RESEARCH ARTICLE OPEN ACCESS

A Review On Internet Of Things: Applications, Operational Areas

Mandeep Kaur [1], Gurpreet kaur [2]
Department of Computer Science
Baba Banda Singh Bahadur Engineering College
Fatehgarh Sahib, Punjab
India

ABSTRACT
IoT may be described as an algorithm that is used to interlink devices installed with sensors, actuators and processors. These devices are interlinked with each other in order to perform a meaningful operation. In this paper the architecture of IoT is used to reviewed in detail along with its applications in various fields. This paper highlights various vital services that have potential to revolutionize the living style of human beings. Moreover, the most common area of IoT i.e. home automation system is also focused in this paper with its ability to enhance the standard of living.
Keywords:- Internet of Things(IoT), Radio frequency identification system, global positioing system (RFID), Home Automation System

I. INTRODUCTION

Due to several advancements in the field of information, sensor and communication technologies leads to the development of vast amount of data. Thus, it remains invaluable until it does not analyzed, interpreted as well as understood. The IoT i.e. internet of things provides a solution of connecting the things and peoples everywhere, every time and to everyone. For that purpose, any network or any service can be used for the connection. Kevin Ashton was the person who initially started term "Internet of things" in the domain of supply chain management. In today's era, IoT has become the most trending domain that has broader definition and so covers several areas such as utilities, healthcare, logistics as well as transportation.

It is the most emerging domain that will take 2 to 5 years for mainstream adoption according to the Gartner in [24]. IoT has been considered as a domain which can be classified into different domains in terms of their network type, availability, scale, user involvement, impact and heterogeneity. Consider an example, where Gubbi et al. in [17] categorized IoT in four areas such as personal and home, utilities, enterprise and lastly mobile. Some of the researchers have classified this domain in terms of smart solutions on the basis of their application such as smart wearable, smart home, smart environment, smart enterprise and smart city. Likewise, it can be sorted out into enterprise applications including monitoring and control, information sharing, business analytics and big data.
Technologies which are involved in the IoT must use or include identification and sensing technologies such as radio frequency identification (RFID), Wireless Sensor Networks, middleware, IoT software applications and cloud computing. The modules which are used in IoT provide communication between individual components such as RFID provides automatic identification of objects with the help of radio waves, a tag as well as a reader. WSNs in IoT are used to monitor the physical as well as environmental conditions. The WSN consists of several sensors which has equipped with a device. Whereas, Middleware component in IoT is treated as a software layer in order to exchange the information between systems and heterogeneous IoT devices. Cloud computing provides the delivery of hosted computing services over the internet. At last, IoT applications facilitate the interactions between machine-to-machine and human-to-machine.
There are three IoT paradigms which are identified through the Atzori et al. in [19] such as "Internet-Oriented", "Things-Oriented" and "Semantic-Oriented".
The "Things-Oriented" are related to the devices which are connected and the related technologies which help these connections such as RFID, Unique Identifier, Wireless Sensors and Actuators, Spimes, Near field Communication and Wireless Identification shown in figure 1. The "Internet-Oriented" paradigm mainly focuses on the languages as well as the protocols which are required for the communication propose between the things and other devices over the internet. Example for the internet things modules are web of things, Internet protocol for smart objects (IPSO) and Internet 0. Lastly, "Semantic-Oriented" paradigm that relies in the center of the framework which is used to organize, bring and represent meaning to the information generated in IoT. The connection between each paradigm shows their ability to connect different things and exchange the information through the internet. Moreover the overlap between the "Semantic – Oriented" and "Internet-Oriented" paradigms makes the system able to communicate things and ability to understand each other.
Further this module has been modified through the Koreshoff et al. in [16] by employing human computer interaction i.e. HCI practitioners. They showed the idea of how everyday objects can be related or added to the computing and what this enable. According to the "Internet" paradigm, the selection of a protocol should be like the information can be transmitted to and from the objects. The connection between the internet and things paradigm by HCI aware the physical limitations along with communication capabilities of a particular object while communicating with other objects. The "Semantic" Paradigm presents the way in which data should be analyzed and offers so that it can be understandable. The connection between the "Internet" and "Semantic" explains the fact that there is a

requirement of designing an object that could fit with other objects. Moreover, consider how these objects will interface with existing objects. To end with, the connection between "Things" and "Semantic" paradigms explained how data could be represented through the IoT devices in such way that it makes the people understand.

