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# IoT: Trends, Challenges, & Future scope

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***Abstract:-*** **IoT (Internet of Things) one of the most exciting trends and innovation in the recent history of technological advancement. IoT can be defined as a network of physical objects, devices that contain embedded technology (like intelligent sensors, controllers etc.) which can communicate, sense, or interact with internal or external systems. Various IoT based applications have been explored and the possible approach for enhancing the use of this technology has been discussed in this paper. Future directions and suggestions for effectively and efficiently improving the IoT based application areas have been touched upon. This paper will provide a better insight for anyone who wishes to carry out research in the field of IoT. Here we have tried to provide a holistic perspective on IoT and IoT based applications, application areas, research challenges in IoT, trends and future possibilities in IoT.In this paper, we have studied the most imperative parts of the IoT with accentuation on what is being done and what are the issues that require further research. We believe that, the given interest shown by industries in the IoT applications, in the next years addressing such issues will be a powerful driving factor for networking and communication research in both industrial and academic laboratories.**

***Keywords*****: Intelligent sensors, Controllers, Innovation.**

## I. INTRODUCTION

The Internet of Things (IoT) paradigm refers to the network of physical objects or "things" embedded with electronics, software, sensors, and connectivity to enable objects to exchange data with servers, centralized systems, and/or other connected devices based on a variety of communication infrastructures. IoT makes it possible to sense and control objects creating opportunities for more direct integration between the physical world and computer-based systems. When IoT is augmented with sensors and actuators.The IoT is comprised of smart machines interacting and communicating with other machines, objects, environments and infrastructures. Now a day's every persons are connected with each other using lots of communication way. Where most popular communication way is internet so in another word we can say internet which connect peoples. Now a day's everywhere like at railway station, shopping malls, in colleges an information desk is mandatory that provides information about the train schedule, promotional offers and important notice immediately. From educational organization perspective, the problem is that it requires some staff that is dedicated to that purpose and that must have up to date information about the institute and the recent happenings in the institute.

### a) Enabling technologies for the IOT:-

There are three types of technologies that enable the internet of things,

i. Near-field communication and Radio Frequency Identification (RFID) - In the 2000s, RFID was the dominant technology. After few years, NFC became dominant (NFC). NFC has become common in smart phones during the early 2010s, with uses such as reading NFC tags or for access to public transportation.

ii. Quick response codes and Optical tags - This is used for low cost tagging. Phone cameras decode QR code using image-processing techniques. In reality QR advertisement campaigns gives less aurnout as users need to have another application to read QR codes.

iii. Bluetooth and low energy - This is one of the latest techniques. All newly releasing smart phones have BLE hardware in them. Tags based on BLE can signal their presence at a power budget that enables them to operate for up to one year on a lithium coin cell battery.

b) Operational technology (OT) is combination of hardware and software that detects or causes a change through the direct monitoring and/or control of physical devices, processes and events in the enterprise. It comprises the devices, sensors and software necessary to control and monitor plant and equipment etc.

c) Information Technology (IT), on the other hand, combines all necessary technologies for information

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processing. Information Technology is the application of computers to store, retrieve, transmit and manipulate data, often in the context of a business or other enterprise. IT is considered a subset of information and communications technology (ICT).In conventional approaches we have computers and Internet being dependent on human beings for information. Nearly majority of data available across the globe on Internet were first captured, generated by humans either by typing, or applying an external trigger event, or by other various modes of creating data. The issues associated with it are that people have limited time, are bound to commit errors while generating data i.e. capturing data will have accuracy issues. With the recent advances in technologies Internet is becoming more widely available, the cost sky-rocketing. This factors have made possibilities for IoT based applications reach new heights whereby creating wider scope for further advances. With this there has been a wide scope of increase in applications of IoT ranging from healthcare, telecom, oil field maintenance, transportation etc... There are basically few key focus areas that one has to consider while deciding upon IoT based applications:

d) Connect and Scale with Efficiency: Connect any asset, thing that's important and useful in your day to day applications and it can range from robotics applications to low-power devices, across diversified platforms or operating system. Easily scale from a few devices to a few million.

