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The Evolution of Internet of Things: Bringing the power of Artificial Intelligence to IoT, its Opportunities and Challenges

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ABSTRACT

The Internet of Things (IoT) presents an opportunity to collect real-time information about every physical operation of a business. Artificial Intelligence (AI) is playing a growing role in IoT applications and deployments, a shift apparent in the behavior of companies operating in this area. Businesses across the world are rapidly leveraging the IoT to create new networks of products and services, that are opening up new business opportunities and creating new business models. The resulting transformation is ushering in a new era of how companies run their operations and engage with customers. There is tremendous opportunity for those businesses that can convert raw IoT data into business insights, and the key to doing so lies within effective data analytic. Organizations are now forced to look deeper into their data to find new and innovative ways to increase efficiency and competitiveness. With recent advances in science and technology, particularly in machine learning, organizations are adopting larger, more comprehensive analytics strategies. For companies to realize the full potential of IoT enablement, they need to combine IoT with rapidly-advancing AI technologies, which enable 'smart machines' to simulate intelligent behavior and make well-informed decisions with little or no human intervention. Integrating AI into IoT networks is becoming a prerequisite for success in today's IoT-based digital ecosystems. So businesses must move rapidly to identify how they'll drive value from combining AI and IoT or face playing catch-up in years to come. In this paper, the author will explore the evolution of IoT and what how best IoT can play a key in combining with AI can do for the industry in future. Later the paper will explore the opportunities and challenges it face during implementation.

Keywords **:-** Internet of Things (IoT), Artificial Intelligence (AI), Machine Learning (ML), Radio Frequency IDentification (RFID)

I. INTRODUCTION

The IoT, sometimes referred to as internet of objects, it is about embedded interconnections of various electronic devices. It is a merger of two technologies: wireless connectivity and smart sensors. In the IoT paradigm, many of the objects that surround us will be on the network in one form or another. Radio Frequency IDentification (RFID) and sensor network technologies will rise to meet this new challenge, in which information and communication systems are invisibly embedded in the environment around us. This result in the generation of enormous amounts of data which have to be stored processed and presented in a seamless, efficient, and easily interpretable form.

Evolution of technology combines these aspects of technology with modern day uses. In the present scenario, the electronic appliances play a vital role in our day to day lives. There are various technologies like IoT, Cloud Computing, Wireless Sensor Network (WSN), RFID, sensors and system on chips which will revolutionize our take on technology. IoT is a vision, which is heralded as the biggest technological development since the invention of the wheel. IoT refers to the addition of communications and sensing capabilities to a very wide range of physical objects. IoT devices can share data directly using protocols such as Wi-Fi and Bluetooth, and via mobile phone networks and specialized radio networks, as well as over the global Internet.

IoT in the logistics and transportation area as well as AI in the informatics field have brought about a tremendous growth and innovation potential for global value chain setups [1]. The question is not if further innovation and automation will happen, but when sooner than later and in which specific way. Independent of physical production innovations (e.g., additive manufacturing) information integration and decision autonomy tendencies will drive new supply chain and customer interaction designs and business models. But it is a core interest of research and business technology forecasting to identify important developments as early as possible as in this way adequate preparation (e.g., training, investment) can

be secured. Therefore, as specific technologies and applications are not yet known, it is prudent and the only way forward to use existing descriptions and state-of-the-art technology concepts as basis for extrapolation methods [2] [3].

There is no single strategy for realizing the vision of the IoT, as services can be provisioned in various ways. In a centralized approach, application platforms located in the Internet (e.g. cloud services) acquire information from entities located in data acquisition networks, and provide raw data and services to other entities. These application platforms control the whole information flow, and there is little or no support for accessing the information providers directly. In fact, there are multiple industrial solutions that make use of this approach [4] [5].

IoT is producing a big hype in the market right now. Many organizations struggle to manage and maintain the enormous amounts of data. Every large corporation collects and maintains a huge amount of human-oriented data associated with its customers, including their preferences, purchases, habits and other personal information. In typically scenario, the IoT is the data flowing between many devices. To be able to find needles in this haystack, you need AI. In some years, AI will be an essential part of any IoT system and move the IoT revolution to a new level. Both AI and IoT have to go both hand in hand in the future.

Venture capital investments in IoT start-ups that are using AI are up sharply. Companies have acquired dozens of firms working at the intersection of AI and IoT in the last two years. And major vendors of IoT platform software are now offering integrated AI capabilities such as machine learning based analytics. The powerful combination of AI and IoT technology is helping companies avoid unplanned downtime, increase operating efficiency, enable new products and services, and enhance risk management [6].

With a wave of investment, a raft of new products, and a rising tide of enterprise deployments, AI is making a splash in the IoT. Companies crafting an IoT strategy, evaluating a potential new IoT project, or seeking to get more value from an existing IoT deployment may want to explore a role for AI [6].

II. POWER OF IOT AND AI

The IoT, or as some prefer to call it, the "Internet of Everything," has been on an increasing growth trajectory that Gartner projects will reach 26 billion units by 2020, with the value of IoT products and services reaching US $300 billion [7]. GE, a long time player in the industrial Internet which comprises the mechanisms and applications for monitoring and optimizing the performance of industrial equipment (including jet engines, locomotives, power turbines, and manufacturing processes) estimates that the industrial Internet will add $10 to $15 trillion (yes, trillion) to the global gross domestic product over the next 20 years [8]. Of course, there is an enormous amount of hype in the marketplace around new and emerging technologies. In fact, Gartner's infamous "hype cycle" report has the IoT at the "peak of inflated expectations" (big data has already entered the "trough of disillusionment") [9].

During the course of the study, Blue Hill Research interviewed three organizations to get a deep understanding of their IoT analytics initiatives including: a U.S. based oil & Gas Company building a sensor network to track oil field performance, a U.S. municipality transitioning to automated water meter readings, and an international truck manufacturer optimizing fleet performance and manufacturing. The following were key business outcomes - $10 million capital savings; Optimized oil field production; Net-new revenue stream & enhanced truck manufacturing.

