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IOT FOR HEALTHCARE AND ITS CHALLENGES

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ABSTRACT

IoT, the Internet of Things, is one of the most promising trend in the recent days, is however the scope of IoT is still not fully exploited. Therefore this paper emphasizes on the application of IoT in healthcare services. It discusses some of the probable reasons why there is less progress in IoT in concern of healthcare services. Some of the innovative ways which are proposed by experts are also mentioned accordingly. Despite of many challenges, a conceptual framework of IoT in healthcare and applications in emergency handling of accidents is discussed where the main advantages and major drawbacks are clearly mentioned.

KEYWORDS: IoT, Healthcare, Sensors

1. INTRODUCTION

VSee is video conferencing based software developed from a PhD project of Stanford University. During Syria refugee camp in Dohuk, VSee team were able to provide an eye clinic which even had the facility of surgery in just a room provided by the camp. VSee, using its main job in providing video conferencing, they were able to successfully establish a mobile eye clinic which could treat a number of patients during the camp. The team brought a telemedicine kit which included all necessary healthcare tools and devices which was needed for the clinic like stethoscope, sphygmomanometer, pulse oximeter, ultrasounds, otoscopes, dermascopes, etc. and the kit was connected to doctors remotely. The most interesting part was according to the need, the type of doctor and type of treatment the kit was totally customizable with only required devices. For example, if there is onlythe need of eye testing or just only the checking of only refractive error of the individual then the kit will selectively provide with the services of a Phoropter (refractor). The expertise could be provided to the patients in real time by VSee's basic service of video conferencing over a remote connection. With the help of real time conferencing and the experts, the technician could give treatment to the patients efficiently. This was a real time example of application of technology in healthcare services.

Today, people live in such an age where the probability of things to remain unchanged is negligible and competitions has reached to an extent where new innovations are more welcomed than a human birth. Companies have eyes and ears everywhere to grasp any new technology which has potential to bring a change and has the capability to keep their market an upper hand. One of those technologies is IOT (Internet of things) in healthcare market. When we talk about IOT, it is more advanced in other fields like house automation system, smart cities and much more smart automation systems but it is advancing in a turtle pace comparatively to other trends. Let us see some of the case studies in the same.

There is case of ABILIFY a drug which is for severe mental disorders (like schizophrenia, bipolar disorder, major depressive disorders). The drug is produced by a Japanese based pharmaceutical company known as Otsuka Pharmaceutical Co. Ltd. And lost its patent to bothEU and US. Eventually Otsuka collaborated with Proteus a software package from Labcenter Electronics Ltd. Which provides ingestible sensor technology. Approximately 50% of patients don't follow prescription in a proper manner and the ingestible devices will provide information to healthcare professionals for treatment and diagnostics. However, the protocols and there is a bound of this Proteus sensors controlled by Food and Drugs Administration (FDA) and the total approval is still in progress.

Sanofi and Novo Nordisk are some of the pharma companies forming partnerships with tech industries like Verily (which was formerly Google Life Sciences) and IBM to ameliorate diabetes treatments. These can be seen as a step towards the improvement of healthcare using computing technologies. In this case study, we can see that Verily which is highly reputed for data analysis and low energy electronic chip will facilitate Sanofi's expertise in diabetes as

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an example of healthcare improved by technology. Patients' health status is constantly monitored in real–time which is an achievement of the mentioned combination.

It is said that there is no official or standard definition of IOT. However, the mantra it follows is A's- Anytime, Anyone, Anything, Anyplace and Any service. In conventional methods, things are merely things only but IOT labelled things as 'smart objects'. Ideally, technology would no more limited to just computing devices like PC's, laptops, smartphones, supercomputers etc. IOT is being facilitated and brought to an era by new technologies of computing like AI, cloud computing and broadly speaking better storage and communication techniques. IOT has also its own long story where the turning point can be seen in the "The Computer for the 21st Century" of 1991 in which Mark Weiser mentioned about 'ubiquitous computing'. Many experts see IOT in multiple ways where it is seen as revolution to automation and computing system whereas some can describe it as an evolution to the existing internet. Here we wouldn't be comparing or contrasting those ideologies but rather we will be looking how IOT can collaborate with different technologies like sensor technologies, information technologies, networking technologies etc. to bring a change in our selected scenario that is, healthcare services. To be very accurate, the advancement of IOT in the fields of healthcare is not as great as peoples' expectations.

