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IoT: Trends, Challenges and Future Scope

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Abstract: IoT (Internet of Things) one of the most exiting trends and innovation in the recent history of technological advancement. Also the advances in computer hardware, embedded system devices, networking devices, display devices, control devices, software enhancements etc. has tremendously supported IoT to grow slowly and steadily from leaps to bounds. With computation, connectivity, and data storage becoming more advanced and universal there has been an explosion of IoT based application solutions in diversified domains from health care to public safety, from assembly line scheduling to manufacturing and various other technological domains. IoT can be defined as a network of physical objects, devices that contain embedded technology (like intelligent sensors, controllers etc.) whichcan communicate, sense, or interact with internal or external systems. In other words, when objects can sense and communicate, it changes how and where decisions are made, and who makes them and accordingly operations can be carried out.In this survey a conscious effort has been put forward to investigate the state of the art involved in IoT and its various diversified engineering applications.Latest trends & evolution,challenges, and future scope of this technology have been touched upon for better understanding.Various IoT based applications have been explored and possible approach for enhancing the use of this technology have 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.In this paper 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.

Keywords: IoT, Intelligent sensors, Controllers, Big Data, Artificial Intelligence, Ubiquitous sensing; Cloud Computing; Wireless Sensor Networks; RFID.

1. INTRODUCTION

Internet of Things (IoT) is the network of physical, devices accessed through the Internet. These objects contain embedded technology to interact with internal states or the external environment. When these objects sense and communicate, it changes how and where decisions are made, and who makes them. It is a modern wireless communication technology having its application areas in various diversified domain areas.The basic idea of this concept is the pervasive presence around us of a variety of things or objects – such as Radio-Frequency Identification (RFID) tags, sensors, actuators, mobile phones, etc. – which, through unique addressing schemes, are able to interact with each other and cooperate with their neighbours to reach common goals. [1] It refers to the ever-growing network of physical objects that have an IP address associated with it for internet connectivity and addressing, and the communication that occurs between these objects and other Internet-enabled devices and systems that enables in some decision making process for applications in health care monitoring, assembly line scheduling, etc.. In other language we can say that IoT is a system of various interrelated computing devices, digital systems, machines, sensors, objects, animal or people that have a unique identifier associated with them, and the ability to transfer data over a network without the need of human-to-computer or human-to-human interaction. IoT is a technology that has evolved with convergence of various technologies like wireless communication, MEMS (micro-electromechanical systems), Wireless Sensor Network, Mobile Communication etc.. This convergence has proved to be vital as it has led to bringing operational technology (OT) and information technology (IT) on a common platform, which in turn allows unstructured machine-generated data to be further analyzed for initiating further improvements in decision making process in automation. **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. [2] Information Technology (IT), on the other hand, combines all necessary technologies for information 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 of connecting is decreasing, more devices are being created with Wi-Fi capabilities and sensors built into them, technology costs are going down, and smart-phone penetration is 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:

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.

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.

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.

In true essence IoT is where various diversified applications are deployed for specific purpose and the data collected from different objects, machines and things being monitored are made available to third-party applications and can be used for further automation or decision making processes.

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." [3]

As defined by Cluster of European research projects on the Internet of Things

"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." [4]

"Interconnection of sensing and actuating devices providing the ability to share information across platforms through a unified framework, developing a common operating picture for enabling innovative applications. This is achieved by seamless ubiquitous sensing, data analytics and information representation with Cloud computing as the unifying framework." [5]

The term IoTcame into existence in 1999 in the context of supply chain management, industrial automation, assembly line scheduling etc.[6] But, over a period of time with technology advancement the definition has been more inclusive covering wide range of applications like healthcare, utilities, transport, etc., but the ultimate goal of making computer devices sense information without the aid of human intervention remains the same[7].The connected objects are aided with Internet enables us to create an environment where we are able to harvest information from the environment and interact with physical world and enable various services for analytics, application control and communication for decision making process in various automated processes. The addition of various embedded devices supporting open standards for wireless communication like Bluetooth, Wi-Fi, RFID etc. and optimization in sensor nodes and devices has transformed the overall scenario of Internet that has enabled us to create smart environment for our day to day living. The worldwide information sharing and diffusion, interconnecting physical objects with computing/ communication capabilities across a wide range of services and technologies can be achieved using IoT technology.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

