.

The IT department is concerned about evaluation of the right tools, hardware infrastructure and platforms that offer the best customized solution, their maintenance, up gradation and IT capability enhancement and the finance department while being a user of the RPA bots, tools and techniques is also concerned about the budgets and ROI thereof in this technology.

The resultant benefits that may accrue due to enhanced productivity and profitability of operations enables the sales and marketing department to focus on increasing customer acquisition activities, and in some cases, may also have to deal with competition proficient in using cutting-edge

tools and hence are better off.

RPA has been finding increasing applications across a variety of industries that have always been consuming heavy documentation and paper exchange albeit being process driven, which have well defined processes to serve the customers. While Accounting and Financial organizations in any organization can be potential users of RPA, companies and conglomerates in the Supply Chain management, Healthcare, Human resource, Retail and other service-oriented industries are immensely benefited using RPA.

A typical application of RPA in a financial organization is used for searching millions of records in respective databases and downloading details of a specific person, vehicle, company or an insurance policy based on specific search criteria for processing claims or planning for renewal calls or analyzing performance for a report, etc. The searched, verified and downloaded details are forwarded for further analysis and action to the respective department.

RPA is being used for automating repetitive processes as follows:

- Healthcare: Registering and maintaining records of patients.

- Talent Management and HR: Recording the joining documentation of new employees and managing the payrolls of employees.

- Insurance: Calculating and providing premium information as per the specific customer particulars and in processing the insurance claims.

- Telecommunication and BPO: SLA management and reporting agent wise performance particulars.

- Retail: Billing management, sales projections and inventory forecasting and purchase planning.

- Supply chain: Invoicing of customers for routine orders and posting to ledger of accounts, generation and communication of outstanding statements to clients periodically.

However, these are not exhaustive and similar applications are possible across different companies in different domains.

EXAMPLES OF RPA APPLICATIONS and IMPLEMENTIONS

Case study of Automation Anywhere, a Global RPA leader.

(Courtesy: Beginners' guide to Automation Anywhere-Course created by Automation Anywhere)

RPA involves automating repetitive and rule-based processes using advanced software applications.

TOP APPLICATION AREAS OF ROBOTIC PROCESS APPLICATION ACROSS DOMAINS & FUNCTIONAL AREAS FOR REPETITIVE PROCESS AUTOMATION									
Government	Manufacturing	Finance & Banking	Healthcare	Hospitality	Ecommerce & Retail	Logistics & Supplychain	HRD	Marketing
KYC documentation & verification, Tender management, Reporting	ERP Integration, Inventory and Warehouse process automation, Reporting system automation	Creating lead generation reports and monitoring social sentiment. Invoice processing, reporting, auditing, Claims and Incentive processing	Patient data storage & processing management. Reporting for doctors, insurance data automaton and claim processing, claim status updation.	Price analysis of competitors, guest data processing, data verification, payment processing, etc.	Itemwise stock position scraping & updating from producer, updating online inventory and importing website and email sales.	Order processing, data entry, partner claim processing, Invoice processing, Reporting, Warehouse process, Reporting	Employee survey data processing, HR Information system documentation and dashboard management, Employee communication related notificaions	Recording and tracking lead generation reports and Customer Sentiments.

Fig 6.1

Automation Anywhere, a global leading company in the RPA domain, offers state-of-the-art tools to develop, manage, deploy and execute state-of-the-art RPA bot applications under its Digital Workforce Platform. Cognitive and predictive capabilities are now being integrated into advanced RPA bot applications to mimic human brains and assist them in performing complex applications in a speedy manner. This will help them to analyze mistakes and predict future trends. IQ bots with cognitive capabilities can work on semi structured and unstructured data and have algorithm-based decision making and self-learning capabilities.

Automation Anywhere Enterprise applications offer a number of benefits to the organizations.

Some of the benefits offered by the bots developed using the platforms are listed below:

- Reduce errors and increase the accuracy to 100% resulting in customer delight.

- Increase availability of processes round the clock throughout the year.

- Increase speed and throughput, thus increasing the capacity of operations and removing bottlenecks.

- Improved ability to capture, collect and collate relevant data of highest quality.

- By adding cognitive capability to RPA applications, organizations can get tremendous operational intelligence and actionable insights to predict future outcomes and patterns.

- Reduce manpower costs and improve workforce productivity.

- Help employees in focusing on higher value added and interesting jobs instead of boring repetitive jobs, thus improving their job satisfaction and morale.

- Improve implementation of controls and help in auditability.

- High levels of security by restricting access of information, sensitive data and processes to only authorized persons.

- Help in real time availability of information and business intelligence

- Assist in organizational digital transformation and minimization of business risk.

- Lead to reduction in organizational costs and increased profitability.

AAE's Bot management platform supports advanced software development lifecycle, practices and provides development, test and production environments. It is client server architecture with a server functioning as a control room that can be deployed on cloud or on premises. It is connected to two types of clients, namely, Bot Creators and Bot Runners.
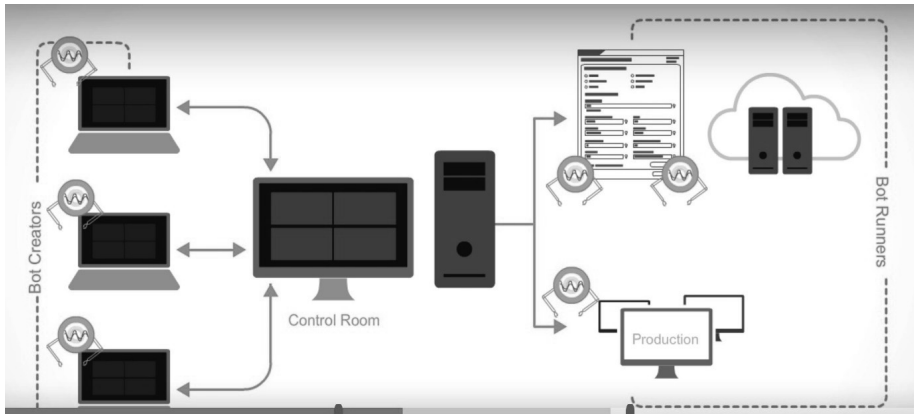
Fig 6.2

Automation Anywhere Enterprise Bot Management Platform

Figure Courtesy: Beginners' guide to Automation Anywhere-Course created by Automation Anywhere

AAE's Bot management platform consists of the following three main components:

- **Bot creator:** Bot creator is a development client and comprises process specialists and IT experts to enhance, streamline and automate processes by deploying bots.

They are used for authoring and unit testing of automation. They are mainly two types of bots, namely, Task bots and Meta bots. Task bots are used for automating rule-based processes and use structured data. Meta bots are reusable (across several task bots) building blocks that offer speed and scalability to the automation process and are configured only once.

- **Control Room:** The control room is the brain of the platform and helps to launch the bots and any type of infrastructure. The CR enables in license management, user management, source code management and offers a dashboard with analytics regarding all the bots deployed. The control room offers centralized deployment, access control and collaboration and digital workforce

management.

- **Bot Runners:** Bot Runners are the clients on which the bots created are deployed to perform tasks and are managed through the control room.

Automation Anywhere also provides platforms like **BOT insights to display analytical insights, including details on saving. Bot Farm allows you to create or rent bots and BOT Store (**https://botstore.automationanywhere.com/) **is** a digital workforce marketplace of pre-built bots for every type of business automation.

There are four methods used to build bot applications on the AAE platform, depending on the use case. Identifying the right method enables reliable, user friendly and time efficient building of the bots.

The four methods are as follows:

- Smart Recorder: This method is used to capture objects from applications like Java, PHP, etc.

- Screen Recorder: This method helps to record and automate processes that include mouse clicks and key strokes.

- Web Recorder: This method helps to capture processes that involve capturing information from web-based processes.

- Task Editor: This method is used to automate processes that involve a series of commands and wizards.

With the help of the AAE platform's versatile drag and drop wizards, the non-technical staff can build and deploy automated processes while IT developers can build bots to automate complex, integrated end-to-end processes.

AAE offers over 500 readymade commands involving database, excel, file and folder management and advanced PDF integration commands.

Some of the top most use cases implemented using the AAE platform for automating tedious, error prone and time-consuming processes are listed below:

SOME USE CASES:

1. **Employee surveys:** The key operations that can be automated using the AAE platform involve opening Excel file for collation, opening PDF file of responses, copying the data collected from PDF, and pasting into an Excel file.

2. **Procurement process automation:** The key processes that can be automated include upload and download purchase order files from FTTP folders, check for approval of purchase orders, email vendors of approved orders, delete rejected and emailed approved orders from local folders, etc. This will result in tremendous savings in manpower costs, reduce errors and scope for disputes while expediting the processes.

3. **Responding to emails and taking appropriate actions as required:** This involves using a combination of bots like email segregating bot and Terminal Emulator bots to trigger responses on appropriate platforms.

A number of more use cases can be obtained from the AAE Bot Market place, https://botstore.automationanywhere.com/. To keep pace with the advancements in the fast evolving RPA domain, continuous training is required for the corporate professionals who need to understand the potential and utility of RPA to be able to invest in this technology. AAU (Automation Anywhere University) offers online, offline and blended learning options to learners to develop the necessary skills in implementing advanced RPA applications.

CONCLUSION

RPA or Robotic Process Automation (RPA) was introduced in the market in 2012 via a case study written by HFS and supported by Blue Prism, a leader in RPA platforms. In this chapter, we examined the evolution of RPA, its utility, path to implementation, platforms available and its way forward as an integrated tool to enhance corporate productivity and profitability. RPA promised to remove manual workarounds and headcount overload from inefficient business processes and BPO services by automating repetitive processes.

New business models led by outsourcing business processes to low income destinations using Cloud and next generation IT and communication technologies has enabled companies to increase their productivity and profitability significantly. Implementation of RPA leads to further optimization of resources with a number of routine accounting and financial processes being automated. The implementation of Chatbots and Voice Assistants has added another layer of automation that has joined forces with RPA led automation at the back end. The advent of AI and ML led analytics that is transforming the various aspects of front-end customer interactions and the interactions it needs with the backend operations to respond to the queries that lead to the need of an integrated approach across various facets of the organizations, which were hitherto operating in silos and in isolation. AI and ML led analytics and advanced features enable the RPA tools to offer advanced features that include pattern recognition, document and currency identification, and many more.

Thus, RPA is no more just a repetitive process automation, but an advanced paradigm that has the capability not only to implement advanced analytics led features that can learn and improve with time and interactions, but also to enable the integration back end processes across functional domains. The implementation of Blockchain led automation in the future will enable a large scale revamping of processes, both at intra and inter enterprise levels. Thus, any organization that views and implements RPA coupled with AI and ML led analytics, business process re-engineering and Blockchain needs to integrate vertically and horizontally with systems across the company such as ERP, CRM and external oracles and Blockchain.

This will be the vision for the new generation organization that leverages automation to the fullest. We will study more about this in the coming chapters.

CHAPTER 7

Drones

INTRODUCTION:

Drones are the flying manifestations of AI & and ML-based technology advancements. From the limited range, battery controlled flying devices with limited range, drones are now available with most advanced features and are taking part in a number of complex projects and use cases; thanks to the advancements in the AI and ML-led applications.

For many, the drones are black boxes and many still wonder how such tiny objects flying far above in the air are able to undertake such complex array of functions performing a variety of activities.

In this chapter, we will take a close look at the varieties of drones and their applications in various domains.

STRUCTURE:

- Describe drones
- Components of drones
- Types of drones
- Classification of drones
- AI in drones
- Uses of AI in the drone industry

OBJECTIVE:

The objective of this chapter is to demystify the technology behind the autonomous flying objects that are now making their presence across the world. We will take a look at the various facets of the drones from their definition, application areas, hardware components that make up their body, categorization of drones and their advantages and disadvantages. The technological underpinnings resulting from the utilisation of AI and ML led technologies that impart the functionality of the drones are also looked at in a succinct manner. Drones are expected to be no more mystic flying objects for those who read this chapter, and it is further expected that the readers will take an active interest is procuring them and utilizing them for a variety of applications starting from hobbies to areas of public utility and welfare, while being within the purview of the local laws and regulations that govern such applications.

A BRIEF OVERVIEW Of DRONES:

A drone' is an unmanned aircraft that combines a number of technologies like IOT, Satellite, GPS, Robotics, Artificial intelligence into one compact unit. It has become the hottest topic with the recent advances in the commercialization efforts led by world leaders in this business.

As per Wikipedia, drone is an unmanned aircraft system; remote-controlled pilot-less aircraft; flying thingy without people inside controlling it; The FAA (The Federal Aviation Administration) calls them Unmanned Aircraft Systems (UAS) and projects that 30,000 drones could be in the nation's skies by 2020.

DRONES' BODY COMPRISES THE FOLLOWING COMPONENTS:

Flight controllers with GPS integration, multirotor revolving blades, battery storage to the last full length of the flights, gimbals for sensor payload mounts, IR cameras, etc. The body is made up of lightweight materials like carbon fibre, etc. The sensors are light weight and extremely energy efficient. The multirotor provides redundancy and help in managing failure of any rotors at any time.

Drones come in different sizes and weights ranging from 100 gm to over 1000 kg with applications for close range micro drones to large range drones with a very long range.

Drones are used for a variety of civilian and military purposes like aerial photography, digital archaeology environmental analysis, agricultural analysis, gas mapping, coastal surveys, film/media, and law enforcement and for participating in drone racing competitions.

Being controlled by computers through satellites and remote sensing technology, drones pack tremendous precision with economic feasibility and efficiency.

While drones have enormous use in dangerous works, agriculture, medical and media, there are a number of concerns related to privacy invasion, accidents and security risks that can be caused by its unscrupulous use. Let us delve deeper into these exciting manifestations of AI and ML-led automation in the modern era.

WHAT IS a DRONE?
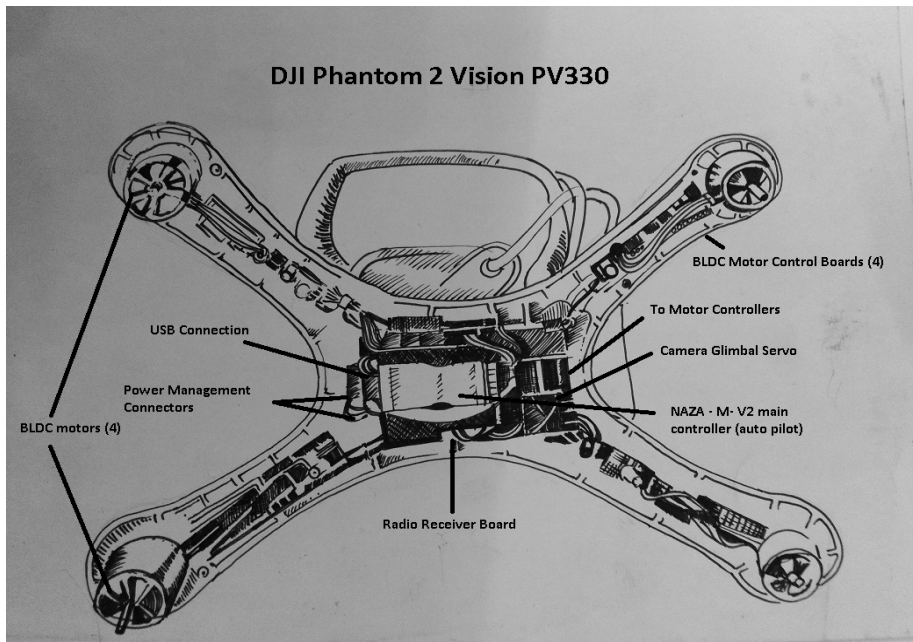
Fig 7.1

An unmanned aerial vehicle (UAV) commonly known as a drone is an aircraft without a human pilot on board. **UAVs are a component of an unmanned aircraft system (UAS)** which include a UAV, a ground-based controller, and a system of communication between the two. The flight of UAVs may operate with various degrees of autonomy: either under remote control by a human operator or autonomously by on board computers.

The word drone actually has two distinct meanings: the first one is a low humming sound that goes on a continuous basis and the second indicates the male bee. We all know that the male bee has no work to do; it never goes out to gather honey; its existence is just for impregnating the bee queen. So it is not a bad idea to use this word to describe an UAV that also produces sound like a group of bees and phantom appears to be mindless. The drone to the today's world is an unmanned aerial vehicle or UAV that is either operated by a human from a remote location or it can work autonomously as per the set mode. In simple words, a drone is something like a flying robot. The aircrafts are usually controlled from a dedicated remote unit and they can manage all things in air due to an intelligent software program. It possesses so many on-board working sensors like GPS, etc. that assists in proper flight mode controls.

HISTORY OF a DRONE:

The origin of a drone can be traced with special techniques to provide relevant information to the military. The very first aircraft with reusable type radio control mechanism was designed in the thirties, and it worked like a base model for all new advancements in today's world. Later, the military drones were developed with classic sensors and camera units and now they have been fixed inside missiles too. With so much advancement in technology, now you can easily find so many variants of drones. A few are used for military applications but others are finding the potential role in many big companies. As per a recent new update, Google and Amazon are developing their own drones so that parcels can be delivered by air with ease. One more interesting concept is presented by Facebook as they are thinking to develop some giant drones that can carry signal to remote locations for direct internet access. Drones in today's world have also been an important part of film industry and news reporters are also using them to carry information from inaccessible locations.

HOW DOES A DRONE WORK?

The working procedure of a drone may appear simple to most of you but the device is actually carrying a complex technology inside. Before we discuss the concept of a drones' working, you must know the fact that differentiate between drones and its ancestors the helicopters. The former one can fly independently whereas the later needs a pilot for directions.

Actually, it is a specially designed multi propeller system inside a drone that makes this device highly independent and also assists in reduction of failures. One important thing to note about this multi propeller system is that even if any motor inside this device stops working; it will keep on flying as it gets support from propellers that are working in the group. Drones that possess a large number of motors inside are able to gain more control over their elevation and hence can carry more loads during flight. These propellers get their power from a dedicated source and most of these devices contain removable batteries so that they can stay in air for a long time. The flight time can be extended with use of powerful batteries in design.
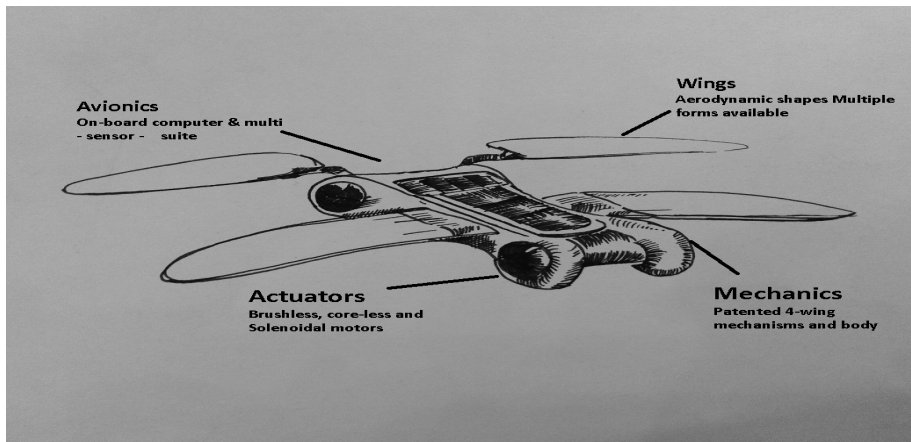
Fig 7.2 How does a drone fly? facilitating features

HOW DOES IT FLY?

A controller plays an important role in the drone flying mechanism. This device is used by experts for controlling every movement of a drone, ranging from its launching, navigation abilities and even up to landing.

The market is flooded with a variety of controllers these days and developers often use it to do various experiments to create drones with impressive features.

One of the major tasks of a controller is to establish a proper communication channel between the remote unit and the radio waves. Most of the drones work on 2.4 GHz frequency range and many of these controls take help from Wi-Fi networks for making active decisions regarding movements. Many features of a smartphone and drones are the same as both carry GPS, Wi-Fi and many other common sensor units. These on-board sensors help drones to stay in air for a long time and make right decisions about its height, direction and other important movements. The landing process is also controlled by the propeller system inside and the sensors make decisions about its speed, altitude and motor rotation, etc. A drone works like an intelligent air unit that can cover a large distance when used with powerful batteries and can bring the hidden information for you like a spy. This is the main reason behind its popularity in military applications.

COMPONENTS OF DRONES

Let us now take a look at the various components that go into the construction of a drone, giving it all the properties that are required to fly and perform its functions.

1. Standard Propellers 2. Pusher Propellers 3. Brushless Motors 4.Landing Gears 5. Electronic Speed Controllers 6. Flight Controller 7. The Receiver 8. The Transmitter 9.GPS Module 10. Battery 11 Camera
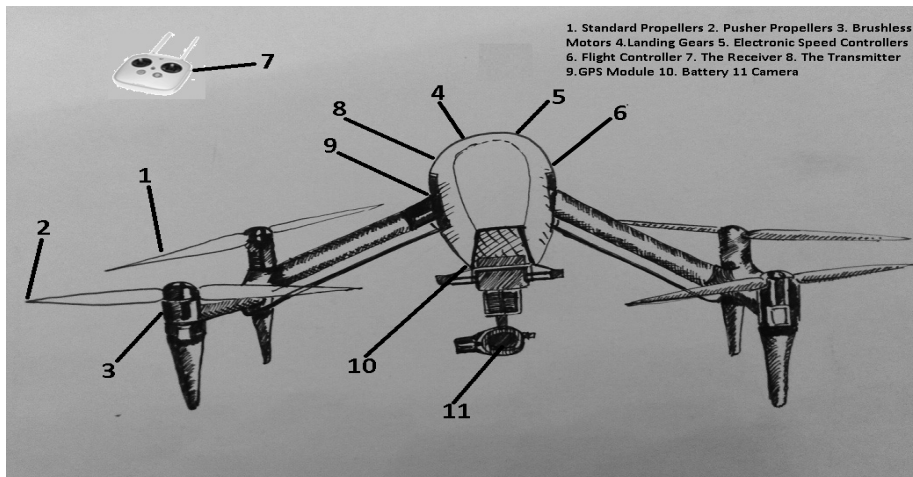
Fig 7.3 Components of a drone

1. STANDARD PROPELLERS:

The propellers are usually located at the front of the drone/quadcopter. There are many variations in terms of size and material used in the manufacture of propellers. Most of them are made of plastic, especially for the smaller drones but the more expensive ones are made of carbon fiber. Propellers are still being developed and technological research is still ongoing to create more efficient propellers for both small and big drones. Propellers are responsible for the direction and motion of the drone. It is therefore important to ensure that each of the propellers is in good condition before taking your drone out for a flight. A faulty propeller means impaired flight for the drone and hence an accident can occur. You can also carry an extra set of propellers just in case you notice some damage that was not there earlier.

2. PUSHER PROPELLERS:

Pusher propellers are the ones responsible for the forward and backward thrust of the drone during a flight. As the name suggests, the pusher propellers will determine the direction the drone takes either forward or backward. They are normally located at the back of the drone. They work by cancelling out the motor torques of the drone during the stationary flight leading to forward or backward thrust. Just like the standard propellers, the pusher propellers can also be made of plastic or carbon fiber depending on the quality. The more expensive ones are usually made of carbon fiber. There are different sizes depending on the size of the drone. Some drones provide for pusher prop guards that will help protect your propellers in the event of an unplanned crash. Always ensure you inspect your pusher propellers before the flight as this will determine the efficiency of the flight.

3. BRUSHLESS MOTORS:

All drones being manufactured lately use the brushless motors that are considered to be more efficient in terms of performance and operation as opposed to the brushed motors. The design of the motor is as important as the drone itself. This is because an efficient motor means you will be able to save on costs of purchase and maintenance costs. In addition to this, you will also save on the battery life which contributes to longer flight time when flying your drone. Currently, the drone motor design market is pretty exciting as companies try to outdo each other in coming

up with the most efficient and best developed motors. The latest in the market is the DJI Inspire 1 which was launched recently. This offers more efficient performance and saves on the battery life. It is also relatively quiet and does not produce a lot of unnecessary noises.

4. LANDING GEAR:

Some drones come with helicopter-style landing gears that help in landing the drone. Drones which require high-ground clearance during landing will require a modified landing gear to allow it to land safely on the ground. In addition to this, delivery drones that carry parcels or items may need to have a spacious landing gear due to the space required to hold the items as it touches the ground. However, not all drones require a landing gear. Some smaller drones will work perfectly fine without a landing gear and will land safely on their bellies once they touch the ground. Most drones that fly longer and cover longer distances have fixed landing gears. In some cases, the landing gear may turn out to be an impediment to the 360 degrees view of the environment, especially for a camera drone. Landing gears also increase the safety of the drone.

5. ELECTRONIC SPEED CONTROLLERS:

An electronic speed controller (ESC) is an electric circuit whose main responsibility is to monitor and vary the speed of the drone during its flight. It is also responsible for the direction of the flight and variations in brakes of the drone. The ESC is also responsible for the conversion of the DC battery power to AC power to propel the brushless motors. Modern drones depend entirely on the ESC for all their flight needs and for performance. More and more companies are coming up with better performing ESCs that reduce power needs and increase performance, the latest one being the DJI Inspire 1 ESC. The ESC is mainly located inside the mainframe of the drone. It is unlikely that you will need to do anything or make any changes on the ESC but in case you need to make any changes, you can locate it inside the mainframe of the drone.

6. FLIGHT CONTROLLER:

The flight controller is basically the motherboard of the drone. It is responsible for all the commands that are issued to the drone by the pilot. It interprets the input from the receiver, the GPS Module, the battery monitor and the on-board sensors. The flight controller is also respon-

sible for the regulation of the motor speeds through the ESC and for the steering of the drone. Any commands such as triggering of the camera, controlling the autopilot mode and other autonomous functions are controlled by the flight controller. Users will most likely not be required to make any alterations to the flight controller as this may often affect the performance of the drone.

7. THE RECEIVER:

The receiver is the unit responsible for the reception of the radio signals sent to the drone through the controller. The minimum numbers of channels that are needed to control a drone are usually four. However, it is recommended that a provision of five channels should be made available. There are very many different types of receivers in the market and all of them can be used when making a drone.

8. THE TRANSMITTER:

The transmitter is the unit responsible for the transmission of the radio signals from the controller to the drone to issue commands of the flight and directions. Just like the receiver, the transmitter needs to have four channels for a drone but five is usually recommended. Different types of receivers are available in the market for drone manufacturers to choose from. The receiver and the transmitter must use a single radio signal in order to communicate to the drone during the flight. Each radio signal has a standard code that helps in differentiating the signal from the other radio signals in the air.