Healthcare system mainly includes monitoring, supervising, analyzing and diagnosing, consultation etc. Which can be achieved using sensors, actuators and monitoring device through a network. It can be seen as a distributed medical system where laboratories, medical staffs, emergency kits, patients can communicate efficiently through a portal system. As already mentioned, it has not advanced much in this field so the initial was monitoring where the most common scenario is where heart rate is being monitored. However we cannot conclude that it remained stationary, it is expanding to treatment where it is used as an application to acute diseases, lab testing, communicable or infectious diseases, epidemic, surgery etc. Therefore companies are quite thirsty of innovations in this field. For better understanding the trend the following are some real time examples showing the height of growth:

- Edisse was developed by group of Sydney students under Incubate accelerator program and this watch is to detect fall which is most useful for old age people and the care taker can track easily and respond as quickly as possible. It uses a sensor, accelerometer for detection of unusualness in movement, GPS, SMS, and a remote connection.
- miPlatform, for easier clinical usage of microscope, is a combination of smartphone and a microscope and provides a better or high quality images.
- Garmin, a company renowned for in-car navigation introduced Vivosmart which is a blend of smartwatch with activity tracker. It is basically an alert system where it can control some applications of your smartphones along with notifications of fitness related exercises for example let's say walking in a treadmill.
- UP3 is introduced by Jawbone which has the facilities of heart monitoring, sleep monitoring (light, average and deep calculation), smart coach (like fitness coach) and activity tracker (records movement).

In this paper, we prepared some of the related works in concern of our topic in Section 2. Moreover the conceptual framework of IoT in healthcare services is being presented in the following Section 3. After that some of the most prominent research challenges are being discussed. In the latter part, we concluded with a future scope of what can be done for improvisation of the current trend.

2. RELATED WORKS

Chen et al. [1] put forth the problems and in efficiencies of using wearable devices and suggested a better way of utilizing IOT and other technologies for healthcare. Here, the idea of "Smart Clothing" is introduced where they provide a detail clothing design which supports applications like emergency response, disease diagnosis, emotion detection etc.

For a definitive healthcare in increasing dependency on technologies, introducing smart healthcare cannot be overlooked therefore a Sensor-Cloud framework is being proposed by Bhunia[2]. Moreover the appropriate routing schemes of the users' mobility pattern is being discussed.

In healthcare the main interest is constant monitoring which is only possible with an appropriate data transferring system so the Paschou et al. [3] gave a clear vision and ideas, metrics and methods of how transfers can be done optimally with lesser cost with a maximization of capabilities.

In additional to the conventional functionalities of gateways like translating between protocols of the ends, there is an introduction of a smart e-health gateway by Rahmani et al. [4] where it can handle some responsibilities of sensors as well as remote e-health centers and high level services like local storage, real-time local data processing, embedded data mining, and much more.¬¬

For a connection IOT is highly compatible with WSN for data transfer as it can provide low cost, long life, fast deployment, low maintenance, high quality service and much more are discussed by Mihai T. Lazarescu [5].

In healthcare services, the most fundamental thing is self-management. To enhance the mechanism of self-management, Lee et al. [6] effectively found out an intelligent model which can give feedback to the user or the patient. For that there is a combination of protocols for risk factors and personal health devices. Moreover an intellectualized service application algorithm for personal health device is also proposed.

Babu et al. [7] elaborated the role of IOT and its advancement to achieve smart healthcare in healthcare field and how it is useful in collecting information from the patient and sending remotely to healthcare centers. It describes how it is useful not only for patients but also for common users to detect any body anomalies from time to time.

There is an introduction of internet of bio-Nano things which is possible due to concepts of Nano scale devices. Akyildiz et al. [8] shows how it can be seen as a journey to combine synthetic biology with nanotechnology to cultivate the applications of IoBNT (Internet of Bio Nano Things).

There are still some security concerns also like in [14], as we will have to observe the behavior of criminal psychology, analyze [15] and prevent our system from them. Likewise, here healthcare systems with IoT has its own security concerns as there is less security mechanisms. Additionally, there may be lot of variable constraints at the users' end which have to be compromised at the medical service side.

3. FRAMEWORK FOR IOT IN HEALTHCARE

Hardware

When we talk about IOT products, the components that come first in our minds are Raspberry PI, Arduino Yun, Beagle Bone Black, etc. These are SBCs (Single board Computers) which has sensors and has its own network functionalities. Windows 10 IoT Core has many applications like reading sensor data, controlling actuators, connecting to cloud, creating IOT applications etc.