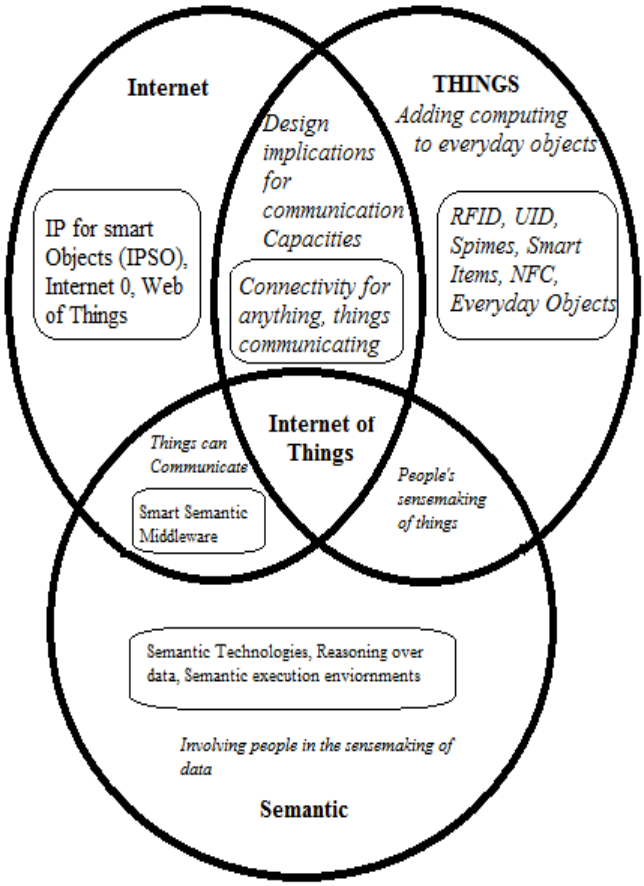

Figure. 1. Modified "Internet of Things" paradigms. Source: Koreshoff, Leong, & Robertson [16].

II. ARCHITECTURE OF IOT

Various researchers have presented architecture for IoT but yet no single architecture for IoT has implemented worldwide, all are using different designs for IoT. Different architectures for IoT as follow:

2.1. **Three- and Five-Layer Architectures**. Basic architecture of IoT is three layers architecture and it is represented in figure 2. This architecture was created when the research in this field has just started. It consists of 3 layers as follow:

(i) **Perception layer:** This layer comes under physical layer. It consists of sensors that are used to collect the information regarding the environment. It is used gather the data regarding the various smart physical parameters of environment.

(ii) **Network layer:** This layer helps in forming the link between two other smart equipments that are network devices and servers. The network layer also helps in transmission and processing the information collected by sensor.

(iii) **Application layer:** The Network layer is used for transmission of services to the user and these services are related to applications. This layer describes different applications in which IoT can be implemented. For instance: smart house, smart cities, and smart hospitals.

The basic concept behind IoT is described by the three layered architecture. But with the information provided by three layered architecture further researches in the field of Internet of things is not possible. This is the reason various architectures for IoT have been suggested in different literatures. One of them is five layered architecture, it consist of all the layers which are described in three layered architecture along with two more layers that are: processing layer and business layer [3–6].

In five layered architecture different layers are as follow: perception layer, transport layer, processing layer, application layer, and business which are show in figure 2. In 5 layered architecture the operation of perception layer and architecture layer is similar to its operation in three layered architecture. So, the operations of other three layers are described below:

(i) **Transport layer:** This layer is responsible for transmission of data collected by sensor from perception layer to processing layer and vice versa by using different through networks like wireless, LAN, RFID, and NFC.

(ii) **Processing layer:** This layer is also referred as middleware layer. Processing layer is responsible for storing, processing and analyzing the large amount of information received from transport layer. It controls and provide large amount of services to the lower layer. Different technologies are implemented with the help of this layer like databases, cloud computing, along with large amount of information processing modules.