In a number of sectors, unplanned downtime resulting from equipment breakdown can cause heavy losses. For instance, according to one study, such losses average $38 million annually for offshore oil and gas operators [10]. Another source estimated that for industrial manufacturing in total, unplanned downtime costs $50 billion per year, with equipment failure being the cause for 42 percent of the outages [11].

Predictive maintenance using analytics to predict equipment failure ahead of time in order to schedule orderly maintenance procedures can mitigate the damaging economics of unplanned downtime. In manufacturing, for instance, Deloitte finds that predictive maintenance can reduce the time required to plan maintenance by 20–50 percent, increase equipment uptime and availability by 10–20 percent, and reduce overall maintenance costs by 5–10 percent [12].

According to Cluster of European research projects on the IoT - 'Things' are active participants in business, information and social processes where they are enabled to interact and communicate among themselves and with the environment by exchanging data and information sensed about the environment, while reacting autonomously to the real/physical world events and influencing it by running processes that trigger actions and create services with or without direct human intervention [17]. According to Forrester, a smart environment – Uses information and communications technologies to make the critical infrastructure components and services of a city's administration, education, healthcare, public safety, real estate, transportation and utilities more aware, interactive and efficient [18].

Bank of America Merrill Lynch (BAML) estimated in December 2015 that the robot and AI solutions market will

surge to US$153bn a year by 2020, comprised of US$83bn for robots and robotics, and US$70bn for AI-based analytics. BAML added that adoption of robots and AI could boost productivity by 30% in many industries over the coming decade, while cutting manufacturing labour costs by between 18% and 33%.

For example, for Hershey, managing the weight of their products during the production process is critical: Every 1 percent improvement in weight precision can mean more than $500,000 in savings for a 14,000-gallon batch of product such as Twizzlers [20]. The company used IoT and machine learning to significantly reduce weight variability during production. Data is captured and analysed by the second, and weight variability can be predicted by machine learning models, enabling 240 process adjustments per day, compared to just 12 per day before the ML-powered IoT solution was installed [21]. AI-based prediction is also helping Google cut 40 percent of data centre cooling costs. The solution, trained on data from sensors in the facility, predicts temperature and pressure over the next hour to guide actions for limiting power consumption [22].

Whatever the precise growth trajectory, it's clear that AI is gaining ground rapidly, an advance that reflects the scale of the benefits it can bring to businesses. At its core, AI is about simulating intelligent behaviour in machines of all kinds—and since IoT is about connecting those machines, there is a clear intersection between AI and IoT. Because AI technologies particularly machine learning can help identify patterns and anomalies and make predictions based on large sets of data, they are proving to be particularly useful in implementing predictive maintenance. Leading South Korean oil refiner SK Innovation, for example, expects to save "billions of won" by using machine learning to predict failure of connected compressors [13]. Similarly, Italian train operator Trenitalia expects to avoid unplanned downtime and save 8–10 percent on its €1.3 billion annual maintenance costs [14]. Meanwhile, French power utility EDF Group has already saved over $1 million with machine learning driven early warning on equipment failure [15].

In fact, the titanic shift and ongoing disruption caused by AI is set to be similar to that caused by the introduction of the personal computer in the 1980s. Like the PC, AI will lay the foundations for an immense acceleration in innovation throughout and beyond the coming decade, creating a significant boost for the global economy. In the 1980s, nobody could have fully imagined the broad and deep changes that PCs would bring to our lives. Similarly, few people today can envision what AI will mean to us over the coming decades [16].

Today, the AI in smart machines is advancing from the ability to handle traditional applications of repetitive tasks to the capability to adapt to continuously changing tasks. As **Figure 1** show, this evolution is seeing AI applications progress from Assisted Intelligence to Augmented Intelligence, and ultimately Autonomous Intelligence. Each stage builds on the one before, bringing to bear its own specific capabilities and characteristics [16]. As this convergence continues, the ongoing headlong growth of IoT is being driven by six factors (see **Figure 2**) of which arguably the most powerful is the advent of big data and cloud/fog computing. The IoT's growth will in turn drive an exponential rise in the volumes of data being generated, with IDC estimating that the number of devices connected to the Internet will surge from 11 billion in 2016 to 80 billion in 2025 generating 180 zettabytes of data every year, up from 4.4 zettabytes in 2013 and 44 zettabytes in 2020 [19].

