Artificial Intelligence and Internet of Things (AIoT): Opportunities and Challenges

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Abstract-
The Internet of Things, or IoT, refers to the billions of physical devices round the world that are connected to the web, all assembling and sharing data, that makes new applications and services. These services lead to rising our class of lifetime. On the other side, Artificial Intelligence (AI) is applicable to various areas of science. It's goal is to know techniques that need associate degree of intelligent action and solve advanced issues. Integration of IoT with AI can produce a strong technology that may solve several of IoT issues that relate to the massive quantity of knowledge developed by different IoT devices. Huge amount of IoT data can be analysed efficiently with the huge analysis capabilities of AI to extract meaningful information. In addition, AI will facilitate IoT devices to communicate with humans and other objects showing intelligence and create independent conclusions. This paper offers a summary of the combination of the IoT with AI by emphasising the integration opportunities and challenges of AI in various IoT applications. In conclusion the integration of AI with IoT will produce a strong technology that can help companies to avoid unintentional downtime, increase operating efficiency, and enable new IoT applications and services.

Keywords: Internet of Things (IoT), Artificial Intelligence (AI), Artificial Internet of Things (AIoT), Integration of AI and IoT.

I. Introduction

Internet of Things (IoT) is the connection of various computing devices via the Internet, embedded in everyday objects, enabling them to send and receive data. It has the capability to connect and communicate worldwide virtual and physical objects through either wired or wireless networks. The consecutive step is to combine the Artificial Intelligence (AI) with the IoT to get what is referred as "Artificial Internet of Things"[3].

Use of AI is rapidly increasing by humans' in day-to-day life activities. The idea of AI is applicable to various areas of science. It is playing an important role in the research of management science and operational research areas. Basically Intelligence is defined as the ability to collect information to solve complex problems, while AI is the study and developments of intelligent machines and software that can reason, learn, gather knowledge, communicate, manipulate and perceive the objects. Currently, intelligent machines replace humans in many areas such as welding and soldering of an assembly line, food preparation, and product packaging [3].

By integration of AI and IoT we get a new set of product functions and capabilities. We have seen very recently advances science and technologies, particularly in machine learning; organizations are adopting larger and more comprehensive analytical strategies. Integration of AI and IoT is becoming day to day more important for achievement in today's fast-growing digital ecosystem. So every business must have to grow rapidly in accordance with the development of these technologies, and they must have to recognize how they will grow together by integrating AI and IoT. Businesses all over the world are rapidly updating or proceeding the AI and IoT to make new networks of products and services that are having new business models and business opportunity.

In this paper overview of the IoT and AI is introduced. In addition, the paper involves discussion on benefits of IoT, AI and integration of IoT with AI. At the end, challenges of IoT, AI and Integration of IoT with AI are discussed.

II. Internet of Things (IoT)

IoT is defined as a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual 'things' have identities, physical attributes, and virtual personalities using intelligent interfaces for seamlessly integrating into the information network [6]. In the IoT, probably 'things' are active participants for business, information and social activities. Things are able to connect and communicate among themselves with the surrounding by exchanging data and information collected or sensed from other devices. Interfaces in the form of variety of services provides exchanges with these 'smart things' over the net, query and alter their state and any information related to them, allowing for security and privacy issues. IoT allows things to communicate and coordinate judgements for various kinds of applications including healthcare, home automation, disaster recovery, and business automation.

III. Artificial Intelligence (AI)

Artificial intelligence (AI) denotes the replication of human brainpower in machines that are set to think and act like humans. This technology can also be applicable to any machine that shows qualities related to a human brain such as learning and problem-solving.
Artificial intelligence is depend on the fact that human intelligence may be defined as a machine can easily impersonate it and implement tasks, ranging from the simpler to that those that are even more complex. The aims of artificial intelligence involves learning, reasoning, and perception.

IV. Integration of IoT and AI

Here we will discuss benefits of AI, IoT and integration of IoT and AI.

You can make your business smarter on combining AI with IoT. AI is the engine or Brain that will analyse the IoT data and make some decisions on that collected data. IoT has the responsibility to collect data and AI has a responsibility to process the data in direction to find meaning of it. By combining AI and IoT we have various systems working together in personal devices like fitness trackers and Google Home, Amazon's Alexa, Apple's Siri and Google Assistant[3].

According to the source at 2020, 50 million devices are going to connect to the internet. Artificial Intelligence plays the important part in collecting huge amount of data and provides analysis required to find meaning and values from data. When we provide a haystack of data into AI from IoT it assesses and analyses the data to remember patterns and similarities that lead to making more informed decisions by humans or machines.