(iii) **Business layer**: it coordinates the complete system of Internet of Things along with its different applications, business models and privacy of users.

Ning and Wang [19] have also presented architecture for Internet of Things whose main concept is derived from processing layers in the brain of human being. Major objective of this architecture is to add features in it similar to the human brain like thinking ability, sense, memorize, take decisions, and respond to the surrounding environment. This architecture comprised of three parts:

- First part is human brain. It is identical to data centre where the information is processed.
- Second part is spinal cord. It is similar to the distributed network which consists of information processing nodes and intelligent gateways.
- Third part is nerves' network. It communicates with devices and sensor in the network.

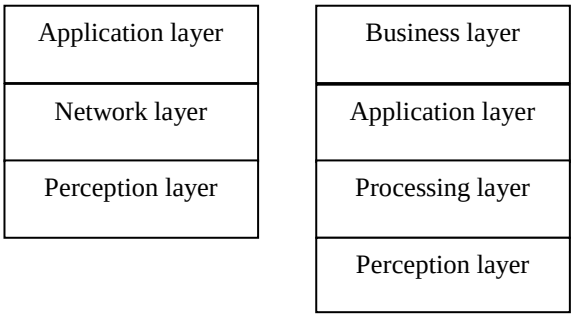

Figure 2: Architecture of IoT A) Three layers B) five layers [7]

III. TAXONOMY OF RESEARCH IN IOT

For research in the field of Internet of Things, taxonomy has been proposed for it and it is shown in figure 3. The taxonomy of IoT is described on the basis of its architectural elements. In architecture of internet of Things first element is perception layer. It is responsible for gathering the information with the help of sensors and these are very critical drivers in IoT. For different applications of IoT different sensors are used. In present scenario, the most used sensor is smart-phone. The smart-phone also consists of different sensors like position sensor (GPS i.e. global positioning system), movement sensors (accelerometer), light sensor, proximity sensor, and magnetometer etc. These are implemented in various applications of Internet of Things. Along with this various other sensors are also used in IoT temperature sensors, pressure measuring sensor, humidity and medical parameters sensor etc. another group of sensors that has outperformed the smart-phone sensors are IR sensors.

Now in various applications of IoT the Infrared sensors are used like Infrared cameras, movement detectors, detecting smoke and gases and moisture. The devices in the network which are communicating with each are using different protocols and different standards. When the devices in the network which are in short distance are communicating with other then the type of technologies used in it are: RFID (Radio Frequency Identification) and NFC (Near Field Communication). When the devices are communicating with each other and devices are placed at medium range the technologies used are: Bluetooth, Zig-bee, and Wi-Fi. For interlinking the devices in IoT network, the specific networking protocols are required. Hence, new technique and set of rules are formulated for all the networking layers in the stack. These protocols are implemented in each layer as per the requirement of devices used in IoT network. Two types of software components are required: first one is middleware and second one is applications. Now, the middleware formulates the basic concept which is helpful for programmer in such a way that the information related to hardware is not revealed. This has improved the interoperability of intelligent devices and different services can be easily implemented. Various services provided by the middleware component to different IoT devices like Open IoT, Middle Where, Hydra, Fi-Ware, and Oracle Fusion Middleware.