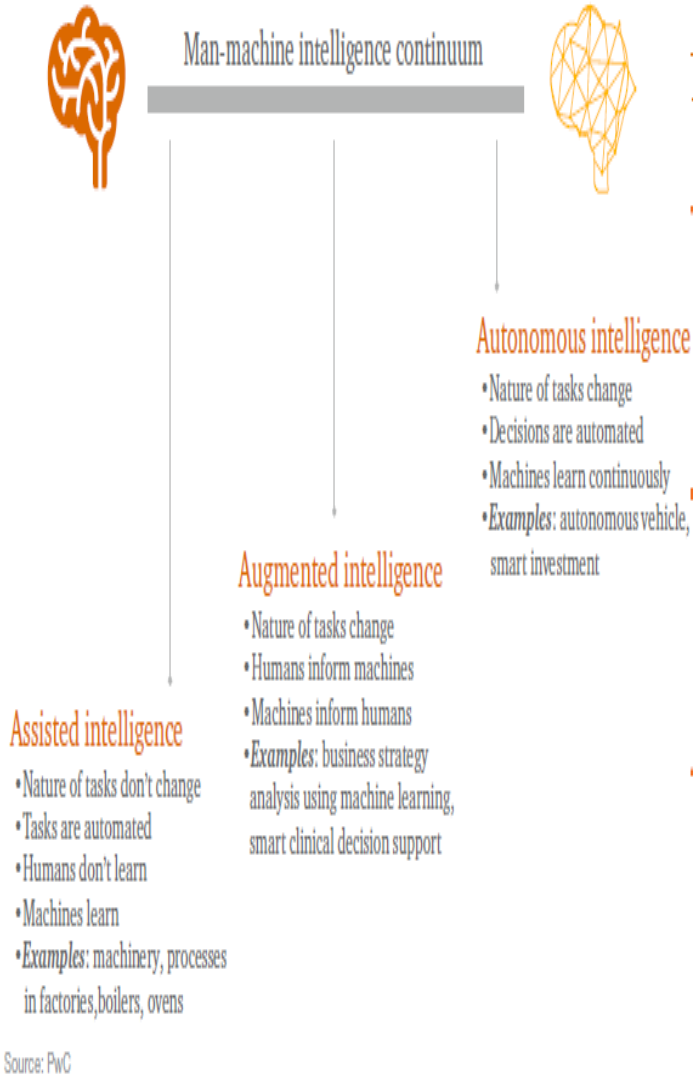

Fig. 1 The Evolution of AI

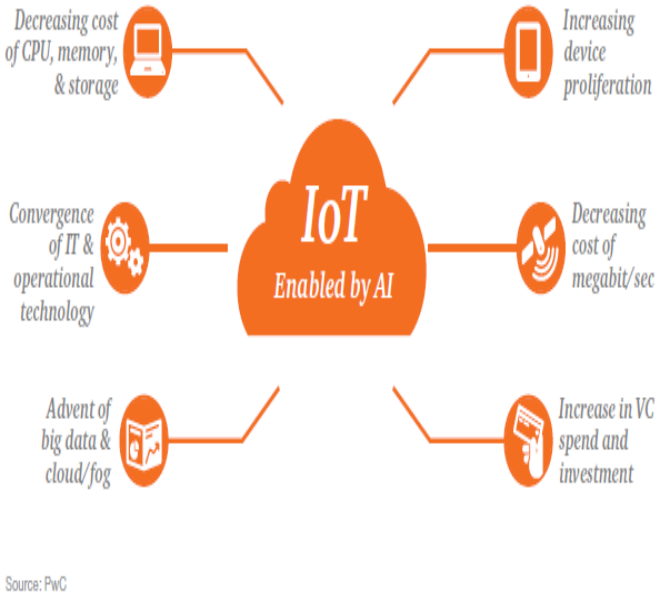

Fig. 2 Headlong growth of IoT is being driven by six factors

GE's drone and robot-based industrial inspection services, the company is looking to AI to automate both navigation of inspection devices and identification of defects from the data captured by them. This could result in safer, more precise, and up to 25 percent cheaper inspections for the client [23]. In health care, Thomas Jefferson University Hospital in Philadelphia seeks to improve patient experience with natural language processing that will enable patients to control room environment and request various information with voice commands [24]. In 2015, Toyota Motor Corp. announced it would spend $1billion over the rest of this decade on initiatives that will put AI into its cars and the factory robots that build them. Toyota, one of the world's largest automakers with fiscal 2016 revenue of US $237 billion, also created a new AI research center in California's Silicon Valley, demonstrating the company's huge commitment to AI [25].

After about 50 years of largely languishing in technology labs and the pages of science fiction books, today AI has taken center stage and is under the bright lights. Barely a day goes by without dozens of new magazine and newspaper articles, blog posts, TV stories, LinkedIn columns, and tweets about cognitive technologies. It shouldn't be at all surprising. The impact of AI has been very upfront and highly personal these days. The technology is beginning to reshape the jobs people hold, the cars they drive, the medical procedures they undertake, and the games they play. Through these capabilities, AI supports enhanced IoT applications by enabling these three key factors: Predictive analytics – 'What will happen?' Prescriptive analytics – 'What should we do?' Adaptive/continuous analytics – 'What are the appropriate actions/decisions, and how can we adapt to the latest changes?'. The interdependence between IoT and AI also works the other way. IoT's capacity to enable real-time feedback is critical to adaptive learning systems, since other technologies do not really enable this advanced type of AI/analytics. So they both need each other.

Let us take an example here for the smart home that is managed by IoT devices and sensors. Let us consider one situation here, we can assume that our refrigerator is connected to the sensors and we don't have bread and Jam. Since our refrigerator is connected with the sensors and internet, your refrigerator will place the order by itself to the nearest supermarket, which now a days uses robots or drones for sending the groceries. Now as the supermarket gets the order of bread and jam, they send the order by the drone or robot, which will deliver the order to your home. Here we can see the use of IoT technology with the AI which makes our life easier. Let us take another example of the weather reports where we use the sensors to monitor the weather and send live weather data to the weather statistics which analyse the reports and predict the weather. We will depend on the IoT devices and sensors because it generates a lot of data and being able to get the information from the data that we collect from it in details. Presently we start depending more on the AI because any human cannot able to read the information from the huge volume of data so we will need the machine to find and analyse the data for us so that we can retrieve the information much faster and the machine will provide the accurately correct results; consider a situation if a machine gets a new pattern in the data for that we don't have to think because the machine will have that much capacity for learning by itself [26].

ML uses supervised learning techniques on historical data to make cognitive decisions. The greater the quantity of historic data, the better the decision-making capabilities of the algorithm. This philosophy makes IoT the ideal use case for machine learning as the data generated by the devices are usually very frequent. AI will be functionally necessary to wield the vast number of connected "things" online, and will be even more important in making sense of an almost endless sea of data streamed in from these devices [27]. Some examples of systems that were founded by MIT roboticist - Automated vacuum cleaners, like that of the iRobot Roomba. Smart thermostat solutions, like that of Nest Labs which was used for temperature checking from anywhere and the Self-driving vehicles, such as that of Tesla Motors. Tesla CEO Elon Musk's response to the question of what makes Tesla's

self-driving cards unique: "The whole Tesla fleet operates as a network. When one car learns something, they all learn it. That is beyond what other car companies are doing".