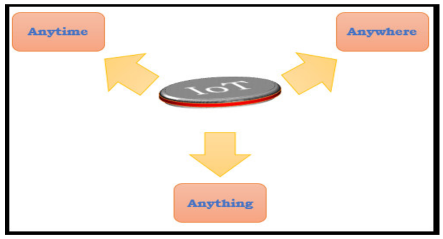

Fig.1 IoT

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 conceptualizationand application areas of IoT.

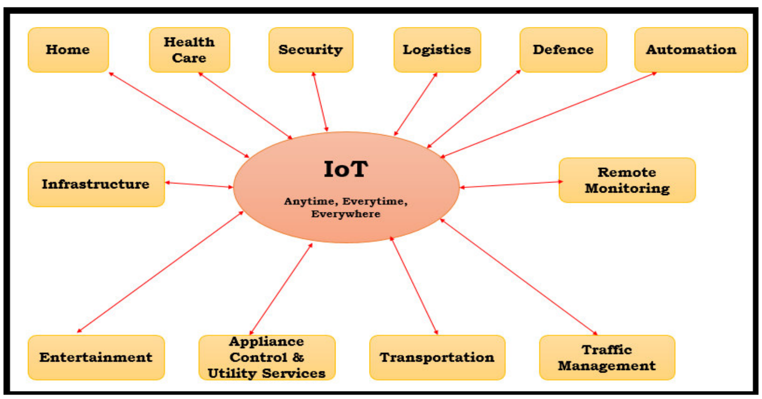

Fig.2IoT and application areas

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) MobilityFig.2 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, andcomputational 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. [9]

The objective of this paper is to provide the readers an insight into IoT and aid them in understanding what IoT is all about, what has been done so far in IoT, what trends are there in current scenario, what still needs to be addressed and what scope does this technology hold in future. The paper is organized as follows: In next section we discuss about various paradigms and visions for IoT which are taken from various literature, then we have touched upon some basic elements involved in IoT, then we have discussed various trends and application areas of IoT, then we have discussed some open issues in IoT and some future directions that can be carried out to address those issues have been highlighted and then concluded with some key points relevant to future line of action to be taken for IoT based applications.

2. PARADIGMS AND MULTIPLE VISIONS FOR IOT

The term Internet of Things contains two terms: (i) Internet & (ii) Things. The first terms weights towards a network centric vision of IoT and the second term focuses on generic objects and things that are supposed to be integrated onto a common framework. There is a possibility of having either a perspective of considering IoT as an Internet Oriented technology or a perspective of considering IoT as a Things Oriented technology. But, when we put this two terms put together it highlights a disruptive level of innovation in today's world.In fact, ‘‘Internetof Things” semantically means ‘‘a world-wide network of interconnected objects uniquely addressable, based on standard communication protocols” [10]. This implies a huge number of (heterogeneous)objects involved in the process. The object unique addressing and the representationand storing of the exchanged information become the most challenging issue, bringing directly to a third, ‘‘Semantic oriented”, perspective of IoT.

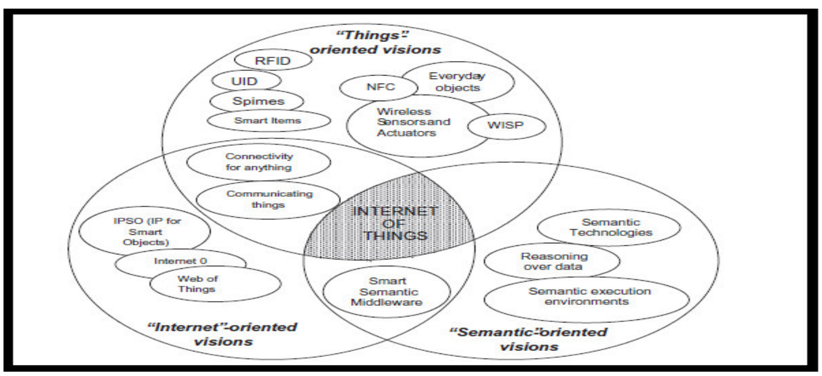

Fig. 3 Convergence of different visions for IoT [3]