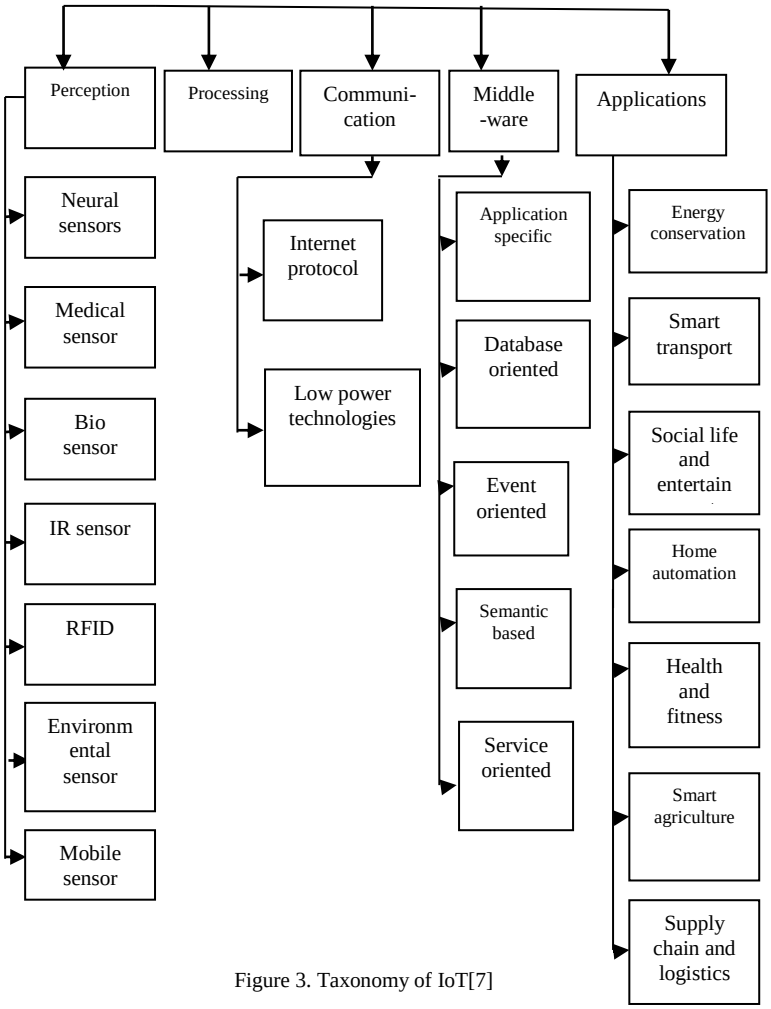

Figure 3. Taxonomy of IoT[7]

IV. HOME AUTOMATION SYSTEMS IN IOT

There are various fields smart applications are implemented. But all the applications are not ready to use. The researches which have been done in the field of IoT have revealed that the IoT has potential enhance the standard of life in our society. Nowadays, people mostly prefer smart homes due to two reasons: First reason is that the WSN networks along with the sensors and actuation techniques have been improved significantly. Second reason is that people prefer the implementation of advance technology for the security reason and also for good standard of life.

The smart homes are comprised of intelligent and automated applications that can increase the quality of life of people residing in these homes. In these homes the daily tasks are operated automatically and really helpful for setting a routine. These are also helpful in efficient energy consumption as the

lights and electronic devices will be turned off automatically when thy arte not in use.

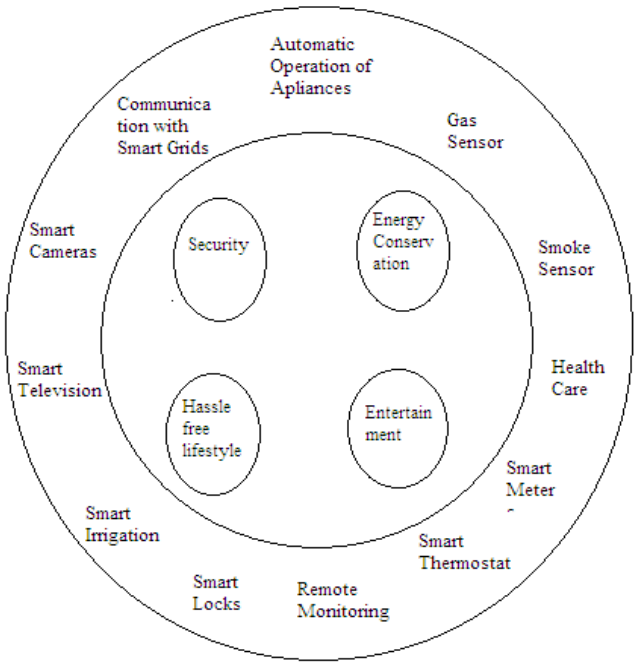

Figure 4: block diagram of smart home system[7]