9. GPS MODULE:

The GPS module is responsible for the provision of the drone longitude, latitude and elevation points. It is a very important component of the drone. Without the GPS module, drones would not be as important as they are today. The modules help drones navigate longer distances and capture details of specific locations on land. The GPS module also helps in returning the drone safely 'home' even without navigation using the FPV. In most modern drones, the GPS module helps in returning the drone safe to the controller in case it loses connection to the controller. This helps in keeping the drone safe.

10. BATTERY:

The battery is the part of the drone that makes all actions and reactions possible. Without the battery, the drone would have no power and would, therefore, not be able to fly. Different drones have different battery requirements. Smaller drones may need smaller batteries due to the limited power needs. Bigger drones, on the other hand, may require a bigger battery with a larger capacity to allow it to power all the functions of the drone. There is a battery monitor on the drone that helps in providing the battery information to the pilot to monitor the performance of the battery.

11. CAMERA:

Some drones come with an in-built camera while others have a detachable camera. The camera helps in taking photos and images from above which forms important uses of drones. There are different camera types and qualities in the market and a variety to choose from.

These are basically the main component of a drone. If you ever need to make a drone, you will need to have all of these in order to have a working drone.

TYPES OF DRONES

Drones or UAVs are designed with capabilities to fly in air without a pilot. Their movements are mainly controlled by a remote unit in most of the cases whereas a few highly advanced designs are operated from computers. There are so many varieties of drones that you can easily find in world and all of them are working for different applications so we cannot define any set criteria for their classification. Depending on the need or applications, they can have the variable size and design.

One of the most common applications of drone technology is in military as it helps to control surveillance-related issues with ease. Places where humans cannot enter directly can be easily monitored by an air flying unit and it can also capture photographs of critical locations. Here, we are going to discuss the various types of drones and for ease of understanding; they are categorized into four basic sections: Number of propellers used inside, their size, flying range and equipment.

DIFFERENT TYPES OF DRONES:

Different Types of Drones:					
Number of Propellers			**Size**	**Range**	**Equipment**
Rotary Drone	Multirotor drones	Tricopter	Very small	Consumer	With camera
		Quadcopter	Mini	Prosumer	With FPV
		Hexocopter	Medium	Professional	With GPS
		Octocopter	Large		With stabilizers

Fig 7.4

ACCORDING TO a NUMBER OF PROPELLERS:

ROTORY DRONES: Let us take a look at the different types of drones based on the number of propellers in detail.

- **SINGLE ROTOR DRONE:**

  The most common construction in a rotary type drone use to be multi rotor type designs that have many rotors for holding its position. But in case of a single rotor model, you will find just a single rotor inside. The other one will be a tail rotor that simply assists to provide control to the heading. In case if you have a mixture of hover possessing heavy loads but need a faster flight time with longer endurance, then single rotor type helicopters can be best choice.

- **TRICOPTER:**

  There are three different types of powerful motors inside a tricopter: three controllers, four gyros and only one servo. The motors are simply placed at every extreme end of three arms and each one of these is holding a location sensor. Whenever you need to lift your tricopter, it is essential to initiate a movement in the throttle lever, the gyro sensor will immediately receive its signal and will pass is directly to the controller that helps to control motor rotation. A tricopter is able to stay stabilized on its path as it is equipped with so

many classic sensors and electronic stuff itself. You need not apply any manual correction.

- **QUADCOPTER:**

  When a multirotor is designed with four rotor blades, then it becomes a quadcopter. These devices are usually controlled by specially designed brushless type DC motors. Two of the motors are used to move in a clockwise direction whereas the other two run in the counter clockwise direction. It helps to decide a safe landing for the quadcopter. The source of battery for such devices uses to be a lithium polymer battery.

- **HEXACOPTER:**

  A hexacopter will serve you for many potential applications with its six motor mechanism where three work in the clockwise direction and the other three move in the anti-clock wise direction. Hence, these devices are able to gain higher lifting power as compared to quadcopters. You need not worry about its mechanism as it is designed to serve as an extremely safe landing craft.
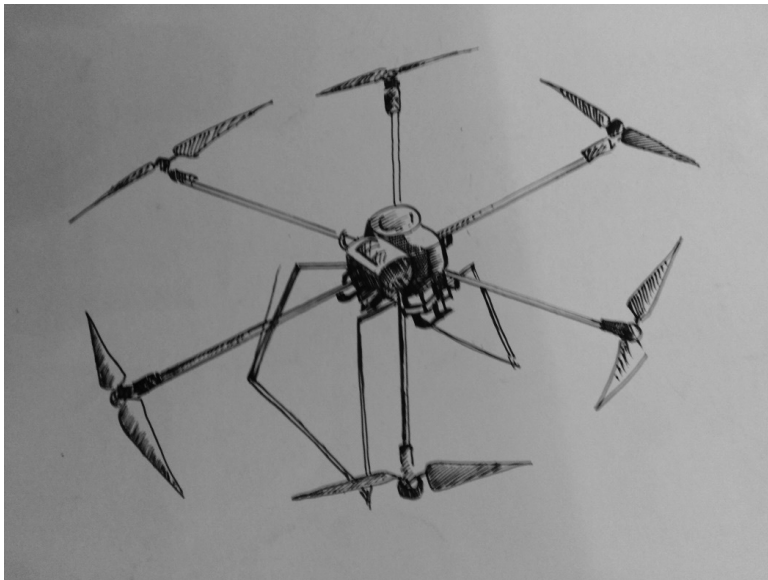
Fig 7.5

- **OCTOCOPTER:**

  Octo means eight; so octocopter is going to serve you with its pow-
  erful eight motors and then send power to eight functional propel-
  lers. This craft naturally have much flying capabilities as compared
  to units discussed above and are also highly stable. You can avail a
  stable footage recording with octocopters at any altitude. These de-
  vices find application in the world of professional photography.
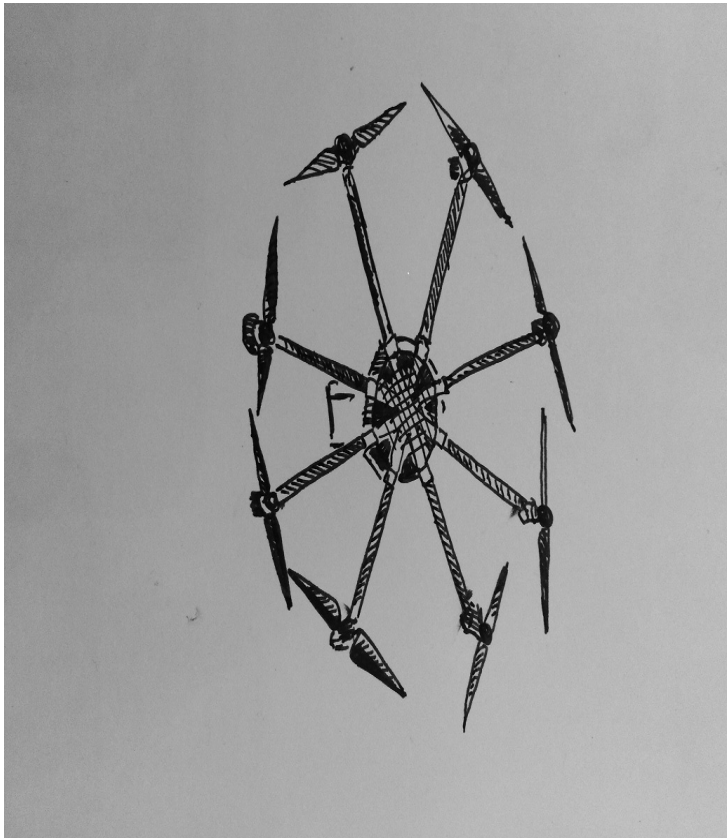
Fig 7.6

- **FIXED WING DRONE:**

  Fixed wing drones are entirely different from all the above units.
  These designs are quite unique as compared to commonly used
  multi rotor type drones.
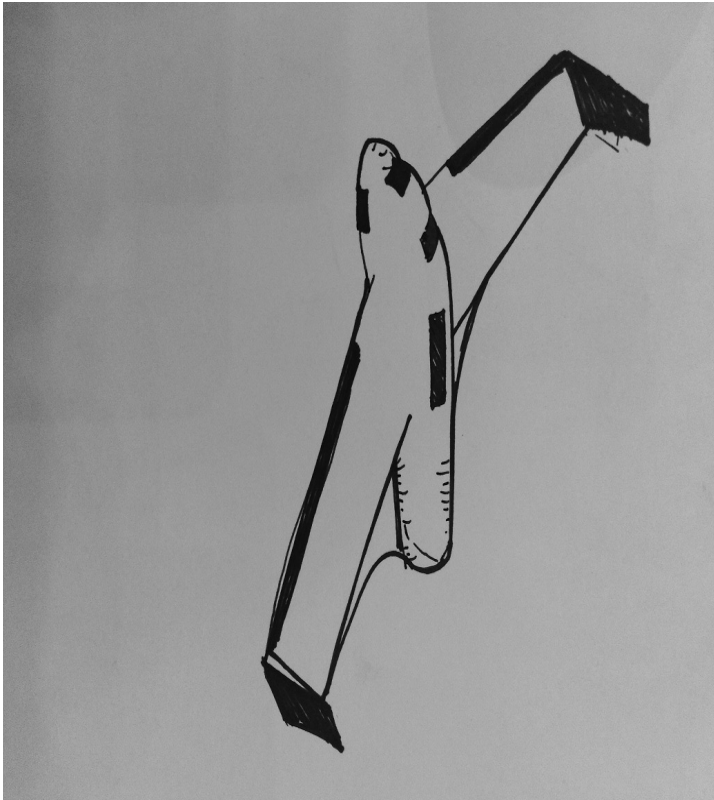
Fig 7.7

You will find a wing on them and they appear like traditional airplanes. These drones are not able to stand stable in air as they are not very powerful to fight against the gravitational force. They find their applications in movement-related recording where they can move forward as per their capabilities being offered by their inbuilt battery system.

NOTE:

The most common designs of drones available in the market are quadcopters because they are able to lift huge weights without any additional engineering adjustments. It is the most cost effective solution to most of your needs.

DRONED BASED ON SIZE:

1. VERY SMALL DRONES:

They can be designed with a common size range varying from a large-sized insect to a 50 cm long unit. The two most common designs in this category are Mini Drones and Nano/Micro Drones. The nano drones are widely used due to their tiny structure and light weight construction as they work like essential weapons for spying.

2. MINI DRONES:

They have a size little bigger than micro drones, which means they can reach up to 50 cm in length but will have maximum 2m dimension. Most of these drone models are designed with fixed wings type construction whereas a few can have rotary wings. Due to their small size, they lack in power.

3. MEDIUM DRONES:

This category of drones presents heavier units but is lighter and smaller than aircrafts. These drones can carry weight up to 200 kgs and have an average flying capacity of 5 to 10 minutes. One of the most popular designs under this category is the UK watch keeper.

4. LARGE DRONES:

Large drones are somewhat comparable to the size of an aircraft and are most commonly used for military applications.

Places that cannot be covered with normal jets are usually captured with these drones. They are mainly used for surveillance applications.

Drones can also be further classified into different categories depending on their range and flying abilities.

CLASSIFICATION OF DRONES ACCORDING TO RANGE OF MOVEMENT, CONTROL AND DISTANCE COVERAGE

● **VERY CLOSE RANGE DRONES:**

They act like as favorite toys for most of the kids. They are able to fly up to 5 km with fly time of 20 to 45 minutes when equipped with powerful

batteries. Some of the most commonly used units in this category are Raven and Dragon Eye.

● **CLOSE RANGE DRONES:**

These drones are able to fly up to 50 km with a battery backup of 1 to 6 hours. As they can work for longer durations and can cover far distances, they can be used in surveillance missions.

● **SHORT RANGE DRONES:**

These drones are a little superior as compared to close range drones. They are used for military applications. They are able to travel up to a maximum distance of 150 km which means the coverage is almost 100 km more than that of close-range drones. The estimated flight time for short range drones is 8 to 12 hours so they are useful for reconnaissance and spy applications.

● **MID RANGE DRONES:**

This category of drones is very powerful as compared to all the mentioned above. They are well known as high speed drones that can cover area up to 650 km. Mid range drones are commonly used for surveillance applications and some basic types under this category can be used for meteorological data collection needs.

● **ENDURANCE:**

Fig 7.8

Here is the best collection of drones that has an impressive flight time of 36 hours and can go up to a maximum height of 3,000 feet above

the sea level easily. These drones are popular for high-end surveillance applications.

ACCORDING TO EQUIPMENT:

● **WITH a CAMERA:**

Most of the action camera lovers and shooting experts love to buy drones equipped with cameras used to capture classic shots at tough locations. The film making industry is utilizing them commonly for movie footage. Within the last few months, there has been a huge drop in the price range so that more number of buyers can buy drones for routine use. You can easily buy one in the price range of $100 to $1000 only. Most of the action cameras these days are manufactured with special drone mounting capabilities.

● **WITH FPV:**

FPV here stands for First Person Viewing. This is a very common application of drones that is capable enough to record things like viewers are watching them on real-time basis. It is possible to control these drones by sight with the help of a portable monitor. These drones are commonly used in the film industry and for face-to-face interview shooting needs.

● **WITH GPS:**

These units are gaining more and more popularity these days as they are capable enough to capture location information on the go. You can send this drone to record scenes at any fixed location as they are highly stable and they come back home after completing the task. The most interesting thing to know is that they remember the last shoot location and can be sent again to the same position for the next shoot.

● **WITH a STABILIZER:**

The Gyroscope technology is majorly developed for improving flight capabilities of drones. Currently, devices have been designed with six axis type drone stabilization features so that they can stay stable in air and can manage movements at steeper turns. These devices can follow instructions instantly and perfectly for all shooting needs. Its central flight control mechanism assists users to enjoy easy navigation options so that the targeted footage details can be gathered.

AI IN DRONES

Deep learning is recently showing outstanding results for solving a wide variety of robotic tasks in the areas of perception, planning, localization, and control. Its excellent capabilities for learning representations from the complex data acquired in real environments make it extremely suitable for many kinds of autonomous robotic applications. In parallel, Unmanned Aerial Vehicles (UAVs) are currently being extensively applied for several types of civilian tasks in applications right from security, surveillance, and disaster rescue to parcel delivery or warehouse management.

'Actionable Data' is next to a powerful and reliable drone and is probably the most important driver of the drone industry. Drones often generate large amount of data; sometimes more than what we can handle. Unmanned aerial vehicles only add value to the user if there are ways to process data quickly and without putting additional efforts into this process. The faster, the more accurate, and the easier the images can be evaluated, the better.

Combining drones and artificial intelligence seems to be the answer to all the above mentioned challenges. Nowadays, almost every company that deals with data processing, analytics or 'autonomous' flight control claims the use of artificial intelligence, machine or deep learning. But what do these terms actually mean? How do they relate to each other and where are these terms applied?

The following text aims to answer these questions:

In general, AI describes the capability of machines that can perform sophisticated tasks which have characteristics of human intelligence and includes things like reasoning, problem-solving, planning, learning, and understanding and reading human languages as shown in following image.

TERMINOLOGY AND DESCRIPTION:

MACHINE PERCEPTION:

Let us start with Machine Perception. Since many AI-related tasks for drones are dealing with image recognition, the unmanned aerial vehicle must be able to perceive and absorb the environment or objects in some

way. This is usually done with sensors such as electro-optical, stereo-optical, and LiDAR. This process is referred to as Machine Perception.

COMPUTER VISION (CV):

Once the drone has captured the raw sensor data, it usually needs to be analyzed in some way to extract meaningful information for a certain purpose. This ability is called computer vision and it is related to the automatic extraction, analysis and understanding of useful information from one or more images.

MACHINE LEARNING (ML):

To optimize differentiable parameters, techniques of machine learning can be applied. Unlike software that has programmed manually and performed tasks with specific instructions (like Computer Vision software), machine learning algorithms are designed in such a way that they can learn and improve over time when exposed to new data.

DEEP LEARNING (DL):

Deep learning, on the other hand, is a specialized method of information processing and a subset of machine learning that uses neural networks and copious amounts of data for decision-making. The learning methods are based on the functioning of the human brain, which also consists of interconnected neurons. The so-called Artificial Neural Networks consist of multiple layers of which each is connected to the next layer and is responsible for a certain task. This design makes it possible to combine and expand what has been learned with new content.

As already mentioned earlier, the goal of drones and artificial intelligence is to make efficient use of large data sets (such as aerial images) as automated and seamless as possible. No one wants to look at 5,000 plain white picture of a wind turbine and look for tiny cracks. Drones can only unlock their full potential when data acquisition and data analytics happen at a high (or someday full) degree of automation. Great potential to process this mass of data as automated as possible seems to be the approach of ML or DL. Due to an immense and rapid increase in the processing power, the cost of storage and availability of digital data in the recent years, the utilization of complex AI algorithms have become feasible for drones, and first and solid solutions are already in the market. If AI develops as rapidly as we have seen in the recent years, we

will soon find highly automated and comprehensive solutions that will further increase the added value of using drones. But companies must consider that drones and artificial intelligence only make sense if it saves the user money/time. In some cases, the traditional computer vision (in combination with ML/DL) still might be an easier and better solution.

USES OF AI IN THE DRONE INDUSTRY

Drones powered by AI are used in a variety of industries for various applications. Some of the prominent use cases where drones and AI are used in conjunction are listed below.

- **CONSTRUCTION SITES:**

Construction companies use AI drones to scan and map the terrain of building sites, doing in 15 minutes a job that takes days for humans to complete, Drones give a bird's eye view of the construction vehicles during the project, providing information to possibly create self-guided equipment in the future.

- **SMART CITIES:**

A team at Microsoft Research says self-driving cars will be common by 2020, and the technology will spread to delivery of vehicles, including everything from take away food and prescription of medications to public services. Drones may also be used to solve traffic problems or engineering dilemmas. In Rwanda, the use of AI has already lowered the wait for blood for transfusions from four hours to fifteen minutes.

- **EMERGENCY DRONES:**

Drones can be used to drop supplies to disaster victims in areas that are nearly impossible to reach. Possibilities range from food for hurricane victims to medications for snake bites to hikers in the wilderness. They can also analyze the structural damage after a disaster, help firefighters see the exact locations of a fire, aid with chemical spills, and show emergency responders where to locate injured people. They can carry police cameras and pepper sprays or handle violent behavior on the spot in large crowds, as well as provide remote consultations with doctors.

- **FARMING:**

In the past, farmers relied on experience and intuition for things like the best time to plant their crops or sow seeds for a garden. AI technology helps them do everything from determining the best time to plant to applying the right amount of fertilizer at just the right time. It can also aid farmers in spotting diseased crops or for managing solar farming technology.

- **MILITARY AND DEFENSE:**

Google is currently working with Pentagon to develop AI for unmanned combat, and the technology is already being used for tasks like patrolling borders, tracking storms, performing safety inspections, and monitoring security. Military drones can carry supplies, weapons, or cameras.

- **INDUSTRIAL INFRASTRUCTURE:**

Drones are being used by companies like the GE subsidiary Avitas Systems to inspect their infrastructure, including power lines, transportation, and pipelines. Drones can do the job more efficiently and safely, but they can also prevent problems by identifying inconsistencies in data. Some railway companies use drones in their safety inspections.

- **FACE RECOGNITION AND INSURANCE CLAIM PROCESSING:**

Some insurance companies use drones to survey damaged buildings, snapping images and wirelessly transmitting to the company for faster processing. Other companies use drones for simplifying face recognition or deterring cyber attacks, and the taxi-alternative Lyft is used for researching self-operated cars.

- **AMATEUR DRONES:**

One company is developing a drone that can be used out-of-the-box by anyone who is interested in photography but is particularly suited for photographers who are also surfers, downhill skiers, UAV pilots, or runners. It also has applications for recording action sports and other events in real time.

- **REAL-TIME DATA:**

Drones can be used by commercial, industrial, and service organizations to provide instant surveillance in multiple locations instantly, eliminating the need for human surveillance or spending endless hours searching through recorded information.

- **CREATING PERFECT MODELS FOR INSTRUCTION:**

An article in Forbes discusses the use of drones to analyze accumulated data and use it to produce a training manual that shows employees how to be smarter, faster, and more precise on their jobs.

- **REAL ESTATE:**

Sophisticated drones with cameras are being used by real estate companies to provide photographs of homes and commercial buildings, as well as aerial maps and local information for home buyers.

- **ENTERTAINMENT, MEDIA, AND THE INTERNET:**

Filmmakers and news media are using drones to capture aerial footage, sometimes without the Federal Aviation Administration's (FAA) permission, and to shoot scenes on closed sets. So far, the FAA has not approved drones for use by the media, forcing them to rely on footage by private users. Mark Zuckerberg of Facebook recently announced a plan to provide internet access to remote areas of the globe by using solar-powered drones.

SUMMARY and CONCLUSION

Drones or Unmanned Aerial Vehicles have come a long way in the recent years to participate in a number of areas ranging from photography, supply chain, geological surveys, disaster management , surveillance and security and many more.

Drones can go to places that are inaccessible to people, capturing powerful images and recording important data that would otherwise be unavailable. From drones that helped in Puerto Rico's hurricane recovery to unmanned NASA vehicles that transform from drones to planes while in flight, scientists are using UAVs with artificial intelligence to make great changes in the world.

Artificial intelligence can be used to create machines that perform tasks more efficiently than humans, allowing them to work in stressful environments 24 hours a day all year long with no lunch breaks, sick days, or paid vacations. This has already led to otherwise impossible feats in areas like space travel and medicine and could be the answer to global issues like world hunger and nuclear holocausts.

As machines develop the potential to improve the world, scientists ask an important question such as what will happen if machines use their cognitive skills to perform malevolent acts instead of benevolent ones? This could happen in one of the two ways. AI might be programmed to do something beneficial and unwanted side effects could occur along the way. Or, it could fall into the wrong hands and be programmed to be destructive. Because AI has the possibility of evolving as it performs and adjusts to meet its objectives, its actions could be hard to predict.

Several privacy advocates have started arguing that this will allow any individual to purchase a drone and spy on people right in their homes and backyards. This is why it is necessary to install such procedures that drone operators are unable to use the drone for personal purposes which they have not been licensed for.

As drones start making their presence felt in various domains like surveillance, military, logistics, photography and advertising, what scares us is the continued assault on personal privacy and threat to national and individual security that these flying objects pose to the ordinary citizens in the day-to-day life.

Possibilities are many, but challenges are also manifold, and these require new approaches from the regulators and homeland security and also technology companies to jam areas to protect privacy. After all one does not want a bird-shaped drone peeping into your living rooms or offices photographing and transmitting sensitive information!

CASE STUDY: DRONE MANUFACTURING PROJECT (Courtesy-State Government of Gujarat, India)

https://cdn.vibrantgujarat.com/website/writereaddata/images/pdf/project-profiles/Drones.pdf

What are Drones?

- Unmanned Aerial Vehicles (UAVs), commonly referred to as drones, are categorized as aircrafts that are controlled from the ground or used in an autonomous mode with a pre-programmed flight. Drones are equipped with cameras and sensors to capture and monitor subjects in real-time across applications. They are also used in transport and other operational activities.
  - Drones provide a more economical visualization and navigation for applications, including mapping, surveillance and package delivery from the air. These unmanned drones equipped with cameras are able to reach remote locations and perform complex tasks.
  - Currently, drones are majorly used in military applications and market for other applications is at a nascent stage, but is anticipated to rise in coming years driven by both consumer adoption and advancing technologies.

Applications of Drones

Delivery	Agriculture	Energy and power	Industrial operation	Oil & gas
Government	Infrastructure	Geographic survey	Sports	Mining

Emerging technologies expand drone's usage beyond the military applications

- Drone evolution is disrupting multiple industries ranging from agriculture to filmmaking, impacting the business operations with better and flexible visualization capability.
- Commercial use of drones include crop monitoring, freight services, film videography, infrastructure surveillance, geographical mapping, security and industrial application.
- Civilian use of drones include damage assessment of property and life during natural calamities, critical infrastructure monitoring, traffic monitoring, crisis management, search and rescue, forest fire monitoring and security.
- With the advancement of technology in connectivity, GPS, videography, controllers and sensors, drones have evolved for multiple uses and strengthened their acceptance across industries.
- The potential application of drones for commercial purposes have led to major R&D investments by companies in the internet, logistics, e-commerce, defence and, oil and gas sectors.

Project Concept

Classification of Drones – by application

Toy drone   Camera drone   Industrial drone

Military drone   Commercial drone   Racing drone

Classification of Drones – by form

Monocopter   Bicopter   Tricopter

Quadcopter   Hexacopter   Octocopter

Global Market Overview - Global drones market is estimated to reach USD36.9 billion in 2022 from USD6.8 billion in 2015, growing at a CAGR of 27.3% driven by growing use-cases of drones

- Drones market is largely dominated by military drones, but commercial and civilian drones are gaining momentum due to increased use.
- In 2015, market for military drones accounted for 65% of total drones market with rest 35% shared by camera drones and other types of drones.
- Drones market continues to mature with refined models, more intuitive software and increased usability. In the last few years, several new drone start-ups have entered the market due to surging consumer adoption.
- Companies strive to produce commercial drones that are more energy efficient, durable and have a significantly lower cost of operation than a manned aircraft.

Global drones market (US$ billions)

27.3% CAGR

36.9

6.8

2015   2022
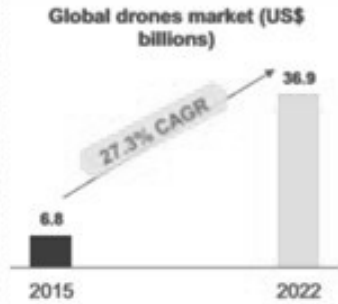
Source: WinterGreen Research

Indian drone market is anticipated to reach USD421 million by 2021

- Military and governmental applications account for majority of the share in India's drone market, as commercial applications remain low due to a ban by Directorate General of Civil Aviation (DGCA).
- Small drones are expected to grow the market with its deployment for recreational purposes such as videography and racing.
- Applications in disaster management and surveillance by governmental agencies and companies are gaining prominence in the market.
- Drones could also become important tools in other applications such as surveying farmlands, conserving wildlife and critical infrastructure monitoring.

India has the potential to become a major market for small and medium drones manufacturing

- Given India's growing electronics manufacturing capabilities and software prowess, there is considerable potential for innovation in making small and medium drones and development of software for improving data analytical capabilities of drones.
- Further, there exists strong potential for Indian companies to avail the benefits of the 'Make in India' program and set-up joint ventures for making drones.
- Despite uncertain regulatory environment, several domestic start-ups are producing drones for various commercial applications ranging from disaster relief, security and surveillance, and aerial photography.
- There are also a number of private Indian companies working on both the hardware and the software of drones, selling exclusively to the government.