The above figure depicts the convergence of different visions for IoT that clearly states that for IoT to exist the stated visions have to coexist. IoT in true essence is more than just merely identifying Objects or utilizing Internet services for data access. The wide range of devices, networks and various service architectures will lead to a strong development of IoT. RFID, Wireless Sensor Network, Wireless Actuators Network form the core component base for IoT that will bridge the real world objects with the digital world.Autonomous and proactive behavior, context awareness, collaborative communications and elaboration are some required key capabilities of objects and things that form the atomic core of IoT applications. According to the vision of ITU,IoT is not just about *anytime, anyplace connectivity foranyone*, but it is about having *connectivity for anything*. [11]According to European Commission document which states IoT involves ‘‘Things having identities and virtual personalities operatingin smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts.”[12] After going through various visions, terms relevant to IoT what we concluded upon is that IoT is a world coexisting with real and digital world where anything can communicate anywhere and at any time automatically with computing systems and amongst each other to provide various diversified services for benefit of human community on the whole. IoT can be thought of as:

(i) A worldwide accepted global infrastructure that connects virtual and real world objects
(ii) Internet and other network technologies aiding a backbone for data communication across and amongst real and virtual objects
(iii) Capability of high degree of autonomous data capture for triggering various events through network connectivity and cross platform interoperability

The above discussion justifies the Things Oriented and Internet Oriented vision for IoT. We will now throw some light on the Semantic Oriented vision for IoT.The number of items involvedin the Future Internet technologiesis destined to become extremely high. Therefore, issues related to how to represent, store, interconnect, search, and organize information generated by the IoT will become very challenging. Taking into consideration this issues, semantic technologies could play a vital role in development of future Internet technologies. Thesecan exploit appropriate modelling solutions for things description, reasoning over data generated by IoT, semantic execution environments and architectures that accommodate IoT requirements and scalable storing and communication infrastructure establishment for full-fledged IoT application development [13]. Keeping into consideration all three primary visions of IoT i.e. Things Oriented, Internet Oriented and Semantics Oriented we have tried to provide an insight on IoT as a convergence of all these three visions where each coexist to form the basis of entire IoT infrastructure.

3. 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:

(i) Hardware
(ii) Middleware
(iii) User End Visualization

Hardwareconstitutes 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[14]. The data collected by various sensor nodes are sent to either distributed systems or centralized systems (based on need) for further processing and analysis that helps in various decision making processes and for automation processes decision making. The breakthrough advances achieved in optimizing hardware components to a greater extent has increased the life time of sensor nodes with optimization at hardware level and at protocol level.

Radio Frequency Identification (RFID): A 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. There are two types of RFID tags: Active Tags and Passive Tags.passive RFID tags are not battery powered and they use the power of the reader's interrogation signal to communicate the ID to the RFID reader. This has resulted in many applications particularly in retail and supply chain management. The applications can be found in transportation (replacement of tickets, registration stickers) and access control applications as well. The passive tags are currently being used in many bank cards and road toll tags which is among the first global deployments. Active RFID readers have their own battery supply and can instantiate the communication. Of the several applications, the main application of active RFID tags is in port containers for monitoring cargo[15].

Near Field Communication (NFC): It is a set of communication protocols that enable two electronic devices, one of which is usually a portable device such as a smartphone, to establish communication by bringing them within 4 cm (2 inches) of each other[16]. In other words NFC, is a form of contactless communication between devices like smartphones or tablets. Contactless communication allows a user to wave the smartphone over a NFC compatible device to send information without needing to touch the devices together or go through multiple steps setting up a connection. Near field communication maintains interoperability between different wireless communication methods like Bluetooth and other NFC standards including FeliCa -- popular in Japan -- through the NFC Forum. Founded in 2004 by Sony, Nokia, and Philips, the forum enforces strict standards that manufacturers must meet when designing NFC compatible devices. This ensures that NFC is secure and remains easy-to-use with different versions of the technology. Compatibility is the key to the growth of NFC as a popular payment and data communication method. It must be able to communicate with other wireless technologies and be able to interact with different types of NFC transmissions.

