Survey on Smart Healthcare: An Application of IoT

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ABSTRACT: Internet of things with their growing interdisciplinary applications has transformed our living. Smart Healthcare being one such IoT application connects smart devices, machines, patients, doctors, sensors to the internet. Healthcare has become a major socio-economic concern when it comes to health expenses, requirement and availability of resources, and personal care especially for senior section of the society. In efficient and smart manner, this new healthcare trend has made it possible for doctors in remote monitoring, chronic disease management and elderly care of the remote patients and even looking after the institutionalized patients by remaining connected to the internet. This paper surveys various trends of smart healthcare that have changed the traditional healthcare system by making health management more efficient through their applications.

Keywords: IoT, Smart Healthcare, IoT healthcare application, IoT security, open issues and challenges.

I. INTRODUCTION

Internet of things is an ever growing network of smart objects connected to each other through the internet. Internet of things has played a remarkable role in improving the quality of life. The various interdisciplinary application of internet of things includes smart healthcare, smart cities, automation in industries, agriculture, transportation where decision making is tough. The sensing devices and objects in IoT sense and collect relevant information which later on can be processed, analyzed for better decision making. Thus allows the physical objects in real-world to connect together to deliver computation based performance. Hence, IoT is an establishing network of smart devices, actuators, smart phones and objects embedded with processors low on memory and connected to the network to collect and exchange information to avail desired services[1]. This paper includes the smart healthcare using internet of things. IoT allows various dynamic applications connecting machine-to-machine, sensor-to-device, patient-to-devices, and patient-to-doctor and device-to-doctor communications. The healthcare IoT have many applications including remote monitoring, early prevention, chronic disease management, elderly care, medical treatment for institutionalized patients etc. It allows us to establish intelligent connections assuring an effective healthcare system.

But even with the advantages certain loopholes are associated relating to their security and privacy that are the key issues of concern for IoT applications. The healthcare application of remote monitoring [2-3] shown in figure 1 allows the doctors to remain connected to the patients remotely thus can provide care to them whenever the need arrive. The sensing devices may be wearable, implanted or the sensors present in the nearby environment are connected to the internet from where the doctors or caregivers can provide effective and timely medication to the patients.
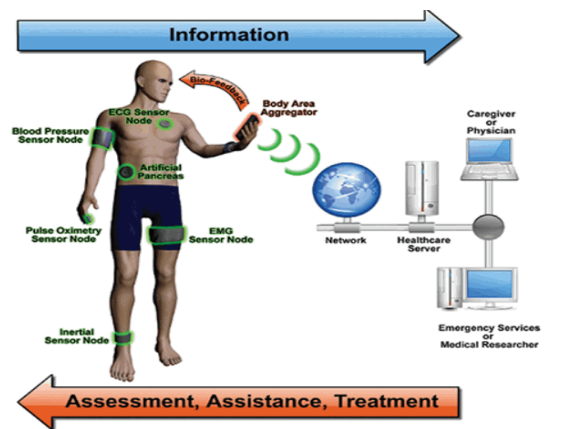

Fig. 1. Shows Remote Health Monitoring application.

For the old age population in the society, healthcare is a major socio-economic concern so providing elderly care or personal health assistance to them may solve the problem to some extent. This paper survey the smart healthcare applications along with the major security concerns and the prevailing open issues and challenges that are need to be overcome.

Paper outline- Section II throws light on the various applications of smart IoT healthcare that have significantly transformed the traditional way of care giving. Section III discuses the major security concern of healthcare IoT along with certain issues that exist due to the lack of security requirements in IoT healthcare applications. Section IV highlights the open challenges and issues that are of major concern and hence require attention. At last section V concludes the entire study about the smart healthcare.

II. IOT HEALTHCARE APPLICATIONS

The section addresses the various healthcare applications of remote monitoring of patients, elderly care, remote medication, telemedicine and providing consultancy through smart applications.

A. Remote patient monitoring: This application is deployed for remotely monitoring the patient's essential parameters through the use of sensors, devices and objects surrounding them. In this, the real time critical data of the patient is transmitted and shared between the patient and the caregivers. Its main relevance is for chronic disease management such as diabetes, cardiac disease monitoring, asthma etc.

