IoT: A Mainstay Towards Intelligent Computing

Shobhita Singh[a]

[a] Assistant Professor, Department of Computer Applications, Government College Of Commerce And Business Administration, Sector 50, Chandigarh.
[a] shobhitasingh2805@gmail.com

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Abstract: After the .com boom, the next big thing in the 21st century is the "Internet of Things". The "Internet of Things" is exploding and infusing intelligence globally. From infinitesimal chips to mammoth machineries, billions of smart gadgets communicate with each other with the aid of wireless devices. The day is not far when every physical item will no longer remain disconnected from the virtual world. Presently, your coffee kettle starts automatically when you wake up in the morning and lights go off when you leave home for your office where all devices are controlled/activated through your voice. Dream becomes reality, when the whole world will be running automatically and virtually with the initiation of a command. Connecting 'Internet of Things' with 'Artificial Intelligence', high-tech and scientific technologies will transform the world into a completely digital world. These two powerful pillars will build super-intelligent e-devices that are ready for new challenges. It will be made possible by evolving IP strategies, Radio Frequency Identification (RFID), embedded sensors, actuators that are intelligently connected in machines and other physical objects. This paper aims to provide an insight into how the third wave of information technology i.e. Internet of Things (IoT) will interconnect the physical world using artificial intelligence. The paper will further discuss the building blocks of the IoT and the perspective areas where it can be implemented smartly.
Keywords: Internet of Things, IoT, Artificial intelligence, RFID, Sensors, Physical objects.

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1. Introduction

The First Wave was tied in with establishment of the Internet. The Second Wave, which has been tied in with building applications and providing internet related services. Now, the third wave has begun i.e. "Internet of Things". It is one of the vital platforms in the technological revolution that will quickly get omnipresent, incorporated into our regular daily existence, almost invisibly. A new digital transformation is being initiated wherein several e-devices, apps and services will be widely used to communicate and interact intelligently with the physical world. The major role in "Internet of Things" will be played by the word "Smart". Smart things will further make our realm smarter. The new face of interaction between human and smart machines will unlock an endless array of opportunities virtually leading us into a world of smart cities, smart homes, connected automobiles, connected wearables and healthcare i.e., a fully connected e-life [1]. This paradigm creates smart interfaces and opportunities that will build a strong foundation for business prospects. Industrial manufacturing and electronic companies have already entered to the race. Products ranging from embedded sensors, supervising machines in the factory to smart appliances via smartphone applications are being used. For instance, an intelligent personal assistant of Apple Inc.'s available on all Apple products called "Siri" and S Voice is Samsung's voice control app that helps you get things done via voice commands [2]. Artificial Intelligence will offer many more promising applications and services with the IoT that will dramatically change the way people live [3]. For instance, self-driving cars from Google and Tesla will introduce smart features to driving [4]. Further, if you are downloading a favourite song from some website then that website will also determine what other songs you may love downloading. Your doctor will receive a notification when you have some health problem. Thus, the Internet of Things (IoT) will empower numerous amenities and will boost the nation's economy.

2. Internet of Things: The Digital Battlefront Moving Beyond the Comfort Zone

IoT refers to an intelligent connection of networks that is programmed with powerful microchips equipped with RFID or similar technologies. It aims at connecting everyday physical objects, devices, people, processes, data, from industrial machines to wearable devices, and many more across the globe that are controlled remotely. Internet of Things is the future of technology that will offer endless opportunities in every field and build a more secured connected world [5].

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3. Artificial Intelligence: Building Intelligent Machines, Think Humanly

The authentic dream of AI is to inculcate artefacts with intelligence and a huge range of human skills. Clickstream analytics takes applications to the next level with the assistance of artificial intelligence. It is a new roadmap that starts off with the go-vertical want for businesses to develop and enhance their digital presences. Whether it's banking, retail, healthcare, e-trade, customer support, or dozens of other industries, there may be a shared desire to gain actionable insights from facts at the same speeds as the customers call for from their web and mobile channels. With clickstream analytics, companies can subsequently convey an omnichannel know-how for their clients in actual time. It's a quicker, more responsive, and flexable solution for every one [6].