The technology behind NFC allows a device, known as a reader, interrogator, or active device, to create a radio frequency current that communicates with another NFC compatible device or a small NFC tag holding the information the reader wants. Passive devices, such as the NFC tag in smart posters, store information and communicate with the reader but do not actively read other devices. Peer-to-peer communication through two active devices is also a possibility with NFC. This allows both devices to send and receive information.Each full NFC devices can work in three modes:

- NFC card emulation—enables NFC-enabled devices such as smartphones to act like smart cards, allowing users to perform transactions such as payment or ticketing.
- NFC reader/writer—enables NFC-enabled devices to read information stored on inexpensive NFC tags embedded in labels or smart posters.
- NFC peer-to-peer—enables two NFC-enabled devices to communicate with each other to exchange information in an adhoc fashion.

Addressing in IoT network: For IoT to be successfully implemented the key holds in uniquely identifying "Things". Through unique identifications of devices we will be able to remotely connect to various devices through Internet.Every element that is already connected and those that are going to be connected, must be identified by their unique identification, location and functionalities. The current IPv4 may support to an extent where a group of cohabiting sensor devices can be identified geographically, but not individually. The Internet Mobility attributes in the IPV6 may alleviate some of the device identification problems; however, the heterogeneous nature of wireless nodes, variable data types, concurrent operations and confluence of data from devices exacerbates the problem further[17]. Data is collected across diverse geographic locations so efficiently channelling those data across network is a key ingredient for successful deployment and working of an IoT based application. The scalability of the device address of the existing network must be sustainable. The addition of networks and devices must not hamper the performance of the network, the functioning of the devices, and the reliability of the data over the network or the effective use of the devices from the user interface[3].

To address these issues, the Uniform Resource Name (URN) system is considered fundamental for the development of IoT. URN creates replicas of the resources that can be accessed through the URL. With large amounts of spatial data being gathered, it is often quite important to take advantage of the benefits of metadata for transferring the information from a database to the user via the Internet [18]. IPv6 also gives a very good option to access the resources uniquely and remotely. Another critical development in addressing is the development of a light-weight IPv6 that will enable addressing home appliances uniquely.Wireless sensor networks are one of the building blocks of IoT, which run on a different stack compared to the Internet, cannot possess IPv6 stack to address individually and hence a subnet with a gateway having a URN will be required. Keeping this into consideration we then need a layer for addressing sensor devices by the relevant gateway. At the subnet level, the URN for the sensor devices could be the unique IDs rather than human-friendly names as in the www, and a lookup table at the gateway to address this device. Now, at the node level each sensor will have a URN (as numbers) for sensors to be addressed by the gateway. The entire network now forms a web of connectivity from users (high-level) to sensors (low-level) that is addressable (through URN), accessible (through URL) and controllable (through URC).

Data Storage after gathering and Data Analytics: IoT has led to creation of huge amount of data. So effectively managing the collected data and deciding upon the ownership of storage of data and time frame for maintaining the unprecedented amount of collected is a vital issue to be considered. Data centres are to be such that they will ensure reliability for data stored and efficient energy efficient technologies to be entertained. Use of stored data should be smart and be intelligently used for smart monitoring and actuation enabling various decision making processes. Artificial Intelligence and computational algorithms should be developed to aid these requirements. Efficient Data Analysis techniques are to be incorporated for extracting useful information from collected raw data from across various sensor devices.

Data Visualization: To enable a user to effectively interact with IoT based system proper data visualization techniques are required to be incorporated. Advances in touch screen technologies, display device technologies, and advances in smart phone technologies have surely aided IoT based applications. 2D and 3D technologies have made data visualization for end users more interactive and efficient.Extraction of meaningful information from raw data is non-trivial. This encompasses both event detection and visualization of the associated raw and modelled data, with information represented according to the needs of the end-user[3].