B. Mobile personal assistance: This application makes use of the mobile technologies to enable remote access to current clinical systems or care giving institutions. The smart mobile apps, portals, websites etc easily available to all have made the automation of e-health systems easy.

C. Smart devices: Smart devices in healthcare are used to store and manage key care parameters and to manage the captured disease data. They are mainly deployed for providing fitness solutions by tracking target activities and diagnostic devices used for storing data from devices. Mainly they are used as fitness solutions for tracking patient activities and smart diagnostic devices such as blood pressure devices, pedometers, Google glass, etc used for capturing the data from the sensors for further analysis by doctor.

D. Telemedicine: This application provides virtual assistance through remote connectivity and efficient solutions enabling virtual care consultation, medicine delivery, education etc.

The diagnosis of providing remote medicinal assistance such as tele-consultations, mobile video solutions has become very common in few countries and markets.

E. Elderly care: This application clinically monitors the aging population for making them independent. These devices include wearable and implanted sensors for monitoring the elderly patients without requiring individual intervention. The monitoring devices track the vital signs of elderly care and transmit them to a standard mobile device which serves as a node for transmitting the real time data to the doctors. The information thus collected can be used to provide medical assistance to the elders and in case of emergencies, nearby hospitals can be alerted.

F. Smartphone apps-an effective solution: Smartphone apps can be used as an interface to provide care giving to the needful. Various open source apps for providing healthcare solutions are developed to provide efficient healthcare facilities. Few of them are diagnosis apps(Diagnose, 5MCC, Prognosis, 5-minute infectious disease consult),drug reference apps(Medical doctor: reference tool, Epocrates, FDA drugs, Lab values),calculator apps(MedCalc, caddy medical calculator, uBurn lite), clinical communication apps(Voalte one, mVisum, Vocera)etc.

III. SECURITY ISSUES IN IoT HEALTHCARE

So far as the research work has been done, the security and privacy of the patient are of major concern. The security requirements shown in figure 2 need to be fulfilled in order to ensure the security in IoT healthcare. Also due to lack in fulfilling these security requirements, certain challenges or issues shown in figure 3 impose big problems.
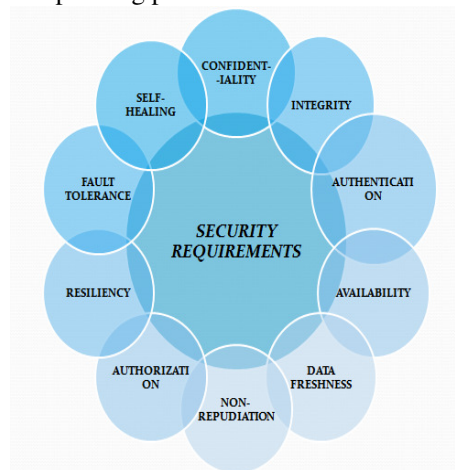

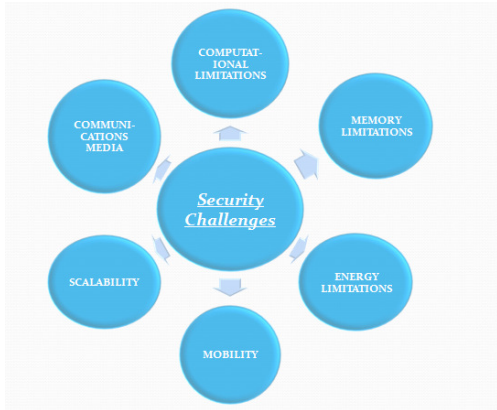**Fig. 2.** Security requirements in IoT Healthcare.

Fig. 3. Security challenges in IoT Healthcare.

Smart IoT devices are computationally constrained due to low-speed processors. These devices are designed for constrained environments performing cost in-efficient operations and for increasing their efficacy, a security solution minimizing resource consumption and maximizing security is the need of hour. Same is the case with memory computation also as these devices do have a limited on-device memory and hence only lightweight protocols or programs can be executed. The smart devices used in IoT healthcare such as blood pressure sensor, temperature sensor etc have limited battery power and thus save power by activating sleep mode when no reading needs to be reported. Thus, an effective design solution should be implemented to deal with the energy, power and computational limitation of these devices. Other security issues related to mobility and scalability need to be addressed [1].