4. Building Blocks of IoT: Technologies on the Move

Millions of IoT products are already in the race to provide the best services to the consumers. Following are the individual building blocks of an IoT solution:

➢ Thing: A microcontroller or microprocessor-based device that transmits and receives information over a network.
➢ Applications: The software element capable to do the task in a real-time environment.
➢ Network: A network of networks that can handle the huge amount of data in the form of wireless communications such as 3G, 4G and upcoming 5G.
➢ Gateway: A set of protocols and communication standards that will enable functionality between the sensors and networks.
➢ Physical objects and devices: Physical objects that are equipped with sensors and actuators.
➢ Cloud server: Set of integrated services that will provide real-time processing of data, storage, security, apps for various tasks [7].

5. The Rise of Connected Living

Internet of Things will be widely accepted in the coming years from smart connected homes to wearables and to healthcare too. Today, IoT is slowly becoming part of our daily life. Internet of Things applications will not only enhance our standard of living by providing more luxuries, but they will also give more openings to facilitate control of our busy life. Following are the Internet of Things application areas that have the prospective for exponential growth.

➢ Smart Decisions: When a tool detects unusual situations because of some errors, it wants to understand how to and when to react and whether it wants human help. Obviously smar knowledge of and selection-making competencies are required to make such wise selections. Google makes use of this approach within the Rank Brain algorithm. Once the answer is made, it responds in actual-time with no human intervention.
➢ Smart Cities: Smart city is a dream for every citizen. An intelligent city of tomorrow's vision that promotes Information and Communication Technologies (ICTs). It envisages a city where every citizen will be engaged to make better and smart use of resources. It includes a sustainable environment, adequate water & electricity supply, effectual urban mobility and public transport, good governance and many more facilities with the optimum use of IoT.
➢ Smart Homes: Smart homes offer possibilities for energy management and cost-saving. Smart homes have the potential to provide a safe and secure environment for everyone for a better quality of living. Today, hundreds of products are available in the market that users can control with their commands to make their lives more connected than ever.
➢ Smart Meters. Smart meters use specifically designed sensors, included into smart grids to record and add electric and background records. Here Artificial Intelligence techniques are implemented to the grid to integrate privacy and are utilized in every strength consumption unit. They have the bidirectional flow of energy and are also equipped with actual-time sensors which records relevant elements consisting of frequencies utilized by distinctive devices and appliances.
➢ Wearables: At present, smartwatches have flooded the market and are quite popular with people of all age and groups. Companies like Apple, Samsung, LG, Fitbit and many more are in the race to provide the best features for their users. They have turned their wrists into an e-way by enabling text messaging, phone calls, weather information and almost everything on a single tap. These watches have revolutionized the fitness world by giving people more data about their health.
➢ Smart Transportation: Smart Transportation is the future advance applications that will aim to provide services for intelligent transportation and logistics systems. The IoT can save lives, diminish traffic, and reduce vehicle impact on the environment by smarter and wiser use of transport networks.
➢ Smart Highway: Intelligent highways and smart lighting will be the future of roads where sensors, robots and self-driven cars will work together to identify faults and carry out maintenance of roads, lights and bridges etc.

➢ Smart Grids: A new gateway that manages electricity demand in a more sustainable, reliable and economic manner. This technology will provide better control over energy cost and will deliver consistent energy supply for consumers.

➢ Retail Industry: A major driving force of the Industrial Revolution is the Retail Industry. This technology will improve store operations in terms of inventory management, reduction of theft, enabling customers with personalized mobile shopping apps. It will provide effective solutions to facilities like tracking goods with RIFD tags etc.

➢ Smart Farming: An innovative farming technique that is adopted widely across the world in the agricultural business. By using sensors technology, farmers can get the latest updates about rainfall, crop yields, pest infestation, soil nutrition. Farmers can also apply precise farming techniques to maximize yields and minimize waste.

➢ E-Health: E-Health is a new approach for using health resources with the power of information technology. Advancement in sensors and connectivity technology has made it more convenient to access patient history and to analyze all that was not accessible before. Doctors and medical staff can easily access the real-time locations of their patients with the aid of tracking devices. Medical apparatus can also be tagged with IoT.

➢ Security: Protecting and securing the network is the main challenge when a wide range of devices are involved. Data movement between IoT devices, back-end systems and applications are the attractive targets for hackers and cybercriminals. IoT is progressing towards providing security but it needs to be strengthened more in the coming times [8][9] [10].