4. 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 (refer Figure 4). A Hype Cycle[19] 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 solutions.

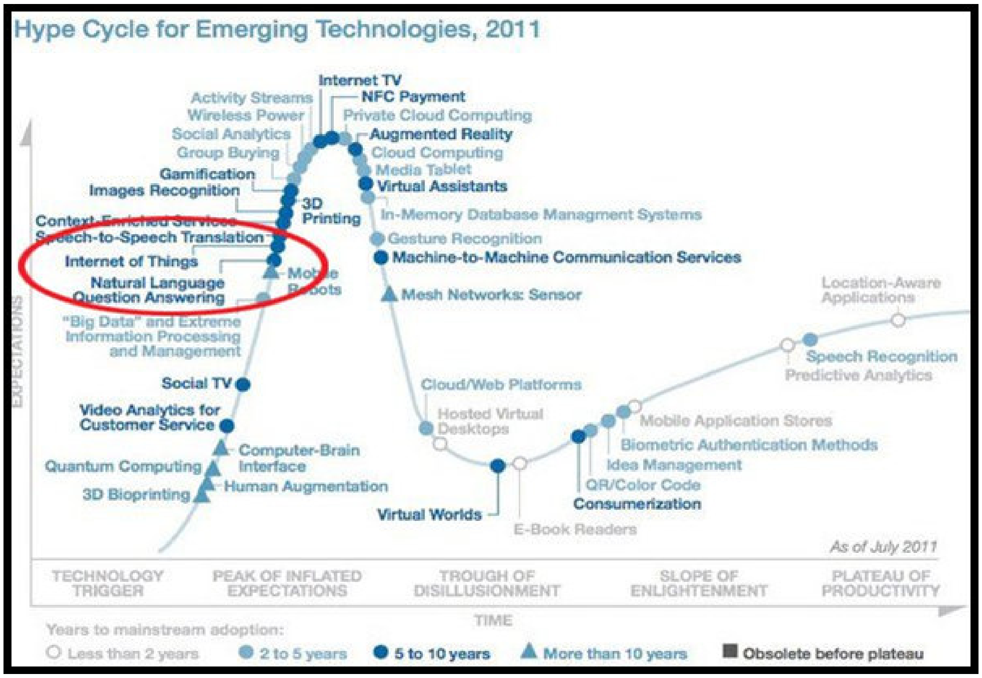

Fig.4: Gartner 2012 Hype Cycle of Emerging Technologies[19]

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 Computing are shown in Figure 5[20]. 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 in Figure 5), this trend is likely to continue as other enabling technologies converge to form a genuine Internet of Things[3].

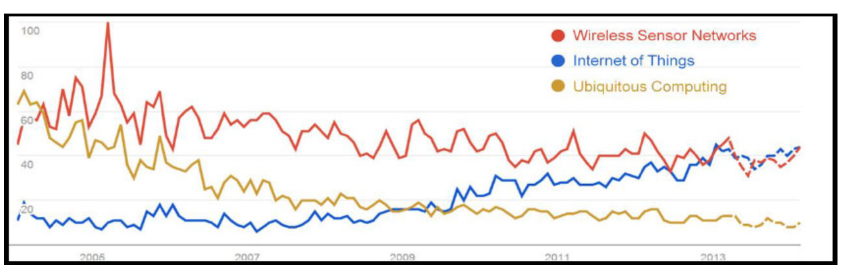

Fig. 5: Google search trends since 2004 for terms Internet of Things, Wireless Sensor Networks, Ubiquitous Computing.

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:

(i) Personal and Home Applications
(ii) Health Care
(iii) Utilities and Services
(iv) Enterprise Applications
(v) Industrial Automation Applications
(vi) Transportation and logistics domain
(vii) Smart environment (home, office, plant) domain.