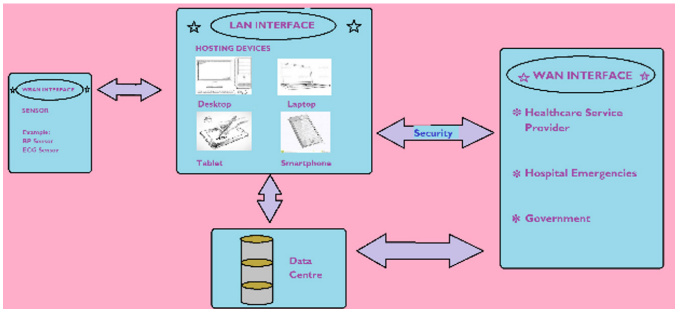

Figure 1: Conceptual framework of IOT for Healthcare

3.1 Sensors:

Sensors will consists of those hardware devices which are directly in contact with the patient or the users. It may be connected to themselves through Wireless Body Area Network (WBAN). These can be in wearable devices or implanted machines which can detect any changes in the users' body physical condition.

3.2 Hosting Devices:

Itwill consists of those devices through which the sensors will be connected and send those information to the caretakers or even to the data centers as a data and to healthcare services for monitoring and further actions.

3.3 Medical Care centers:

They are those bodies which are responsible for monitoring the users' condition and giving treatment accordingly and can be connected through a WAN interface.

3.4 Data centers and repositories:

These are dedicated for the storage of all the records of the users who are registered for this system.

The sensors will be sensing the patients physical changes and will be sending information to the medical service centers, related government authorities (if needed), hospital casualties if it is of emergency cases where the information transfer must be provide with high security because of mainly two reasons that is patients confidentiality and the need of accuracy of medical data. The physical changes mentioned above may varies from simple blood pressure, blood sugar level, heart beat rate measuring devices to smart pill dispenser, mood and emotion detection of the patient.

4. RESEARCH CHALLENGES

In the above sections, it is already mentioned that there is no rapid progress in the growth of this field. But most importantly, it is necessary to find out where is it going and where did we overlook which led to such consequences. Therefore, the following are some of the most probable loopholes which is preventing the progress.

Data management and Scalability: The main issue in current IOT is its connection to the network and data transfer and storage. It is understandable that cloud computing and big data handling surely uplifts IOT in healthcare but this is not that easy as said. Scalability sound very vast but somehow it is needed as there are billions of devices and data to be handled and processed.

Interoperability: One of the most important issue here is technologies and standards are scattered and there is surely lack of interoperability in real time though theoretically many ways are proposed, implementation is still lacking.

Lack of support: In the above sections, it is mentioned that the expansion level is fully in the hands of FDA in a case study, similarly there is no less cases of lack of support from regulatory bodies and government. A proper assessment and support from higher authorities has still has a long way to go.

Technological side effects: From healthcare point of view, healthcare devices may turn to something which is opposite of its real purpose. No doubt, it is made as healthcare devices however they are devices which can again more human health vulnerable in many cases due to many reasons. For example, patient is wearing it more continuously and for data transfer and other purpose it's still using many frequencies to connect to network and eventually the radiation itself can deteriorate patients' health slowly. It is a very critical issue.

Security: Perhaps, there is a big compromise between IOT implementation and security issues. It is not too much to say that security and privacy has not improved much in recent years also. CIA- Confidentiality, Integrity and Availability which are main components of security are not paid much attention in implementations.

Miscellaneous issues: Though there is a great progress in designing IOT systems there are still issues regarding design. Some may be due to limited hardware capability, limited memory, or limited technology etc.

5. CONCLUSION AND FUTURE SCOPE

Following the theme, IOT and its related technologies can be used in an effective manner in emergency purposes like accidents handling and first-aid provision. It can be discussed in two different ways:-

First, we can introduced wearables and smart clothing ideas and before an ambulance even arrives, the emergency ward which is connected remotely can scan immediately to take further actions. The advantage is, health experts and doctors can remotely instruct what dos and don'ts while giving first-aid procedures as they got the information thoroughly from the devices attached. After admitting to emergency ward, treatment may become hopeful. In some cases, smart clothing can have mini emergency devices kit attached for these purposes. The limitation is that there should be registration to protocols of multiple hospitals and healthcare centers and a single standard for all health centers can be approved with much difficulties and conflicts managerially and financially.