The smart houses are also equipped with motion sensors which are used for security purpose. For efficient energy utilization in smart houses sensors are required. These sensors gather the information regarding the various parameters in surrounding like light, temperature, gas etc. The information collected from uniform sensors are fed at the input of context integrator, this in return transmit the gathered information to context based service engine. For instance, whenever humidity increases, the AC will be turn on automatically, also if in case there is a gas leakage then the lights will be automatically turned off. The services provided by the smart homes are really efficient for old people and differently able persons. It is also possible to monitor the health of elder people in smart homes and informed immediately to their relative in case of urgent situation. In smart homes the pressure sensors are installed over the floor that can track the motion of the person. The smart homes are also equipped with CCTV cameras that are used to record each and every activity in the home. These services provided by the smart homes which are mentioned above can be used to monitor the activities of home.

For example: floor sensors in smart homes are helpful in identifying in case if elder person fallen down. Artificial Neural networks (ANN) can also be deployed to detect the movements of people. Various other smart-phone based services can also b used to determine the movement of people in the smart homes by utilizing the information gathered by accelerometer and gyroscope. With all the services which are provided by smart homes there are some disadvantages which are associated with it. One major problem is security issue. As the data is recorded about all the tasks that are happening in the home so the intruder can get this data and attack the home.

V. RELATED WORK

In all the institutes, there is one information desk that provides the information to customers as well as staff. So all the organization need to have separate dedicated staff for this purpose. People in this staff need to be updated with the information related to that institute. Because of internet of things various intelligent devices can be easily seen around us. In the smart world all the equipments are installed with sensors and actuators that can improve the quality of life. Many researchers have contributed in this field.

In literature [4] the Internet of Things had described the smartly interlinked equipments and systems to collect the information from the sensors and actuators that were installed in all the devices. It was predicted that in upcoming years the Internet of Things will spread quickly that will enhance the efficiency of services in turn the standard of people will improve. Presently because of mobile network wide range of devices has been interlinked with each other and this can initiate the formulation of new services. This enhance form of interconnection was not just limited up to tablets and laptops but also able to connect various other devices cars, smart meters, can be used to control the traffic. The main ides was to interlink almost every device. This is actually the GSMA describes as “Connected Life”.

The author in [4] had described the idea of network comprised of sensors that had been made feasible with the transformation of techniques used in micro-electro-mechanical systems. In the beginning the services related to sensors network along with sensing operation had been investigated, and on the basis of this the review parameters that had affected the sensor network was observed. After this the paradigms and set of rules were generated for all the layers in the protocol and the actual design of sensors network was presented.

The authors in [20] had created an electronic help desk system. In this system the SMS based technique had been implemented. The model proposed by the author operates automatically and the human operator was not required here to provide any data to consumer, student o employee. Whenever information is required by the user, then only an SMS need to forward to the system and in response the user will get the desired information. Various technical groups are working together to do experiments in the field of IoT. In [21] the main objective of Internet of Things is to determine the viability of IoT implemented in bus transportation controlling system in Singapore. In Singapore the transportation system is already advance but still there is large scope of improvement. The novice bus transportation system was developed using the IoT so that the passengers can easily distinguish between different bus services efficiently. After this, the research was conducted to forecast the timing of buses arrival and departure along with the passengers inside the bus

The literature [22] had proposes a 3 layer architecture of IoT for communication system comprised of transmission of high level voltage signal. The propose model was comprised of automatically organized sensor network, optical fiber composite overhead ground wire (OPGW), general packet radio service (GPRS) and the (COMPASS) navigation satellite system (CNSS). Operation of all the layers, implementation of various applications and efficient way to utilize the energy had been studied in this paper. The proposed technique can analyze the real time data transmission.

In [23], in present scenario the sensing, transmission and controlling techniques are improved significantly. This had resulted in enhanced cooperation among various communities. In order to discuss the obstacles that limit the further research in the field of IoT, a clear vision had been provided in this paper regarding the efficiency of Internet of Things in revolutionizing the whole world.

VI. CONCLUSION AND FUTURE SCOPE

This paper surveyed about various techniques that are used in Internet of things. At present the IoT is at emerging phase. From the paradigms which are used in different layers of IoT protocol it can be analyze that the IoT depicting the signs of improvement. Yet large amount of efforts are required to incur the improvements in the field of IoT applications and services. In future, Internet of things will surely change the standard of human living and revolutionize the whole world.