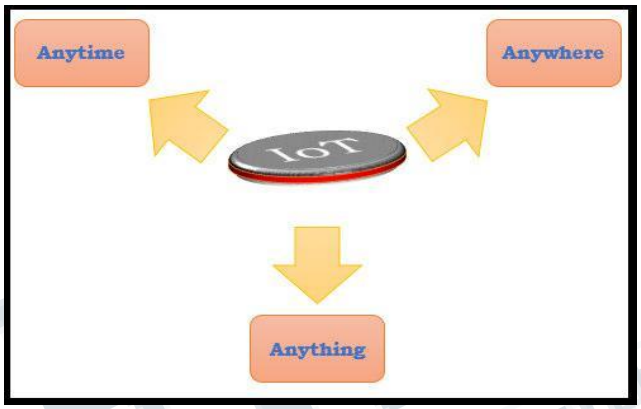
e) Analyze and act on untapped data: Data and alerts from all of your connected assets spread around the globe. Spot issues related to managing wide range of available data before they become operational problems. Utilize the available data for relevant application areas. Take advantage of advanced analytics and machine learning to increase reliability and uptime of your processes. Decrease costly outages and expensive repairs with prescriptive maintenance. And, take preemptive actions instead of understanding just the "what" and "why" behind a prediction.

f) Visualize what is important: Create rich dashboards and reports to show anything from high level of abstraction to low level of abstraction. Customize visualization so the right people have access to the metrics that matter to them, updated in real-time. Access data and reports from any device, anywhere; and publish reports to your organization.

Some standard definitions for IoT are mentioned here: "As defined by Atzori et. al., Internet of Things can be realized in three paradigms – internet-oriented (middleware), things oriented (sensors) and semantic-oriented (knowledge). Although this type of delineation is required due to the interdisciplinary nature of the subject, the usefulness of IoT can be unleashed only in an application domain where the three paradigms intersect."

The IoT can be viewed as an advanced technology that resides on few basic pillars as mentioned below:

(i) Anything is identifiable Anytime and Anywhere
(ii) Anything can communicate at Anytime and Anywhere
(iii) Anything interacts Anywhere and at Anytime

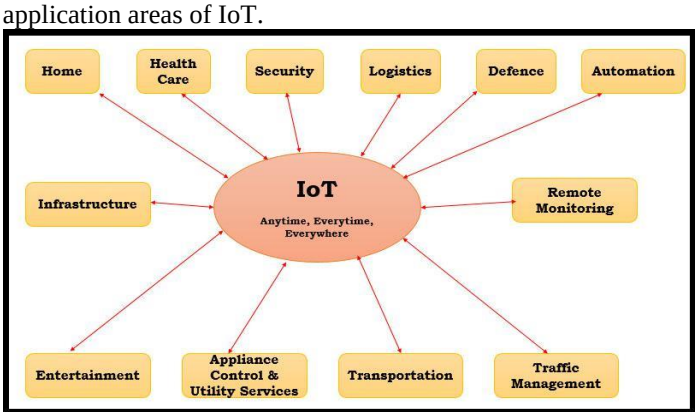



The objects or things defined in the discussion in previous paragraph can be elaborated as mentioned below.

These smart objects/things are physical entities that:

(a) Possess a unique identity
(b) Has some basic computing capability
(c) Can sense some physical parameters like intensity of light/sound, temperature, pressure etc.
(d) Can trigger specific actions based on sensed information
(e) Should produce, consume, and process data and aid in some decision making process.

The following figure depicts the conceptualization and application areas of IoT.



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IoT is an advancing technology that focuses on various aspects which are as mentioned below:
(i) Global Real Time Integration of Objects/Things
(ii) Heterogeneous nature of devices and network infrastructure
(iii) Mobility IoT
(iv) Continuous sensing for collecting data for meaningful information retrieval
(v) Distributed Intelligence
(vi) Continuous Connectivity
(vii) Optimum Processing with Optimum Decision Making Processes
(viii) Cross Platform Services and Utilities

Smart phones, PDA and other handheld devices are changing our environment by making it more interactive as well as informative and in this process a smart environment is created. According to Mark Weiser "the physical world that is richly and invisibly interwoven with sensors, actuators, displays, and computational elements, embedded seamlessly in the everyday objects of our lives, and connected through a continuous network" is termed as a smart environment.[8]The advancements and convergence of micro-electro-mechanical systems (MEMS) technology, wireless communications, and digital electronics has resulted in the development of miniature devices having the ability to sense, compute, and communicate wirelessly in short distances. These miniature devices called nodes interconnect to form a wireless sensor networks (WSN) and find wide application in environmental monitoring, infrastructure monitoring, traffic monitoring, retail, etc.

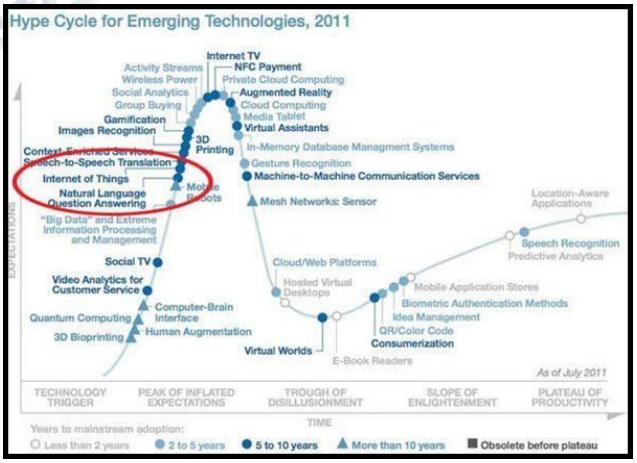
## II. IoT ELEMENTS

In this section we have listed and discussed on some key elements for IoT and IoT based applications. If we classify IoT elements/components into few basic categories that aids seamless connectivity then it can be as followed:
a) Hardware
b) Middleware
c) User End Visualization

