Internet of Things in Reshaping Healthcare

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Abstract- *In the Internet of Things, devices collect the information and share the information with every device connected to them and the cloud, making it easier in collecting the data, recording and analyzing the data streams in a faster way. IoT has a lot of applications in healthcare. It is reshaping the modern healthcare with a very good technological, social and economic prospects. IoT offers greater promise in the field of healthcare, where its principles are used to improve the access and quality of care and importantly reduces the cost of use. There is no insufficiency of predictions about how IoT revolutionizes the healthcare by reducing costs and improving the quality. The development of State-of-the-art IoT based healthcare devices safeguards the health activities of the patients. Some of the IoT healthcare driven systems are sensors to collect patient's data, microcontrollers to process, analyze and for the wireless communication of the data, microprocessors that provide a rich graphical user interface, healthcare-specific gateways which analyze and send the data to the cloud.*

Keywords- Internet of Things, healthcare, cloud, applications, technologies.

I. INTRODUCTION

A wide range of appliances, devices, and objects interact and communicate among themselves using a set of technologies enclosed by IoT. As per the definition of Gartner[1], "Internet of Things is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment." The IERC definition[2] states that IoT is a, "A dynamic global network based on standard and interoperable communication protocols where physical and virtual things have identities, physical attributes, virtual personalities and use intelligent interfacesand are seamlessly integrated into the information network." The human being is the one who supplies most of the information and content on the internet so far, but in IoT small devices are the active elements that provide information frequently. Appropriate solutions are provided for different applications like smart cities, traffic congestion, waste management, structure health, security, emergency services, logistics, industries, health care. The most attractive areas of IoT are medical care and health care. Medical applications such as remote health monitoring, fitness programs, chronic diseases monitoring are possible with IoT. The growth of smart phones and tablets can be credited as the main contributor for the IoT. The mobile devices function as a window to the IoT world. A wide variety of tasks for the patients and doctors, besides mobility and connectivity, are performed by these mobile devices. The mobile revolution pushes the physical objects connectivity seamlessly using the cloud. Increase in the connectivity and communication between the devices leads to the exchange of huge amounts of data. This data needs to be stored, analyzed with different data analytic techniques in order to provide required information for both the patient and doctor. But, in the present situation, only the medical devices within the healthcare infrastructure are connected among themselves and this network provides access through medical applications available to the doctors.

II. PERCEPTION AND ARCHITECTURE

Based on the things, digital and semantic perspectives there are three main views of IoT[3]. All the three perspectives of IoT should be combined with each other seamlessly as shown in the following fig1, to extract the full advantages of IoT architecture[4].

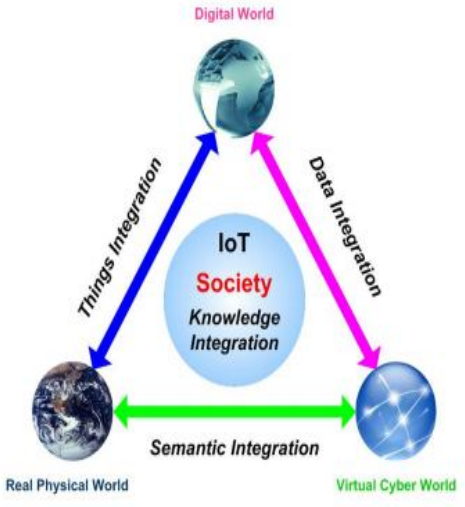

Fig.1 Vision of Internet of Things

Things oriented vision: This vision provides the view that sensors can be attached to the real physical objects to obtain the real time information. This can be achieved by sensors based network of embedded devices using RFID, NFC etc. It

is the base for combining of all "things" using various sensor based networks to integrate and co-exist together.

Internet oriented vision: It provides the view that it is possible to connect the devices through internet and they can be described by using a unique IP address for each and every object connected. It is the base for combining the data of small objects that are monitored continuously.

Semantic oriented vision: It provides the view that all the data that is collected from sensors is to be analyzed for meaningful study. It is achieved using semantic techniques that separate raw data from meaningful data. It is base for the semantic combination through the use of semantic middleware.