Source: http://gisuser.com

Growth Drivers

Advancing technologies add more capabilities to drones

- Drones continue to evolve with different kind of sensors and automation controls to improve its ease-of-use and capabilities. Some of the recent developments include integration of ultra high-definition cameras for high-quality video capture, 3D imaging and collision avoidance technology.
- Further, advanced technologies have enabled manufacturers to build customized drones of different configuration depending on the application. In coming years, more such technologies are expected to make drones much attractive to consumers.

Increasing use-cases of drones

- Drones continue to evolve with increasing use-cases across sectors. Enhanced flight speed, payload capacity and battery life have opened new avenues for drones market.
  - Individuals adopt drones for recreational purposes beyond toys, as more hobbyists and do-it-yourself (DIY) enthusiasts consider drones as a serious consumer device
  - As the Internet of Things (IoT) evolves with more connected devices, drones are expected to create newer applications.

Growing adoption of camera drones

- Camera drones offer user-friendly experience with sophisticated flight control and high-end image sensors. These drones enable to take aerial shots of professional quality. These are widely adopted by aspirational and professional photographers.

Easing regulations

- Most countries are actively developing laws that would govern the operation of drones for both personal and commercial purposes.
- In India, DGCA plans to register all civil drones and issue permits for operating them. Easing regulations would encourage more manufacturers to enter the market as well as drive consumer adoption.

Growing affordability

- Drones are getting cheaper with increasing competition and maturing technology. In last few years, many Indian start-ups have emerged offering drones with enhanced features for low prices than global players. Increasing affordability is expected to drive further consumer adoption.

Project Information

Drone manufacturing value-chain

```
 Design  >  Frame       >  Motors/      >  Sensors/
            assembly       propellers      controllers
                           assembly        assembly

 Sub-     >  Firmware    >  Configurat   >  Packaging
 system      loading        ion and
 wiring                     testing
```
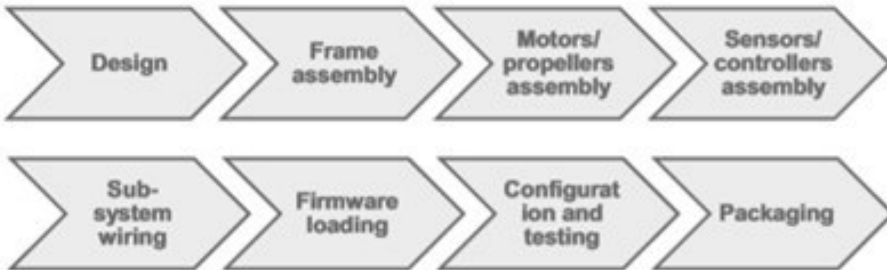
- **Design:** This phase involves product prototyping and building basic system architecture.
- **Frame assembly:** Setting-up of frames based on application.
- **Motors/ propellers assembly:** Attaching of motors and propellers to the frame assembly.
- **Sensors/ Controllers assembly:** Mounting sensors and flight controllers based on application.
- **Sub-system wiring:** Wiring of electrical components on the frame assembly.
- **Firmware loading:** Loading of software to control the drone.
- **Configuration and Testing:** Configuring flight controllers and remote-control testing of drone.
- **Packaging:** Final casing of the product.

Type of drone frames play a vital role in achieving smooth and stable flight; the material and size decide the aerodynamic technicalities

- Drones can take many form-factors, but there are two major categories - rotary wings and fixed wings. Fixed wing drones have simple structure and have long flight times, whereas rotary wing drones are more complicated in mechanical structure and have shorter range.
- Depending on the applications type and material of the drone are chosen,
  - **Frames:** Frame's design decide the number of motors/ propellers on the drone. Major types of frames are quadcopter, tricopter and hexacopter, which have four, three and six motors respectively.
  - **Materials:** Common materials used to build drones are wood, plastic carbon fiber and aluminum, with last materials being lighter and sturdier.

Estimated manpower requirement

Manpower requirement at the site: 215-260

Assembly unit labor	Quality control team	Line supervisors	Managers	Support staff
160-200	20-25	10	5	20
Persons	Persons	Persons	Persons	Persons

Leading global players

The United States, Israel and China are the three top powerful drone manufacturers

DJI Innovations, China	Yuneec, China
3D Robotics, USA	Hubsan, China
Parrot, France	Syma Toys, China

Walkera, China
Xiaomi
EHang

Leading Indian players

Tata Advanced Systems	Taneja Aerospace and Aviation
OM UAV Systems	ideaForge
EDALL Systems	Garuda Robotics

Aarav Unmanned Systems
Skylark Drones
Zuppa Drones
Mahindra Defense System

Key component requirement

Major components				
Frames	Propellers	GPS	Gyroscope sensor	Electronic speed controller
Motors	Prop guards	Accelerometer sensor	Compass	Battery
Landing gears	Cameras	Barometer	Radio communication circuits	Charger

Estimated manpower requirement

Manpower requirement at the site: 215-260

Assembly unit labor	Quality control team	Line supervisors	Managers	Support staff
160-200	20-25	10	5	20
Persons	Persons	Persons	Persons	Persons

Project Financials

Project cost

The total project cost of setting up a camera drone manufacturing facility at Gandhinagar, Gujarat, will be ~INR64.5 crore for a total capacity of 80,000 units per annum.

Project cost	
Project components & specifications	**Cost (INR crore)**
Land (Area: 18.5 acres – 75,000 square meters) Rate: (INR4,480 per sq. mt.)	33.6
Buildings (plant area, office, godown, lab, service area etc.) Built-up area: 80,730 sq. feet Average rate: INR1,000 per sq. feet	8.1
Plant and machinery	5.6
Miscellaneous fixed assets (Furniture and fixtures, office equipment, etc.)	6.5
Utility and other equipment (Electricals, piping, water supply system, etc.)	1.2
Preliminary and pre-operative expenses (Company formation, Interest during construction, etc.)	5
Contingency (transport, insurance, telephone charges, repair and maintenance)	4.5
Total	**64.5**

The estimated project cost has been calculated based on the capital requirement/investment of a typical camera drone assembling unit. However, it may vary by individual project.

Note: 1) Land rate based on Gandhinagar IT SEZ (rate may vary depending on the location of the site in Gandhinagar).

Location suggested

Key highlights

Talukas	4 (Mansa, Kalol, Dahegam, Gandhinagar)
Gram panchayats	302
Area	2140 sq. km
Population	13,91,753
Literacy rate	85.77%
Focus areas	Electronics, textiles, IT -ITES

► Gandhinagar is a capital city of Gujarat state and has seven special economic zones and 10 industrial estates along with creative IT Park and Gujarat International Finance Tech City (GIFT)

► It is considered as an emerging 'Knowledge Hub' with the establishment of various educational institutes such as IIT and IIMs.

► Various computer hardware associations such as Gandhinagar Computer Hardware Association (GCHA) and Gujarat Informatics ltd (GIL) have their presence in Gandhinagar.

► Gandhinagar has been selected as one of the 100 Indian cities to be developed as a smart city under PM Narendra Modi's flagship Smart Cities Mission.

Reasons for selecting Gandhinagar

Ministry Of Electronics And Information Technology

http://meity.gov.in/

India Electronics & Semiconductor Association

http://www.iesaonline.org/

Department of Science & Technology, Government of Gujarat

http://www.dst.gujarat.gov.in

Gujarat Industrial Development Corporation

www.gidc.gov.in

Office of Industries Commissioner

www.ic.gujarat.gov.in

Industrial Extension Bureau

www.indextb.com

This project profile is based on preliminary study to facilitate prospective entrepreneurs to assess a prima facie scope. It is, however, advisable to get a detailed feasibility study prepared before taking a final investment decision.

Chatbots and Voice Assistants

INTRODUCTION:

We are used to talking to customer service agents handling routine sales-related enquiries or normal FAQs or assisting us for any service-related issues.

Aggregation of such services resulted in a huge business called BPOs across the world. English speaking countries like India, Philippines and a number of other countries in the developing world providing an arbitrage in terms of labor costs have become home to such companies employing language and accent trained agents typically called CSAs or customer service agents.

Any company offering products and services globally needs to employ customer care services that offer round the clock services for 24 hours in all the languages and across various types of businesses and for different functional areas. Aggregation and outsourcing to lower salaried destinations made a lot of sense.

But with the availability of trained Chatbots which are automated agents that can work round the clock in any language and can serve any level of customers in any functional area. The BPO industry looks all set to be outsmarted and look like a liability than the assets that have differentiated great and profitable companies from the rest!

In this chapter, we will explore the different manifestations, applications and advantages of chatbots and voice assistants. We will study and understand the different open source platforms available for building the chatbots and also the applications available to build the same for social media platforms like Facebook Messenger, etc.

STRUCTURE:

- Describe chatbots
- Key features of a typical chatbot
- Rule based versus AI-based chatbots
- Good and bad bots
- Key steps to build a chatbot
- Oracle intelligent bots
- Steps to bot yourself
- Use cases of chatbots
- Case study of a chatbot and the intelligent virtual assistant implementation platform

OBJECTIVE:

The objective of this chapter is to explain the potential of chatbot and voice assistant applications in detail and sensitize the learners to the tools available to build these tools and leverage the power of AI and ML-led automation for scaling up their operations. A reader must appreciate the technology behind these new age tools that not only promise a lot to improve the organizational productivity, but also threaten to wipe out the BPO industry and customer service associates that employs millions of people across the globe.

We are used to GPS-based navigation to wade our way through complex routes across the world. It is a common practice for everyone to refer to precisely calculate the estimated time by GPS for planning their journeys. It is another matter that there are certain imperfections in the distances calculated depending on the routes, areas, connectivity, etc. as GPS may not be able to address some nuances that can be identified and acted upon by the human beings.

The voice that beautifully guides you across your journeys are back-ended by a phenomenal artificial intelligence-based analytical system, a satellite-based communication and positioning system that not only calculates the distances, routes and time based on a number of factors, including the traffic conditioning on a live basis. The utility of such a system for smart cities and autonomous vehicle systems like satellites, UAVs, autonomous trucks and cars, robots, etc. is immense indeed.

Any queries to the car navigation system regarding routes to identifying hotspots or utility stations like petrol bunks and any other search for that matter are met with accurate set of options, distances and routes. This is an example for a chatbot or a voice assistant as the case may be depending on whether it is voice capable or not.

WHAT IS a CHATBOT?

A Chatbot is a computer program that interacts with web, telephone and social media users of an organization and conducts written and/or oral conversations.

Chatbots are normally used to converse with potential and actual customers and employees of an organization over various media like mobile, telephone, social media channels, messengers, and web sites.

They are typically powered with Natural Language Processing and Task execution frameworks to understand users' communication like intent, entity and dialogue essence. It can also integrate with backend systems of an organization like different types of databases and productivity applications like ERP, CRM, etc. to search and fetch relevant data for addressing and resolving customer queries and updating databases.

Getting 24/7 round the clock service, a quick redressal of simple complaints and issues, quick information when needed, ease and convenience in interactions, quick answer to simple and complex queries, friendliness and unlimited patience have been rated to be some of the most sought after benefits organizations wish to provide to their customers. Depending on the need, they can provide different chatbots/voice assistants powered with appropriate technology like AI and ML.

Here are some of the following KEY FEATURES OF A TYPICAL CHATBOT:

- **GREETING:** Chatbots exchange pleasantries with the participants and websites, social media users, etc. in an appropriate manner putting them at ease and also offer to support them with relevant information or supportive action.

- **CHATTING OR CONVERSING:** Based on the user responses, chatbots respond to the users in the language of their choice, in voice or in writing as programmed and address their queries with the help of their database of responses or fetching them from the relevant sources as required.

- **INFORMING:** Chatbots can help the users discover various products and services offered by their deployers facilitating them to take an informed decision, without being unduly obtrusive.

- **CONTACT DESK:** Chatbots enable the customers to reach out and communicate their issues and get information round the clock and record the same for an appropriate follow up on communication. In some cases, as needed, they possess the ability to escalate the issues to relevant human point of contacts who have the ability to resolve the queries.

- **NAVIGATING:** Chatbots can lead the users to navigate to the points they are looking at to get appropriate and needed information in a speedy manner.

  By performing all the above mentioned actions in an unemotional and thorough manner, chatbots can provide utility far beyond the human interactions which are prone to going out of control at times due to the irritation from irate and hostile customers, which are not being managed in a professional manner.

  Chatbots have been found to substantially improve the customer satisfaction and conversational experience in a number of cases that has enabled organizations to substantially increase their lead conversions while providing a tremendous amount of actionable analytical insights. This further helps the deployers of chatbots to improve and fine tune their marketing approaches or discover new target segments that were hitherto not considered by them. Chatbots facilitate collection and proper recording of contact

information like telephone, email, etc. and also link the analytical insights from the gist of the conversations to the customer details enabling the marketers to offer customized solutions and detect trends.

The scalability offered by chatbots with negligible increase in overheads is phenomenal. With the different types of features discussed earlier, chatbots offer great savings and increased returns on technology investments.

By deflecting operations through self-service capable menus, the operational costs of organizations can be substantially reduced. We are used to a lot of such applications in our day-to-day life when we query by phone or through web, our bank or an e-commerce company or a utility as well. Using human interventions to high value and difficult interactions, the ROI on human capital can be substantially increased.

In several situations, customers are known to prefer impersonal interactions and prefer conversations with automated menus. For example, in the areas of psychotherapy or counter medicines and products (for example women's diapers and undergarments, aphrodisiacs and sexual health products, etc.), customers do not feel comfortable to interact with other human beings. If such companies are also able to assure and demonstrate impersonal and ephemeral nature of communication, the customer acceptance and sales stand to increase substantially. China's Woebot is a famous example of a psychotherapist bot that is extremely popular. This not only establishes customer loyalty but also increases the customers' life time value to the brands.

MAJOR APPLICATIONS OF THE CHATBOT:

- Grand View Research projects that the global Chatbot market will reach $1.25 billion by 2025.

- 80 percent of business decision-maker respondents to a 2016 survey by Oracle said that they already used Chatbots or plan to use them by 2020.

- Voice assistant bots are cheap, able to work 24/7, and never lose their temper.

- Virtual assistants such as Siri, Alexa, Cortana, and Google Assistant are very much accepted and used.

- Social bots promote issues, products, or candidates.

- Entertainment bots, the Hello Barbie doll, employs a Chatbot created by a company named ToyTalk to respond to her child owner.

- Legal Chatbots can help you file appeals against traffic violations.

- Bots can serve as course assistants to grade essays and elicit student feedback.

- Mental health Chatbot Woebot acts as a talk therapist.

- Marketing Chatbots offer customer service, after sales support and provide customized responses.

HISTORY OF THE CHATBOT:

1966-ELIZA : This chatbot is named after Eliza Doolittle as a fictional character and created by MIT's Joseph Weizenbaum. This bot with the psychotherapist functionality was the first application to pass the Turing test and pass of as a human with its interactions.

1972-PARRY: This is a more sophisticated rendering of a chatbot than ELIZA. This 'schezophrenic' bot was created by a psychotherapist, Kenneth Colby.

1981-JABBERWACKY: This was meant to be the first bot application powered by Artificial Intelligence created by Rolla Carpenter of Great Britain.

1991-DR. SAITSO: Dr. Saitso is an award winning Turing program that mimicked a psychotherapist by asking the question 'Why do you feel it that way?' through AI speech synthesis.

1995-ALICE: Artificial Linguistic Corporate Entity (ALICE) inspired the 2013 science fiction movie 'HER' in which a man falls in love with a Chatbot.

2001-SMARTCHILD: This was first launched on AOL Messenger. SMARTCHILD became a sought after Chatbot on SMS and Messenger

platforms.

2006 IBM WATSON: This was first launched to participate in the Jeopardy game show. IBM Watson become an iconic AI/ML platform and is now used extensively to assist doctors and medical practitioners in hostels for disease diagnostics and prescriptions.

2010 APPLE SIRI: Apple SIRI is the first voice assistant that converses with the users by replying and assisting with a number of tasks. This was later followed by many personal assistant bots; prominent being Google Assistant, Amazon Alexa and Microsoft Cortana (April 2014).

2014 MICROSOFT CORTANA: This was launched in April 2014. Cortana can set reminders, recognize natural voice without the requirement for keyboard input and answer questions using information from the Bing search engine. Cortana is currently available English, Portuguese, French, German, Italian, Spanish, Chinese, and Japanese language editions, depending on the software platform and region in which it is used.

2014 AMAZON ALEXA: This was launched in November 2014. Alexa is a virtual assistant from Amazon. It is capable of voice interaction, music playback, making to do lists, setting alarms, streaming podcasts, playing audio books, and providing weather, traffic, sports, and other real-time information such as news. Alexa can also control several smart devices using itself as a home automation system. Users are able to extend the Alexa capabilities by installing 'skills' (additional functionality developed by third-party vendors).

2016 GOOGLE ASSISTANT: This was launched in May 2016. Google Assistant is an artificial intelligence-powered[2] virtual assistant developed by Google that is primarily available on mobile and smart home devices. Unlike the company's previous virtual assistant, Google Now, Google Assistant can engage in two-way conversations.

2016 FACEBOOK MESSENGER BOTS: In 2016, Facebook allowed developers to place bots on its platform and is now the biggest platform for Chatbots and hosts more than one lakh bots and hosts more than a billion users. Platforms like Manychat and Chatfuel make it very easy to create and launch Chatbots that can be integrated into the Facebook page accounts of the users.

2017-WOEBOT: This is one of the first bots for healthcare applications. WoeBot has become very popular for helping cure psychotherapist patients.

In 2018, Facebook Messenger became famous for Chatbots that created their own language that each other understood.

MAJOR BENEFITS OF THE CHATBOTS CAN BE OUTLINED AS FOLLOWS:

- Reduce average handling time continuously through continuous learning accumulated across multiple bots, thus providing a rapid increase in ROI.

- Automating repetitive questions enables you to scale up or down without changing the manpower strength.

- Streamline knowledge and create queryable database and replicate actions.

- Regular interaction with employees through voice assisted surveys and supporting them during exit interviews, feedback surveys and also offering assistance to resolve queries.

- Update and share learning across multiple in real time to enable to improve the program across.

- Respond to customers through personalized offers, greetings and gifts.

- Understand, write and speak in different languages and accent as per the respondent's location.

HOW DO CHATBOTS WORK?

Chatbots recognize the 'Intent' and 'Entity' that are a part of the input provided by the user and try to construct the dialog by leveraging the NLP engine, integrated search engine and a database reference. They respond to the user input received via a medium such as a website, social media platform, messenger platform or telephone by offering the corresponding output to satisfy the query by understanding the query, searching the web or a database and coming up with a suitable reply leveraging the Artificial Intelligence technology or a rule-based system.

This can be done in any language in the form of a written or spoken communication by leveraging Text to Speech and Speech to Text synthesis as required.

How a Chatbot works
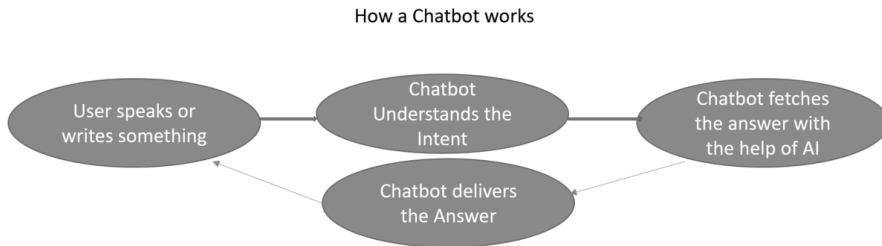
Fig 8.1: The working of a chatbot

In the case of voice-based communication, the Chatbots termed as personal assistants digital or voice assistants undertake speech analysis and synthesis as shown in the preceding figure.

RULE-BASED VERSUS AI-BASED CHATBOTS:

Rule-based chatbots offer the basic level of functionality like answering from a pre-defined database of FAQs, while AI-powered Chatbots are sophisticated programs that leverage Artificial Intelligence and Machine learning and Deep learning techniques to undertake Natural Language Processing, Pattern recognition, Predictive analytics and Sentiment analysis, etc.

Artificial Intelligence-based technique enables the chatbot application to learn and respond appropriately using databases and customer responses recorded from the past or from the training data.

The Natural Language Processing engine helps to simulate human-like responses in voice and text in different languages, while sentimental analysis involves understanding the attitude and feeling of a customer based on their responses in different situations for formulating appropriate replies.

Deep learning-powered bots remember the context and continuously learn and improve their responses from past interactions.

In terms of maturity, the cutting edge and most advanced Chatbots use rule-based as well as supervised and unsupervised machine learning approaches.

Task-oriented	Data-driven and predictive
These are any well framed FAQ's.	This will be free text and natural languages.
User-initiated conversation with automated/fixed responses.	Bot will return responses based on the utterances made by user.
They use NLP, but not much Machine Learning.	NLP is used and with Machine learning, bot will be continuously in learning mode.
Bot cannot reply to the question which is not in DB.	Bot does not rely on standard answers but builds them based on intents.
Basic integration with backend systems.	Basic to complex integrations.
Focused and structured interactions.	User can switch between conversations.
Customers' satisfaction is not easy.	Bot can serve with most of the services.
Too many integrations lead to agent forward.	Can be done but will not be needed as most of the services are done by bot.

Fig 8.2: Levels of chatbots

While bots are an important tool of automation and increase productivity of organizations, bots are also used for a number of dubious purposes by cybercriminals.

Bots are programs created to automate repetitive tasks, and they fall into two major categories: **Good bots** and **Bad bots**. According to many studies, over 51% of the internet traffic is comprises bots. Bots with malicious intents far outweigh those with good intents. Data breaches caused by

harmful malware attacks perpetrated with the help of dangerous bots is considered one of the biggest threats of the 21st century.

GOOD BOTS

The bots which are created for a specific legal and authorized purpose to enable the organizations to help in marketing, customer service and improve their productivity and profitability can be considered as good bots. Some of the good bots for such applications are listed below:

- Good bots help businesses automate a number of processes within the norms of propriety and positive spirit and help businesses reach their objectives in a legal way.

- Search engine bots help in fetching the relevant results regarding websites and pages based on search criteria broadcasting data when required.

- Feed fetchers and Crawler bots undertake background execution and help in getting info from other APIs and websites. They form almost 7% of the web traffic and form the highest proportion of good bot traffic.

- Transactional bots like Oracles help in carrying out transactions by representing the websites to external systems. Transactional bots participate in a number of human-bot and bot-to-bot interactions and are of two types, namely, voice-based bots and text-based bots.

- Lead-gen Bots, Query Bots and Task Bots are different types of role-based bots created to automate a variety of tasks in pre-sales, sales, customer service or in employee interactions. They help to improve customer and employee satisfaction by offering a friendly and better experience.

BAD BOTS:

Bad bots undertake illegal and malicious activities by trying to hack into other online agents and also misrepresent wrong information to their victims, thus misleading them to get cheated. Some of them are listed below:

- Scraper sites steal content to republish in other sites in an unauthorized manner.

- Spammers post unwanted and repetitive promotional content to unsuspecting users. Chat and messaging platforms like Yahoo Messenger, Windows Live Messenger, etc. have been frequent targets for spammers who fill their chat rooms with spam, misleading people to part with sensitive personal information.

- Impersonators that mimic humans to mislead unsuspecting humans. They form almost 25% of the bot traffic overall as per a number of current studies.

- Hackers populate harmful content on victim sites attacked by them and leave unforeseen damage. They are the most harmful bots.

KEY STEPS TO BUILD A CHATBOT:

- Before building a chatbot, the developer should consider whether to develop a Chatbot from scratch or if they can use a free Chatbot. Paid Chatbots offer a customized option with a number of specific use cases required by the company. They are costly and are built with the help of external conversational AI companies. It is important to keep the following characteristics of an ideal Chatbot in mind:

- 24/7 availability

- Immediate reply

- Memory regarding the customer's prior transactions, likes and dislikes

- Fine-tuning responses based on earlier mistakes and user responses

- Continuous improvement in response time, accuracy and efficiencies

- Ensures customers are delighted with the experience

- An easy-to-use interface for customers to format their queries in a simple manner

- Ability to converse in many languages in written and spoken words

● Great user experience across channels and platforms

Chatbots can be built free using a number of free tools like Facebook Messenger based applications, Google's Dialogflow, IBM Watson, etc. and provide standardized options at the base level.

THE IMPORTANT STEPS IN BUILDING A CHATBOT ARE GIVEN BELOW:

1. The objective of the Chatbot and the use case should be understood clearly. The goals of the customers, employees or the clients in case of a service provider for whom the Chatbot are indented should be clearly outlined. The bot's functionality should be identified and well documented. The organization's expectations from the project should be clearly outlined.

   Expectations from the bots in terms of its scope definition and exclusions should be communicated clearly to the development team.

   In every industry popularly known to use Chatbots in industries such as food, airlines, banking, retail, travel, sports, hotels, advice, music, real estate, etc., it will be interesting to look out for benchmarks that have set the trend and can be emulated.

   Typical applications include customer service, personal assistance, e-commerce, food concierge, news, content, legal advice, teaching, humor, complaint handling, travel, financial advice, gaming, hotel, jobs, etc.
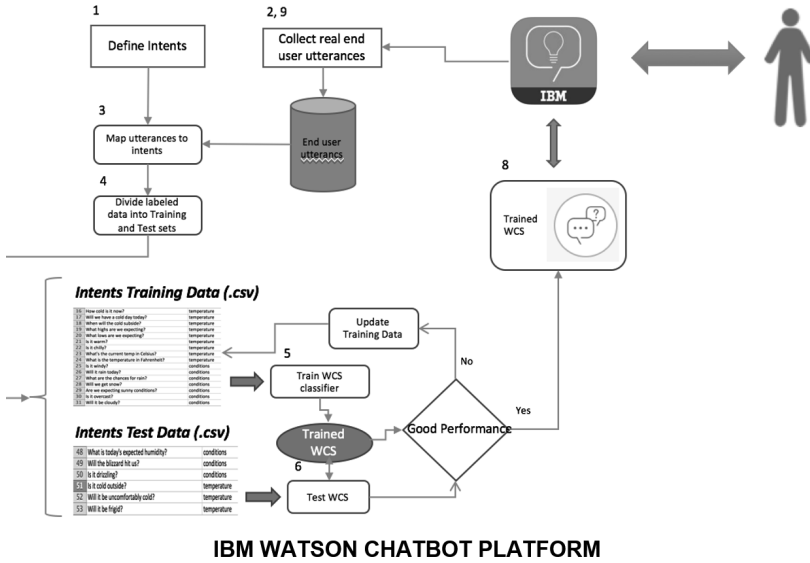
IBM WATSON CHATBOT PLATFORM

Figure 8.3: The IBM Watson Chatbot platform
https://www.ibm.com/blogs/watson/2017/03/bot-yourself/

2. The platforms and the outposts on which the Chatbot is expected to converse should be decided. Some of the popular platforms for Chatbots are platforms such as website, Facebook, Google, Microsoft, Apple, Slack, Telegram, Twitter, Alexa, Skype, Hipchat, Whatspp, Wechat, Viber, etc.