From a technological point of view, it is important to remember that AI is composed of a set of technologies such as ML and Deep learning (DL). "AI, the IoT and Analytics form three facets of the same reality", said the head of Huawei, Wael William Diab, who also indicates that: "While IoT focuses on networks of sensors that generate data, analytical processes are limited to the analysis of such data with the objective of creating value, whereas artificial intelligence enables the generation of knowledge and predictability using the valuable data that has been gained" [28]. The technology vendors vying for space in the advanced apps and analytics market will accelerate their efforts in delivering AI-enabled applications and systems. In other words, AI will penetrate all business models.

Sundar Pichai, CEO of Google, wrote last year that "the last 10 years have been about building a world that is mobile-first. In the next 10 years, we will shift to a world that is AI-first." Experts tend to agree that AI technology is at a tipping point and could have a profound impact on the world in the near and long-term future. So, the technology is racing ahead but what do consumers really think of AI? [29].

III. CHALLENGES OF IoT & AI IN IMPLEMENTATION

Let us first start discussing the key challenges that are faced by various organisations. **Survey report from PWC 2017 suggests**:

- Determining how to manage, analyse and create meaningful insights from all this data.
- Maintaining the accuracy and speed of analysis.
- Balancing centralisation and localisation of intelligence—how smart or dumb do you want the sensors and devices to be?
- Balancing personalization with the need to maintain the privacy and confidentiality of data.
- Maintaining security in the face of growing cyber risks and threats [16].

Researchers namely **Seth Earley, Earley & Associates in 2015**, in their article titled "Analytics, Machine Learning, and the Internet of Things – Highlighted the 'The Challenges Organizations will need to focus on'

- understanding the relative maturity of enterprise capabilities in the realms of product technology and IT;
- understanding the types of IoT functionality that can be incorporated and where new capabilities will impact customer value;
- understanding the role of machine learning and predictive analytics models; and
- rethinking business models and value chains based on how quickly the market is changing and the relative agility of competitors [30].

Based on various survey and research a consolidated report is prepared and highlighted below the various challenges that are faced by the industry in implementing IoT.

A. Create an IoT Strategy for Your Business

IoT is not just another IT program; it's an initiative that will require collaboration from across the organization and with many stakeholders. A central IoT strategy that furthers your organization's overarching goals and has both dedicated resources and a defined set of objectives will act as a rallying cry for your workforce and a road map for operational development [31].

A major issue is developing a solid vision and action plan. Leaders need to identify exactly what the company wants to attain with IoT. It is equally important that the same vision and action plan are mutually accepted by all business functions. The primary purpose of IoT implementation—to enable all physical and digital devices of the organisation to interact with each other—must be borne in mind. Therefore, if different IoT related choices or action plans are made without considering business functions, then the result maybe a failure. Companies need to have a clear vision about the use cases in which they will use IoT: changing the business model, increasing operational efficiency or enhancing product/service offerings [32].

B. Start Small and Focused

IoT can positively impact many parts of your organization, from product development to operations and maintenance to manufacturing. When starting out, the temptation is to be ambitious; so many organizations take on broad-based projects that quickly become unwieldy. With IoT, agility is important. It is better to start with smaller pilot programs that allow you to move and learn quickly as you test your technology, organize your data and develop expertise [31].

C. Have a C-Suite Champion

For IoT initiatives to succeed, they need C-suite support and a senior executive overseeing the day-to-day management. Whether it be, the CTO or another executive, such as the CIO or line-of-business manager, IoT projects, IoT projects should be led by individuals who can dictate strategy, allocate resources and hold teams accountable for progress [31].

D. Include External Partners on IoT Teams

Planning, implementing and executing an IoT project is not a job that will be started and completed by internal IT departments alone. To build a holistic, co-created IoT solution, include end-users, suppliers and customers on your IoT teams. This will allow you to tap expertise and capabilities not available in-house, help you understand what's possible and get a comprehensive view of what success looks like [31]

E. Sensor Compatibility

IoT sensors may vary from simple temperature sensors to complex sensors which extracts information from its surroundings. Design, development and successful implementation of wide range of smart sensors are often challenging task. There are still no standardization of the sensors and still its dependency on vendors, which sensors to be used and how the data to be fetched. Different types of Sensors: Active Sensors & Passive Sensors. Purpose and selection of sensors significantly impacted by many factors, including: Purpose (Temperature, Motion, Bio…etc.), Accuracy, Reliability, Range, Resolution, Level of Intelligence (dealing with noise and interference). The driving forces for using sensors in IoT today are new trends in technology that made sensors cheaper, smarter and smaller. Challenges facing IoT sensors: Power consumption, Security, Interoperability

F. Security & Data Governance

Companies are concerned, for good reason, that when they connect their physical environment to the cloud or data centers, it becomes at risk of being accessible to the outside world. The security of data is the biggest concern, as data encryption possibilities are negligible through the sensors on the devices. It can cause the big security threat and breach and may lead to losses may be in IP, Financial etc. Ownership and security of data transfers will be important concerns. The networks are also prone to hacking and this may lead to loss of crucial data to the unintended entities thereby losing competitive edge. A way to face this challenge is to review and strengthen your current IT security infrastructure. Then, carefully select your new hardware and software partners by understanding their security profile. Security should be a number one priority when implementing an IoT platform [33].

G. Connectivity Challenges

Majority of the IoT devices would be connected to a wireless network for its specific requirement and convenience. There are many wireless transmission technologies used IoT system like Wi-Fi, Bluetooth, LoRa WAN, SigFox, Zigbee etc. Each of this system has its own advantages and specifications. Implementation of multiple technology platforms is challenging for developers since information has to be shared between devices and application [34].