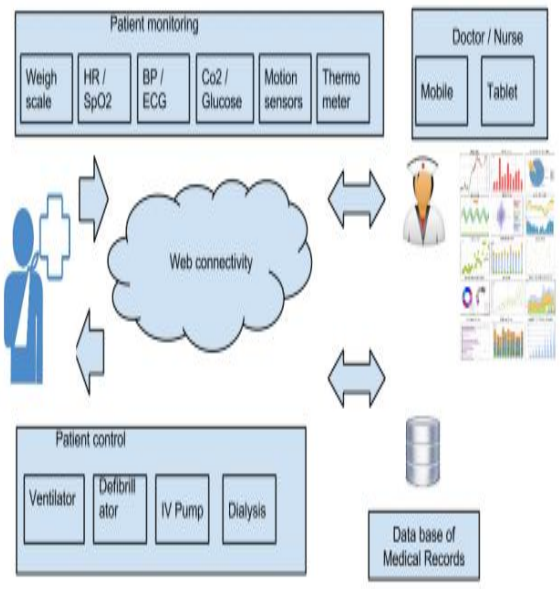

Fig.2 Architecture of IoT in health care

Physical world data including human health data is transformed to the digital world using sensors and the digital data to physical actions using actuators. The IoT devices consists of sensors to receive signals from the environment for analysis or actuators to control the environment based on the inputs. These devices are connected to each other through internet and cloud to communicate with similar devices and people as shown in fig 2.

III. HEALTH CARE TRENDS

Based on the view of technology, functionality, and the advantages, the current situations in the healthcare can be classified in different ways [5]. Most recent trend is that smartphones are being launched with health sensors in accessories like wrist gear. This permits the mHealth, that refers to the usage of mobile and wireless technologies in the field of medicine and the monitoring of public health. As a result, the medical errors can be reduced based on continual monitoring practices. Tracking of objects and people, authentication and identification, automatic data collection and sensing are some of the IoT applications that are classified based on the functionality. These application areas in medical field can be used to analyze the health care trends. Based on the usage of IoT concepts and the advantages some of the application areas are wireless patient monitoring systems like pacemakers and automatic defibrillators, medical devices like digital glucometers, blood pressure devices and pedometers. Physiological data that is received from wireless devices is a valuable contributor for management and prevention of chronic diseases, to monitor patients post hospitalization. Subsequently, an increased number of medical devices are becoming wearable these days. So all the data is stored and monitored in real time in order to see the trend along with analytical capabilities of the modern systems. Internet of Things helps the medical organizations to take critical data from different sources in real-time, and increases the decision-making capabilities. As a result, the productivity is increased by providing a path for better care towards the patients.

IV. CHALLENGES AND ISSUES

The world of IoT faces many challenges in different ways like technical, market-based and socio-ethical considerations. The major objective is to protect the privacy of data which is the major cause of other challenges. The development of the Internet of Things will be inhibited if the privacy is not protected by the combined work of government along with the society and private sector members.[6]

- *Scalability* – Huge volumes of data is to be processed becuase, a large number of IoT devices are connected to a network. Due to this reason, the systems which are used for analyzing and storing the data are to be scalable. In the present situation of IoT evolution, everyday objects and people are connected to each other. Big data analytics and cloud storage can be used for interpreting meaningful data from the raw data.
- *Interoperability* -- In most of the areas, technological standards have not developed completely. These technological needs should meet the demands of people. A common framework should be established to standardize the IoT devices. Interoperability of IoT devices with legacy devices is considered critical, as the standardization process is still lacking behind. Because of this issue, it is not able for people to move towards the

vision of truly connected smart things, that are interoperable.

- *Lack of support from Government*–Government should play an important role in regulating the safety and security of the devices by setting up the standards for IoT devices.
- *Safety of patients* – As the IoT devices are attached to the real world objects, they are left unattended for most of the time. If these are used as wearable or implantable objects for patients, any violation in the security may cause life threatening issues.
- *Design challenges* – The challenges that are faced in designing IoT devices are a limited amount of energy, memory and computation powers. With the help of faster growing technology, these design issues can be met in the future.

V. CONCLUSION

All the physical objects work with machine-to-machine and human-to-human interfaces seamlessly. It is a boon for healthcare, where internal and external factors related to health of the human body can be analyzed based on the model. The mobile doctor apps should work along with experienced doctors rather than replacing them. This approach complements doctors with the technology based on inputs and the new trends in IoT have the capacity in changing the way the primary care is given to the patients. IoT has revolutionized the delivery model for healthcare with good quality at affordable prices. Diagnostic devices for detecting epidemic diseases like malaria and cholera, are the proposals of IoT devices for the developing world. It is evident that IoT will propose new business models and new healthcare delivery models in the future for developing world, irrespective of the challenges faced in the present situation

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