Hardware constitutes of various sensors, actuators, embedded devices and other communication devices .Middleware constitutes of various tools used for on demand storage of data collected by sensor devices and processed by embedded devices and various computing tools used for data analytics. User End Visualization consists of various data visualization and interpretation tools which can be accessed on various diverse platforms which aids the end user to keep a track of various events driven by those data collected by various sensory hardware's. We have highlighted few breakthrough and enabling technologies in the above mentioned categories which will provide a clear conscience for the three components listed above. Wireless Sensor Network (WSN): The advances in low power integrated circuits and wireless communications has made it a possibility of making available efficient, low cost, low power miniature devices for use in remote sensing applications. These factors has improved the viability and feasibility of utilizing a sensor network consisting of a large number of intelligent sensors, enabling the collection, processing, analysis and dissemination of valuable information, gathered in a variety of environments Radio Frequency Identification (RFID): major breakthrough advancement in the embedded communication paradigm which enables design of microchips for wireless data communication. They help us in automatic identification of anything they are attached to acting as an electronic barcode that can be used in various IoT based applications

## III. TRENDS & APPLICATION AREAS

Internet of Things (IoT) has been identified as one of the emerging technologies in IT as noted in Gartner's IT Hype Cycle. A Hype Cycle is a way to represent the emergence, adoption, maturity, and impact on applications of specific technologies. It has been forecasted that IoT will take around 5 to 10 years for full-fledged market adoption and with cost efficient solution




The popularity of different paradigms varies with time. The web search popularity, as measured by the Google search trends during the last 10 years for the terms Internet of Things, Wireless Sensor Networks and Ubiquitous

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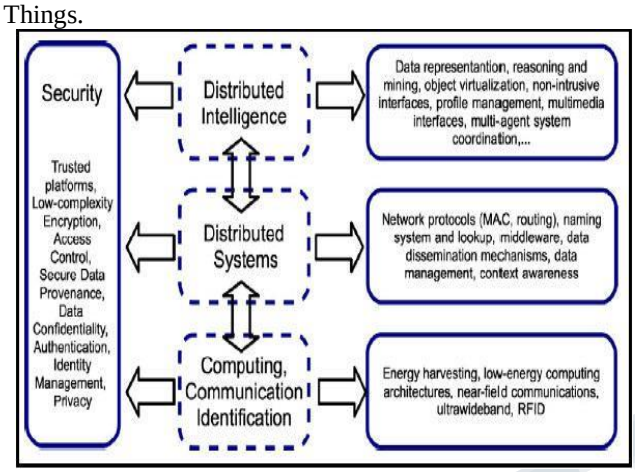
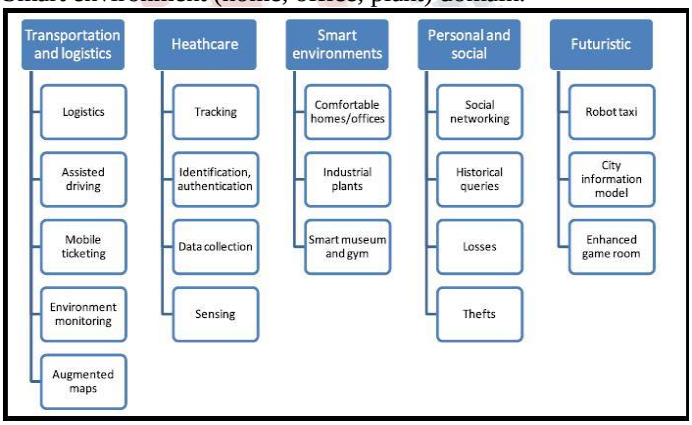
Computing are shown in Figure. As it can be seen, since IoT has come into existence, search volume is consistently increasing with the falling trend for Wireless Sensor Networks. As per Google's search forecast (dotted line), this trend is likely to continue as other enabling technologies converge to form a genuine Internet of Things.




There are various diverse application domains which will be impacted by the emerging technology Internet of Things. The applications can be basically categorized based on the type of network availability, coverage, scale, heterogeneity, repeatability, user involvement and impact. Applications of IoT can be broadly classified in following categories:

Personal and Home Applications
Health Care
Utilities and Services
Enterprise Applications
Industrial Automation Applications
Transportation and logistics domain
Smart environment (home, office, plant) domain.