H. Delivering Value to The Customer

Defining the problem statement clearly is directly proportional to the success of an IoT implementation. But this is what most IoT service providers miss out. They should understand how these solutions can impact the efficiency, customer satisfaction and productivity in the long run. This entire cycle needs great retrospection and there cannot be a bigger IoT implementation challenge than this gap of understanding the customer problem statement. Therefore, it is crucial for IoT consultants to figure-out the key performance indicators to measure and improve through an IoT solution [35].

I. Lack of Data Protocol Standards

An ongoing struggle some companies endure is having a consistent global protocol for all of this extra data that is being collected [33]. Technology standards which include network protocols, communication protocols, and data-aggregation standards, are the sum of all activities of handling, processing and storing the data collected from the sensors [36]. This aggregation increases the value of data by increasing, the scale, scope, and frequency of data available for analysis. Standard for handling unstructured data: Structured data are stored in relational databases and queried through SQL for example. Unstructured data are stored in different types of NoSQL databases without a standard querying approach. Technical skills to leverage newer aggregation tools: Companies that are keen on leveraging big-data tools often face a shortage of talent to plan, execute, and maintain systems [37].

J. Trained Workforce

To implement IoT, companies will require skilled workforces. As such to work on IoT requires a combination of skill sets from software, hardware to networking. Skilled manpower in this field is quite less and requires more time to train the existing workforce to deploy them for the various functionalities in the IoT environment. If not trained to cope up with the present phase then staffs have to be ready for losing their jobs. It is difficult phase for the organisations to go through during their transition phase from the legacy systems to IoT enabled systems.

K. Lack of Infrastructure

As such only the developed countries have 24x7 internet connection with uninterrupted power supply; developing countries and especially in the rural areas where the

organisations have their concentration of their manufacturing plants it is difficulty to automate.

L. Data and Analytics Complexity

A common practice that is being seen within companies is that they are sending their sensor data directly to the cloud or data center. This is not always the best choice because it can create latency, drive costs, and can open up security risks [33]. Key factors driving adoption intelligent analytics within the IoT will be the - AI models; Growth in crowd sourcing and open- source analytics software; and the Real-time data processing and analysis. Challenges facing the adoptions of intelligent analytics within IoT when we look into it - Inaccurate analysis due to flaws in the data and/or model; Legacy systems' ability to analyse unstructured data; Legacy systems' ability to manage real- time data [38].

When dealing with large amounts of data, companies like Dell, recommend looking into Gateways, stating that this is a strong architecture choice to improve performance, reduce cost, and improve security [33].

M. Lack of Vendor Support

Many companies are in the IoT market and have many products to explore for the industry and customers to use it; but the issue is whether it supports their existing systems network, OS, software application is the question to be asked. When choosing a provider we need to consider Business stability of the company before adopting it, is the vendor follows IoT standards, whether they provide public or private cloud options for Hosting. Big data support is provided with some tools to support the existing system, Security is the key which need to be taken care off; check the vendor creditability, their policies and track record for security and privacy of user data.

In conclusion, the aforementioned challenges are major factors influencing the decision-making process for Enterprises & potential customers for a successful IoT implementation. As the IoT continues to proliferate, there are bound to be growing pains. Hardware will continue to advance and improve. Software will become more sophisticated. New standards, protocols and connectivity options will become more prevalent. But companies must remember to ensure that their new capabilities remain compatible with legacy systems and that existing processes account for innovation. With this type of approach, companies can more easily handle the speed of change that comes with the IoT and fully realize its benefits [39]. The IoT is an ecosystem of ever-increasing complexity; it's the next weave of innovation that will humanize every object in our life, which is the next level to automating every object in our life.

AI Challenges in Implementation

AI and ML will soon become an inherent part of everything we do in our daily lives. It's the "big data" of 2019, but very few people write about the challenges facing AI. This week a report by PwC found that artificial intelligence could add as much as $15.7 trillion – around same as the combined output of China and India – to the global economy by 2030.

Machines will not be taking over the world anytime soon. AI is pretty rudimentary right now, and the foreseeable future shows AI being a benefit that augments the ability for people to get more done. But now AI has entered the realm of fact: several studies predict that intelligent machines will have a big impact on how we work, how we move and even how wars are fought. Innovators and scientists around the world believe that now is the time to ensure that AI is beneficial above all for humans. And even if there are plausible reasons to be anxious about machines that could one day be more intelligent than we are, many scientists are ready to take up the challenge.

But the explosion of AI has also highlighted the fact that while machines will plug some of the holes human-led efforts leave behind, they will bring disruptive changes and gives rise to new problems that can challenge the economical, legal and ethical fabric of our societies.

But as with many emerging technologies, there are challenges, and AI presents no shortage of them. That might explain why, according to a new MIT-Boston Consulting Group survey, 85% of executives believe AI will change business, but only 20% of companies are using it in some way, and just 5% make extensive use of it.

A. Lack of Compute Power

AI – specifically the machine learning and deep learning techniques which show the most promise require a huge number of calculations to be made very quickly. This means they use a lot of processing power [40]. Volumes of data is continue to grow, and deep learning drives the automated creation of increasingly complex algorithms, the bottleneck will continue to slow progress. So we need to be ready with high end infrastructure to adapt to AI and to manage the huge volume of data. Cloud service has given us leverage but still the power of data retrieval from one location to another location mainly depends to the organisation capacity to cope with the speed to their system performance. We need to rethink about our strategy that will take time.

B. AI Human Challenges

The reason for this is not because there is a lack of technologies on the market. What the research uncovered was that the challenges come from a shortage of data science people, AI,ML, DL skills are still on the initial stage and people are not that well versed in it. Industry feels there are still not enough people to enable every business or organization to unleash their vision of machine-powered progress on the world. Just as in other areas of science and technology there is a skills shortage – simply not enough people who know how to operate machines which think and learn for themselves. From driving trucks to writing news and performing accounting tasks, AI algorithms are threatening middle class jobs like never before. Now in healthcare industry it is already replacing doctors by performing heart surgery. In future more jobs will be replaced by robots; this might create an issue with present professionals not showing much interest for implementation of AI in to their organisations.