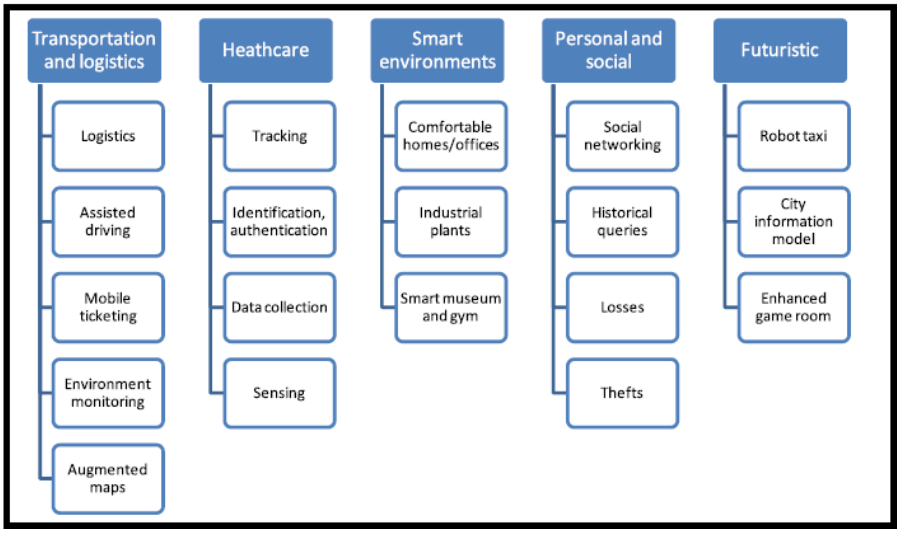

Fig. 6: Core Application Areas of IoT [3]

We have described few applications areas of IoT in this section.Advanced cars, trains, buses as well as bicycles technologies equally supported advances in technologies for building roads and/or rails are becoming more instrumented with sensors, actuators, and processing power. Roads themselves and transported goods are also equipped with tags and sensors that send important information to traffic control sites and transportation vehicles to better route the traffic, help in the management of the depots, provide the tourist with appropriate transportation information, and monitor the status of the transported goods.

In healthcare domain IoT has made huge inroads. Advanced medical diagnosis and remote patient medical monitoring is possible using IoT.Tracking of objects and people (staff and patients), identification and authentication of people, automatic data collection and sensing is carried out for remote monitoring of patients located across diverse geographic locations.

A smart environment is that making its ‘‘employment”easy and comfortable thanks to the intelligence of contained objects, be it an office, a home, an industrial plant, or a leisure environment.Sensors and actuators distributed in houses and officescan make our life more comfortable in several aspects: rooms heating can be adapted to our preferences and to the weather; the room lighting can change according to the time of the day; domestic incidents can be avoided with appropriate monitoring and alarm systems; and energy can be saved by automatically switching off the electrical equipment’s when not needed. For instance, we may think of energy providers that use dynamically changing energy prices to influence the overall energy consumption in a way that smoothestload peaks. An automation logic may optimize the power consumption costs throughout the day by observing when the prices, which are provided by an external web service and are set according to the current energy production and consumption, are cheap and by considering the specific requirements of each appliances at home (battery charger, refrigerator, ovens)[21]. Also for entertainment and gaming purpose IoT has become a popular technology, where focused research and application development is going at various sectors across the globe.

5. RESEARCH SCOPE & OPEN ISSUES/CHALLENGES

Considering the rich blend of various technologies involved in IoT, there is a need of lot of research required to stream line the efficient and optimized working of IoT based application. In the table mentioned below we have listed few open research issues associated with IoT. We have tried to enlist some open challenges based on elements of IoT discussed in section 3 of this paper. These challenges include privacy, standardization, data integrity, QoS support, and data analytics. Specific challenges associated with WSN include energy efficiency, security, protocols optimization etc.