Benefits of IoT
1. Smart IoT: IoT have many applications like machine learning based on AI, IoT show smartness when an unpredicted query or unusual condition detected by a device, IoT is required to decide whether to react on that situation or not. To solve such query needs intelligent learning and decision-making capability. Such type of methodology used by Google which uses deep learning to predict the meaning of an unpredicted query then it replies.
2. Healthcare: IoT have the applications in the healthcare sector and improve the patient care. Health-oriented smart systems inspect the activities of a patient such as heart rate, temperature, weight, etc. AI can analyse the health problem from health devices and give the review, and if needed it alerts the patience for doctors' advice.

Benefits of AI
1. Reduction of Error: Artificial Intelligence also reduces error and gives possibility of getting accuracy in less number of attempts. This type of process is useful in many studies such as exploration of space.

2. Daily Application: In daily applications when we clicks a picture and when we are placing our photographs on the social media sites, the Artificial Intelligence algorithm works and recognizes and detects the person's face and tags the persons.

3. Difficult Exploration: As we know robots can perform more complex task in easy manner and the can do more difficult and hard work with better duties is all because of programming of the robots.

4. Digital Assistants: In Artificial Intelligence, there is no emotional side so there is no distraction at all, robots think logically and take right decisions of problem.

5. Medical Applications: Artificial Intelligence also works in medical system, AI have wide applications for medical sector. With the help of machine based on Artificial Intelligence, Doctors can check the patients and their health risks. It provides the information them about the side effects of various medicines.

6. Time Utilization: Breaks and refreshments are not required to machines. Machines are set for many extensive hours and can constantly complete tasks without getting bored or unfocussed, they can perform smooth better task in less time.

7. Repetitive Jobs: Actually we are interacting with Artificial Intelligence, while we are playing a computer games. When we are playing the game, our opponent is the computer. Machine technology intellects plan the game movements in regards to our movements.

Benefits of Integration of AI and IoT

1. Aircraft: Aircraft comprises of many sensors that constantly monitor the rank of various systems and sub-systems to detect current errors and forecast future faults and their intensity of severity. When we apply AI on these vast collected data, will result in greater safety and lower aircraft delays or downtime.

2. Connected and Remote Operations: Due to smart and connected warehouse operations, workforces will easily get the warehouse to pick goods off the shelves to fulfil an order. Order fulfilment is faster, safer, and more efficient.

3. Smart buildings: Smart sensors increase the safety of buildings by reducing the risks such as fire and flooding, also decrease the operational cost and improve energy efficiency by applying AI capabilities.

4. Healthcare: Various bodily activities are monitored by smart sensors to increase safety and maintain the health. People's activities are monitored by some devices to alter their activities to improve well-being. Overall health is monitored by medical sensors.

5. Maintenance: Large manufacturing and industrial companies are allowing their machinery with sensors to have analytical maintenance and separately recognize faults that may occur in the future.

6. Cognitive systems: IoT with machine learning be able to be very important in determining our surroundings regarding to our own likings. It will produce new ways that charm to the user's choice of style, making enhanced menus for every individual, and mechanically adjusting to native materials.

V. Challenges of IoT

1. Scalability

    Internet of things is very vast technology, and it communicates with all networks. But some of the applications demand the technology with some small-scale environments, so scalability is the challenge in IoT, IoT must have to handle with all large scale as well as small-scale environments.

2. Interoperability

    Since the internet always handles the results according to our need or situation. Internet of Thing is subjected to internet connection subjected to objects, so objects should also be standardized along the orthodox internet field.

3. Discovery

    In today's environment every client needs active surroundings with appropriate services for everything should be automatically identified which requires some intelligence functionality.

4. Software Complexity

    Software systems require large resources, but in IoT the software systems in smart objects should have functions with minimum resources.
5. Data Interpretation

    In real-world applications, we have to provide the users of smart things. Interpreted data should have some accurate sensing capability.

Fig. Challenges of IoT

VI. Challenges of AI

1. Building Trust

    AI is the new technology which is growing day by day rapidly. People who are unaware of this technology lie about this technology that it finds to difficult and very complex to apply. Artificial Intelligence has to face trust of Humans with various issues.
2. AI Human Interface

    The challenge is that many people unaware of data science skills so maximum peoples do not get the output of Artificial Intelligence. In the industrial area there is also a scarcity of innovative skills employees related to this technology, so venders need to train their employees, experts to be able to deal with the advantages of Artificial Intelligence.
3. Investment

    As Artificial Intelligence is very vast so many businesses and organization are not ready to invest in it, because it reserves to implement it are high.
4. Software Malfunction

    As we all know no humans are perfect as well as no technology are perfect. If any technologies hardware or software crashes so it is difficult to find what is wrong in it.
5. AI Won't Replace Humans

    AI increases the productivity of all tasks.AI can manage its way into our daily lives, every task, every process and even every minute can be accomplished by AI, it can be true to a certain level but, not every the task can be accomplished by AI.
6. Higher Expectations