REFERENCES

[1] K. Ashton, That "Internet of Things" Thing", RFiD Journal, Vol. 22, Pp. 97-114, 2009.

[2] I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, Wireless sensor networks: a survey, Computer Networks 38 (2002) 393–422.

[3] A. Menon1, et al. " Implementation of internet of things in bus transport system of singapore"Asian Journal of Engineering Research(2013).

[4] Vandana Sharma et al, "A review paper on "IOT" & It"s Smart Applications", International Journal of Science, Engineering and Technology Research (IJSETR), Vol. 5, No. 2, Pp. 472-476, February 2016

[5] M.U. Farooq et al, "A Review on Internet of Things (IoT)", International Journal of Computer Applications, Vol. 113, No. 1, Pp. 1-7, March 2015

[6] Aishwarya Pandey, "A Review Paper on Internet of Things (IoT)", National Conference on Technological Advancement and Automatization in Engineering, Pp. 194-198, January 2016

[7] Pallavi Sethi et al, "Internet of Things: Architectures, Protocols, and Applications", Journal of Electrical and Computer Engineering, Vol. 2017, Pp. 1-26, 2017

[8] Somayya Madakam et al, "Internet of Things (IoT): A Literature Review", Journal of Computer and Communications, Vol. 3, Pp. 164-173, 2015

[9] Vaishnavi S. Gunge et al, "Smart Home Automation: A Literature Review", International Journal of Computer Applications, Pp. 6-10, 2016

[10] Sharon Panth et al, "Home Automation System (HAS) using Android for Mobile Phone", International Journal of Electronics and Computer Science Engineering, Vol. 3, No. 1, Pp. 1-10, 1956

[11] Nathan David et al, "Design of a Home Automation System Using Arduino", International Journal of Scientific & Engineering Research, Vol. 6, No. 6, Pp. 795-803, June 2015

[12] Jer-Vui Lee et al, "Smart Elderly Home Monitoring System with an Android Phone", Vol. 7, No. 3, 2013

[13] Ms.Pradnya et al, "Review Paper On Iot Based Technology", International Research Journal of Engineering and Technology, Vol. 4, No. 1, Pp. 1580-1582, January 2017

[14] Li Da Xu et al, "Internet of Things in Industries: A Survey", IEEE Transactions on Industrial Informatics, Vol. 10, No. 4, Pp. 2233-2243, November 2014

[15] P. Suresh et al, **"**A state of the art review on the Internet of Things (IoT) history, technology and fields of deployment", Science Engineering and Management Research (ICSEMR), 2014 International Conference on, November 2014

[16] Treffyn Lynch Koreshoff et al, "Internet of things: a review of literature and products", Proceedings of the 25th Australian Computer-Human Interaction Conference: Augmentation, Application, Innovation, Collaboration, Pp. 335-344, November 2013

[17] J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, "Internet of Things (IoT): A vision, architectural elements, and future directions," Future generation computer systems, vol. 29, no. 7, pp. 1645–1660, 2013.

[18] L. Atzori, A. Iera, and G. Morabito, "The internet of things: A survey," Computer networks, vol. 54, no. 15, pp. 2787–2805, 2010.

[19] R.Wang, F. Chen, Z. Chen et al., "Student life: assessing mental health, academic performance and behavioral trends of college students using smart-phones," in Proceedings of the ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp '14), pp. 3–14, Seattle, Wash, USA, September 2014

[20] Memon, Azam Rafique, et al. "An Electronic Information Desk System For Information Dissemination In Educational Institutions".

[21] I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, Wireless sensor networks: a survey, Computer Networks, Issue 38,Pp-393–422, 2002.

[22] A. Menon1, et al. "Implementation of internet of things in bus transport system of singapore" Asian Journal of Engineering Research, 2013.

[23] Stankovic, John. "Research directions for the internet of things." Internet of Things Journal, IEEE 1.1, Pp 3-9, 2014.

[24] Gartner, "Hype cycle for emerging technologies identifies three key trends that organizations must track to gain competitive advantage", March 2017,