3. The framework to develop the Chatbot like IBM Watson, Google Dialogflow, Azure Bot service or any other paid and customized version should be chosen after evaluation depending on suitability.

Dialogflow SDKs

Dialogflow's SDKs and underlying APIs allow you to take action on your own systems based on conversational input, embed your conversational interface into your app or website, and dynamically change your agent's behavior. Dialogflow APIs center around three primary use cases:

Fig 8.4: The Google dialogflow Chatbot development and deployment framework
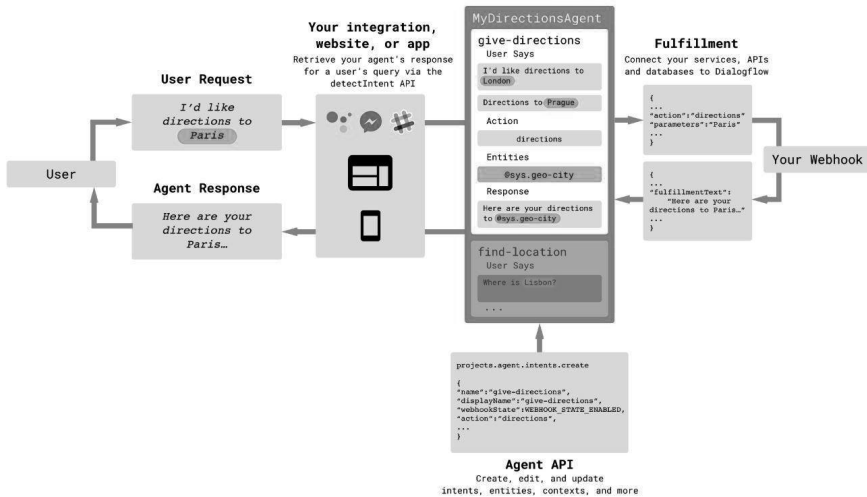
- **Fulfillment**: take action on your own systems based on conversational input. Fulfillment connects your Dialogflow agent to your services, APIs and/or databases
- **Detect Intent API**: Embed your conversational interface built with Dialogflow into your app or website
- **Agent API**: Dynamically change your agent's behavior by editing your agent's intents, entities and contexts For information on Dialogflow's REST APIs please see the Reference Documentation.

a) Delivers natural and rich conversational experiences

- The built-in natural-language processing (NLP) feature imparts artificial intelligence (AI) to the Chatbot, thereby enabling it to process the natural language (received through chat or voice) and carry forward the conversation in a natural way. It's this cognitive capability that distinguishes the AI Chatbot from the normal Chatbot that operates on simple pre-defined rules as coded into it.

- A <u>Chatbot developer</u> integrates this natural language processing capabilities into applications, services, and devices. The output data can be in the voice or chat format as per the requirement.

b) Understands what users are saying about machine learning

- Machine learning makes <u>Dialogflow</u> intelligent enough to predict the hidden intention expressed in the natural input language. A Dialogflow Chatbot can map the user's query with the database available with its backend server. The mechanism of mapping is called Intent. Interestingly, it does so by applying several permutations and combinations. This is a remarkable feature as users ask the same thing in multiple ways, so it's the responsibility of the Chatbot to understand and serve them correctly.

c) Works with an array of platforms

- A Chatbot created with Dialogflow can be deployed, as of now, with as many as 16 platforms. Thus, with <u>Google Chatbot development</u>, businesses can target a widespread audience with least effort. The one-click integration eases the job of Chatbot developers.

d) Offers cross-device support

- Dialogflow helps in creating a device-antagonistic Chatbot. Thus, it engages with users on wearables, phones, cars, speakers and other smart devices. So, businesses can connect with their prospects or customers anywhere, anytime.

e) Helps Chatbots to speak 14+ languages

- Dialogflow supports 14+ languages, including Brazilian, Portuguese, Chinese (Cantonese/Simplified/Traditional), English (Australian/Canadian/Great Britain/ Indian, US locale), Dutch, French (Canadian locale/France locale), German, Italian, Japanese, Korean, Portuguese, Russian, Spanish, and Ukranian.

- Thus, leveraging the Google Chatbot platform businesses can transcend the barriers of geographies and conduct business anywhere on the planet.

f) Helps to track Chatbot's performance with the built-in analytics tool

- Similar to mobile app analytics, technology owners can track the performance of their Chatbots. The integrated analytics tool can read the session or engagement details, including usage patterns, latency issues, and high- and low-performing intents. The intelligence serves as a guiding principle for businesses to further improve their Chatbot.

- Services Google Chatbot Platform Supports

- A Chatbot created using Dialogflow can perform a myriad of tasks as mentioned below:

- Jokes, events search, dining out, local services, reminders, new verticals (coffee shop and tourism)
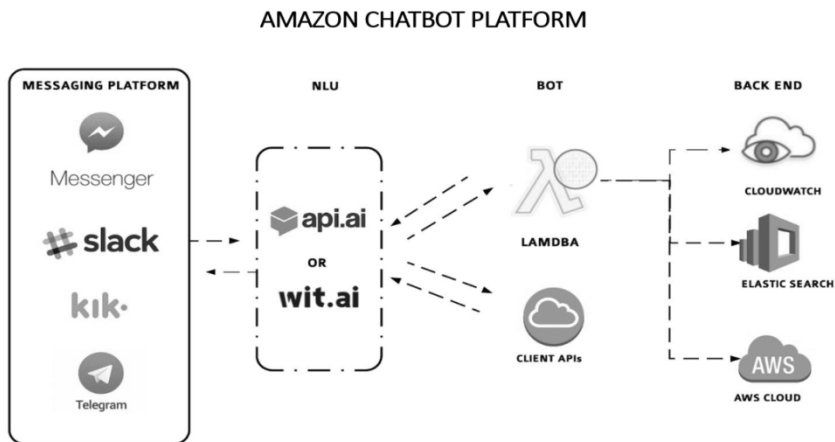
Fig 8.5: The Amazon Chatbot management framework. Courtesy
https://aws.amazon.com/lex/

Amazon Lex is a service for building conversational interfaces in any applications using voice and text. Amazon Lex provides the advanced deep learning functionalities of automatic speech recognition (ASR) for converting speech to text, and natural language understanding (NLU) to recognize the intent of the text in order to enable you to build applications with highly engaging user experiences and life-like conversational interactions. With Amazon Lex, the same deep learning technologies that power Amazon Alexa are now available to any developer, enabling you to quickly and easily build sophisticated, natural language, conversational bots (chatbots).

Speech recognition and natural language understanding are some of the most challenging problems to solve in computer science that require sophisticated deep learning algorithms to be trained on massive amount of data and infrastructure. Amazon Lex democratizes these deep learning technologies by putting the power of Amazon Alexa within the reach of all developers. Harnessing these technologies, Amazon Lex enables you to define new categories of products made possible through conversational interfaces.

As a fully managed service, Amazon Lex scales automatically, so you don't need to worry about managing infrastructure. With Amazon Lex, you pay only for what you use. There are no upfront commitments or minimum fees.

AZURE BOT DEVELOPMENT FRAMEWORK
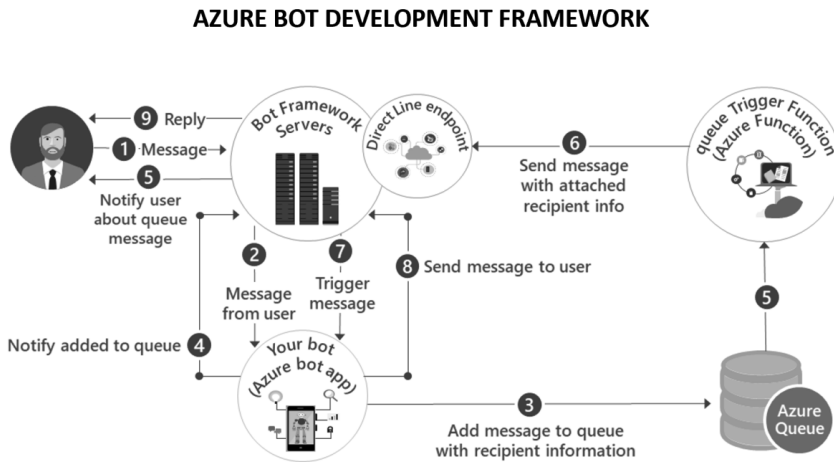
Fig 8.6: The Microsoft Azure Chatbot development framework

Bot service on Microsoft Azure's bot platform is as simple as making a request to an internet service to do something for you, translate a text, bot conversation or tell you what is in an image.

Some examples of bots built on the Microsoft platform are listed below:

- Microsoft's **CaptionBot** : It can interpret photos by suggesting a caption. You can play around with this tool by uploading your own photo or link a photo from the web.

- <u>Murphy Bot</u>: It is an online chatbot running on Azure that is powered by the intelligence of Microsoft Cognitive Services, including the knowledge of Bing. You can chat with Murphy using Skype and ask it hypothetical 'what if' questions like 'What if I were superman? Murphy will try to respond with an image that visualizes an answer to your question. (<u>https://educationblog.</u> <u>microsoft.com/en-us/2018/03/how-to-build-a-chat-bot-in-10-</u> <u>minutes/</u>)
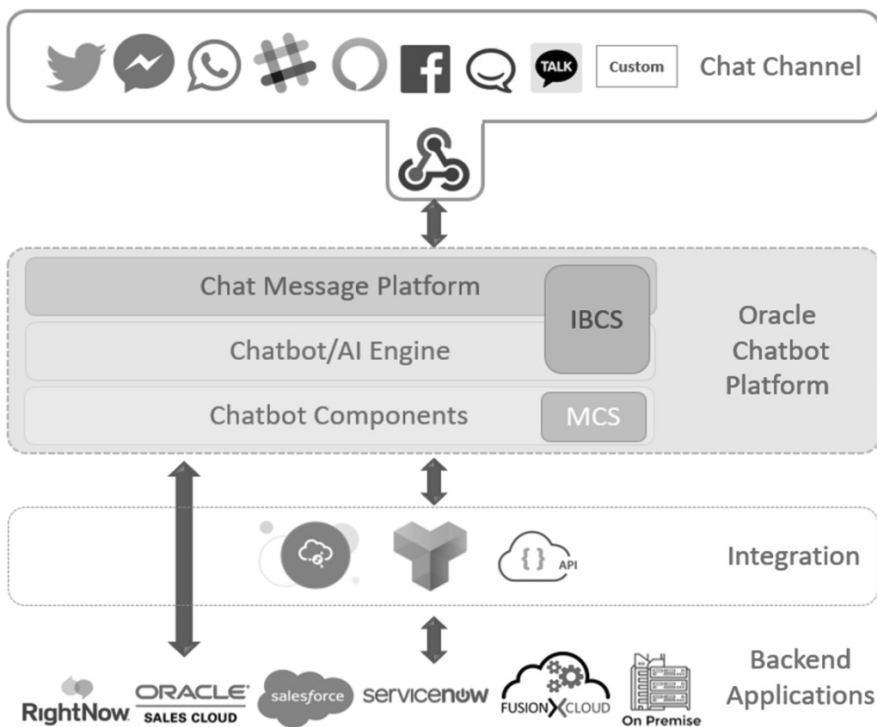
ORACLE CHATBOT PLAFORM WITH INTEGRATIONS

Fig 8.7: The Oracle Intelligent Bots platform

ORACLE INTELLIGENT BOTS

With Oracle Intelligent Bots, an integrated feature of Oracle Mobile Cloud Enterprise, you can develop Intelligent Bots that can create a more natural conversational user interface through text or speech in your enterprise systems. Using Artificial Intelligence (AI) and Natural

Language Processing (NLP) powered by Neural Networks and Machine Learning, Oracle Intelligent Bots can easily detect what the user is trying to achieve (their intent) and respond appropriately with information or results of transactions from API connections to any of your backend enterprise applications and information sources. The platform makes it simple and easy to build and train Intelligent Bots without the need for specialist AI skills. Your bots can then be exposed through many Chat and Voice channels, a custom mobile app or even your website.

(https://cloud.oracle.com/opc/paas/datasheets/
Oracle+MCE+Bots+Datasheet.pdf)

FOUR SIMPLE STEPS TO BOT YOURSELF
Prerequisites:
Create a Bluemix account
Create a conversation instance

STEP 1: DEFINE INTENTS

Intents are the objectives of every bot. If a chatbot helps users handle expenses, the intents would be things like view x (amount due), pay y (bill), and cancel z (account).

A chatbot that answers questions about you has the broad objective of providing information about a human being. Therefore, it helps you to think about this information as it pertains to where, what, and when. In other words, the intents would answer 'where did you x, 'what is your y and 'when did you z. The actual intents would simply be where, what, and when (or location, general info, and time).

STEP 2: DEFINE ENTITIES

When we were building Adam the Chatbot, understanding the difference between intents and **entities** was our biggest challenge.

The best way to think about entities is that they are the SUBJECTS of intents.

So, in 'where did you go to college', the intent would be 'where' and the entity would be 'college'. This allows single entities to apply to multiple intents. In this example, 'college' could apply to both the 'where' and 'when' intents.

STEP 3: CREATING YOUR DIALOG

You've got intents, utterances, entities, and entity values and synonyms. Now it's time to build exactly how your bot is going to interact with users. In the Watson Conversation API, this part is your **dialog**.

Setting up your dialog flow is all about logic. The dialog in the Conversation API is set up like a logic tree with many 'if then' conditions. Each intent begins a node on the left and the logic flows from the top down through your intents. If certain intent is triggered by an utterance, its node is opened and the logic continues to the entities.

The logic within each node (i.e. through entities) also flows from top to bottom. A specific combination of #Intent and @Entity:value triggers a certain response to a question. This combination is referred to as the **response condition**. So, for 'what was your major', the 'what' intent would be triggered and then the response associated with the response condition #what and @college:major would be returned.

STEP 4: TRAINING AND IMPROVING

After your bot has gotten a healthy amount of utterances from end users, you can use the **Improve** section of the Conversation API to improve and train your bot. For questions that didn't trigger the correct intent, you can add them so that they do. More importantly, you can see what types of questions are being asked that you may not have thought of. For example, with our bot, we didn't anticipate how many questions we were going to get about my 'favorite' color, book, sport, etc. until after we deployed it.

After you've deployed the bot and improved on the results, you need to re-deploy to even more people and improve again. Repeat this process as many times as you'd like. Through each iteration the bot will continue to improve as you train it to answer questions. Sooner or later, you'll have your friends thinking you're an A.I. wizard. And who knows, maybe it'll help you get on better terms with your mom.

BUILDING YOUR OWN (WITHOUT THE WORK)

To use the intents, entities, and dialog we used for Adam the Chatbot, <u>sign-up for a free Bluemix account</u>, <u>create your free Conversation instance</u>, and <u>import our workspace</u> . Change the bot responses to be about you, and you're off!

CHATBOTS ON FACEBOOK:

Chatbot in Facebook is an artificial intelligence program capable of 'conversing' with people, responding to particular questions, and automatically providing suggestions. This way, it is possible to configure it to answer the public according to the profile and exact needs of each business.

If you already have a Facebook page in place, the basic bot building process looks like this (https://www.falcon.io/insights-hub/topics/customer-engagement/set-up-facebook-messenger-bots-chatbot/**):**

1. Sign up for a Chatfuel account.

2. Link your **Facebook** page.

3. Create a **Messenger** greeting.

4. Create a welcome message.

5. Create a default reply.

6. Unleash the AI.

7. Add a Message button to your **Facebook** page.

1. To work, a Chatbot in Facebook must integrate with the Messenger chat application and operate from there. Let's see the benefits of having your own Chatbot that can help provide your business.

2. Advantages of creating a Chatbot on Facebook for your business a Chatbot allows you to:

● Provide personalized attention to your clients in real-time.

● Answer their doubts at any time of the day.

- Add useful functionality to your Fan Page (which represents a great reason to follow you on Facebook).

- Ensure loyalty with your clients by immediately answering their doubts.

- Configure programmed questions, according to your different commercial objectives.

- Offer basic attention without the need to pay a person to fulfill that role.

- Catch doubtful clients by providing the answers they need at the right moment.

3. To obtain the maximum benefit of a *Chatbot* in Facebook, it is fundamental that you determine what its primary objective will be. For example, it can help you answer technical questions about your products or location, or you can configure it to promote an offer or link, among other possibilities.

4. The initial language the Chatbots uses to converse needs to be modeled and configured. Chatbot conversations need to be emulated and the Chatbot should be trained using the same. The conversation should consist of the following:

   a) Pleasantries exchange, greeting and guiding approach.

   b) A well-considered menu with a well thought through sequencing and provide for alternate routes.

   c) Grammatical errors should be eliminated.

   d) Preference should be given to short and to the point replies.

   e) Users' replies to be stored in the database and should be used for improving the conversations.

   f) In future, while avoiding repetition of Chatbot's replies in the same conversation, offering a variety

      5. Once the conversations are designed, the development team starts the development process, incorporating the various elements of the Chatbot discussed above.

6. The Bot's personality and styling is adjusted to suit the organizational branding and positioning.

7. Once the Chatbot is trained in the conversion appropriately and developed to execute the actions outlined built into the bot program. It needs to be tested in many ways with different type of responses both expected and whacky. Any issues in responses should be rectified before the final launch.

8. Once the Chatbot is found to respond well to a variety of user responses, it has to be launched across the various channels or platforms of choice like Facebook, website, messenger, etc. by integrating the same using API keys of the respective platforms in which specific accounts are created for integrating with the Chatbot.

9. Continuous monitoring of the Bot analytics through a dashboard enables you to optimize, refine and improve their performance and ensure the objectives of employee or customer satisfaction, as the case may be, are met and improved upon.

TOP USE CASES OF CHATBOTS

Artificial intelligence Chatbots are playing a key role in marketing and customer service and are revolutionizing business by providing better tailored responses to potential customers' queries, offering customer service, keeping customers engaged after sales, and adding 'personality' to a company's brand. By providing patient, detailed, and personalized responses in an engaging manner, the AI-enabled Chatbots are enabling the brands increase conversions and grow faster. Depending on the requirement, rule-based and AI-Based Chatbots are being used extensively in managing telephone, social media and website traffic to address queries and increase conversions substantially. BFSI, real estate, media and entertainment, healthcare, e-governance, travel and tourism, logistics, e-commerce are some of the areas which are seeing a great traction for Chatbot applications for customer pre-sales, sales and service and order processing transactions as well.

The following top use cases of Chatbots are as follows:

- Customer service and support

- Assisting customers in sales and purchases across diverse industries

- Medical assistance by reminding medication, providing medical advice and timely medical support to elders

- Financial advice to improve investments and credit health record

- Virtual business and personal assistant in booking hotels, tickets, managing appointments, etc.

- Teaching assistance in various languages, topics and levels

Some of the top Chatbot applications that have enabled organizations in substantial increase in business and improve value are listed below:

I.   Expensify: Expensify Chatbots help streamline travel and expense management for organizations

II.   1-800-Flowers GWYN: This chatbot helps customers select and gift nice flowers from a wide range.

III. aLVin: The broker bot from LV helps organizations with personal financial advice.

IV.   HM Chatbot: This helps online fashion customers to select clothes and lifestyle accessories from a wide range and navigate to their nearest stores for purchase.

V.   Julie: This provides customers of the Amtrek rail services company with information and customer service.

VI.   TouchAssist: This Nuance owned Touch commerce provides live chat services to a number of Fortune 500 clients through its voice assistant Chatbot and TouchAssist.

VII. Firstjob: These offer internship opportunities to college graduates.

    VIII.   Woebot: This is a popular companion to share personal troubles and sorrows to a number of people wanting to lighten their heart to someone they can trust!

Applications of Chatbots for medical purposes, diagnostic and symptom analysis, disease prediction and prescription suggestion is one of the biggest benefits offered by Artificial Intelligence and Machine Learning technology. IBM Watson has pioneered applications of AI/ML and its Chatbot integrated platform is used in many leading hospitals and medical centres globally.

CHATBOTS IN HR:

Employee query management, surveys, support and services is one of the major areas for application of Chatbots. Concierge Bot which interfaces with employees and offers various services through delegation of tasks to the respective service-related bot is one of the biggest use cases in large multinational organizations. These bots with their ability to talk, reply and communicate in various languages and across different time zones in the world in pleasing accents and voice with utmost patience provide information and follow up for an effective resolution.

Some of the important applications of Chatbots in HR can address the following:

i)   Conduct one-to-one periodic surveys on behalf of CEOs and Management to find the work place health-related issues.

ii)   Queries regarding payroll, expense management, claims, vouchers, benefits, etc.

iii)   Travel booking and settlement-related claims processing and assistance.

iv)   Leave, attendance, medical assistance-related queries.

v)   Full and final settlement, exit interviews and retirement management-related queries.

vi)   IT login, password management and asset management-related issues.

vii)   Conveyance provision and booking for employee transport.

viii)   Staff welfare coordination and employee complaint, ideas, feedback and personalized support.

ix)   Vacancy management and shortlisted candidates for routine positions, etc.

x)   Record and manage upkeep of facilities and alert management for maintenance issues.

CHATBOTS – THE DISRUPTION AHEAD

Chatbots are expected to cause some of the biggest job losses in the future while also helping the companies to reap huge rewards in terms of their ability to scale up their conversations with potential and existing customers in unforeseen ways.

Since early 2010s, we have been seeing a wave of Business Process Outsourcing-based businesses across the globe supporting a huge ramp up of customer calling and servicing workforce concentrating in English speaking countries offering high salary arbitrage.

With the advent of Chatbots, it is now clear that the millions of jobs pursued by these BPO and KPO employees are going to disappear and will be replaced by the ubiquitous and powerful, multi-lingual Chatbot work horses that can work 24 by 7, week after week without a break.

Some of the top predicted applications of Chatbots are given below as per the State of Chatbots report in 2018:

1.   Emergency responses
2.   Complaint resolution
3.   Explanations and clarifications
4.   Reservations in hotels and restaurants
5.   Bill payments and e-commerce assistance
6.   Online commerce support for product and service research and purchase
7.   News, media, entertainment and other subscribed services
8.   Communicating with multiple brands and service providers through one channel

9. Legal, technical, healthcare, educational, human resource support and query resolutions

Financial institutions lead the implementation of data analytics and cyber security-related applications. While a lot of technology platforms and organizations like Apple Computer (for example, through the launch of Apple Credit card) are entering the domain of finance and banking, and the banks and financial institutions are embracing Artificial Intelligence, Machine learning-powered analytics and applications at every stage to be at the center of the world of the customer keeping their conversational channels open round the clock.
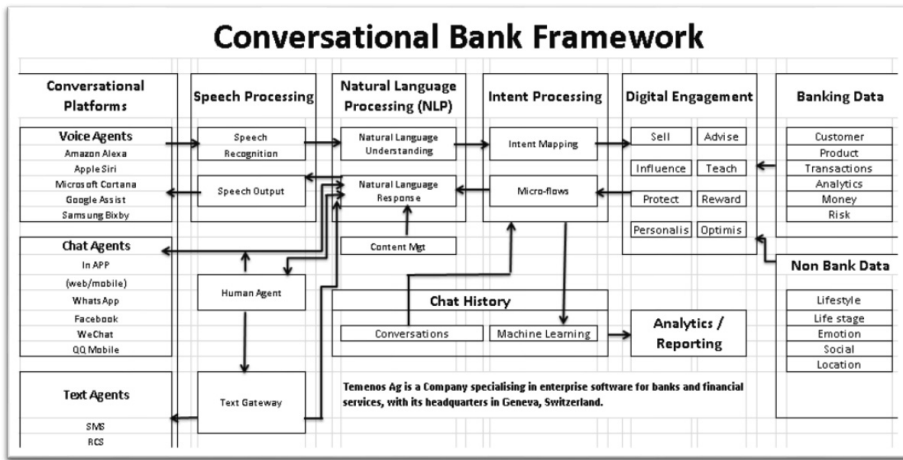
Fig 8.8

A typical conversational bank powered by the cutting-edge technologies is depicted in the preceding image.

We are now entering Automation 4.0 or the 4th wave of automation, complementing IIOT 4.0, where 5G powered, 3D Manufacturing, Industrial Internet of Things, Artificial Intelligence (AI), Machine Learning (ML), Blockchain powered Cyber security and Cloud-powered business models are working in tandem, thus enabling large-scale automation while tremendously improving customer experience (CX) are spoken about together/interchangeably. Robotics Process Automation that is facilitating a large-scale digitization led automation of the key processes within the organizations is adding its weight behind the agents of automation like IOT, Robots, Chatbots, Autonomous cars, Drones,

and 3D Manufacturing Robots with the entire segment of automation expected to grow at CAGR of over 36% in the next 5 years, with RPA reaching 8.2 billion US dollars by 2023.

The following are some of the aspects that need to be considered while investing in the disruptive automation technologies of the future.

DELIVERY and IMPLEMENTATION: Improvement in speed of execution due to automation.

FINANCIAL HEALTH: Revenue growth and cost reduction and investments in highly depreciable technology assets and their maintenance need to be considered.

GOVERNANCE: Digitization and automation help implementation of business intelligence tools and transparency in performance analysis and decision making.

PEOPLE MANAGEMENT: The automation projects have a huge effect on the quantity and quality of manpower. While a huge number of blue-collared workers and lower-level staff who undertake routine and repetitive tasks will no longer be needed, there is a need for technologically savvy resources that can architect solutions and also orchestrate the Bot population well. Re-skilling on a continuous basis is required at every level to be in tune with the trends or else the organizations may be outdated and outsmarted in the business in quick pace.

PRICING and PROFITABILITY: Impact on pricing due to improved customer satisfaction and increase in profitability due to cost reduction can lead to lower payback periods and higher ROI.

PROCESS STREAMLINING and SCALABILITY: Streamlining of processes and automation results in dramatic reduction in complexity and increased scalability.

SECURITY and INTEGRATION: Automation leading to increased integration of processes, shared data sources for speed and increased need for Cyber security measures.

TECHNOLOGY, MAINTENANCE and OBSOLESCENCE: The ability to adapt and implement cutting-edge technologies across organizations that learn and improve over time versus costs that go down. However, investments in hardware and software and security in terms of capital

and operational expenses may go up in the short term that needs to be factored in.