## IV. RESEARCH SCOPE & OPEN ISSUES/CHALLENGES

The taxonomy of main research areas related to IoT has been graphically represented in the figure below. For IoT to be accepted as an efficient technology for various applications efforts are required to be streamlined in development of scalable and suitable service delivery platforms that permits multiple services to coexist.

We have tried to enlist and discuss few key challenges as mentioned below

a) Heterogeneous Things: An IoT empowered framework keeps running with a few heterogeneous gadgets those are diverse to each other as far as correspondence convention, information position, information accumulation, and information storage ability and so forth. This is a challenging task to develop communication protocols supported by all devices. Standard information configuration is required to empower machine to machine (M2M) correspondence all the more productively.

b) Energy: The devices forming the base of IoT are wireless in nature and reside at remote places (e.g. environment monitoring sensors) where energy is the most vital issue. We need ultimate energy efficient algorithms and hardware so as to avoid quick draining of battery power and make sensor nodes to live active for longer duration.

c) Security: Much the same as some other framework, security is a standout amongst the most essential issues. This issue turns out to be all the more difficult In an IoT when we are utilizing the system pervasively. We require particular information seclusion methods to give appropriate benefit to the end clients as indicated by their power. Information encryption calculations should be much more grounded. We require specific data isolation techniques to provide proper privilege to the end users according to their authority. Most importantly, the algorithms devised should be energy efficient so that they could be used in very low power, low energy devices across various IoT based applications.

d) Privacy: The pervasiveness and communications included in IoT can give numerous accommodations and helpful administrations for people, additionally make numerous chances to abuse security i.e. it creates many opportunities to violate privacy. To take care of the security issue made by IoT utilizations without bounds, the

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protection arrangements for every (framework) space must be determined. Once determined either the individual IoT application or the IoT base (e.g., the utility ability) must uphold security. Consequently paradigm must be able to express users' requests for data access and the policies such that the requests can be evaluated against the policies in order to decide if they should be granted or denied.

e) Intelligence: Machine to machine (M2M) communication has high priority in IoT because machine automation must be improved to minimize delay, traffic, and immediate action. Smart technologies need to be more intelligent to enable automated systems.

f) Communication Protocol: The heterogeneous nature of IoT enabled services meet an unavoidable problem with communication protocols. Each types of device use separate protocol in terms of data communication. Standard communication protocol needs to be developed for successfully implement IoT services.

g) Real-Time Solution: It will be really tough to implement the 'Anytime' concept of IoT in reality. The real- time systems need to be implemented in grass root level of the IoT things to react prominently at any time. The complexity of the existing real-time systems must be minimized, so that they could be used in nano-scopic devices.

h) Creating knowledge and Big Data: In an IoT world there exists a boundless measure of raw information being ceaselessly gathered. It can be normal that an extensive number of continuous sensor information streams exist as it is regular for a given stream of information to be utilized as a part of various routes for a wide range of induction purposes. Here, the information provenance and how it was prepared must be known, and protection and security must be connected as well. At the point when the information is enormous, challenge gets to be greater. Information mining strategies are relied upon to give the making of imperative learning from this information. In IoT framework colossal and tremendous measure of information should be overseen in every second. It is said that 220 Extra bytes of information will be put away in this year. The huge information idea must be executed in IoT to deal with this tremendous measure of information. That is the reason taking care of this enormous measure of information and making learning from it is a noteworthy examination issue for IoT.

## V. CONCLUSION

IoT has been continuously bringing a progression of mechanical changes in our day by day lives, which thus makes our life less difficult and more agreeable through different innovations and applications. There is incalculable value of IoT applications in different areas including medicinal, fabricating, mechanical, transportation, training, administration, mining, living space and so on. Notwithstanding plenteous advantages IoT is confronting a few imperfections in administration and execution level. Key perceptions in the writing are as per the following. Firstly, there is no standard definition worldwide till date. Second, widespread institutionalizations are required in structural level as well. Third, as advances shift from seller to-merchant, interoperability issues are to be tended to all the more genuinely. In this paper, we have studied the most imperative parts of the IoT with accentuation on what is being done and what are the issues that require further research. Without a doubt, current advances make the IoT idea possible however doesn't fit well with the versatility and effectiveness prerequisites they will confront. We believe that, given the interest shown by industries in the IoT applications, in the next years addressing such issues will be a powerful driving factor for networking and communication research in both industrial and academic laboratories. In this review article, we tried to provide an overview of the key issues identified with the improvement of IoT advances and administrations. Various examination challenges have been distinguished, which are relied upon to end up significant exploration patterns in the following years. The most pertinent application fields have been discussed, and various cases have been distinguished. We do hope that this survey will be useful for researchers and practitioners in the field of IoT, helping them to understand the huge potential of IoT and also highlighted which are the major issues to be tackled, devising innovative technical solutions able to turn IoT from a research vision into reality.

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