The Internet of Things

Shubham Kumar[1] Dr. Neelu Trivedi[2]
[1]M. Tech Student [2]Assistant Professor
[1,2]Department of Electronics & Communication Engineering
[1,2]IFTM University, Lodhipur Rajput Moradabad (244001), India

Abstract— The Internet of Things (IoT) is the internetworking of physical devices, vehicles and other objects which consists of an embedded system with sensors, actuators and network connectivity that enable to collect and exchange data. The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more integration of the physical world into computer-based systems, and result in improved accuracy, efficiency and economic benefit. The IoT is a rapidly increasing and promising technology which becomes more and more present in our everyday lives. Furthermore, the technology is an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes and smart cities. Considering the high-rate development of IoT technologies, and the significant increment in the number of the connected devices, comprehensive overview of the IoT system aims, architecture, challenges, applications, protocols, and market overview were discussed. In order to give an example of IoT solution, a simple IoT demonstrator was implemented using the current affordable hardware, and cloud efficient software. With this demonstrator, the simplicity and design flexibility of IoT solution were highlighted and two of the IBM IoT software, Node-RED and Bluemix, were examined. We see the IoT as billions of smart, connected "things" (a sort of "universal global neural network" in the cloud) that will encompass every aspect of our lives, and its foundation is the intelligence that embedded processing provides. The IoT is comprised of smart machines interacting and communicating with other machines, objects, environments and infrastructures. As a result, huge volumes of data are being generated, and that data is being processed into useful actions that can "command and control" things to make our lives much easier and safer—and to reduce our impact on the environment. The creativity of this new era is boundless, with amazing potential to improve our lives. The following thesis is an extensive reference to the possibilities, utility, applications and the evolution of the Internet of Things.

Keywords: Internet of Things, M2M communication, ARM mbed, Node-RED, Bluemix

I. INTRODUCTION

Internet of Things (IoT) is a new revolution of the Internet. It makes Objects themselves recognizable, obtain intelligence, communicate information about themselves and they can access information that has been aggregated by other things. The Internet of Things allows people and things to be connected Anytime, Anyplace, with anything and anyone, ideally using any path/network and Any service as shown in Fig. 1. This implies addressing elements such as Convergence, Content, Collections, Computing, Communication, and Connectivity. The Internet of Things provides interaction among the real/physical and the digital/virtual worlds. The physical entities have digital counterparts and virtual representation and things become context aware and they can sense, communicate, interact, exchange data, information and knowledge. Through the use of intelligent decision-making algorithms in software applications, appropriate rapid responses can be given to physical entity based on the very latest information collected about physical entities and consideration of patterns in the historical data, either for the same entity or for similar entities. These paves new dimension of IoT concept in the domains such as supply chain management, transportation and logistics, aerospace, and automotive, smart environments (homes, buildings, infrastructure), energy, defense, agriculture, retail and more. The vision of IoT is to use smart technologies to connect things any-time, any-place for anything. The IoT was started in the year 1998 and the term Internet of Things was first coined by Kevin Ashton in 1999.

The Internet of Things has been evolved in a tremendous way over the past decade and still IoT is an emerging trend for researchers in both academia and industry. Many findings of IoT reported in literature presents meaningful definitions. According to CASAGRAS project [1]: "A global network infrastructure linking physical and virtual objects through the exploitation of data capture and communication capabilities. This infrastructure includes existing and evolving Internet and network developments. It will offer specific object identification, sensor and connection capability as the basis for the development of independent cooperative services and applications. CERP, emphasizes the internetworking between heterogeneous 'smart' devices such as sensors, actuators, computers and smart phones etc., and the use of services over the internet. Any application development framework for the IoT, therefore, needs to support these heterogeneous devices.

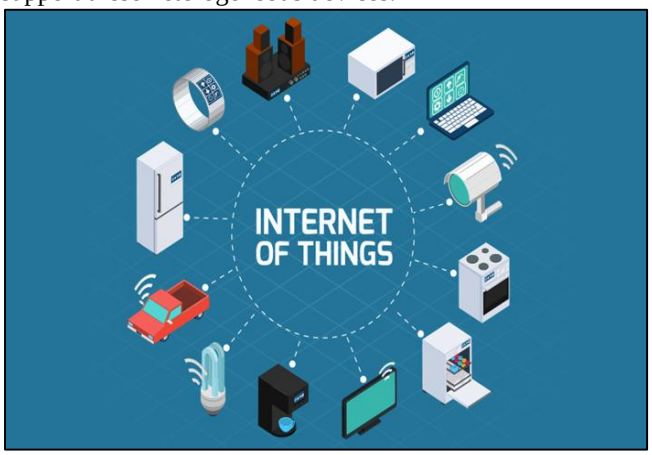

Fig. 1: Internet of Things

Nowadays, the Internet is a global system of networks that interconnect computers using the standard Internet protocol suite. It has significant impact on the world as it can serve billions of users worldwide. Millions of private, public, academic, business, and government