Open issue	Brief description of the cause
Standards	There are several standardization efforts but they are not integrated in a comprehensive framework
Mobility support	There are several proposals for object addressing but none for mobility support in the IoT scenario, where scalability and adaptability to heterogeneous technologies represent crucial problems
Naming	Object Name Servers (ONS) are needed to map a reference to a description of a specific object and the related identifier, and *vice versa*
Transport protocol	Existing transport protocols fail in the IoT scenarios since their connection setup and congestion control mechanisms may be useless; furthermore, they require excessive buffering to be implemented in *objects*
Traffic characterization and QoS support	The IoT will generate data traffic with patterns that are expected to be significantly different from those observed in the current Internet. Accordingly, it will also be necessary to define new QoS requirements and support schemes
Authentication	Authentication is difficult in the IoT as it requires appropriate authentication infrastructures that will not be available in IoT scenarios. Furthermore, things have scarce resources when compared to current communication and computing devices. Also man-in-the-middle attack is a serious problem
Data integrity	This is usually ensured by protecting data with passwords. However, the password lengths supported by IoT technologies are in most cases too short to provide strong levels of protection
Privacy	A lot of private information about a person can be collected without the person being aware. Control on the diffusion of all such information is impossible with current techniques
Digital forgetting	All the information collected about a person by the IoT may be retained indefinitely as the cost of storage decreases. Also data mining techniques can be used to easily retrieve any information even after several years

Table 1: Open Issues in IoT[22]

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.

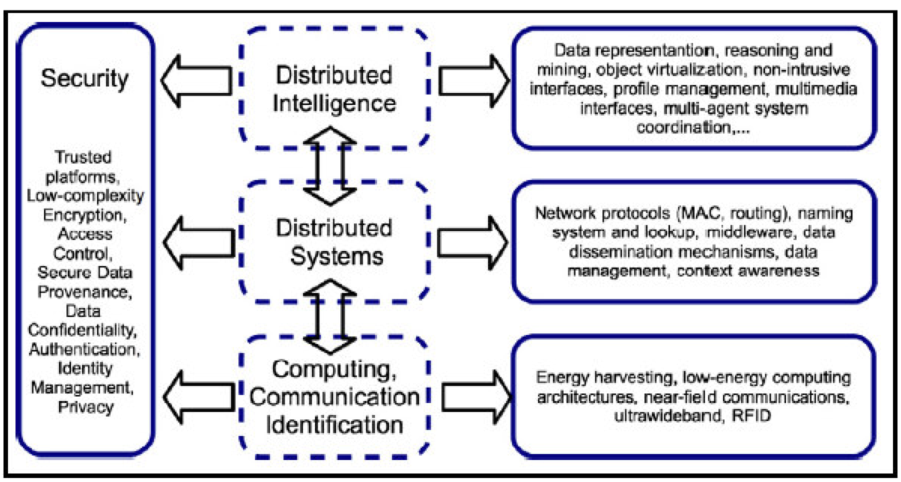

Fig. 7: Taxonomy of research areas relevant to IoT [23].

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

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.

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.

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.

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 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.

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

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.

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 minimised, so that they could be used in nano-scopic devices.

Creating knowledge and Big Data: In an IoT world there exist 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.

6. 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. Ultimately, for better worldwide administration, we have to manufacture consistently acknowledged worldwide standard conventions with legitimate wellbeing and security issues.

The expansion of gadgets with imparting impelling abilities is bringing nearer the vision of an Internet of Things, where the detecting and incitation works consistently mix away from plain sight and new capacities are made conceivable through access of rich new data sources. The development of the cutting edge portable framework will rely on upon the inventiveness of the clients in outlining new applications. IoT is a perfect developing innovation to impact this space by giving new advancing information and the required computational assets for making progressive applications.The expansion of gadgets with imparting impelling abilities is bringing nearer the vision of an Internet of Things, where the detecting and incitation works consistently mix away from plain sight and new capacities are made conceivable through access of rich new data sources. The development of the cutting edge portable framework will rely on upon the inventiveness of the clients in outlining new applications. IoT is a perfect developing innovation to impact this space by giving new advancing information and the required computational assets for making progressive applications incorporating 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. Without a doubt, current advances make the IoT idea possible however don't fit well with the versatility and effectiveness prerequisites they will confront.We believe that, given the interestshown 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 has 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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