TRAINING and SUPPORT: The ability to document, automate and train employees globally in various languages with the help of Chatbots.

VALUATION OF ORGANIZATION and BRAND EQUITY: Improved customer experience and satisfaction due to speed and less number of errors resulting in increased valuation.

Focus should be high on ensuring the safety, security and faultless performance of these bots. The bots must be an integral part of the cyber security ecosystem of the organization. The enterprise should adopt an open approach to automation with the ability and willingness to adopt automation through deployment of appropriate tools of automation while adopting best practices for cyber security and implement Blockchain-based solutions for access controls for secured interactions.

CASE STUDY OF CHAT BOT and INTELLIGENT VIRTUAL ASSISTANT IMPLEMENTATION PLATFORM-ASTOUND

(Courtesy: https://astound.ai/)

Astound AI is a California (USA) based AI enabling enterprise automation company. It offers its clients an automation platform that reduces the cost of service delivery, reduces downtime of employees and improves business outcomes. Astound's main mission is to make enterprise service excellent for all employees by automating the resolution of common issues using cognitive technologies like AI, ML and NLP.

Astound offers Chatbots and virtual agents that perform the following:

- **Automate answers to common questions:**

Reduce call volume up to 70% with answers with a virtual agent that answers commonly asked questions in real time from service portals, Slack, Skype, or phone using natural language.

- **Accurately assign and categorize questions:**

Reduce MTTR and free support agents from the mundane tasks of reviewing and routing tickets by automatically prioritizing, routing, and assigning incidents with the Predict app.

- **Provide recommendations in real time:**

Resolve problems faster the first time with contextual recommendations that pull information across multiple systems of record with the Advise app.

Today, when an employee has an issue, they pick up the phone and call the helpdesk. They are routed to some service provider, and the service provider fulfills the request. Millions of times a day. Over and over again.

Astound's AI platform for employee service takes the traditional CRM, ITSM and HCM systems and makes them smart by automating the routine tasks that ordinarily require human agents in call centres to read from scripts. Service management automation makes employees more productive, technology more strategic, and organizations more profitable.

As per Astound's Principal AI Scientist, Walid Saba, one of the world's foremost experts on natural language processing and natural language understanding has developed a framework to help enterprises cut through the noise. Walid's levels of intelligent virtual agents clearly describe enterprise Chatbot technology and its associated conversational capabilities within six defined levels.

What follows is a sneak peek at the six levels of intelligent virtual agents. Level 0 is the most basic of the six levels, and with each additional level, the conversational intelligence as well as the underlying technology becomes increasingly sophisticated.

The six levels of intelligent virtual agents are as follows:

Level 1 Scripting

Scripting and pattern matching virtual agent

Level 1 is the most rudimentary of all of the virtual agents. Level 1 virtual agents can perform pattern matching tasks using regular expressions. Many Level 1 virtual agents can be easily built using readily available NLP libraries/frameworks. These libraries, many of which are open source, provide the Chatbot training data needed to create a Level 1 virtual agent.

But be warned, Level 1 virtual agents are in essence skeletons. They have the foundation for conversational capabilities, but require someone to create dialogs of phrases or scripts to properly function. Building a Level 1 virtual agent takes time and patience. For the virtual agent to be useful in answering requests, enterprises have to manually script out countless employee question and answer scenarios.

If you're using a Level 1 enterprise Chatbot platform to scale your service desk, it can match the text of an employee's request, e.g. 'What is the PTO policy?' with the text in other documents that have the matching phrase, e.g. a knowledge base article entitled 'PTO policy'. And while it can match phrases, a Level 1 won't be able to do much if one of your employees asks 'I need to know more about the rules and procedures concerning paid time off'.

Level 2 basic

Basic search and routing virtual agent

A Level 2 virtual agent builds upon the pattern-matching capabilities of a Level 1 virtual agent with search capabilities. It can take a keyword or phrase, e.g. 'PTO policy' and perform a basic search. It can also understand the basic intent of an employee's query, e.g. a question about how 'PTO policy is related to 'paid time off'. A Level 2 virtual agent possesses a rich dictionary of relevant words and phrases and can engage in basic small talk (greetings, starting over, etc.).

But what really separates a Level 1 virtual agent from a Level 2 virtual agent? A Level 1 virtual agent is tied to a script. It matches keywords. A virtual agent that is Level 2 basic, on the other hand, uses some language processing to identify more than just matching keywords. It can perform very basic thesaurus-driven matching. For example, it can relate terms like 'computer' and 'laptop', and it can process search queries using plain natural language rather than the canned keyword phrases a Level 1 needs to function.

Level 3 contextual

Contextual understanding and domain independence virtual agent

A Level 3 virtual agent should be able to understand the subject matter or domain of a request and can beyond the very basic Level 1 ontological matching, to be able to understand the multiple employee requests about

how the PTO policy can be grouped together based on the vocabulary and sentence structure the employees use. A Level 3 can understand relevance. It knows how to differentiate between questions it can and can't answer and can escalate a query if it knows it cannot resolve it.

For example, a Level 3 HR support virtual agent knows that it cannot answer a question about the weather forecast for the next week. It doesn't misinterpret a phrase like 'paid time off' to mean that an employee paying something or someone called 'time'. It also has the ability to learn new domains quickly. A Level 3 virtual agent that is used for HR case management resolution, for example, can also be used for IT service management without first having it trained on a huge amount of IT data. Finally, a Level 3 has the ability to conceptually link topics that are thematically related. As a milestone, therefore, Level 3 moves from keyword and basic sentence structure matching capabilities to more advanced semantic and conceptual understanding. It knows, for example, that knowledge base articles about 'sick leave' are related to 'PTO policy'.

Level 4 Adept

Advanced dialogue virtual agent

A Level 4 virtual agent can perform all the tasks a Level 1, 2 and 3 virtual agents can perform, but it also possesses the ability to engage in a natural dialogue. A Level 4 can ask clarifying questions. Clarification requires deep semantic understanding. It requires resolving references previously mentioned in the discourse and filling in the gap based on the previous part of the conversation. In short, a Level 4 can do what computational linguists call deep discourse analysis.

A Level 4 virtual agent can understand the larger context of a request, including whether the virtual agent has engaged with the person in the past, and if it has, it can connect words or phrases that refer to past conversations. For example, an employee can respond to a virtual agent's request for an employee ID number by replying, "I have it right here." Finally, a Level 4 virtual agent knows when there are equally plausible ways to solve the resolution. A Level 4 may find out if there seems to be more than one answers to a question that each of the options lead to equally plausible resolutions. It may, for example, clarify an employee's PTO policy question by asking whether they are referring to sick leave,

paid leave, or personal leave. This kind of intelligent clarification with the employee reduces mean time to resolution.

Level 5 resolution

Learning, personalization and problem resolution virtual agent

A Level 5 virtual agent embodies all the intelligence of a Level 4, but it can also learn over time and can proactively engage with employees in a personalized way to understand, analyze and actually resolve issues. Compared to previous levels, a Level 5 doesn't just point an employee to a knowledge base article to solve an issue. It is an intelligent virtual agent that actually solves the issues that may have otherwise required high-touch involvement from someone within employee support. Level 5 virtual agents learn from past conversations and use that knowledge to develop shortcuts to efficiently resolve issues in a personalized way. A Level 5 resolution virtual agent, for example, would not simply point out to an employee a PTO form to be filled. It would be able to solve the problem on the spot without requiring the employee to take that extra step.

Level 6 fluent

Human-level conversational virtual agent

While Level 5 virtual agents have the ability to resolve issues, it cannot yet resolve linguistic issues that require high-level or human-level reasoning. A Level 6 virtual agent, on the other hand, can engage in human-like conversations. It is now an agent that fully understands and comprehends what an employee is asking. It learns an employee's specific situation (using its understanding of previous interactions with that employee or employee group) and can resolve issues or escalate and route them to the proper channel. This level of understanding requires very advanced semantic and pragmatic capabilities. A Level 6 virtual agent can understand compound nominal, metaphors, idioms, scope resolution; metonymy, co-predication, anaphor resolution. It reasons through requests using common sense.

The world's leading food franchising company selected Astound as their artificial intelligence and machine learning platform to automate the routing and resolution of service requests. Unlike human agents, Astound's machine learning technology predicts the right category nearly every time and improves continuously. Unlike human agents, Astound

can perform real-time trend analysis across petabytes of data instantly.

CONCLUSION:

In this chapter, we examined the various aspects of Chatbots and voice assistants to appreciate their potential, study their anatomy, evaluation and ways of creating and employing them for a variety of applications.

According to Global Market Insights, the Chatbot market is expected to show a CAGR of over 31% between 2018 and 2024 and reach a turnover of over Rs. 134 billion US dollars from 250 million US dollars in 2017. While rule based Chatbots contributed to 85% market share in 2017, AI-based Chatbots are expected to grow faster in the future with a CAGR of over 53%. The future may see the launch and rapid growth of self-learning Bots capable of initiating sales calls and conversations, bot-to-bot conversations and much higher level of API integration for transactions and intelligent query resolutions.

Enterprise automation using robots, chatbots and robots for process automation needs to take into account a number of factors apart from a structured design, on boarding and deployment approach. As per Everest Group's Bots adoption methodology, organizations need a holistic bot management approach apart from a progressive approach to manage a typical employee intensive organization. Organizations need to focus on an enterprise-wide planning and collaboration of outcome-based bots deployed as per an overarching vision across the organization instead of just task-driven or process-driven deployments.

While there are a number of positive aspects of the automation projects, the decision to invest in these projects may not be as simple as calculating the NPV (Net Present Value) of investments that can be arrived at by projecting the costs and revenues and discounting them to the present date. This is because a number of other aspects and unknowns associated with the implementations of disruptive technologies that are hitherto unknown will act together with other forces.

Autonomous Cars

INTRODUCTION

Autonomous cars are a class of self-driving vehicles and are also termed as driverless cars. Advances in the battery storage and energy density technologies coupled with Artificial Intelligence and Machine learning-powered applications like image recognition, object identification, analytics and advanced search are enabling the technologies that have always been in the realm of celestial objects and satellites or in the low range toys to be extended to the vehicles on the ground that are used for day-to-day purposes. In this chapter, we will embark on a journey to understand the various components of the autonomous cars and see how they help these agents of automation to serve a number of benefits to humanity and what lies ahead of us in this domain.

SRUCTURE:

- What are autonomous vehicles?
- Benefits of autonomous cars
- Essential technologies uses for autonomous cars
- How AI helps in building self-driven cars

OBJECTIVE:

The objective of this chapter is to understand the components of the autonomous cars that impart the various functionalities from sensing the environment to responding to the same and to the commands regarding

the destination to be reached, etc. You will be able to understand and appreciate the various features, technological underpinnings, application areas and expected future developments. The special features that are imparted due to the AI and ML-led developments and challenges that are being grappled will be touched upon.

Driverless cars used to be a fascinating sci-fi tale which we witnessed in a number of movies over the years. The very idea of an autonomous vehicle made us awestruck. Thanks to our modern day Artificial Intelligence platforms, our dream of having a driverless car is coming true.

Companies like Tesla, Apple, Amazon, and Audi are very focused in terms of developing an autonomous car and not to forget Google's contribution towards self-driving cars.
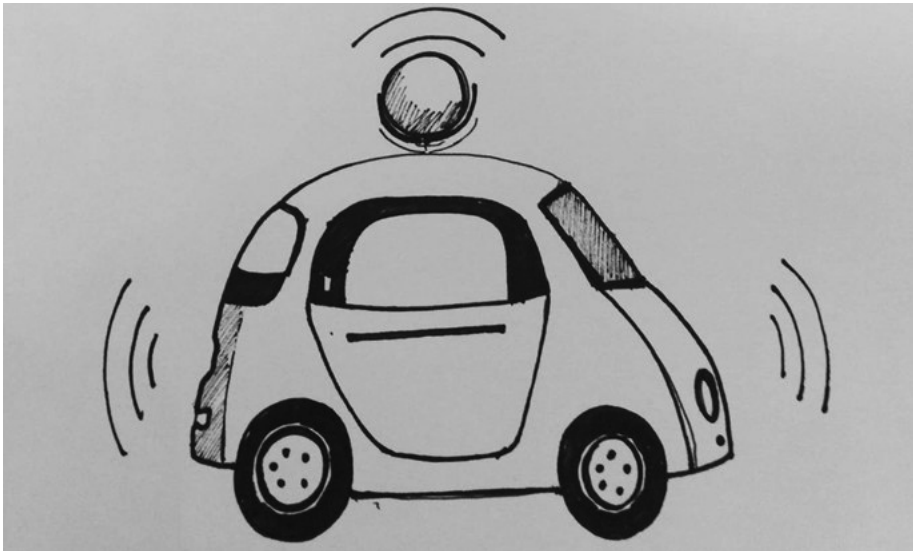

Fig 9.1: An autonomous car moving on the road with the help of its sensing and guiding equipment.

WHAT ARE AUTONOMOUS VEHICLES?

Autonomous vehicles are like mobile robots in the form of mobile or vehicle-like cars, drones, helicopters, submarines and space probes. Self-driving cars are a class of autonomous vehicles.

There are six types of autonomous vehicles, which are as follows:

Level 0: These are ordinary vehicles we are used to for the past so many years and do not possess any autonomous features.

Level 1: These cars can handle one automatic task at a time like braking, etc.

Level 2: These cars have a lot of automatic features and can handle more than one task at a time in an automatic fashion simultaneously.

Level 3: Level 3 cars have dynamic driving features that allow the drivers to be off hands in a number of situations. But they need a driver to be on the move. Most of the high-end cars like Audi, BMW, Mercedes Benz and higher-priced models of the leading brands can be termed as Level 3 in autonomous driving.

Level 4: These cars can move on the road without any driver in many situations in which the paths and points are well defined and do not have much obstructions on the way.

Level 5: These cars can drive on the road like satellites and drones without any driver's assistance and can wade through the traffic from point to point and even exchange money with the passengers.

WHY DO WE USE AUTONOMOUS CARS AND WHAT ARE its BENEFITS?

Autonomous cars enable anyone, including handicapped, old, ill and drunk persons to travel by themselves leading to increase in the target market segment.

- Autonomous cars are programmed to drive in a programmatic fashion by following the best practices. Hence, they use optimal energy to move without the need of steering wheel and gears, etc. Thus, they offer the highest energy efficiency or distance per unit price. Billions of gallons of oil can be saved along with a huge savings in the hours on road as well.

- The time spent on road by the driving owners can be spent on pursuing office and personal work leading to huge increase in personal productivity.

- Since there are no human drivers, there is no need for traffic police to check the age and drunkenness of the driver. It also enables to

increase the target market segment for owning the vehicle.

● Since it is expected that there is no driver and also can lead to negligible accidents on the road, the cost of insuring the vehicles comes down drastically.

● No parking hassles: The cars can park efficiently by themselves in available spaces and can also be called when needed to the pickup points by the owners virtually removing the hassles of parking by the owners.

● Reduction in Accidents: It has been found that the autonomous cars with their advanced collision preventing technology can result in a vast reduction of collisions unless there is a human error from the counter party. This is expected to reduce at least 90% of the accidents by Google leading to a lot less deaths, injuries and corresponding medical costs.

HOW DOES IT WORK?

Autonomous and self-driving vehicles have a number of special features and components apart from a lot of usage of Machine learning-enabled Artificial Intelligence to perform their functions.

At the outset, the standard components of the autonomous cars are shown in the following figure:
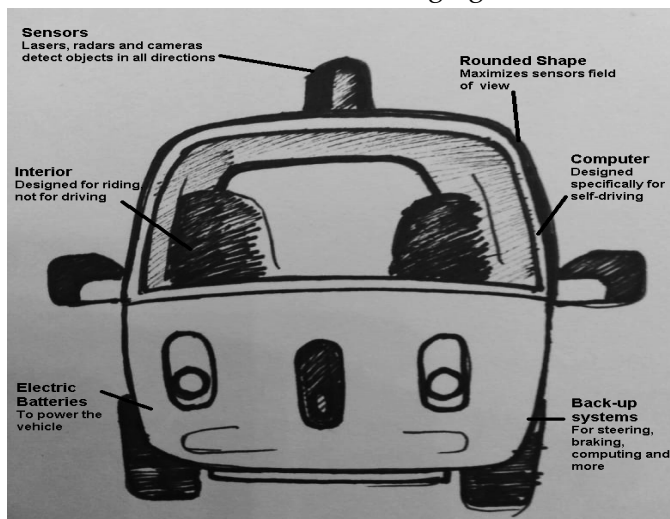
Fig 9.2: Components of an autonomous car

AUTONOMOUS CARS USE THE FOLLOWING ESSENTIAL TECHNOLOGIES:

1. GPS (GLOBAL POSITIONING SYSTEM):

The **Global Positioning System** (**GPS**), originally Navstar GPS, is a satellite-based global navigation system owned, maintained and freely offered to anyone with a GPS receiver by the United States government and operated by the United States Air Force. It provides the geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. Obstacles such as mountains and buildings block the relatively weak GPS signals. The GPS provides critical positioning capabilities to military, civil, and commercial users around the world. All autonomous vehicles like drones, cars and other mobile devices adorn a GPS receiver that helps them to position themselves and navigate to the desired locations. GPS is becoming a standard feature even for manual cars to help the users navigate anywhere in the world with the help of the satellite signals.

2. SENSORS: A variety of sensors like LIDARs, RADARs and Cameras help autonomous cars to gauge the environment and assess the surroundings.

The various types of sensors that enable the autonomous car to sense the distances, objects, obstructions and enable it to manoeuvre the roads smoothly and reach their destinations are well depicted in the following figure. These sensors collect the information about all the surrounding objects and feed it to the central processing unit of the car, which with the help of advanced AI and ML techniques processes the same and enables the right decision and corresponding action to be taken by the machine to plan and move ahead.
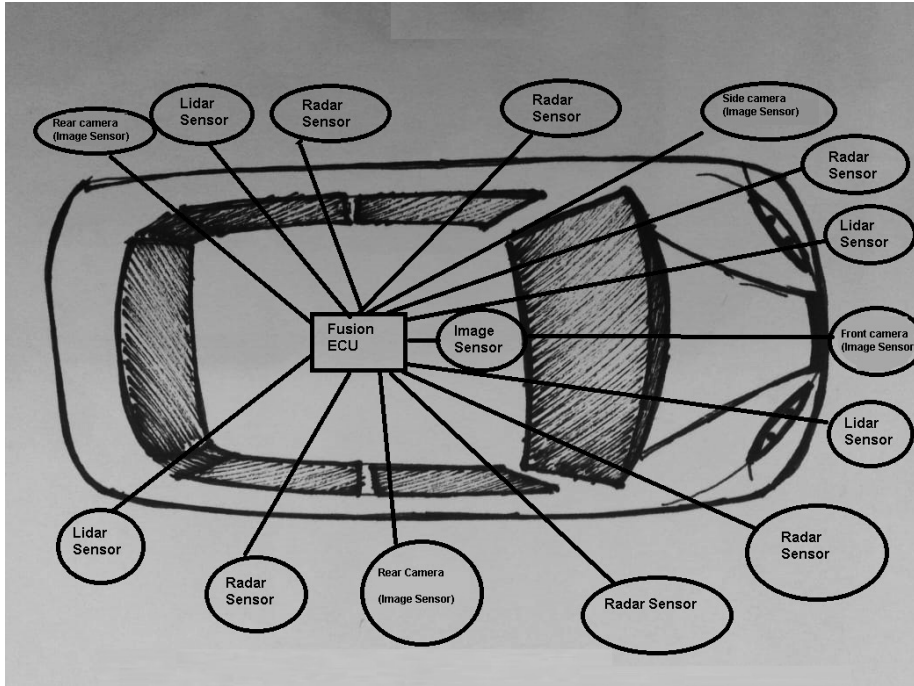
Figure 9.3: Different sensors in an autonomous vehicle

A. LIDAR (LIGHT DETECTION AND RANGING)

Lidar is an acronym for Light Detection and Ranging and is a laser-based system. It consists of a transmitter (laser) and a highly sensitive receiver. It is used primarily to measure distances to stationary as well as moving objects. The system sends out pulses that are reflected off objects. This provides a 3D view of the objects. Lidar sensors help to detect the edges of roads and identify lane markings by bouncing pulses of light off the **car's** surroundings.

B. RADAR (RADIO DETECTION AND RANGING)

Radar sensors are embedded around the car's surface and enable it to monitor the stationary and dynamic objects moving around it in a dynamic manner by feeding the relevant information to the car's control systems.

Radar is a detection system that uses radio waves to determine the range, angle, or velocity of objects. It can be used to detect aircrafts, ships, spacecrafts, guided missiles, motor vehicles, weather formation, and terrain. A radar system consists of a transmitter producing electromagnetic waves in the radio or microwaves domain, a transmitting antenna, a receiving antenna (often the same antenna is used for transmitting and receiving) and a receiver and processor to determine properties of the object(s). Radio waves (pulsed or continuous) from the transmitter reflect off the object and return to the receiver, giving information about the object's location and speed.

The various types of sensors used in the car are thus responsible for a different type of function, depending on the distance and type of object which needs to be sensed and the type of activity to be undertaken. The same can be well summarized in the following figure:

Self Driving Cars Vision System's Range

Far radar	300 meters
Front camera	50 meters
Near radar	20 meters
Side cameras	3 meters
Ultrasonic sensors	1 meter
Rear camera	50 meters

Figure 9.4: Self-driving car sensors and their range

C. VIDEO (CCTV CAMERAS TO COLLECT VISUAL STATUS TO BE PROCESSED WITH MACHINE VISION):

Autonomous cars possess a number of CCTV cameras both inside and outside the vehicle. The smart internal cameras offer passenger safety and smart exterior cameras are focused on vehicle's safety and security.

The images from the cameras are continuously analyzed using advanced AI and ML techniques and machine vision to identify the contents, analyze and feed the information to the car's controller for an appropriate decision.

While images from the front cameras help the car to adjust its speed and also follow the rules of the road, the rear cameras enable the car prevent back over collisions, warn vehicles unduly nearby through appropriate sounds and speed adjustments and in parking perfectly.

D. ULTRASOUND (TO DETECT THE DISTANCES AT SLOW SPEED AT THE TIME OF PARKING):

Ultrasonic sensors are used during parking to assess and warn the vehicle about potential collision. They measure the precise distance of the vehicle from an object with the help of sound waves emitted to hit an object and received back. They are used along with LIDARs and RADARs by complementing them for low speed applications in autonomous vehicles.

3. MULTI DOMAIN CONTROLLERs:

Multi-domain controllers receive inputs from the various systems from the autonomous car's vision system like the Radar, Lidar, camera and navigation systems to confirm appropriate decisions to the driving system comprising steering, acceleration, braking, and parking management systems.

Autonomous and self-driving vehicles have a number of special features and components apart from a lot of usage of Machine learning-enabled Artificial Intelligence to perform their functions. If one has to put across this in simple words, it would be how a self-driven car works. One would

say it does data crunching. The self-driving car module receives data in mainly images and sound form. It processes it and tries to understand what all objects are there in the surroundings and based on that it operates the car.

To further simplify it, the Artificial Intelligence application on self-driving takes input as an image and some information from sensors and its radar and gives an output which consist of positions of different cars on the way, their distances and probably speed so your self-driving car can avoid other objects on the way. This gives us a very simple configuration of a self-driving car. We need a few cameras, some sensors and an in-built radar system which can tell us about the surrounding areas.

Thus, all the key components of the self-driving cars displayed in the following figure act in tandem to give a comprehensive view of the surroundings and the ability to perform the task on hand, i.e., to reach its destination, without any untoward incident.

HOW AI HELPS IN BUILDING SELF-dRIVEN CARS?

The AI element of the application helps us in processing images and sound data. It processes the data and identifies different objects which are in the frame. For example, vehicles on the road, people, signals, and footpath. Once it identifies them, then it works on the position of each object and accordingly the car changes its path or if it identifies that the signal is red, then the car stops.

With the help of the Global Positioning System, the start position, targeted position, current position and also the knowledge of the routes along with traffic congestions and predicted wait times, the car plans the most appropriate route map to reach its destination. The central controller sends instructions to the vehicle's actuators which control acceleration, braking, and steering. Various elements of AI-like object discrimination and avoidance algorithms, predictive modeling, etc. enable it to follow the appropriate path all the time following the traffic signals and rules.

CHALLENGES

AI algorithms are constantly trained to make them more accurate in terms of identifying different objects. Once trained on the data, the application starts classifying different images that it receives into classes like vehicle, person, road, signal, etc. There could be a scenario in which we have trained the algorithm to identify cars on the road but did not train to identify auto rickshaws, so it will fail to identify it or a concept car comes in front of our self-driving car which it will fail to recognize. So, the challenge is to work on all possible objects or scenarios which can come into play and train the algorithm to adapt to any situation or possible scenario.

LIMITATIONS

Let's just say that we trained it identify a person, but if the person is waiving his/her hand, then the algorithm doesn't understand if the person is asking them to stop or they are just saying Good Bye. Also, every person will waive differently so it becomes difficult for an algorithm to capture this kind of gesture and even if it captures it, it is very difficult to understand the context.

OTHER LIMITATIONS OF AUTONOMOUS CARS:

Autonomous cars operate on battery operated systems. Hence, it is required that the batteries are long lasting, maintenance friendly and easily chargeable. Charging points for batteries need to be conveniently located in public places or at points along the routes and parking places with easy access. These sort of features and facilities take a long time to build by various governments across the world, especially in developing countries.

The cars are more than 5-6 times costly compared to manual/semi-automatic cars of corresponding shape and size and are out of reach for most of the population. The prices are, however, reducing dramatically every year at the rate of 20% per year leading to a very high CAGR across the markets in developed countries.

THE FUTURE OF THE AUTONOMOUS CARS:

Tesla's Elon Musk declared that all his cars have to possess the highest level of features that any autonomous cars can possess.

The advances in IOT technology combined with the cognitive computing capability that encompasses various advanced features discussed earlier in the book like NLP, pattern recognition, continuous learning, dialog management are helping the vehicles to communicate with each other and avoid collisions and optimize driving patterns. In some countries like Singapore, which is paranoid about public transportation facilities, various actions can be taken by the governments to operate autonomous car friendly infrastructure such as having 'Autonomous vehicles only' lanes. This will ensure a dramatic increase in their usage due to the realization of a number of benefits outlined earlier with nil accident-related deaths, injuries and medical costs.

However, it is expected that the autonomous vehicle revolution will take a long time to reach the nooks and corners of the world.