networks, of local to global scope, all contribute to the formation of the Internet [11].Another fundamental technology for the IoT is the embedded computer system. This term was first used in 1974 and describes a computer that is physically incorporated into a larger system whose primary function is not data processing, and integral to such a system from a design, procurement and operations viewpoint [12]. These systems are implemented by using devices like microcontrollers and single board computers (SBC), and have recently gained popularity with affordable and easy to use prototyping platforms as Arduino, Raspberry Pi or Lego Mind storms. At the early 1990s, Mark Weiser proposed the concept of ubiquitous computing, later regarded as "pervasive", where the main idea was for computers to be present and invisible in everything [13].The backbone of the ubiquitous computing paradigm relies on the advances in embedded computing technologies and deploying a ubiquitous network on a scale of hundreds of computers per room. The concept might resemble that of the actual IoT, but at that time, Weiser stated that the main challenge was the design of operating systems that allow software to fully exploit the capabilities of networks, as software systems barely took any advantage of them [13].By mid-1990s, sensor nodes started developing as several technologies like wireless communications and digital electronics presented important advances. These are tiny modules capable of sensing data, which is then processed and transmitted over a network.

Large numbers of sensor nodes allow for the implementation of sensor networks and have applications in several areas. Things in the IoT share some of the characteristics and purpose of sensor nodes. However, despite all the existing work and experience related to these and other areas such as nanotechnology, big data, identification, localization and cloud technologies, there is still no consensus on the definition of the Internet of Things concept, as pointed out by several researchers and evidenced by the number of ideas and conceptions around the topic that can be found in research literature, magazines and websites of alliances, organizations and industry interested on development of the IoT. Since the term was used for the first time in 1999, its scope has widened and different definitions have been proposed, varying according to changes and creation of new technologies or the addition of old ones that have found a place within the IoT. Moreover, new terms have appeared as the IoT has extended into several domains or depending on the intended use of the technology. Taking as a starting point this diversity of views, a systematic literature review (SLR) on the evolution of the concept of the Internet of Things was conducted. It was intended to understand the way the concept has changed and to assess the influential factors that triggered such changes. Certainly, there exist reviews, surveys and overviews that have been performed on the IoT, reflecting a considerable amount of work and analysis in order to obtain important results, but they usually try to cover a comprehensive view of the state of the art in the IoT, its enabling technologies, application areas, research opportunities and common problems. It is of our interest to focus specifically on the IoT concept and the way it is understood across different application domains, to provide a detailed report that serves as a reference for future research on the area.

The IOT concept was coined by a member of the Radio Frequency Identification (RFID) development community in 1999, and it has recently become more relevant to the practical world largely because of the growth of mobile devices, embedded and ubiquitous communication, cloud computing and data analytics. Imagine a world where billions of objects can sense, communicate and share information, all interconnected over public or private Internet Protocol (IP) networks. These interconnected objects have data regularly collected, analyzed and used to initiate action, providing a wealth of intelligence for planning, management and decision making. This is the world of the Internet of Things (IOT). Internet of things common definition is defining as: Internet of things (IOT) is a network of physical objects. The internet is not only a network of computers, but it has evolved into a network of device of all type and sizes , vehicles, smart phones, home appliances, toys, cameras, medical instruments and industrial systems, animals, people, buildings, all connected ,all communicating & sharing information based on stipulated protocols in order to achieve smart reorganizations, positioning, tracing, safe & control & even personal real time online monitoring , online upgrade, process control & administration[1,2].We define IOT into three categories as below: Internet of things is an internet of three things: (1). People to people, (2) People to machine /things, (3) Things /machine to things /machine, Interacting through internet. Internet of Things Vision: Internet of Things (IoT) is a concept and a paradigm that considers pervasive presence in the environment of a variety of things/objects that through wireless and wired connections and unique addressing schemes are able to interact with each other and cooperate with other things/objects to create new applications/services and reach common goals. In this context the research and development challenges to create a smart world are enormous. A world where the real, digital and the virtual are converging to create smart environments that make energy, transport, cities and many other areas more intelligent. Internet of Things is refer to the general idea of things, especially everyday objects, that are readable, recognizable, locatable, addressable through information sensing device and/or controllable via the Internet, irrespective of the communication means (whether via RFID, wireless LAN, wide area networks, or other means). Everyday objects include not only the electronic devices we encounter or the products of higher technological development such as vehicles and equipment but things that we do not ordinarily think of as electronic at all - such as food , clothing ,chair, animal, tree, water etc. [1,2]Internet of Things is a new revolution of the Internet. Objects make themselves recognizable and they obtain intelligence by making or enabling context related decisions thanks to the fact that they can communicate information about themselves. They can access information that has been aggregated by other things, or they can be components of complex services. This transformation is concomitant with the emergence of cloud computing capabilities and the transition of the Internet towards IPv6 with an almost unlimited addressing capacity. The goal of the Internet of Things is to enable things to be connected

anytime, anyplace, with anything and anyone ideally using any path/network and any service.