    With AI peoples have lots of expectations it is a serious issue. Many peoples don't know what is AI and instead of that they have higher expectations, and few of them are not possible.
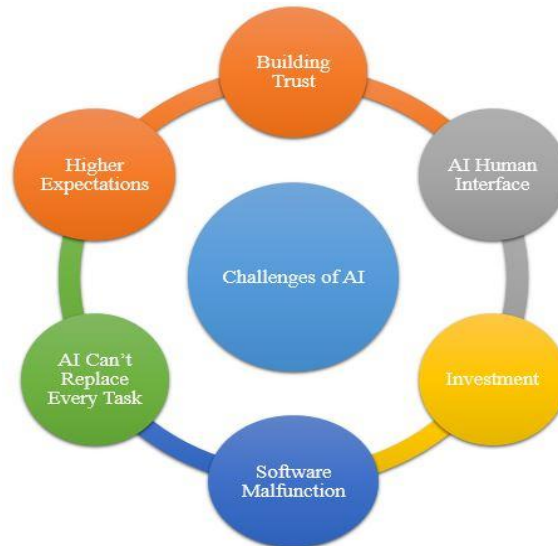
Fig. Challenges of AI

VII. Challenges in AI and IoT

IOT and AI both have challenges in their own, when we merge this both technologies challenges become more complex, some of the challenges are the following:

1. Security
   Since AI and IoT are collecting vital and delicate data from its users or clients, it is very essential to make sure that the data is protected and in safe hands. However we don't know when hackers hack our important and sensitive data, that's why security is the major issue of any technology.

2. Compatibility and Complexity
   As we know, IoT is the combination of many devices that have many diverse technologies, this may grounds many complications after combining this all devices in one. There are huge numbers of different devices led to more difficult ecosystems.

3. Artificial Stupidity
   Artificial stupidity means incapability of an AI program to perfectly do basic tasks. AI systems and the algorithms of AI uses need to be evolved to recognize and interpret data so more correct and practical results can be made.

4. Lack of Confidence
   As we know IoT is latest emerging technology that's why both consumers and businesses have a serious concern about the security and have a little confidence about to protect IoT devices and on integrity of the data created.

5. Cloud Attacks
   There is no surprise that the rapid growth of cloud computing technologies has attracted unwanted attention from harmful viruses. IoT needed large amount of data which is stored in cloud, because of these the risk of data security increases.

6. Technology
   It is the most important problem which is having tough competition to all other technologies so giving competition to every technology is not an easy task.
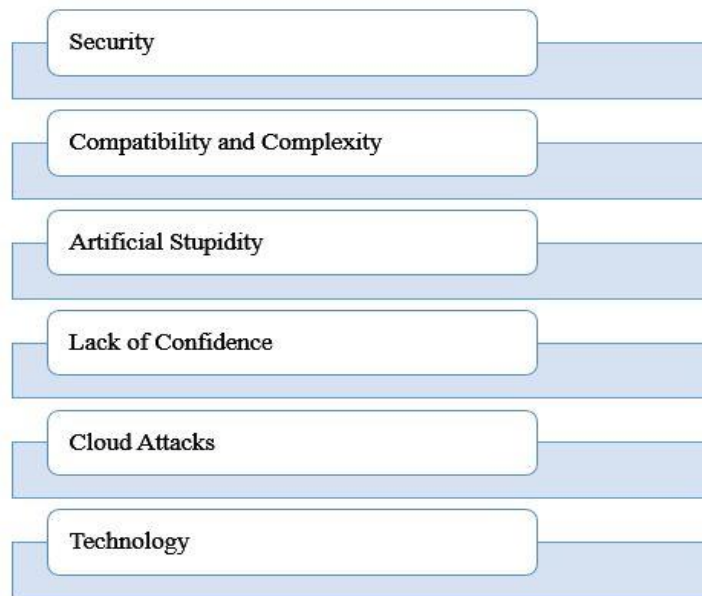
Fig. Challenges of AI and IoT

VIII. Conclusion

Internet of Things (IoT) is a technical and logical technology used for future computing and communication. We can connect and communicate billions of wired and wireless devices with IoT for sharing their data. Due to large amount of data produced by IoT objects, traditional analysis approaches are not able to cope up with IoT systems. By integrating AI and IoT this difficulty can be resolved. AI offers new resolutions to analyse and extract meaningful information and provides tools for decision systems. A large amount of IoT data and analysis power of AI have many benefits of IoT data, which in turn will produce various benefits for both IoT users and companies. In this paper, we have depicted an overview of the integration of IoT and AI. In this paper benefits of IoT, AI and integration of IoT and AI is discussed. At the end, challenges of IoT, AI and Integration of IoT with AI are discussed.

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