IV. OPEN CHALLENGES AND ISSUES

This section highlights the trending open challenges and issues related to healthcare IoT:

1. With the rapid advancement of IoT, billions of smart devices and objects get connected to the internet. These smart devices collect huge amount of data that need to be processed, analyzed and even stored for future use. Hence scalability of IoT network and devices tend to be a major concern.

2. Technological convergence helps in establishing a standardized framework for the IoT devices. Due to lack of standardization, interoperability of the things becomes a serious issue to consider and by working on it we can achieve the vision of very-well connected interoperable smart devices.[4]

3. An active participation of the government bodies towards building regulations for safety and security of objects, devices and people associated should be considered.

4. In remote monitoring of the patients, sensors being implanted or wearable may sometimes refrained from attention may cause a threat to the security of patients that can become critical. [6].

5. Since IoT is an open network hence security requirements like confidentiality, integrity, and availability of patient's data should be ensured so that threats related to security and privacy can be dealt with.

6. As the IoT technology is improving at fast pace, the challenges pertaining to design issues need to meet in the future. These challenges include overcoming energy limitation, memory and computational limitations in IoT smart devices [5].

7. Since effective healthcare is everyone's right. Hence IoT-based healthcare services may be perceived as a low-cost technology.

V. CONCLUSION

This paper briefly reviews the advance trends in smart healthcare as an IoT application that has transformed the conventional medical system. Smart healthcare systems have reduced the complexity and the complications associated with the use of IoT environment. The vital information regarding the patient's health is recorded by the deployed IoT objects leading to efficient decision making. This paper addresses the various ways in which the healthcare can be provided to the needful patient through remote monitoring, elderly care management, virtual consultancy etc. Also there is a need to provide security and privacy of the healthcare data to improve quality of life of every person associated. This survey highlights the current security challenges along with the open issues imposing threats to the researchers. Hence a standardized framework should be proposed which will reduce security risk and overcome the open issues of constrained environments, cost-effectiveness, scalability and interoperability of healthcare applications.

REFERENCES

[1]. S.M. Riazul Islam, MD. Humaun Kabir, D. Kwak, Kyung-Sup Kwak, Mahmud Hossain, "*The Internet of Things for Health Care: A Comprehensive Survey*", date of publication June 1, 2015, date of current version June 4, 2015. 10.1109/ACCESS.2015.2437951.

[2]. K. Natarajan , B. Prasath, P. Kokila,"*Smart Health Care System Using Internet of Things"*, Journal of Network Communications and Emerging Technologies (JNCET) www.jncet.org Volume 6, Issue 3, March (2016).

[3]. Ashok Khanna Business Head UK, EU and Major Accounts, Life Sciences (EIS) Global Head, Presales and Solutions for Life Sciences (EIS) Prateep Misra Research Area Manager, TCS Innovation Labs ,"*The Internet of Things for Medical Devices Prospects, Challenges and the Way Forward"*.

[4]. *Internet of Things: From Research and Innovation to Market Deployment* - IERC 2014. http://www.internet-of-thingsresearch.eu/pdf/IERC_Cluster_Book_2014_Ch.3_SRIA _WEB.pdf.

[5]. D. Christin, A. Reinhardt, P. Mogre and R. Steinmed, "*Wireless Sensor Networks and the Internet of Things: Selected Challenges*," in Proceedings of the 8th GI/ITG KuVS Fachgespräch "Drahtlose Sensornede, pp. 31-33, 2009.

[6]. C. Li, A. Raghunathan, and N. Jha, "*Hijacking an Insulin Pump: Security A\acks and Defenses for a Diabetes Therapy System*" in IEEE 13th International Conference on eHealth Networking, Applications and Services, Columbia, MO, 2011, pp. 150-156.

[7]. D. Miorandi, S. Sicarib, F. De Pellegrinia and I. Chlamtac, *"Internet of Things: Vision, applications and research challenges",* Ad Hoc Networks **10** (2012) 1497–1516.