6. IoT and AI: To make a Magical world for Smart Things

AI and IoT are the two sides of the same coin which together form a new realm for the upcoming generations. This combination i.e. AIoT (Artificial Intelligence of Things) will be considred as the Superpower of Innovations. The association of these technologies will enable the next level of automation and productivity in every field. The Internet of Things has delivered magic and technology fiction to fruition from real world to movies. With every year that passes, films and webseries are coming up with numerous interpretations of new rising technology like artificial intelligence, machine learning and robotics. These AI-based movies and webseries are exciting and turn out to be more magical and enlightening for every generation and also target the market. Few days back, I came across some webseries and movies like Unpaused, Humans, Intelligence and many more streaming on different OTT platforms which superbly describes a future world driven by the forces such as data, technology, numbers, deep neural network (DNN), and artificial intelligence.

## 7. Future of AI: Less Artifical More Intelligent

IoT is not a distant dream but a reality. According to the IDC, by 2021 with 5G the widespread use of IoT cases will drive 70% of G2000 companies to spend US $1.2 billion on telecommunications management solutions. Although 5G is in its infancy, its technological capabilities offer many reasons for rejoicing. In addition to addressing connectivity issues and providing increased network integration, 5G will allow technology expertise in network cutting, edge computing, AI, and machine learning processes to be delivered to the end user. Edge computing will take place due to ultra-low latency via Multi-Access Edge Compute (MEC), which delivers load processing at the edges. This will continue to make huge profits in business. Steve Szabo, Vice President, wireless, IoT, and partner for telecommunications provider Verizon Business, says 5G also brings high performance. "We've seen experiments with vendors up to 4Gbps at high speeds, which can give you a sense of what 5G knows," said Szabo. In future, IoT is set to control the telecom sector. Based on market analysis of labor company TeamLease Digital, the demand for skills in the Indian telecommunications sector is expected to rise by 18-20% by 2021 due to widespread adoption of internet services, demand for better communication networks, and the rollout of 5G technology.[11]

A famous IT company HP, conducted a survey in April, 2019 to predict the rise of devices linked online through the years and the results obtained are very suprising. According to survey, by the end of 2025, almost 1.0 trillion devices will be connected online (table 1). These gadgets will bridge the gap between physical and virtual world which will enhance the quality and productiveness of lifestyles, society and industries.

Table 1: Number of devices connected and to be connected online [14]

YEAR	NUMBER OF CONNECTED DEVICES
1990	0.3 million
1999	90.0 million
2010	5.0 billion
2013	9.0 billion
2025	1.0 trillion

In another study as shown in figure 1 conducted in 2012 by KRC Reserach in UK, US, Japan and Germany, those who accessed IoT revealed which devices customers could use the most in the coming years. Smart appliances such as a thermostat, a smart refrigerator to name a few are very popular with customers and seem to change the way we accomplish our routine jobs.
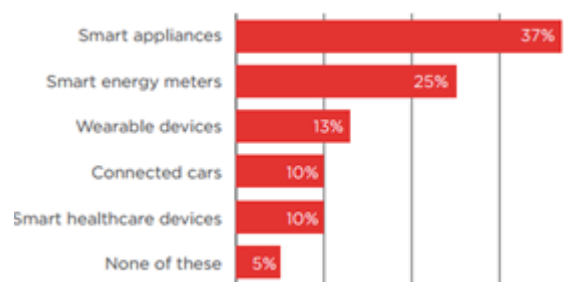
Figure 2: Which connected device are you most likely to use in the next five years [15]

8. Challenges of IoT and AI:

The Future of the Internet of Things and Artificial Intelligence is amazing. Experts from the different fields and excited consumers have already declared the IoT as the Next Revolution for smart things or the Next Internet. It will be the enabled future where large organizations such as governments, industries, and consumers interact smartly with the physical world. In the coming years, IoT will be the greenfield market that will open new prospects for business models, solutions and will be more advanced than it is today. As technology advances, the challenges will be multidimensional. IoT and AI have already turned into a serious security concern across the world. When we combine the digital and the physical world then we require utmost security standards to prevent malware, hacking and accidental attacks. A more holistic set of governance frameworks is required for AI and IoT systems to build strong, secure, resilient networks that will empower consumers and businesses and shape the future of the digital economy.

9 Conclusion

Today in the times of shrinking global distances and fast-paced lives, we need the things that are globally connected and can make intelligent decisions. The Internet of Things has the potential to transform the world with the power of Artificial Intelligence. These technologies promise to deliver breakthrough services in the internet environment and open new doors of developments between people and things. This revolution will enable utilization of resources appropriately that make the world more connected and "Smart" so as to take automated intelligent systems and decisions.

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