II. LITERATURE REVIEW

In every organization there is always information desk that provides information, advertisement messages and many notifications to their customers and staff. The problem is that it requires some staff that is dedicated to that purpose and that must have up to date information about the offers advertisement and the organization. Due to IOT we can see many smart devices around us. Many people hold the view that cities and the world itself will be overlaid with sensing and actuation, many embedded in "things" creating what is referred to as a smart world. Similar work has been already done by many people around the world. In literature the IoT refers as intelligently connected devices and systems to gathered data from embedded sensors and actuators and other physical objects. IoT is expected to spread rapidly in coming years a new dimension of services that improve the quality of life of consumers and productivity of enterprises, unlocking an opportunity.

Now this time Mobile networks already deliver connectivity to a broad range of devices, which can enable the development of new services and applications. This new wave of connectivity is going beyond tablets and laptops; to connected cars and buildings; smart meters and traffic control; with the prospect of intelligently connecting almost anything and anyone. This is what the GSMA refers to as the "Connected Life". The author in describes the concept of sensor networks which has been made viable by the convergence of micro electro-mechanical systems technology, wireless communications. Firstly the sensor networks applications and sensing task are explored, and according to that the review factors influencing the design of sensor network is provided. Then the algorithms and protocols developed for each layer and the communication architecture for sensor networks is outlined. In the purpose of research is to understand the feasibility of IoT in bus transportation system in Singapore.

The Singapore, which is technically very advanced but still has scope of advancement in their transportation system. The made a system by the using the IOT for the consumer to understand and evaluate different bus options in an efficient manner. Secondary research was used to predict arrival timings of buses as well as the crowd inside each bus. The literature presents a three layered network construction of Internet of Things (IOT) communication method for high-voltage transmission line which involves the wireless self-organized sensor network (WSN), optical fiber composite overhead ground wire (OPGW), general packet radio service (GPRS) and the Beidou (COMPASS) navigation satellite system (CNSS). The function of each layer of network, application deployment and management of energy consumption are studied. The method can meet the needs of interconnection between the monitoring center and terminals, reduce the terminals" GPRS and CNSS configuration and OPGW optical access points, and ensure the on-line monitoring data transmission real-time and reliable under the situation of remote region, extreme weather and other environmental conditions.

Many technical communities are vigorously pursuing research topics that contribute to the IoT. Today, as sensing, communication, and control become ever more sophisticated and ubiquitous, there is significant overlap in these communities, sometimes from slightly different perspectives. More cooperation between the communities is encouraged. To provide the basis for discussing open research problems in IOT, a vision for how IOT could change the world in the distant future. Now in this era the iot may be used in various research field in this literature those may classified as: massive scaling, creating knowledge and big data, architecture and dependencies, robustness, openness, security, privacy, and human-in-the-loop.

A. *Advantages:*

- Students or employee easily get important notice or information by message any time 24x7.
- Within a seconds organization can change notice or information by sending SMS only.
- Admin can change the display message or notice from any place or anywhere.

B. *Disadvantage:*

- If anybody wants information they have to do message and for every new information they have to send message again and again to the system.

III. APPLICATIONS

This system is designed for a shopping complex mall but it can be also used in various organizations like educational Notice board system or at Railway station, Bus stand and Air-port to display the information and notification. In mall it is also used to control the humidity and temperature of mall via central AC by using temperature sensor. In Industrial organization it can be also used. E-display system may be used to display Emergency message in Hospitals. Some areas where IoT frequently used

A. *Smart Cities:*

- To make the city as a smart city to engage with the data exhaust produced from your city and neighborhood.
- Monitoring of parking areas availability in the city.
- Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.
- Detect Android devices, iPhone and in general any device which works with Bluetooth interfaces or WiFi
- Measurement of the energy radiated by cell stations and and Wi-Fi routers.
- Monitoring of vehicles and pedestrian levels to optimize driving and walking routes.
- Detection of rubbish levels in containers to optimize the trash collection routes.
- Intelligent Highways with warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams.