C. Different Development Approach

Most development in a traditional systems environment follows the usual phases such as plan, analyse, design, build, test, and deploy. The AI environment is quite different. Most of the time, development is about identifying data sources and then gathering content, cleansing it and curating it. Such an approach requires different skills and mindsets, as well as different methodologies. In addition, AI-powered intellectual systems have to be trained in a particular domain [41]. In case we compare conventional (regular) and AI programming, the differences will look the following way in **Table I**:

TABLE I

Attribute	Conventional programming	AI programming
Knowledge	Precise	Imprecise
Solutions Sought	Optimal	Satisfactory
Definition of Solution Steps/Technique	Exact/Algorithmic	Inexact/Heuristic Search
Control/Data	Mixed	Separated
Processing	Numeric	Symbolic and Concepts
Viewpoint	Quantitative	Plausible and Logical Reasoning
Changes	Rare	Frequent

credit: Artificial Intelligence Methods and Applications

D. Building Trust and Ethical/Moral Challenges

Industry experts predict that by 2020 there will be a revolt by at least 10 per cent against the hold AI has taken over our lives. AI is referred as a black box in which people don't feel contented when they don't understand how the decision was made. Consider algorithms written for the bank to issue loans through ML, after analysing the application of an applicant the system finds the person is without job or any other reason it rejects the same. If there was a manager then he might have consider based on his previous job, experience etc. It is now becoming that we should challenge machines, because we might still know something that they don't.

Think about this capability getting into the wrong hands. What havoc could it wreck? How could it prove to be detrimental to society? The most popular are dating bots, where a computer program (chatbot) that uses AI strikes up conversations with dating site users, enabling the scammer to "talk" with multiple potential victims at once. These discussions are primarily aimed to trick and get users to send them money or download malware onto their PC. This may also be targeting victims for identity theft or other criminal activities. This is one of the many ethical challenges that AI might pose to society [42]

E. Legal Challenges

Legal challenges related to AI's application in the financial industry could be related to the consequences of erroneous algorithms and data governance. Erroneous algorithms, due to

the lack of appropriate data, can leave a big dent in the profits of an organization by making incorrect and perhaps detrimental predictions. Poor data governance can result in data breaches where customers' PII (personal identifiable information) that acts as a feedstock to an algorithm may get into the hands of hackers and can cause legal challenges for the organization [42].

Legislation, which has so far failed miserably to keep up with the speed of technological progress, is likely to play a part in this. Growing consumer awareness of the growing number of decisions made by machines, using our own personal data, has prompted lawmakers to tackle the problem from our (the consumer's) point-of-view. One example is the General Data Protection Regulation (GDPR), which will come into force across the EU next year (and affect anyone dealing with the private data of EU citizens, wherever they are in the world [40]. India should also follow some regulations to keep in track of IoT developments.

F. AI Myths

Not everything you hear about AI is true. Let's look at few myths related to AI and clear up some of the most common misconceptions about it [42]. See **Figure 3** for detail.

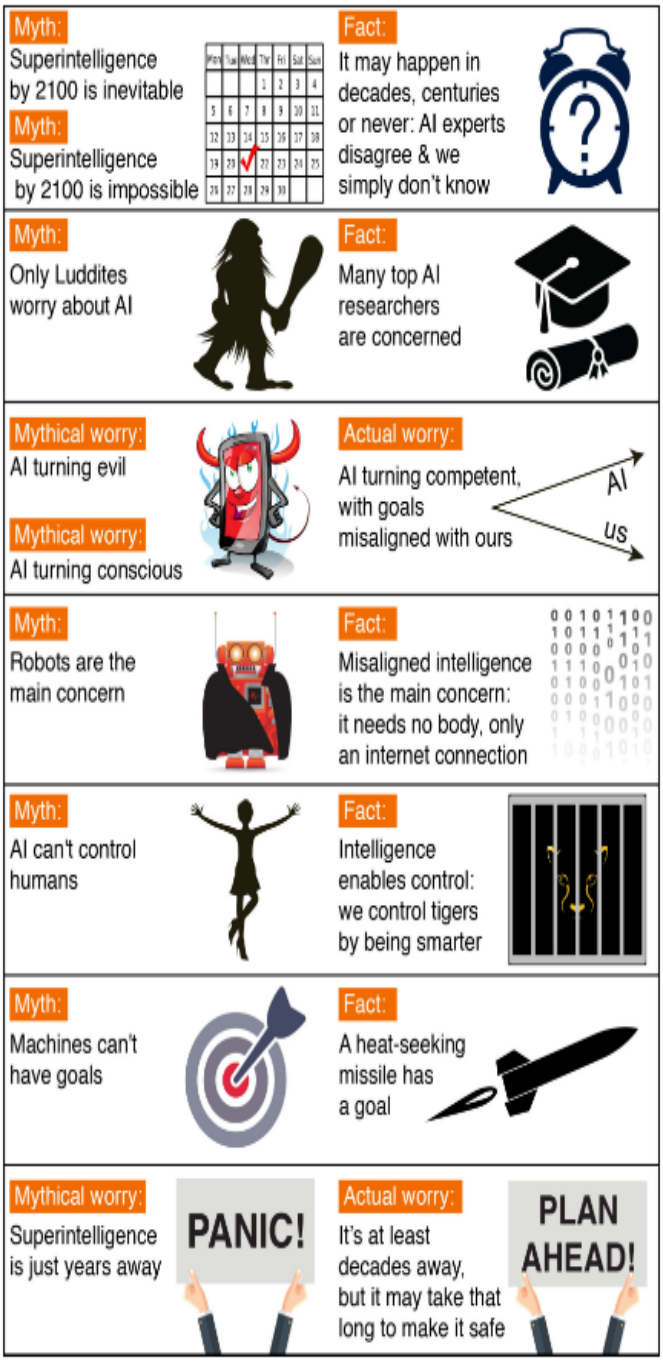

Fig. 3 Source DZone [42]

In conclusion AI, It is worth mentioning that Stephen Hawking, Elon Musk, Bill Gates, and many other big names in science and technology have recently expressed concerns about the risks posed by AI. Because AI has the potential and power to be more intelligent than any human, we have no sure way of predicting how it will behave. Unless companies developing and using AI technology regulate their information collection and sharing practices and take necessary steps to

anonymize and protect user data, they'll end up causing harm than good to users. The use and availability of the technology must also be revised and regulated in a way to prevent or minimize ill use.