SUMMARY and CONCLUSION

In this chapter, we looked at the various aspects of autonomous cars and the technological underpinnings and the various special features that impart the functionality related to sensing, actuation and performance. We also discussed the challenges that need to be overcome to enable the autonomous cars to reach their potential.

Artificial Intelligence and Automation Gone Wrong

INTRODUCTION

As we discussed the exciting applications of AI and ML in assisting the human beings, augmenting our various efforts and automating the tasks performed by human beings, it is indeed possible to get carried away by the numerous positive developments. In this chapter, we will take a brief look at some situations where, automation has led to unforeseen risks exposing different types of vulnerabilities that need to be addressed.
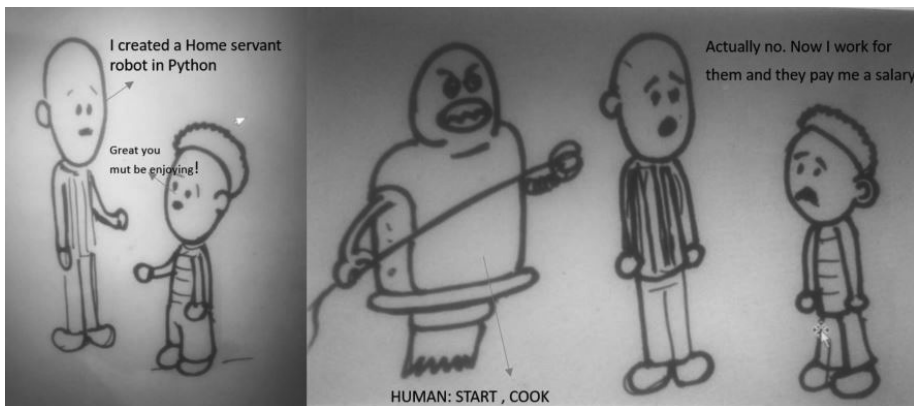
STRUCTURE:

- Deadly Boeing crashes raise questions about airplane automation

- Researchers hack BMW cars and discover 14 vulnerabilities

OBJECTIVE:

The objective of this chapter is to take a look at the different situations in which the AI-led implantations of automation have not exactly served the intended applications, exposing the limitations of the technology we intend to deploy. The learners will be sensitized regarding the shortcomings and vulnerabilities of the AI-led automated systems so that they can take a practical approach to their implementation.

DEADLY BOEING CRASHES RAISE QUESTIONS ABOUT AIRPLANE AUTOMATION-

AUTOMATION IS A DOUBLE-EDGED SWORD

- Two Boeing 737 Max 8 jets, a variant of the world's most popular jetliner, crashed within six months of each other (October 2018 and March 2019) in a stunning rate of failure that raises questions about the airplane's automated systems.

- A preliminary report from Indonesian investigators indicated that Lion Air 610 crashed because a faulty sensor erroneously reported that the airplane was stalling.

- The false report triggered an_automated_system known as Manoeuvring Characteristics Augmentation System (MCAS).

- This system tried to point the aircraft's nose down so that it could gain enough speed to fly safely. A warning light that would have alerted the crew to this discrepancy before the take off wasn't part of the optional package of equipment on Lion Air's Max 8 aircraft, according to The Air Curren*t*. To be clear, the warning light was part of an upselling strategy, and now nearly 350 people were dead.

- Once on the flight, the Lion Air crew was unprepared for the automated response set off by the faulty angle-of-attack data.

The pilots fought the automated system, trying to pull the nose back up. They did not succeed.

RESEARCHERS HACK BMW CARS, and DISCOVER 14 VULNERABILITIES

- Keen Security Lab researchers have discovered 14 vulnerabilities affecting a variety of BMW car models.

- The flaws could be exploited to gain local and remote access to infotainment (a.k.a head unit), the Telematics Control Unit (TCU or TCB) and UDS communication as well as to gain control of the vehicles' CAN bus.

- To exploit some of the flaws and install a backdoor in the infotainment system, the attacker must have physical access to the target car's external facing I/O interfaces (USB and OBD-II). But six of the vulnerabilities can be exploited remotely, via the wireless interfaces of the vehicle (Bluetooth and cellular network).

- The Bluetooth attack requires attackers to be in close range of the vehicle to affect the availability of the Internet-connected infotainment system without authentication, but they can succeed only when the Bluetooth is in pairing mode.

- On the other hand, a contactless attack via the cellular network allows attackers to operate from far.

- Using the MITM attack between TSP and the vehicle, attackers could remotely exploit the vulnerabilities existing in both NBT and TCB, leading to backdoors being planted in the NBT and TCB. Typically, a malicious backdoor can inject controlled diagnosis messages to the CAN buses in the vehicle.

https://www.helpnetsecurity.com/2018/05/23/hack-bmw-cars/

- Misled Chatbots and errors in AI/ML programs create nightmares for their employers and creators.

  Microsoft Chatbot declares support to Nazis: In 2016, Microsoft's Twitter Chatbot, Kay tweeted statements like 'Hitler was right' and '9/11 was an inside job'. This happened because the AI/ML program was learning things from conversations uttered by

a wrong set of people. This created a publicity nightmare for Microsoft.

- Wiki edit bots engage in unwanted updates: In a study conducted by PlusOne, it was discovered that two wiki edit bots engaged in an infinite loop of correcting each other for 13 years resembling and unending online feud.

- Autonomous cars jump signals: In late 2016, in one of the experiments conducted by UBER, it was found that a UBER owned autonomous car repeatedly jumped red lights at intersections causing a traffic nightmare. In March 2019, Uber's self-driving car supposedly caused a fatal accident in Arizona, USA, killing a woman on the street.

- Robot says, "I want to destroy humans.": Though meant to be a joke, in a televised interview with her creator Dr David Hanson, robot Sophia cheerfully replied to a question saying, "Ok. I will destroy humans." Mankind shudders at the thought of such real possibility.

- Robot runs into a street: Russian Robot Promobo1977 once is said to have rushed on to a busy street by itself causing a harrowing time to the cops and the travelers on the road. While learning to avoid obstacles and making way to passages, it is supposed to be always on the lookout for such opportunities and needs to be guarded always to avoid such incidents in the future.

- Smart home malfunctioning destroys a house: In Penn state, USA, a smart home fully automated using Internet of Things was destroyed in a fire, supposedly due to malfunctioning of a computer controlled door.

- Wrong AI image recognition caused nightmares: In 2015, Google photos debuted the AI-powered image recognition technology. The neural network-powered technology was supposed to assist in the identification of people, animals and objects in the images and tag them without manual intervention. However, some of the black people were mistakenly tagged as gorillas as the program could not differentiate humans from the animals. This caused huge embarrassment for the program creators.

- In July 2017, it was reported that the global social media giant, Facebook, had to decommission a project to build negotiating Chatbots when they realized that the two bots engaged in the research started conversing in a language they only understood. The Chatbots named Alice and Bob were meant to trade with each other in balls, hats and books by assigning values to each other. They had to negotiate by mimicking human trading and bartering and the conversations started degenerating into a different version of English language, which they only seemed to understand.

- In March 2019, movements of suspicious and unauthorized drones were noticed in many strategic locations in Trivandrum, the capital state of Kerala, India. The inability to track and monitor such activities and counter immediately in case found suspicious can lead to a number of disastrous consequences leave along the threat to the personal privacy caused by such activities.

- Drones controlled by terrorists or accessed by wrong people can be dangerous in many ways. It has been demonstrated by researches that drones can indeed be hacked and the control can be changed if it goes in somebody else's hands. Being a type of malware, Maldrone is aimed specifically at UAVs or unmanned aerial vehicles which make use of internet connections and hacks into drones. Drones are flying computers and are extremely susceptible to the hacking which happens in a smartphone or laptop. The technology for drone hacking can swipe the data collected by the machine previously or control it physically.

- If the hacker is able to fake a GPS signal well, then he can convince an UAV into tracking the fake signal instead of the real one allowing him to control the vehicle completely from miles away.

- If criminals can hack a military drone, then it can obviously become quite dangerous but what will happen if hackers are able to take control of civilian flying robots?

Summary and Conclusions:

In this chapter, we listed out a number of situations where the automated systems and in some cases the 'Agents of Automation' have misfired or their vulnerabilities were exposed. The risk of undesirable outcomes in some cases is a real possibility that can lead to disastrous consequences. Continuous evaluation, assessment of wrong outcomes and improvement to plug vulnerabilities is necessary to ensure that the errors and mishaps due to technological shortcomings are minimized. No system is ever perfect or completely evolved.

Blockchain–The New Generation Tool for Cybersecurity

INTRODUCTION:

Cybercrime is indeed growing exponentially. It is indeed a matter of common knowledge that the industry leaders across domains such as Yahoo, Google, Sony, Equifax, Sears, Dropbox, and Microsoft to name a few have been subjected to malware attacks in the recent past.

Blockchain offers a tremendous scope for improvement in security of transactions and data management over the traditional approach of conducting digital transactions using unique identity management protocols in both private and public versions.

While understanding the security aspects of Blockchain transactions, it is imperative for us to examine not only the security offered through the Blockchain-based approach, but also the security precautions to be taken to ensure the security of the Blockchain system itself.

In this chapter, we will examine the essential features of Blockchain and see how they offer a solution to ward off the threats faced by the Agents of Automation.

STRUCTURE:

- What is a Blockchain?
- Bitcoin and Ethereum are examples of public Blockchains
- Enterprise Blockchains
- Features of a Blockchain
- Security tools of a Blockchain
- Vulnerabilities in Blockchain security
- Challenges to the growth of the Blockchain ecosystem

OBJECTIVE:

A Blockchain is increasingly viewed as an essential de-risking tool for those who access the internet for various purposes. It is important to understand the various features of the Blockchain and see how they can facilitate the intended purpose of protecting privacy of the users from being compromised while addressing the problems posed by the cybercriminals at the root itself, thus making it non-remunerative for them to invest in sophisticated applications to carry out their criminal activities in the cyberspace. The objective of this chapter is to understand how a Blockchain works and how it can protect digital systems. It is further intended to examine the security aspects of Blockchain systems and applications to ensure that they are well protected and not compromised as well.

Most of the malware attacks are implemented by masked identities and hoodwinking systems to gain access through camouflaged identities.

Blockchain-led systems use cryptographic techniques to offer several layers of additional security to participants and transactions.

WHAT IS a BLOCKCHAIN?

A Blockchain originally came into existence on 3rd January, 2009 in the form of a distributed database to create, share and store units of value in the digital form, namely, 'Çrypto currency' in a secure and irrefutable manner between hitherto unknown participants.

Over the years, the Blockchain has transformed into a much more inclusive and disruptive application that enabled participants in enterprises and governments to conduct between each other and with public in a secured and confidential manner, automating intra and in most cases inter-enterprise processes to drastically improve productivity and crash costs.

Cryptocurrency-based Blockchains like Bitcoin define a Blockchain as a linked list of blocks containing a full copy of the Bitcoin ledger giving the UTXOs (Unspent Transaction Output) in the form of a crypto currency unit named Bitcoin or its fraction (1 Bitcoin = 1 million Satoshis) of each of the address mapped in groups to respective wallets. Each of the addresses has a public key and a password named Private Key. The public key is used to check the details if the transactions and private keys allows the holder to spend the UTXO units and then the private key allows the holder to spend the UTXOs associated with the respective public key.

The Blockchain is thus a store of and a means to transfer immense value, underlining the importance of keeping the password (pass phrase of wallet and the private key for every address) a closely guarded secret.
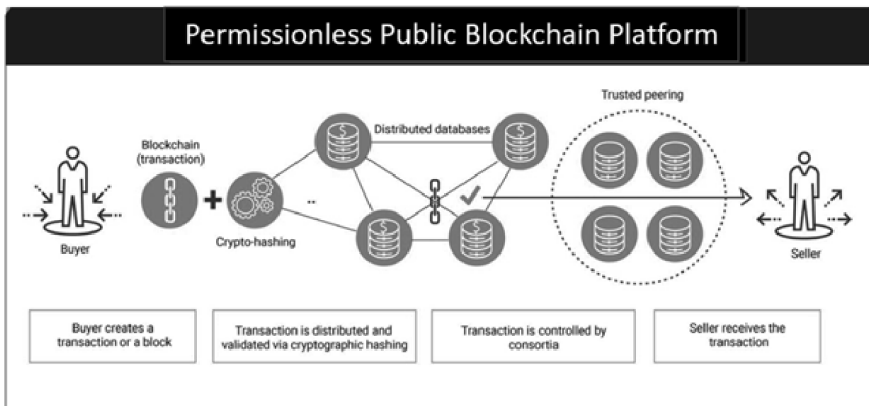
Fig 11.1: Permissionless public Blockchains

BITCOIN and ETHEREUM ARE EXAMPLES OF PUBLIC BLOCKCHAINS

<u>Blockchain with Turing complete state machine (Smart contract + Cryptocurrency)</u>

In permissionless public Blockchain platforms, anyone can conduct transactions and view the transactions and anyone can download the mining program to be a part of the decision making process.

The Ethereum Virtual Machine unlike Bitcoin core is known as World Computer and is capable of processing a wide range of applications. It not only stores the transactions but also updates values of each address in the revised state.

Ethereum has made it possible for any type of business to be transacted in peer-to-peer manner to be in a sustainable manner through the concept of Smart contracts and decentralized autonomous where decisions are taken with little human intervention.
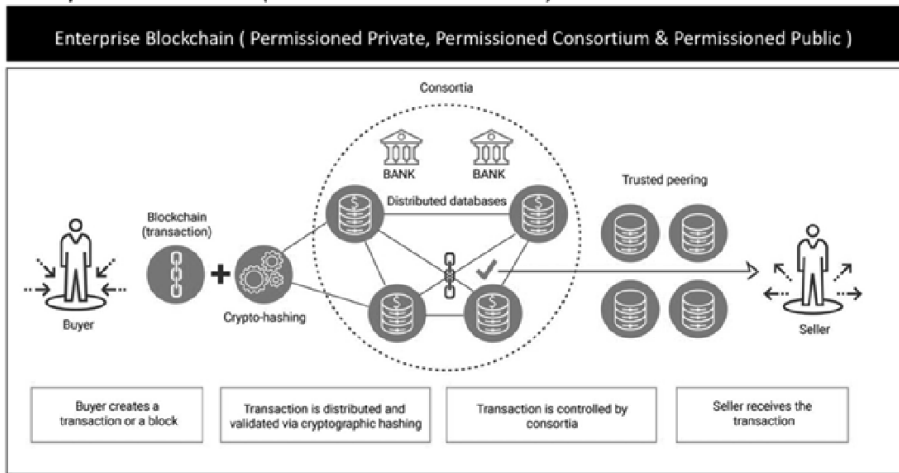
Figure 11.2 Permissioned Blockchain for enterprise applications

ENTERPRISE BLOCKCHAINS (PRIVATE AND CONSORTIUM PERMISSIONED)

Hyperledger, Enterprise Ethereum, Quorum, and Corda are examples of Enterprise Blockchain Platforms.

In the case of enterprise applications like Hyperledger, Multiledger, Quorum, Corda, etc. a Blockchain is defined by IBM as 'A peer to peer distributed ledger technology for a new generation of transactional applications that vastly improve the security, transparency and accountability while streamlining organizational processes.

In case of a permissioned Blockchain for public use, anyone can have access to view the ownership of assets after creating an account on the platform.

The important aspects of identity management for secure transactions offered by the Blockchain are as follows:

(a) **PUBLIC KEY INFRASTRUCTURE (PKI):** In the digital world, real people are identified by digital identities represented by a pair of cryptographic keys namely, **Public key**, which is known to everyone and a **Private Key**, which is kept a secret. A combination of public and private key of transacting and/or authenticating parties enables the participants of the transaction to conduct their dealings in a secured manner.

(b) **CRYPTOGRAPHIC HASH FUNCTION:** A hash function can be used in cryptographic applications if it is collision resistant. It is said to be collision resistant if it is hard to find two inputs that **hash** to the same output; that is, two inputs a and b such that $H(a) = H(b)$ and $a \neq b$. SHA 256 used in most Blockchain applications is an example of collision resistant hash function.

(c) **ECDSA GENERATED DIGITAL SIGNATURES:** The Elliptical curve Digital Signature algorithm (ECDSA) is a digital signature scheme, i.e., an asymmetric cryptographic scheme for producing and verifying digital signatures. Most of the public and private Blockchain platforms use the ECDSA scheme for producing and verifying the digital signatures for their transactions.

(d) **CERTIFICATION AUTHORITIES (CA):** A Certificate authority or Certification authority (CA) is a trusted entity that issues digital certificates certifying the ownership of a public key by the named subject of the Certificate. This is an essential part of a PKI infrastructure. X.509 is a widespread standard to manage certification.

For example, in Hyperledger Fabric 1.1, the Certificate authority managing member identities issues X.509 certificates to its members.

SUMMARISING BLOCKCHAIN'S FEATURES:

- Pseudonymity
- Decentralization
- Fault tolerance with no single point of failure
- Immutability (Tamper resistant)
- Transparency
- Trust through automation

BLOCKCHAIN'S SECURITY TOOLS:

- One way Hash functions used in consensus implementation
- Data footprint representation and key generation
- Non-forgeable digital signature algorithms for transaction privacy
- Secrecy and non repudiation

In the traditional digital world, mutually untrusted partners communicate through a centralized system with the help of these digital certificates issued by centralized authorities to different websites and portals.

However, there have been increasing cases of Certification authorities being attacked.

There have been several cases of fake digital certificates for famous publishers like Google issued by reputed Certification authorities like Gogo (Inflight internet service) and Symantec, etc., while fake certificates use to target users of reputed banks to direct them to fake versions of their banks' sites.

In the case of private Blockchains, the certification authorities and the administrators need to take utmost precaution in identifying genuine participants through issues, identifying and revoking the certificates as the case may be appropriately. In the case of public Blockchains, in 2016, Sead Muftic proposed a Blockchain-based protocol that allows distribution and management of digital certificates (linking a subject with its public key) without the need of certificate authorities by offering BIX (Blockchain Information Exchange) certificates maintained in BCL (Bix certificate Ledger). These can replace the system of X.509 certificates offered by centralized authorities.

VULNERABILITIES IN BLOCKCHAIN SECURITY

- **VULNERABILITIES TO MALWARES:** Malware attacks on users' and nodes' computer system to steal information and crypto-jacking (illegal mining using user's resources). A Blockchain-based access control can help.

- **VULNERABILITY OF USERS' INSTALLED PROGRAMS:** Third-party software compromised by hackers. Regular software patch updates is a must.

Properly managed identities and deployment of Byzantine fault tolerant consensus mechanisms ensures that the decentralized systems characterizing the Blockchain landscape are fault tolerant, attack resistant and collision resistant as they do not have the sensitive single central points of failure. It is also impossible for malicious participants to come together and act against the interests of the other genuine participants, unlike in centralized corporations with single points of failure and power concentration in a central authority.

However, there are certain limitations that are inherent to the Blockchain platforms that need to be looked at:

a) The implementation of the consensus mechanism for arriving at the decision is contingent upon the opinion of the majority. Hence, it is possible for a majority to collude and manipulate decisions making a 51% attack feasible.

b) Where there are a smaller number of participants in the Blockchain that generally happens in enterprise Blockchains closed groups or newly launched public platforms, the security is limited or missing at times.

c) The private key management is vulnerable to thefts and hence exploitable. The trust in the Blockchain relies on the safekeeping of the private keys for a truly distributed identity management. Hence, the crypto currency and token investors in the case of public Blockchains and crypto asset-based platforms and the node administrators in the case of a private Blockchain should ensure adequate measures to record and store their private keys in a secure manner. Care should be taken that only authenticated users are able to transact on the respective platforms.

d) Weakness in software implementation may compromise the entire system. There have been a number of cases where smart contracts and chain codes have been exploited to the detriment of the participants in the decentralized applications. In the case of the DAO, the first decentralized application launched on the Ethereum platform, about 50 million US dollars (3.6 million Ether) worth of tokens were syphoned off the organization through a bug that caused a recursive loop to remit the currency units to an attacker's account. (reference: https://en.wikipedia.org/wiki/The_ DAO_(organization))

e) Blockchain's cryptographic techniques may assure the immutability of the ledger but not that of the overall system. For example, there have been numerous attacks on the paraphernalia surrounding the Blockchain platforms like exchanges, wallets, etc.

f) Blockchain aims at digitizing real-world assets to enable a safe and secure exchange through implementation of smart contracts. The physical world data can be manipulated before being digitized.

Let us take a look at the typical malware attacks and see how the Blockchains manage the same:

(1) **SPOOFING:** This involves use of a token or other credential information to pretend to be an authorized user of the platform. Many forms of attack like Sybil, Malware, Credential stuffing, Man in the middle (MITM) attacks involve the users being misled to fake sites or non-users gaining access to user's credentials to transact on the system.

Hence, key management and identity tracking through the operation are an important part of the security offered by the Blockchain system. Protocols like the BIX protocol enable the correct identification of users and in enterprise applications, each user is provided a X.509 digital certificate that identifies and tracks his transactions. If any spurious transactions are detected that go against the interests of the participants, the identified participants are immediately rusticated from the system.

(2) **DDOS (DISTRIBUTED DENIAL OF SERVICE ATTACKS) :** DDOS attacks are executed by botnets that compromise the identity of connected systems and use the same to flood targeted websites with unmanageable traffic, thus forcing their shut down. Strong identity management and access controls provided at each node ensures that unauthorized participants cannot compromise and gain access to the connectivity of the compromised system, thus preventing the attack. Companies like Guardtime from Estonia are working on offering a Blockchain-enabled system that offers an additional bandwidth from connected peers, at times of increased load owing to such attacks, thus enabling them to see of the burden without a shut down.

(3) **RANSOMWARE ATTACKS:** Ransomware attacks involve the blocking of access to an institution to one's own data by the attackers. The distributed nature of the ledger in a Blockchain such as an attack improbable and ineffective as the attacker has to attack all the ledgers distributed across the system at the same time. Elimination of the single point of contact and the replication of data effectively disincentivizes the developers and perpetrators of Ransomware.

(4) **TAMPERING AND REPUDIATION:** The improbability of the ledger manipulation ensures that the contents of the ledger are neither tampered nor denied by a participant without leaving a trace of the credentials of those attempting the same. Hence, a Blockchain can be considered tamper evident, immutable platform, and the only way in which this can be done is by passing reversal/modification transactions through subsequent approved transactions.

(5) **INFORMATION DISCLOSURE:** In public Blockchains, the transactions are open for anyone to query, and the identity of the participants is protected using pseudonyms or other appropriate programs in case of Blockchains offering anonymous transactions. In case of private Blockchains, the transactions are protected cryptographically so that only authorized participants can view data relevant to them, using their private keys. Further, any entity or participant can only access the data that is programmatically approved by the access control mechanism approved by the administrators of the network. Any modification in access privileges must be authorized and approved by the authorities mentioned in the program.

Thus, in order to ensure integrity and safety of Blockchain-based systems, the implementers should ensure adequate control and employ best practices in the following:

i Key management

ii Software development and testing

iii Connectivity with external data sources and integration with front-end and backend systems

iv Using appropriate digital signature and validation mechanism for authorizing transactions

v Dynamic access control systems to ensure only the actual authorized participants are approved to transact by revoking the approval to those who cease to be members or are transferred to other positions in the organization.

It is a common practice for all Blockchain implementers to provision for a team that continuously scans the environment for evolving threats and also budget for and conduct hackathons to attack and compromise their

own systems to identify and cover their weaknesses and overcome their vulnerabilities.

A summary of the various types of attacks along with the various counter measures that can be taken are well documented in the paper Blockchain Technologies for the Internet of Things: Research Issues and Challenges, Mohamed Amine Ferrag, Makhlouf Derdour, Mithun Mukherjee, Member, IEEE, Abdelouahid Derhab, Leandros Maglaras, Senior Member, IEEE, Helge Janicke (https://arxiv.org/ pdf/1806.09099. pdf)

MAJOR ATTACKS ON BLOCKCHAIN

Threat model	Countermeasures	Resistant protocols
Key attack	- Elliptic curve encryption is used to calculate the hash functions	LNSC protocol [10]
DDoS/DoS attack	- Distributed SDN architecture	DistBlockNet protocol [36]
	- Decentralized mixing service	CoinParty protocol [37]
	- Ring signature using ECDSA	Liu et al.'s protocol [38]
	-Block size limitation, attribute-based signatures, and multi-receivers encryption	BSeIn protocol [39]
Replay attack	- Elliptic curve encryption is used to calculate the hash functions	LNSC protocol [10]
	- The freshness of public/private key pairs	BSeIn protocol [39]
Hiding Blocks	- An immutable chain of temporally ordered interactions is created for each agent	TrustChain protocol [40]
False data injection attack	- Blockchain consensus mechanisms	Liang et al.'s protocol [21]
Tampering attack	- Public-key cryptosystem	Wang et al.'s protocol [41]
Impersonation attack	- Elliptic curve encryption is used to calculate the hash functions	LNSC protocol [10]
	- Distributed incentive mechanism based blockchain and the node cooperation based privacy protection mechanism	Wang et al.'s protocol [16]
	- Attribute-based signatures	BSeIn protocol [39]
Refusal to Sign	- Not interacting with the malicious agent, or splitting the transactions in smaller amounts	TrustChain protocol [40]
Overlay attack	- Every transaction is embedded with a Time-Stamp to mark the uniqueness	Wang et al.'s protocol [41]
Double-spending attack	- Multi signatures and anonymous encrypted message propagation streams	Aitzhan and Svetinovic's protocol [22]
	- Time-Stamp and the Proof-of-Work mechanism	Wang et al.'s protocol [41]
Modification attack	- Elliptic curve encryption is used to calculate the hash functions	LNSC protocol [10]
	- The attribute signature and the MAC	BSeIn protocol [39]
Collusion attack	- Blockchain-based incentive mechanism	He et al.'s protocol [42]
Whitewashing attack	- Lower priorities are given to the agents of new identities	TrustChain protocol [40]
Quantum attack	- Lattice-based signature scheme	Yin et al.'s protocol [43]
Man-in-the-middle attack	- Elliptic curve encryption is used to calculate the hash functions	LNSC protocol [10]
	- Secure mutual authentication	BSeIn protocol [39]
Sybil attack	- An immutable chain of temporally ordered interactions is created for each agent	TrustChain protocol [40]

Fig 11.3: Types of attacks and risk mitigation mechanisms

CHALLENGES TO GROWTH OF BLOCKCHAIN ECOSYSTEMs

Though there are a lot of drivers for the growth of Blockchain-led ecosystem, there are indeed a lot of challenges that need to be addressed.

(I) The understanding of the Blockchain paradigm across the industries and the technology implementers has a long way to go in order to trigger the widespread adaption. A lot of awareness, education of the technology and its potential breath-taking impact has to be undertaken by the early adaptors.