B. *Security & Emergencies:*

- Perimeter Access Control: Detection and control of people in non authorized and restricted.

- Liquid Presence: Liquid detection in data centers, sensitive building grounds and warehouses to prevent breakdowns and corrosion.
- Radiation Levels: In nuclear power stations surroundings distributed measurement of radiation levels to generate leakage alerts.
- Explosive and Hazardous Gases: Detection of gas leakages and levels in industrial environments, surroundings of chemical factories and inside mines.

C. Smart Agriculture:

- Wine Quality Enhancing: Monitoring soil moisture and trunk diameter in vineyards to control the amount of sugar in grapes and grapevine health.
- Green Houses: Control micro-climate conditions to maximize the production of fruits and vegetables and its quality.
- Golf Courses: Selective irrigation in dry zones to reduce the water resources required in the green.
- Meteorological Station Network: Study of weather conditions in fields to forecast ice formation, rain, drought, snow or wind changes.
- Compost: Control of humidity and temperature levels in alfalfa, hay, straw, etc. to prevent fungus and other microbial contaminants.

D. Domestic & Home Automation:

- In home by using the IOT system remotely monitor and manage our home appliances and cut down on your monthly bills and resource usage.
- Energy and Water Use: Energy and water supply consumption monitoring to obtain advice on how to save cost and resources.
- Remote Control Appliances: Switching on and off remotely appliances to avoid accidents and save energy.
- Intrusion Detection Systems: Detection of windows and doors openings and violations to prevent intruders.
- Art and Goods Preservation: Monitoring of conditions inside museums and art warehouses.

E. Medical Field:

- All Detection: Assistance for elderly or disabled people living independent.
- Medical Fridges: Monitoring and Control of conditions inside freezers storing medicines, vaccines, and organic elements.
- Sportsmen Care: Vital signs monitoring in high performance centers and fields.
- Patients Surveillance: Monitoring of conditions of patients inside hospitals and in old people's home.
- Ultraviolet Radiation: Measurement of UV sun rays to warn people not to be exposed in certain hours.

F. Industrial Control:

- Machine to Machine Applications: Machine auto-diagnosis the problem and control.
- Indoor Air Quality: Monitoring of oxygen levels and toxic gas inside chemical plants to ensure workers and goods safety.
- Temperature Monitoring: Monitor the temperature inside the industry.
- Ozone Presence: In food factories monitoring of ozone levels during the drying meat process.
- Vehicle Auto-diagnosis: Information collection from Can Bus to send real time alarms to emergencies or provide advice to drivers.

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REFERENCES

[1] Memon, Azam Rafique, et al. "An Electronic Information Desk System For Information Dissemination In Educational Institutions.“
[2] Karimi, Kaivan, and Gary Atkinson. "What the Internet of Things (IoT) needs to become a reality." White Paper, FreeScale and ARM (2013).
[3] Stankovic, John. "Research directions for the internet of things." Internet of Things Journal, IEEE 1.1 (2014): 3-9.
[4] Gubbi, Jayavardhana, et al. "Internet of Things (IoT): A vision, architectural elements, and future directions." Future Generation Computer Systems 29.7 (2013): 1645-1660.
[5] "Understanding the Internet of Things (IoT) “, July 2014.
[6] Dogo, E. M. et al. "Development of Feedback Mechanism for Microcontroller Based SMS Electronic Strolling Message Display Board." (2014).
[7] N. Jagan Mohan Reddy, G.Venkareshwarlu, et al. “Wireless Electronic Display Board Using GSM Technology”, International Journal of Electrical, Electronics and Data Communication, ISSN: 2320-2084 Volume-1, Issue-10, Dec-2013
[8] Yashiro, Takeshi, et al. "An internet of things (IoT) architecture for embedded appliances." Humanitarian Technology Conference (R10-HTC), 2013 IEEE Region 10. IEEE, 2013.
[9] Vermesan, Ovidiu, and Peter Friess, eds. Internet of Things-From Research and Innovation to Market Deployment. River Publishers, 2014.
[10] www.gsma.com/connectedliving/wp-content/.../cl_iot_wp_ 07_14.pdf
[11] http://www.libelium.com/top_50_iot_sensor_applications_ranking
[12] I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, Wireless sensor networks: a survey, Computer Networks 38 (2002) 393–422.
[13] Menon1, et al. “Implementation of internet of things in bus transport system of singapore"Asian Journal of Engineering Research(2013).
[14] Shao-Lei Zhai et.al "Research of Communication Technology on IOT for High-Voltage Transmission Line" International Journal of Smart Grid and Clean Energy(2012)