IV. OPPORTUNITIES OF IOT & AI

After exploring all the challenges that are faced in IoT and AI implementation in section III, in this section we will highlight the key facts that will revolutionise the opportunities that are available for customers and the industry to know the future of IoT and AI. AI-powered IoT can do more than help avoid unplanned downtime. It can also help improve operational efficiency. This is due in part to the power of machine learning to generate fast and precise predictions and deep insights—and to AI technologies' ability to automate a growing variety of tasks.

The growth of the IoT market in recent years is hard to ignore. According to Forbes, the global IoT market will grow from $157 billion to $457 billion between the year 2016 and 2020. The major contributors to the investment include leading industries like manufacturing, logistics, and transportation. When it comes to sectors that dominate this investment, smart city initiatives and industrial IoT top the chart by owning more than 50 percent of the market. Gartner predicts that more than 65 percent of enterprises will adopt IoT products by the year 2020.

Martin defines AI as "machines learning as they go." In other words, these devices are learning from the consumers who use them. In 2018, we will see this learning start to transform businesses in a big way. "IoT is impacting everything, mainly because IoT now encompasses everything," Martin said. From virtual reality to augmented reality, AI and IoT have altered nearly everything that we see and touch. One particular trend within AI and IoT that will take precedence in 2018 is voice-based technologies. "Every business basically has to do [voice]," Martin said. "They don't have a choice." [43].

Our planet is being swept by a tsunami of data, which continues to surge as connected people and devices produce ever more. According to IDC's Digital Universe update, the number of connected devices is projected to expand from less than 20 billion today to 30 billion by 2020 to 80 billion by 2025, when more than 150,000 new devices will connect per minute. IDC also estimates that the amount of data created and copied annually will reach 180 Zettabytes (180 trillion gigabytes) in 2025, up from less than 10 Zettabytes in 2015 [44]. See the **Table II and Table III;** a consolidated write up by Chirag Thumar titled "What is the chemistry between IoT and AI? Trending 2018: What does the future hold for AI & IoT?" [45] Had given a clear cut idea about the latest trends in IoT and AI.

TABLE III

Latest trends in AI
AI will grow significantly in 2018. AI technologies which will be in news in the upcoming year are: 1. **Speech Recognition**. Instead of typing commands, you can directly ask questions and get answers from supercomputers. 2. **Natural Language Generation**. Using AI businesses can generate reports, prepare dashboards and use the business intelligence insights in customer service. 3. **Virtual Agents**. AI will be used to make Smart Home Managers in 2018. From identifying your presence in your home to locking doors and switching off air conditioners, AI assures more energy savings and enhances comfort. 4. **Machine Learning Platforms**. Artificial Intelligence is used to design, train and deploy applications; frame online training toolkits and provide algorithms. 5. **AI Compatible Hardware**. Artificial Intelligence (AI) cannot operate on standard hardware available in the market, hence special devices will be designed and architected to match the advanced needs of Artificial Intelligence.

TABLE IIIII

Latest trends in IoT
How will IoT bring change people's lives in 2018?

1. **Fast Growing Insurance Sector**. Insurance companies can now get real-time data with IoT. This will help them analyze risks, perform product segmentation, improve loss control and get more premium growth.
2. **Better Products**. With IoT in place, users will no longer have standalone devices but appliances which voice services like Siri and Cortana.
3. **Instant Health Care**. IoT has led to digital therapies, devices which can treat insomnia, depression, fertility and back pain.
4. **Transformation of Retail**. IoT means sensor-based analytics and a lot of data related to customer preferences. Using this the retail sector can identify prospective customers and sell their products better.

So what does the future hold for IoT? Researchers are quite certain IoT is going to grow at a faster rate in 2018. Some of the insights regarding IoT in the coming year are:

- *More than 24 billion electronic devices will be connected through IoT by 2020.*
- *Approximately $6 trillion will be spent on IoT in next few years.*
- *Edge analytics and cloud analytics will play a vital role while deciding IoT investments.*

How will AI bring change in people's lives in 2018? As per a Narrative Science Report, just 38% companies used AI in 2016 but the percentage is going to rise to 62% in 2018. AI is already making our lives better. In 2018, the trend will be to become digital rather than doing digital. Tech-savvy marketers will use ML-powered AI systems to become digital at rapid speed. Benefits of AI-driven marketing: transformation from traditional content marketing to machine-guided intelligent marketing; Marketing campaigns targeting micro markets will be more research oriented; Customer is the key so we need to be more customer-centric communication; Marketing outcome will be emphasis on intelligent tracking.

AI and IoT are shaping up to be a symbiotic pairing. AI doesn't just depend upon large data inputs; it thrives upon them. Given new data and scenarios, cognitive systems evolve and improve over time, inferring new knowledge without being explicitly programmed to do so. Got vast volumes of data from IoT? Feed it to AI systems and let them make sense of it. Six in ten early adopters report that AI is essential to tackling data challenges that conventional analytics cannot, and 53 percent say it will unlock the hidden value of their organization's dark data (data that hasn't conventionally been tapped or analysed). And they regard IoT and AI as a match made in tech heaven: Eighty-five percent of early adopters also say that IoT will play an important role in their AI initiatives within two years [46].