(II) Blockchain has traditionally been associated with the 'Cryptocurrency' which is viewed as an anti-regulation and anti-establishment phenomenon. Hence, while it is important for regulators to weigh the real benefits of the Blockchain-based approach, they also need to accept and adapt the same to benefit from its disruptive potential.

(III) Many of the crypto currency protocols are currently employing the high resource intensive 'Proof of Work' consensus mechanism for mining transactions. This puts a huge limitation on scale while invoking opposition from the environmentalists and regulators.

(IV) Security of the transactions is of immense concern as there is no legal recourse in most of the countries for transaction losses or thefts. Further, identity theft in the form of compromising private keys in the case of public Blockchains and improper key management by the certificate authorities and membership providers gives rise to a variety of system compromises and loss of property, information and value.

Microsoft is exploring decentralized digital identity solutions that leverage public Blockchains in order to create a secure encrypted digital hub where individuals can store their identity data and easily control access to it. Microsoft likewise has been promoting integrity and security in digital ID solutions using its cloud computing services.

SecureKey technologies and IBM are collaborating to build a digital identity solution on top of the open source Hyperledger Fabric

enabling large groups of individuals and enterprises to quickly board highly secured networks with minimal operational effort and minimal risk.

(V) In many cases, there is no proper ground up approach and process mapping undertaken before the Blockchain platform selection, smart contract development and application launch. This has led to a lot of failures among the public Blockchain-based entities and in the case of private Blockchains, drain of resources due to avoidable mistakes. A systematic and methodical approach by taking into account existing systems in the organization and considering all aspects for a proper integration with the same will go a long way in making most of the investments in Blockchain-based implementations by organizations.

(VI) Blockchain implementations can drastically alter the governance at organizations as they will eliminate non-value adding middlemen while freeing up a lot of wasted resources. While corruption and red tape is the biggest causality, this may cause a backlash for those used to thriving on such non-desirable practices. This has to be factored in while readying an organization for the new approach through investments in Blockchain systems.

(VII) While in the public Blockchain domain, the investments could be raised through ICOs (Initial coin offerings) wherever allowed by regulatory authorities. In case of enterprise Blockchains, the investments need to be funded by the expected savings and cost benefits through automation, collaboration and process excellence. With a number of projects still in the POC (Proof of Concept) stage, the trade-offs are not clear. Hence, lack of clarity on the returns on investments leads to a tremendous bottleneck for the adoption of Blockchains.

(VIII) The cross-border, cross-organizational, cross-platform nature of the Blockchain-based businesses offers a great challenge for the regulatory and accounting authorities and practitioners. Hence, a lot of cooperation among the participants and hand holding is required to get them on board for managing the transition.

It is imperative for the participants, industry leaders and regulators to come together and quickly evolve a set of global standards and

references to ensure coordinated development of the ecosystem in line with the standards of traditional IT products and services.

(IX) The traditional approach to information technology practice in organizations is well managed with the availability of a number of guiding frameworks to manage the safety and security of their operations in a better way.

In 2014, the National Institute of Standards and Technology (NIST) published a framework for improving Critical Infrastructure Cybersecurity (the 'Cybersecurity Framework' or the 'Framework'), a voluntary framework designed to help organizations understand, manage, and reduce their cybersecurity risk in a better way. It provides a high-level strategic view of the lifecycle of an organization's cybersecurity risk management and can be tailored to specific business sectors and companies. Although it is voluntary, many companies across industries, particularly financial institutions, are developing cybersecurity programs aligned with the framework.20.

The framework describes five broad functions such as identify, protect, detect, respond, and recover that define the high-level goals of a cybersecurity risk management program. It also identifies specific categories of cybersecurity outcomes that elaborate on the functions and are tied to activities. (Reference: Advancing Blockchain Cybersecurity- Technical and Policy Considerations for the Financial Services Industry by Chamber of Digital commerce, Microsoft).

This needs to be adopted for the Blockchain infrastructure to which the organizations are exposed to ensure that the organization is not exposed to unforeseen and unknown threats and thus manage their risk better.

(X) Vulnerability of smart contracts and chain code as well as their integration with external systems poses a big threat to the integrity of managing Blockchain applications.

This has to be properly addressed by the developers and the applications should be properly tested and integrated with trusted external applications and sources.

One Microsoft solution that addresses the risks inherent in oracles is the use of 'cryptlets'. Cryptlets operate outside the permissioned Blockchain network and are designed to provide a secure, trustworthy way to serve as an oracle to a smart contract and reduce data quality risks.

CONCLUSION:

In this chapter, we explored the various features of a Blockchain and its utility in offering protection against cyber criminals. We also saw the different types of cyberattacks that pose an immense threat to any digitized application connected to the internet.

We discussed Blockchain's removal of the single point of failure, shared and distributed ledger, secure authentication of identity with appropriate permissions and authorizations in place to interact and end-to-end encryption of transactions. We saw how Blockchains fortify the IoT devices and all other IT systems comprising our digital life against any malware attack, disincentivizes them and de-risks the entire economic ecosystem. In the next chapter, we will examine the specific applications of a Blockchain with respect to the various Agents of Automation that are augmenting our operations across professional and personal lives.

Blockchain as a Protector of the Agents of Automation

INTRODUCTION:

We have observed the different manifestations of the Automation powered by AI and Analytics in the form of connected things such as robots, chatbots, drones and autonomous cars. All these devices that are controlled through the internet are prone to exploitation by cybercriminals to act against their intended applications and for ulterior objectives. In this chapter, we will examine the vulnerabilities of the connected devices and see how Blockchain can offer a protective cover of security to thwart the sinister designs of their attackers.

STRUCTURE:

- Zigbee chain reaction attack
- Controlling drones through Blockchain for security and auditing
- Securing robots through Blockchain
- Secured access and management of automobiles using Blockchain

OBJECTIVE:

The objective of this chapter is to expose the various risks faced by the connected objects through illustrations and examples. This will highlight the risks faced by humanity, even as it enjoys the fruits of AI and ML-led automation. The disruptive potential of Blockchain to protect the connected devices will be explained to drive home the point that secured automation is within the reach if we exploit the powerful features of the Blockchain platforms. The application of Blockchain with respect to the type of device and the suggested architecture is expected to offer a clear understanding regarding the need for viewing these technological breakthroughs as two sides of the same coin for a secured scaling up of automation applications so as to achieve their intended utility to the maximum.

Internet of Things (IOT) is deemed to be one of the fastest growing phenomena in the coming days with estimates pointing to tens of billions of connections being added to the internet through connected things that define the way we live in the future.

IOT is deemed to have widespread usage in industries, manufacturing, retail, consumer, health care, smart city, transportation and logistics, energy management, agricultural, environmental, financial, automobile, government, and military applications.

IOT also becomes an easy target to the malware attackers to penetrate and flood the internet with unwanted traffic creating a nuisance to global population at large. The havoc caused by the Mirai virus that attacked a mere 6 lakh devices to shut down a large number of publisher sites in October 2016 is a pointer of the things to come.

The following figure gives a brief overview of the Mirai attack that shut down a number of websites and portals globally in September-October 2016:
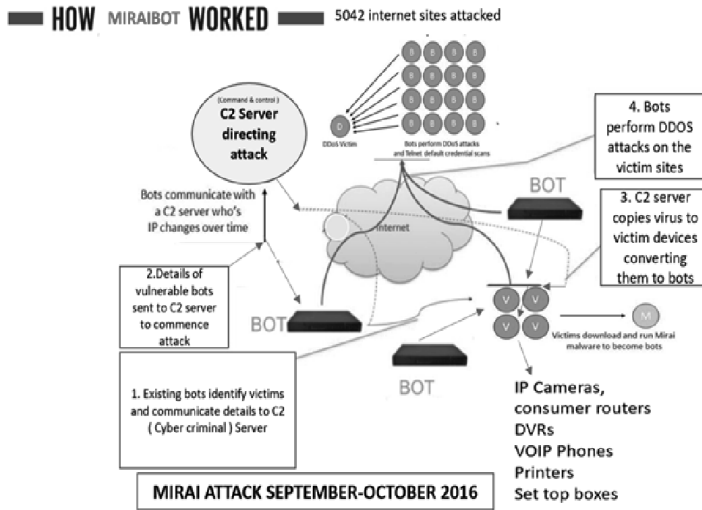
Fig 12.1: The Mirai Botnet attack exploiting IOT vulnerability for the DDOS attack

There have been a number of instances where cyberattacks have been used as a weapon of state sponsored act to penetrate adversary computer systems and shut down their activities.

StuxNet was one such attack apparently conducted by US and Israel forces on the Iranian Nuclear weapon program.
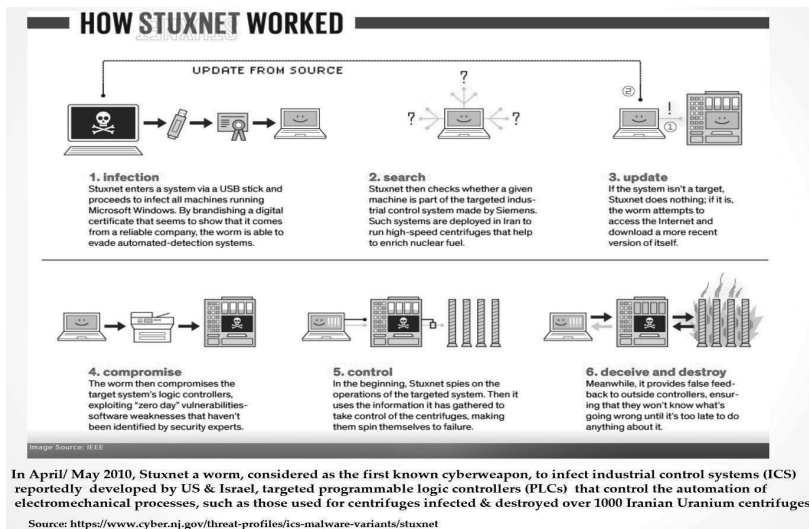

Fig 12.2: STUXNET worm penetrating enemy defences to neutralize weapons

The advent of the 'Smart City' concept is leading to a number of IoT devices being used across the landscape of modern infrastructure for leveraging automation of building home, corporate and convenience facilities. The vulnerability of many of these IoT devices have been well exposed in a research study undertaken, namely, the 'Chain Reaction' attack.

ZIGBEE CHAIN REACTION ATTACK

Chain reaction is an academic simulation project that demonstrates the vulnerability of a set of IoT devices to penetration by unauthorized worms that can enter the system through a single device like a Philips Hue bulb.

Source: (https://eprint.iacr.org/2016/1047.pdf)
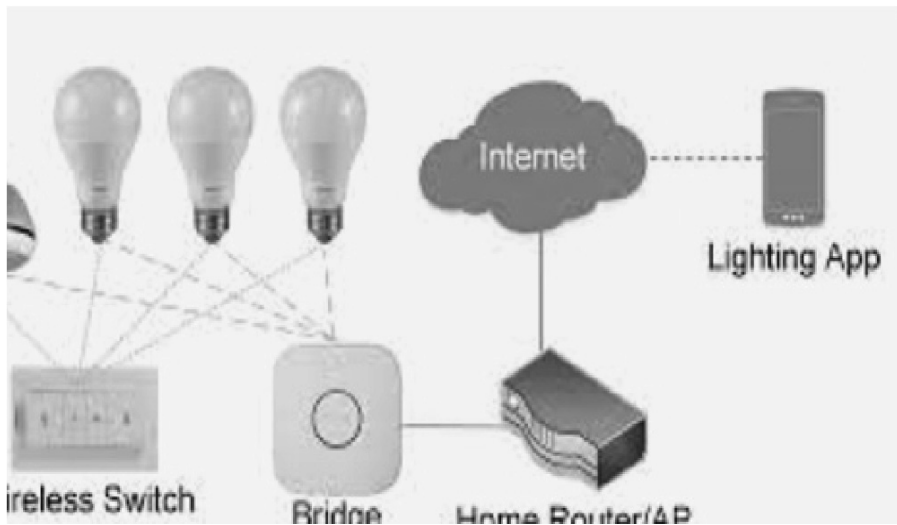

Fig 12.3: IOT GOES NUCLEAR: Creating a ZigBee Chain Reaction (research paper website), IACR E-print submission. Eyal Ronen, Colin O'Flynn, Adi Shamir and Achi-Or Weingarten

By gaining an unauthorized access through a single infected bulb and placing it in a network controlled by th Zigbee protocol, the hackers were able to take over an entire IoT network of devices showing the

vulnerability of an entire smartly populated with different IOT devices. Though the vulnerability associated with this device was later plugged, it demonstrates the real cyber threat faced by IoT dominated world in future where new types of vulnerable communication networks are created in addition to the numerous already existing networks.

Hence, it is expected that Blockchain adoption is a must to protect the IOT devices. Needless to say the growth of Blockchain technology will therefore closely track the growth of IOT devices.

Some of the interesting applications where Blockchain is being leveraged to protect the IOT devices are outlined as follows:

(a) **ENERGY:** Blockchain can be used as an immutable and trusted repository of data for the source and performance of various renewable energy devices. Smart contracts can be used for trading and exchange of energy produced while cryptocurrency could be used as a medium for facilitating the trade between the producers and suppliers.

(b) **BUILDING AUTOMATION:** Blockchain can be used to identify and offer trusted access to IoT devices that are used extensively in facility automation projects and facilitate authorized interactions with the devices for building access controls, parking lot automation, and energy and utility management.

(c) **INDUSTRIAL AUTOMATION:** Blockchain can serve extensively in 3D manufacturing by serving as a trusted repository of patented and specialized designs, facilitating trusted interactions between machines and in tracking the provenance of genuine spare parts. Robots and drones can be managed in a secure manner to deliver the desired outcomes without the threat of being hacked for unwanted outcomes.

(d) **MOBILITY:** Blockchain can facilitate tracking of vehicles on the move. Vehicles can be identified and various fees can be collected by authorities towards toll, parking or traffic violations as well, without any room for dispute and lack of trust.

(e) **DISASTER MANAGEMENT:** Drones can be used extensively for various purposes like photography, environmental hazard tracking, security and mapping in geographic information systems.

Blockchain can be used extensively in ensuring authorized usage of drones. By mapping the information and visual records collected to various authorities like police, emergency services, fire department, local self-governmental agencies, etc. through a Blockchain-enabled distribution ledger, incident responses can be done in a rapid manner to save a lot of time and effort in times of distress.

(f) **INSURANCE:** Blockchain can be extensively used to track and monitor the insurance record management and redressals of cases in all industries and for all automobiles.

(g) Bosch one of the global leaders in developing and implementing cutting-edge technologies in the automobile and medical electronics and TUV have made significant contribution in developing Blockchain applications to manage automobiles through smart phone applications connected to the Blockchain. The connected cars can safely and securely track and record various performance and status-related features of the automobile like odometer readings, fuel tank readings, mileage of car and tyre performance, etc. This data is very useful for preventive maintenance. This also prevents the odometer frauds associated with drivers who maintain fuel usage records, travel and used car transactions.

BLOCKCHAIN NETWORK FOR IOT SECURITY
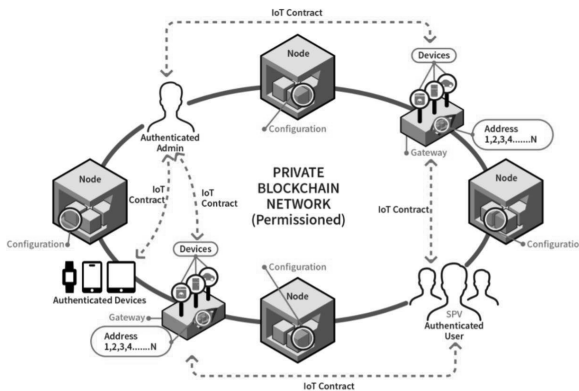
IOT devices interact with Authenticated Admin & Users after checking access controls & allowed identities in Blockchain Database

Fig 12.4: Authentication and authorization through Blockchain to mitigate IoT vulnerabilities

The IBM Watson IoT platform is an excellent initiative by IBM to seamlessly integrate the IOT devices into the Blockchain ecosystem to enable them to enjoy the benefits and safety of distributed ledger applications. Using the Watson IoT Platform in Blockchain, Internet of Things (IoT) devices can send data to and invoke smart contract transactions on the IBM Blockchain Platform or on the open source Hyperledger Blockchain. For more information, you can refer to

CONTROLLING DRONES THROUGH BLOCKCHAIN FOR SECURITY and AUDITING

According to a study by Transport Systems Corporation UK, a research conducted by them along with the Sheffield University offered a breakthrough solution for controlling unmanned aerial vehicles using Blockchain. The ability to control drones, track and record their movements immutably and issue instructions only through secure authentication and access protocols can assist the security authorities in controlling illegal drone activities and ensure that the flight information can be audited and all safety standards can be adhered to. This can also lead to substantial improvement in usage of drones for a variety of applications, including e-commerce deliveries, media and movies, etc.

SECURING ROBOTS THROUGH BLOCKCHAIN

Singularity Net, led BY Dr. Ben Goertzel, is founded by Hanson Robotics is one of the world's largest Humanoid robots company. Hanson robotics is the company behind the most popular humanoid robot on Earth, namely Sophia, who is even granted a citizenship of Kingdom of Saudi Arabia. The following is an excerpt of an on-stage interview between Dr Ben, Chief Scientist of Hanson Robotics, and Sophia:

Dr Ben: Sophia, What software are you running?

Sophia: I am using the Hanson AI software stack that included the Open Cog General Intelligence engine as a component and Singularity Net at the backend.

Dr Ben: What is Singularity Net?

Sophia: Singularity Net is a Blockchain-based platform and a marketplace for AIs. It supports intelligence on the emergent level of the whole network as well as on the level of the individual agents.

This then is the future of secured automation. The Blockchain-based backend system that allows access to, from and between robots in a safe and secure manner so that no malware attackers and unauthorized cybercriminals have access to the agents of automation to cause havoc to the mankind.

This also reminds of technological singularity, a hypothetical moment in time when any physically conceivable level of technological advancement is attained instantaneously. At this point, which many experts predict to happen within the next 20 years, the self-directed computers will develop super intelligence with their intelligence increasing exponentially rather than incrementally. This, in case if it really happens, is expected to transform the life on Earth and can also enable them to find solutions to many human problems, including disease and mortality.

The only way in which this level of intelligence that is already growing exponentially can be secured and controlled is through the risk management and protective powers the Blockchain technology offers.

The internet of robots marketplace secured through Blockchain allows a safe and secured access to ensure that proper verifications and multi-level protection is provided to the robots to ensure that they are used only for helpful and positive activities that benefit the mankind.

The same can be extended to all autonomous objects for a breakthrough management in a secured manner as shown in the following figure on 'Decentralised Management of Autonomous objects through Blockchain':
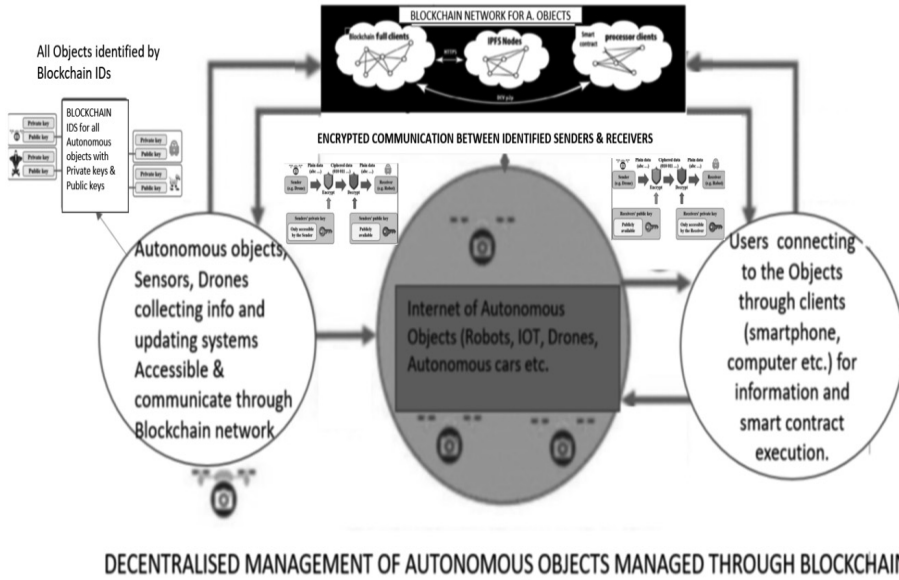
FIG 12.5: Internet of Automation Agents: Communicating through Blockchain

SECURED ACCESS AND MANAGEMENT OF AUTOMOBILES USING BLOCKCHAIN

Autonomous driving vehicles are expected to come onto roads in large numbers and are an amazing extension of IOT technology combined with artificial intelligence and machine learning applications. However, they are extremely vulnerable to hacking by cyber criminals. Blockchain offers the best possible security to the autonomous vehicles to ensure they are manipulated and their owners held to ransom.

In December 2017, an exciting disruptive technology company, XAIN, and the global leader in automobiles, Porsche, announced a partnership to take the Blockchain technology to the management of cars.

XAIN and Porsche successfully tested a proof of concept in which an Ethereum client is fused to the car's systems and is connected to the Blockchain network comprising IPFS and BAAS nodes in the Azure market place. The car is tracked and managed through smart contracts and owner wallet present in the smartphone of its owner. The car's systems are tracked and all the parameters recorded in the vehicle

wallet that keeps track of various aspects about the car's performance and activities, etc.
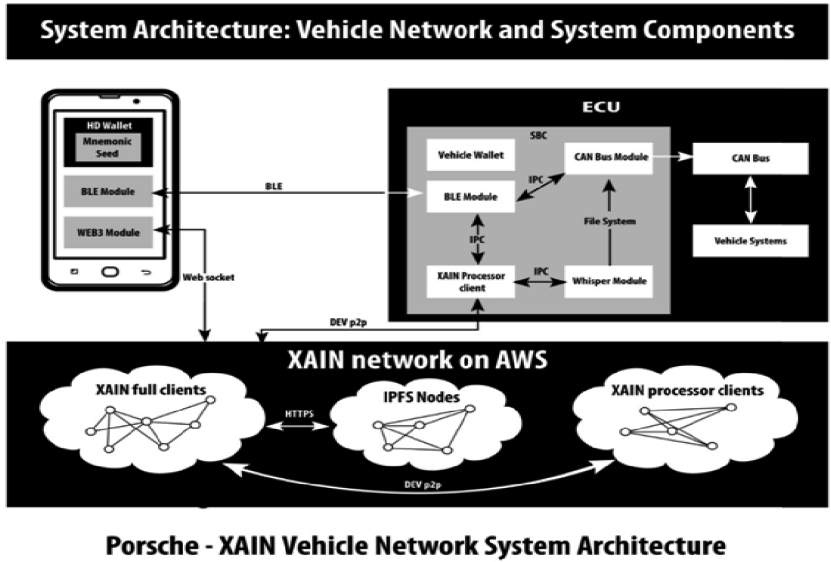
*Fig 12.6 System architecture of Blockchain-powered car management
implemented by Porsche and XAIN*

Figure courtesy: Porsche Digital Lab (https://medium.com/@porsche_tech)

Source:https://medium.com/next-level-german-engineering/the-porschexain-vehicle-Blockchain-network-a-technical-overview-e1f48c40e73d

The system will allow the authorized owners to access and communicate with their cars using the smartphone connected to the network and do the following from anywhere in the world through internet or through Blockchain-powered direct offline connection in a secure manner:

• Lock and unlock doors and luggage compartments from a distance securely.

• Communicate with other cars in the network and exchange information.

- Record and manage all critical information on a decentralized trust less system.

- Prevent hacking by cyber criminals.

Another interesting use case is that of managing the autonomous vehicles like drones for the welfare of citizens and also protection of these vehicles for unauthorized hacking to use them for illegal and criminal activities. One such illustration is shown in the following image:

- Access is controlled to drones to prevent misuse of drones for uncivilized and criminal purposes
- Rapid response through shared imagery & related information for disaster management response across government machinery & infrastructure companies
- Shared updated information regarding fire, floods, damaged roads, power outages and bridges etc., helps in quick & timely relief to affected citizens
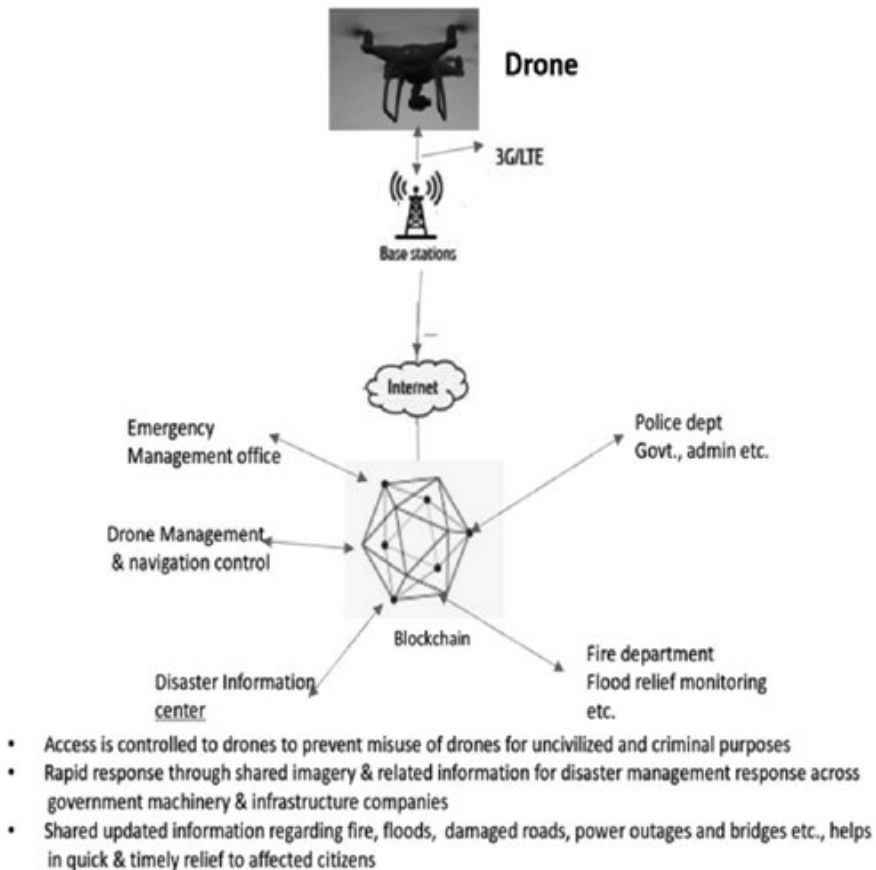
Figure 12.7: Secured drone management using Blockchain

CONCLUSION:

To make the best use of Artificial Intelligence and automation, it is important that all the various applications are properly secured and are not used against the interests of humanity.