One of the major IoT trends is the integration with *Blockchain*, which will probably make its big entrance into the market in 2018. It will improve security transactions and the supply chain. According to IBM, "A blockchain is a highly secure way of recording transactions and contractual agreements." It's a simple way of recording transactions in a digital 'block', linked to records of other operations to form a chain. Companies can use a blockchain to record exchanges of money, store contractual agreements or even document the way goods move through a supply chain.

Fig. 4 PwC Top 10 AItech trends for 2018[47]

Industry Expert opinion on IoT [48]

Shift from Consumer to Industrial IoT: while consumer IoT's growth will slow, 2018 will be the year of industrial IoT (IIoT) by Alex Kubicek, CEO, Understory.

Strategising Disaster Management: It seems that regulation may be the only way such security gets implemented and hence a trend may be that governments and regulators from the US, EU and possibly China and/or Japan start recognizing the threats which consumer IoT devices pose and begin issuing regulations around their security. Mike Ahmadi, Global Director, IoT Security Solutions at DigiCert.

Steady but not Explosive Growth: However, instead of explosive growth, this year will be about steady growth. Currently, companies are struggling with fragmentation and security issues that will need to be addressed this year. Sanjay Malhotra, CTO and Co-Founder of Clearbridge Mobile.

Auto-ML for Data Security - 2018 will bring a heavy focus on new methods to securely share data using blockchain like technologies, now that data lakes are more common. Many industrial companies will begin to accept and trust machine learning model predictions and adapt their operations to prevent downtime based on model outputs. Dr. Jeff Jensen, Arundo Analytics CTO.

Going Beyond Reports to Actions: In the near future, IoT devices will not only give reports on their environment but provide technicians with insightful suggestions. Trent Guillory, Owner, Software Engineer at Sitesprout.

Emphasis on Risk and Compliance Requirements to Mitigate Risk: It won't be enough to stuff a WIFI chip and a battery in a sensor, toy or robot. Providers must consider the full implications of their product – not just how the hardware and software work – but how and what types of PII (Personally Identifiable Information)-related data are utilized. Jason Remillard, President of Data443 Risk Mitigation, Inc. Former VP of CISO Global Security Architecture and Engineering at Deutsche Bank.

IoT Edge Computing to Evolve: A day may come where we may have more computing power and more computers on the edge of the network than we will have in datacentres. Ian McClarty, President at phoenixNAP - Global IT Solutions.

Decentralization using IoT & Blockchain: Expect to see monolithic and centralized computing models broken into micro-services and jobs distributed to decentralized machines and devices. Scott Amyx, global thought leader and venture capitalist, author of Strive: How Doing the Things Most Uncomfortable Leads to Success @AmyxIoT.

Creation of a Unified Framework for Integration: Craig believes blockchain could help speed up adoption by enabling the development of apps that have high-performance thresholds, supporting the data-intensive processing required. Craig Sproule, CEO of Crowd Machine.

IoT as a Data Collection Device: The end game of IoT is intelligent, self-learning systems.- Riaz Merchant, Founder and CEO Thriftly.io, a tool that enables applications written in any software language to quickly transform existing functions into globally accessible web APIs.

Smart Cities to Become Mainstream: In 2018, we'll see forward-thinking cities invest in innovative data exchanges that allow for the combination and access of data between citizens, public institutions, and private organizations. Kurt Uhlir, serial entrepreneur, patented inventor, and operator.

Blockchain as an Effective Backend: If we're going to welcome dozens of smart devices in our homes, we need to solve for the trust issue or consumers stand to lose more than just their identities. The blockchain is emerging as a solution to all of these issues. It's naturally decentralized architecture fixes the security issue of retaining massive amounts of data in one place, can scale easily up or down and is therefore much more cost effective for handling IoT deployments. Critically, it allows for a token economy that creates a marketplace where users can sell their data to providers, or choose not to and keep it private. Raullen Chai, co-founder of blockchain company IoTeX and Ph.D. cryptographer.

V. CONCLUSIONS

AI and IoT is like brothers if put together we can achieve many things in future. Only thing is we need to take preventive measures in knowing the security and legal aspects of it and improve our skills, infrastructure. If we want to achieve financial benefits through IoT is not easy. The lack of tangible objectives is disturbing. The advancement of digitization and IoT places new prerequisites on both buyers and sellers. Organizations are not clear what areas will change with the implementation of an IoT strategy. In general, clearly defined, tangible intermediary objectives are missing. When we look into industrial companies produce a massive amount of data on a daily basis; were mostly by and large, companies fail to thoroughly collect, store, analyze and use such data to improve process efficiency or meet other goals.

Moreover, most of the vendors are unable to establish, in tangible terms, to the client how to sensibly create constructive impact on business operations with IoT solutions. Just suggesting cloud-based IoT platform is not good enough in long run. According to Gartner, Finland is headed toward a trap where discussion about IoT revolves around technical terminology instead of business goals. Innovative ideas need to be looked into it by the clients and they should have the courage to hold change. On the contrary, vendors need to get better their skills in describing, in more tangible terms, what companies can realize through the use of IoT, and be willing to help identify business opportunities and develop realistic plans.

There are benefits and dark sides to every disruptive technology, and AI is no exception to the rule. What is important is that we identify the challenges that lie before us and acknowledge our responsibility to make sure that we can take full advantage of the benefits while minimizing the tradeoffs. The robots are coming. Let's make sure they come in peace.

According to Gartner, at present, there are only 10 percent enterprise IoT projects that include an AI component. It predicts that by 2022, this figure will rise to 80 percentage. Almost every industry vertical's operations have been redefined by the combination of IoT and AI. IDC predicts that by 2019, IoT deployed data without AI supporting its efforts will have a limited value. Enabling better offerings,

productivity, and operations, AI will only boost the value created by IoT deployments thereby providing a competitive edge to companies[7][44].

AI and IoT are two different trends which will be used together in 2018 to get the best results in business and daily life. While IoT will create a large amount of data, AI will help you track and get an in-depth analysis of the data. Get ready to use these two technologies and get more from your life and business in 2018.

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