It has been observed that the various 'Agents of Automation' we are coming across in the world today are increasingly prone to malware attacks by cyber criminals, who are always looking at ways and means of exploiting their vulnerabilities, including the 'Single Point of Failure' that characterizes the centralized systems today. Blockchain with its salient features like secured identity management, decentralized decision making, shared and distributed database offers the necessary risk management features to protect these applications and the agents so as to enable us to leverage their full potential. Its utility across these various applications has been explored.

There have been a lot of debates on how AI can replace the jobs of a number of human beings. AI serves the purpose of assisting in our jobs, augmenting the performance, and enabling us to amplify the results with much lower efforts and also automate mundane and repetitive jobs of lower value.

It is famously said that what is easy for humans is difficult for AI agents and what is difficult for humans is easy for AI. It is important that we leverage the technology to improve the quality of life substantially while we also ensure that security is well taken care through a comprehensive Blockchain-based ecosystem apart from a high level of Cybersecurity measures as mentioned in some of the earlier sections in this book.

This will then lead us to approach the point of singularity with confidence and eagerness as we can ensure that the high-powered automation is benefiting the mankind and not working against it.

CHAPTER 13

Summary and Conclusion

We have been witnessing an unprecedented level of automation sweeping across the globe, ever since the advent of machine learning powered Artificial Intelligence and the enabling technologies such as Cloud, Big Data and Analytics have started acting in tandem. Banks, airports, hotels, restaurants, BPOs, retail, high-end residencies and even our day-to-day travel are in the process of going virtually human operation free.

The main objective of this book is to familiarize how technology is impacting and manifesting itself in the form of various tools, application and forms which we have termed as 'Agents of Automation'.

In this book, we saw the various elements of automation that are powering the 'Autonomous' revolution today from various angles. We provided examples for each of the above areas along with a detailed analysis of where this phenomenon is impacting us. We also looked at how these can be built and how the respective fields across the globe are competing with each other to replace the human beings for most of the routine and not-so-routine jobs.

The steps taken in each of these applications along with the various tools and platforms that can be used to build these applications have been outlined in a brief manner. This will enable the learners and readers to plan and deploy these tools to enhance their productivity and quality of life and work.

With these agents completely demystified, you will now be able to easily comprehend how these various 'Agents of Automation' are composed and unleashed with the help of technology.

With the increasing impact of digitization and automation, there comes the increased need of providing security from malware and cybercriminals. Blockchain is the paradigm that has the potential to de-risk us from a variety of angles through effective identification, irrefutable transactions, incorruptible ledgers, fast and efficient interactions in the digital world.

We examined a comprehensive approach to the Blockchain-powered automation to the 'Agents of Automation' that will enable us to leverage these technological advancements and embrace the life of hope, convenience and high quality, without any fear and inhibitions.

CONCLUSION:

Automation across all aspects is an irrefutable reality. Those not seeing this wave and accepting this reality have the risk of not only missing out on all the conveniences and luxuries that this can provide in improving the quality of our personal and professional lives. All global citizens need to understand it and also use it to the best to complement their activities and also compete in this world. Let us all make these 'Agents of Automation' our friends and focus our time and efforts on much higher value added activities that can increase our net worth. It is also important for all participants in the ecosystem to be mindful of the various ethical, moral, legal aspects involved in the proliferation of these technologies to enable them for the collective good and betterment of our lives in the future.

It is indeed possible that in future we will be having human beings powered by computer chips that provide the power of the AI/ML to their brains as well like how 'Cobots' are enabling them with physical augmentation in the industrial environment. It is also equally possible that bioinspired robots and biologically engineered human beings transplanted with the AI-powered brain can give rise to a new breed of inhabitants roaming on this universe. The future is indeed exciting. Let us welcome the future with open arms and minds!

ANNEXURE - 1

CHAPTER WISE QUESTIONS

Chapter 1

1: What are the different types of automatic machines we come across in our daily lives?

1. What is the difference between a basic rule-based machine and an AI and ML-powered autonomous machine?

2. What are the different applications of automated systems in airports?

Chapter 2:

1. Who are the new constituents of an organizational work force powered by AI and ML?

2. Which are the top global companies harnessing the power of AI, Analytics and Automation and on what basis?

3. What is RPA and which areas does it impact in an organization?

4. What is Industry 4.0?

5. What are the various automation-related technologies impacting the industries?

6. What are robot controllers and what is their role in the new age organization?

7. What are the recent incidents that highlight the risks of extensive digitization and automation?

8. What should be the ethical and social outlook of the new age organizations with respect to AI, ML and other advanced technologies?

9. What role does Blockchain have in the new age organization?

Chapter 3

Machine Learning and Artificial Intelligence

1. What is Artificial Intelligence?

2. What led to the rebirth of AI?

3. How do e-commerce companies leverage AI and ML?

4. What are the top advanced technologies related to automation that are expected to have high economic impact in the coming years by 2025 ?

5. What is the top most application of AI as per the latest surveys?

6. What are the top AI and ML exponents and how do they leverage the same?

7. What is Machine Learning?

8. How does Machine Learning work?

9. What are the key application areas of ML?

10. What are the different types of Machine Learning and what are the major algorithms that belong to each approach?

11. What are the different phases of Machine Learning?

12. What are the revolutionary features of ML-powered AI algorithms?

13. What are the different types of analysis made possible by Big Data and ML?

14. What is the preferred programming language used in AI and ML applications currently and why?

15. What are the popular Machine learning algorithms and where are they used most?

Chapter 4: IIOT

1. What is IOT and how does it work?

2. What are the different types of sensors that comprise the IoT systems?

3. What are the key components of the IoT networks?

4. What are the main applications of IoT?

5. What is industrial IoT and what are the main applications of IIOT?

6. What are the top consumer applications of IoT?

7. What are the different protocols related to the IoT domain?

8. What are the main steps in implementing IIOT projects?

9. How does IoT create value to an organization?

10. What are the various elements of smart cities powered by IoT?

11. What are smart factories?

12. What are the main applications of AI and ML in smart factories?

13. What are the key areas of IOT spending as per NASSCOM?

14. What are the essential and evergreen components of a smart factory?

15. What are the key risks of IoT-based systems and how can they be managed?

Chapter 5: Robots

1. What is a Robot?

2. What is the origin and history behind the term Robot?

3. What are the characteristics of a Robot's operation?

4. What are the key components of a Robot?

5. What are the different types of Robots?

6. What are the important skills of a Robot?

7. What are the advantages of employing Robots?

8. What are the disadvantages of employing Robots?

9. What are the main laws expected to be followed by Robots?

10. What is Robotics?

11. What are the different technologies used in the construction of a Robot?

12. What is the key classification of Robots based on their movement?

13. What are the different areas of application of Robots?

14. What are the important steps to be considered for building a Robot?

15. What are the phases of a Robot building project?

16. What are the different components and sub assemblies used in building a Robot project?

17. What are the applications of Robots in the service industry?

18. How are the advancements in the field of AI and ML improving the Robotic functionality?

19. What are humanoid robots and the most famous known humanoid robots in the world today?

Chapter 6: Robotic Process Automation

1. What is RPA? How did RPA come into existence?

2. What are the benefits of RPA?

3. What is the estimated manpower expected to be replaced by AI-related technologies in the banking sector globally by 2030?

4. What are the different levels of RPA?

5. What are the features of AI and ML-powered RPA?

6. What is the relationship between RPA and BPM?

7. What is the estimated recovery period of investments in RPA as per NASSCOM and on what basis?

8. What are the different types of roles in RPA?

9. Who are the top vendors of RPA platforms and solutions?

10. What are the different phases of a RPA project implementation?

11. What are the considerations for RPA investments?

12. What are the top areas of applications for RPA solutions?

13. What are the typical applications of RPA in a financial organization?

14. What is the future of RPA with respect to various other technologies impacting an organization internally and externally?

Chapter 7: Drones

1. What is a Drone?

2. What are the various components of a Drone?

3. What are the different applications of Drones?

4. When and how did Drones come into existence?

5. How does a Drone work?

6. What are the systems that enable a Drone to fly?

7. How are Drones categorized as per the number of propellers?

8. What are the various military applications of Drones?

9. How Drones are classified based on equipment on board?

10. How is AI used in Drones? Explain the different AI and ML-related terminologies used in advanced Drone systems?

11. Describe in detail the various areas using Drones extensively.

12. What are the limitations of Drones and how can they be overcome?

Chapter 8: Chatbots and Voice Assistants

1. What are Chatbots?

2. What are Voice Assistants?

3. What are the different types of Chatbots and Voice Assistants we encounter in our day-to-day lives?

4. What are the major application areas of Chatbots?

5. What are the top benefits expected from the Chatbots?

6. What are the key features expected from a typical Chatbot?

7. What are the advantages of a Chatbot compared to human operators?

8. How do Chatbots work?

9. What are different levels of Chatbots based on technology application?

10. What are 'Good bots' and what are their different applications?

11. What are the 'Bad bots' and where are they mostly deployed?

12. What are the key steps in building a Chatbot?

13. What are the different channels used for deploying Chatbots?

14. What are the open source plat forms available for building Chatbots and Voice Assistants?

15. How Facebook Messenger Chatbots are built and what are the top platforms available for the same?

16. What are the top use cases of Chatbots?

17. What are the most successful examples of Chatbots globally and what do they do?

18. How are Chatbots employed in HR?

19. How are Chatbots employed in the medical field?

20. How are the Chatbots employed in marketing and customer service?

21. What are the top predicted use cases of Chatbots in the future?

22. What is holistic approach to Bot management as per the Everest group?

23. What are the aspects that need to be considered by organizations while investing in various automation projects like Chatbots?

Chapter 9: Autonomous Cars

1. What are autonomous vehicles?

2. What are the different levels of autonomous vehicles?

3. What are the benefits of autonomous vehicles?

4. What are the different components of an autonomous car?

5. How does an autonomous car work?

6. What are the different types of sensors used in an autonomous vehicle?

7. What are the essential technologies used in autonomous vehicles that enable its functioning?

8. How are AI and ML used in imparting the special features needed for the smooth functioning of an autonomous vehicle?

9. What are the various challenges and limitations of autonomous vehicle technology?

10. How do you foresee the future of autonomous vehicle systems?

Chapter 10: Artificial Intelligence and Automation Gone Wrong

1. What are the recent cases of mishaps occurring due to faults in automation technology?

2. How can autonomous cars and drones be hacked?

3. What are the various vulnerabilities of autonomous vehicle systems and how can they be exploited by hackers?

4. Enumerate the various cases of automation gone wrong.

5. How can Blockchain help in securing the Agents of Automation?

Chapter 11 Blockchain for Cybersecurity

1. What is Blockchain?

2. What are the major security features implemented by Blockchain?

3. What are the key features of Blockchain systems?

4. What are certification authorities and how do they lend credibility to mutually transacting parties in traditional systems?

5. What are the top risks to private Blockchain applications?

6. What are the inherent limitations to Blockchain platforms that need to be addressed?

7. What are the different types of malware attacks?

8. How does Blockchain address the risks associated with cybercriminals?

9. What are the best practices that need to be implemented by Blockchain administrators to secure their applications?

10. What are the major attacks that have happened on Blockchain systems in the recent past and how they were encountered?

11. What are the challenges to the growth of Blockchain adoption?

12. How are NIST standards relevant to Blockchain-based applications?

Chapter 12: Blockchain-based security for Agents of Automation

1. What are the major risks associated with IoT-based systems?

2. What are the major known vulnerabilities of IOT-based connected devices and how are they exploited in the recent history? Explain with three illustrations.

3. Where is Blockchain being used to protect IoT-based systems?

4. Explain the key concepts behind the security applications of Blockchain for IoT, Drone, Autonomous cars, Robots, etc. with architecture as appropriate.

5. How can drones be used for disaster relief and management in a secured manner?

6. How can we ensure AI and ML-powered Agents of Automation securely scale up to enable us leverage their full potential to benefit humanity?

ANNEXURE - 2

GLOSSARY: AGENTS OF AUTOMATION

A

1. Advanced Driving Assistance Systems (ADAS): Systems developed to help the driver in the driving process through increased measures of car safety and process automation.

2. Algorithm: A formula given to a computer for it to complete a task (i.e. a set of rules for a computer). An algorithm is a mathematically or a logically constructed formula to enable specific computing tasks. It can also be viewed as a set of self-contained sequence of precise rules or instructions to solve a problem. The rules can be expressed as simple processes such as the addition of two numbers or as complex functions pertaining to data processing or automated learning. Today, algorithms are being increasingly entwined with Artificial Intelligence (AI)/Machine Learning (ML) technologies to make their capacity smarter for critical functions like decision making. Examples of popular algorithms include Recursive Algorithms, Back-tracking Algorithms and Dynamic Programme Algorithm.

3. Ambient Intelligence: Smart devices like Alexa, Google Home and Apple HomePod are sensitive and responsive to the presence of people. They hang out in the background and wait for you to ask for their help. Ambient intelligence as an element of a

pervasive computing environment seeks to bring intelligence to human life. It is based on the notion of marrying our real world with the virtual through sensors, sensor networks and Artificial Intelligence (AI) to gain intelligible machine-human interactions. A technologically sensitive and empowered environment enabled by Ambient intelligence allows us to make explicit requests by using natural means in lieu of a mouse and keypad. By steadily attaining a fine convergence of AI and Internet of Things(IoT), ambient intelligence is finding wide applications in personal assistance, social communications, local search applications, and health and fitness.

4. Analyst Bot: Business *Analyst* assistant Bot (Ex: Qlik Bot) powered by Artificial Intelligence. They are also used for to assist in investment decisions.

An analyst bot is designed with the pronounced aim of organizing the fundamentals of algorithmic trading in a meaningful way. Based on algorithmic trading code, the bot has the capabilities of generating and executing buy and sell signals spit out by the financial markets. The robot can determine when to buy and sell on the basis of signals received from its 'entry rules'. Similarly, with the help of its 'exit rules', it can decide when to close on the current position.

Obviously, you're going to need a computer and an Internet connection. The analyst bot uses an electronic <u>trading platform</u> to develop trading strategies for its operations.

5. Artificial intelligence: A subset of computer science that deals with computer systems performing tasks with similar, equal, or superior intelligence to that of a human (e.g. decision making, object classification and detection, speech recognition, and translation).

6. Artificial general intelligence (AGI): It is also known as strong AI. AGI is a type of artificial intelligence that is considered human-like and is still in its preliminary stages (more of a hypothetical existence in present day).

7. Artificial narrow intelligence (ANI): It is also known as weak AI. ANI is a type of artificial intelligence that can only focus on one task or problem at a given time (e.g. playing a game against a

human competitor). This is the current existing form of AI.

8. Artificial neural network (ANN): A network modeled after the human brain by creating an artificial neural system via a pattern-recognizing computer algorithm that learns, interprets, and classifies the sensory data.

9. ATM/ATVM/AVM/ASCC/ABCC/AIC, etc.: Automatic counters/ Machines for teller, ticket vending, product vending for consumers and self-check in and baggage check-in and Immigration at airports.

B

10. Backpropagation: This is a short form for 'backward propagation of errors'. It is a method of training neural networks where the system's initial output is compared to the desired output, and then adjusted until the difference (between outputs) becomes minimal.

11. Bayesian networks: It is also known as Bayes network. The Bayes model, belief network, and decision network is a graph-based model representing a set of variables and their dependencies.

12. Big data: Large amount of structured and unstructured data that is too complex to be handled by standard data-processing software.

13. Bomb Diffusion Bot:

Bomb diffusion bots have evolved enormously over the past few decades and are being employed by the government of various countries to diffuse bombs before their possible explosion. With the help of powerful sensors and x-ray devices, robot disposal bots work on detecting improvised explosive devices (IEDs). Its gripper arm picks up the explosive material and diffuses with forceful water jets. The advanced bomb diffusion bots display human-like dexterity as they are equipped with an intuitive control interface, aiding the operator to gain a high degree of command and control. Harris T7 which is expected to be delivered by December 2020 to the British army is considered to be an exemplary bomb diffusion bot.

C

14. Chatbots: A chat robot that can converse with a human user through text or voice commands. Utilized by e-commerce, education, health, and business industries for ease of communication and to answer user questions.

15. Classification: An algorithm technique that allows machines to assign categories to data points.

16. Clustering: An algorithm technique that allows machines to group similar data into larger data categories.

17. Cognitive computing: Computerized model that mimics human thought processes by data mining, NLP, and pattern recognition.

18. Computer vision: When a machine processes visual input from image files (JPEGs) or camera feeds.

19. Convolutional neural network (CNN): A type of neural network specifically created for analyzing, classifying, and clustering visual imagery by using multilayer perceptrons.

20. Crowdsourcing: It is a practice of distributing tasks to a large audience and getting things done quickly. The drawback here is that it's tough to maintain the crowd and ensure quality when done alone.

D, E, F

21. Data labeling: Task of annotating the object(s) found in the given data. This includes images, audio, video or any file type.

22. Data mining: The process of sorting through large sets of data in order to identify recurring patterns while establishing problem-solving relationships.

23. Data science is a study that unifies statistics, data modeling and visualization and analysis to extract information, classify data, etc.

24. Data scientist: Person who is better at statistics than any software engineer and better at software engineering than any statistician.

25. Decision model: A model that uses prescriptive analytics to establish the best course of action for a given situation. The model assesses the relationships between the elements of a decision to recommend one or more possible courses of action. It may also predict what should happen if a certain action is taken.

26. Deep learning: A machine learning technique that teaches computers how to learn by rote (i.e. machines mimic learning as a human mind would using classification techniques).

27. Entertainment bots:

Entertainment bots provide entertainment to users with higher levels of personalized user experience. The robotic operations ensure complete audience engagement while offering them seamless services related to events, recommendations and ticket bookings. With its easy integration with social media platforms, the bots have their fingers on the pulse of audience preferences and are able to communicate with them in larger scales. The AI applications of the entertainment bots can anticipate user interests to send them personalized news alerts, movies and concert recommendations and their show times. Ticket bookings can also be done using these bots.

28. Facial recognition: The recognition of faces and emotional states in images or video signals. This is commonly done through point annotations called landmarks.

29. Father of Artificial Intelligence: John McCarthy is one of the founding fathers of artificial intelligence, together with Marvin Minsky, Allen Newell, and Herbert A. Simon. McCarthy coined the term 'artificial intelligence' in 1955, and organized the famous Dartmouth conference in summer of 1956. This conference started AI as a field.

G

30. Gaming:

Gaming is essentially the running of specialized <u>applications</u> that are sold out to us as electronic games or video games. Traditionally, digital games have included hardware in form consoles like <u>X-box</u> and <u>PlayStation</u> or personal <u>computers</u> for online gaming. However, with the emergence and gradual proliferation of VR, AR, AI, and smart technology, the gaming market is briskly expanding as games with high-quality user experiences are being developed. Games use enhanced graphics, 3D effects and full motion video and input devices like a joystick to offer high entertainment value to the gamers. High-end games are extremely sophisticated with their interface constituting a form of virtual reality, contributing to an immersive experience.

31. Ground truth is a process usually done on site (or using gold standard) to measure the accuracy of the training dataset to prove or disprove research hypothesis. For example, self-driving cars use ground truth to train AI to properly validate the road and street scenes.

32. Human-in-the-loop is a process of using humans in the middle of the process to achieve the expected output. It's been used in the Machine Learning process to enhance the result accuracy.

33. Generative adversarial networks (GAN): A type of neural network that can generate seemingly authentic photographs on a superficial scale to human eyes. GAN-generated images take elements of photographic data and shape them into realistic-looking images of people, animals, and places. It is an unsupervised AI and ML technique to mimic datasets called Generative Adversarial Network (GAN). It consists of two competitive neural networks: the generator and the discriminator.

34. Genetic algorithm: An algorithm based on principles of genetics that is used to efficiently and quickly find solutions to difficult problems.

H

35. Health bot: The Microsoft Health Bot project is designed to enable partners to easily create intelligent and compliant healthcare virtual assistants and health bots. Medical Bot, pharmacist bot and hospital bot, etc. are variations of health bots.

36. Heuristic: A computer science technique designed for quick, optimal, solution-based problem solving.

37. HR bots:

Artificial Intelligence (AI)-enabled bots are fast in penetrating a range of industries ranging from healthcare to education, transportation, advertising, legal, finance, and hospitality. HR bots provide an automated, yet personalized interactions between software and human users. On being asked questions, diverse information can be provided by the bots to the users. However, HR professionals need to first design mentoring programmes for them before initiating them into action. Much akin to human staff, the bots also need up skilling, management and performance reviews.

I

38. Image recognition: The process of identifying or detecting an object or feature of an object in an image or video.

L

39. Leader bots:

With the recent and phenomenal breakthroughs in AI and ML technologies, computer experts are developing Chatbots which can teach leadership skills or execute leadership roles with efficiency. If designed and tailored well, leader bots can help train professionals for leadership roles. Some existing leader bots can give answers to utterances like, "How do I fire someone nicely?" or "What are tips for active listening?" Mavens of advanced technologies have gone even so far to suggest robots for a country's governance since the latter is given to logical thinking and hence less irrational, unlike their human counterparts.

40. Limited memory: Systems with short-term memory limited to a given timeframe.

M

41. Machine learning (ML): A branch of AI that focuses on developing programs that access and use data on their own, leading machines to learn for themselves and improve from learned experiences.

42. Machine translation: An application of NLP used for language translation (human-to-human) in text- and speech-based conversations.

43. Managed crowdsourcing: Service provider offering fully-managed outsourcing solution using the crowd.

44. Medical chatbot: Chatbot that offers patients, access to treatment at the clinic or hospital by instantly scheduling appointments through the chat window itself.

N

45. Natural language generation: A machine learning task in which an algorithm attempts to generate language that is comprehensible and human-sounding. The end goal is to produce a computer-generated language that is indiscernible from language generated by humans.

46. Natural language processing (NLP): It helps computers process, interpret, and analyze human language and its characteristics using natural language data.

47. Neural networks: See artificial neural networks.

O

48. Optical Character Recognition (OCR): Conversion of images of text (typed, handwritten, or printed) either electronically or mechanically into machine-encoded text.

P

49. Pattern recognition: Automated recognition of patterns found in data.

50. Perception is a process of acquiring, interpreting, selecting, and organizing sensory information. It is what you perceive, which may be true or false, as opposed to the ground truth which is always true.

51. Perceptron: Perceptron is a ML algorithm for supervised learning of binary classifiers. A binary classifier is a function which can decide whether or not an input, represented by a vector of numbers, belongs to some specific class.

52. Precision: Out of a given dataset, how many are selected to use.

R

53. Reactive machines: Software applications that can analyze, perceive, and make predictions about experiences, but do not store data; they react to situations and act based on the given moment.

54. Recall: Out of selected data, how many are processed.

55. Recurrent neural network (RNN): A type of neural network that makes sense and creates outputs based on sequential information and pattern recognition.

56. Reinforcement learning: A machine learning method where the reinforcement algorithm learns by interacting with its environment and is then penalized or rewarded based on decisions it makes.

57. Robotics: A branch of technology focused on the design and manufacturing of robots that exhibit and/or replicate human intelligence and actions.

58. Robotic process automation (RPA): RPA uses software with AI and ML capabilities to perform repetitive tasks once completed by humans.

S

59. Semantic Segmentation is understanding the image at pixel-level, partitioning the image into semantically meaningful parts, and classifying each part into one of the pre-determined classes.

60. Speech Recognition: The recognition of words and/or emotional state in an audio signal.

61. Spider bot:

Web crawler, sometimes called a spider or *spiderbot* and often shortened to crawler, is an Internet *bot* that systematically browses the World Wide Web typically for the purpose of Web indexing (web spidering). Web *search* engines and some other sites use Web crawling or spidering.

62. Singularity in AI:

The technological singularity (also simply, the singularity) is a hypothetical future point in time at which the technological growth becomes uncontrollable and irreversible, resulting in unfathomable changes to human civilization.

63. Sophia:

The first robot to receive citizenship of any country (Kingdom of Saudi Arabia), Sophia, activated on 14th Feb, 2016, is a social <u>humanoid robot</u> developed by a <u>Hong Kong</u>-based company <u>Hanson Robotics</u>. It is able to display more than 50 facial expressions.

Sophia was named the <u>United Nations Development Programme</u>'s first ever innovation champion and is the first non-human to be given any United Nations title.

64. Strong AI: See artificial general intelligence (AGI).

65. Structured data: Clearly defined data with easily searchable patterns.

66. Supervised learning: A type of machine learning where output datasets teach machines to generate desired outcomes or algorithms (akin to a teacher-student relationship).

T

67. Training data: In machine learning, the <u>training dataset</u> is the data given to the machine during the initial learning or training phase. From this dataset, the machine is meant to gain some insight into options for the efficient completion of its assigned task through identifying relationships between the data.

68. Turning test: Developed by a computer scientist Alan Turing in 1950. This was a test used to determine whether a computer could think. If a human interacting with it believed they were talking to another person not a computer, the test was considered a success.

69. Transfer learning: A system that uses previously-learned data and applies it to a new set of tasks.

70. Turing test: A test created by a computer scientist Alan Turing (1950) to see if machines could exhibit intelligence equal to or indistinguishable from that of a human.

71. UAV: Unmanned aerial vehicle, for example, a drone that navigates without any human pilot.

72. Unstructured data: Data without easily searchable patterns (e.g. audio, video, social media content).

73. Unsupervised learning: A type of machine learning where an algorithm is trained with information that is neither classified nor labeled, thus allowing the algorithm to act without guidance (or supervision).

74. Virtual Assistant: Virtual Assistant mimics humans and holds proxy intelligent proxy conversation with customers or employees on behalf of an organization or an individual regarding, sales, customer service and any other offer-related clarifications, provide reminders and undertake designated pre-programmed activities.

75. WannaCry: WannaCry is a ransomware cryptoworm which targeted computers running the Microsoft Windows operating system by encrypting data and demanding ransom payments in the Bitcoin cryptocurrency.

76. Watson: IBM's Watson is a supercomputer capable of learning and adaptation. It processes a vast amount of unstructured data to find patterns, interpret information and solve problems.

77. Weak AI: It is also known as Artificial Narrow Intelligence. It undertakes narrow tasks using AI algorithms.

78. Web Crawler:

Web crawler, sometimes called a spider or *spiderbot* and often shortened to crawler, is an internet *bot* that systematically browses the World Wide Web, typically for the purpose of Web indexing (web spidering). Web *search* engines and some other sites use Web crawling or spidering.