The more feasible solution would be devices provided by ambulance personnel. And it is somehow implemented in some cases. But the flaw here is, ambulance takes average of 95% of target time if conditions are favorable and there is some cases where the accident is severe and needs immediate actions. This way may not prove to be very efficient and effective for those. Additionally, taking scans from a moving body may not be accurate which may lead to ambiguity in treatment.

All the physical objects work seamlessly with machine to-machine and human-to-machine interfaces but IOT will bring an interoperability and interconnection between these and this will ultimately lead to bloom to healthcare services explicitly and implicitly. There is a big gap between the promises given by IOT services and healthcare trends. The reasons may varies from security issues (from network point of view), uncertainties (from sensors and hardware based), patients' consents and much more reasons. As it is in its infancy stage, the cost and monetary values are not given much priorities which consequently leads to the myth that these smart objects synonyms to expensive things. Somehow it is shown that IOT in healthcare is somehow lacking behind other advancements and researches. So, there is clearly a need for a thrust to push forward the ideas in this area as it can be seen that there are many things like hardware and technologies to cooperate in a perfect sync to accomplish the most awaited and desirable progress. This will bring a new era of lifestyles, health status, technologicalchange in a positive manner.

6. REFERENCES

1. M. Chen, Y. Ma, J. Song, C.-F. Lai, and B. Hu, "Smart clothing: Connecting human with clouds and big data for sustainable health monitoring," Mobile Networks and Applications, vol. 21,no. 5, pp. 825-845, 2016.
2. S. SankarBhunia, "Adopting internet of things for provisioning health-care," in Adjunct Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2015 ACM International Symposium on Wearable Computers, 2015, pp. 533-538.
3. M. Paschou, E. Sakkopoulos, E. Sourla, and A. Tsakalidis, "Health Internet of Things: Metrics and methods for efficient data transfer," Simulation Modelling Practice and Theory, vol. 34,pp. 186-199, 2013.
4. A.M. Rahmani, N. K. Thanigaivelan, T. N. Gia, J. Granados, B. Negash, P.Liljeberg, and H. Tenhunen, "Smart e-health gateway: Bringing intelligence to internet-of-things based ubiquitous healthcare systems," in 2015 12th Annual IEEE Consumer Communications and Networking Conference (CCNC), 2015, pp. 826-834.
5. M. T. Lazarescu, "Design of a WSN platform for long-term environmental monitoring for IoT applications," IEEE Journal on emerging and selected topics in circuits and systems, vol. 3,no. 1, pp. 45-54, 2013.
6. B. M. Lee and J. Ouyang, "Intelligent healthcare service by using collaborations between IoT personal health devices," blood pressure, vol. 10,p. 11, 2014.
7. B. S. Babu, K. Srikanth, T. Ramanjaneyulu, and I. L. Narayana, "IoT for Healthcare," 2016.
8. I. F. Akyildiz, M. Pierobon, S. Balasubramaniam, and Y. Koucheryavy, "The internet of bio-nano things," IEEE Communications Magazine, vol. 53,no. 3, pp. 32-40, 2015.
9. S. M. R. Islam, D. Kwak, M. D. H. Kabir, M. Hossain, and K.-S. Kwak, "The internet of things for health care: a comprehensive survey," IEEE Access, vol. 3,pp. 678-708, 2015.
10. A. Kulkarni and S. Sathe, "Healthcare applications of the Internet of Things: A Review," International Journal of Computer Science and Information Technologies, vol. 5,no. 5, pp. 6229-32, 2014.
11. C. Perera, A. Zaslavsky, P. Christen, and D. Georgakopoulos, "Context aware computing for the internet of things: A survey," IEEE Communications Surveys & Tutorials, vol. 16,no. 1, pp. 414-454, 2014.
12. G. Sebestyen, A. Hangan, S. Oniga, and Z. Gal, "eHealth solutions in the context of Internet of Things," in Proc. IEEE Int. Conf. Automation, Quality and Testing, Robotics (AQTR 2014), Cluj-Napoca, Romania, 2014, pp. 261-267.
13. P. Vlacheas, R. Giaffreda, V. Stavroulaki, D. Kelaidonis, V. Foteinos, G. Poulios, P. Demestichas, A. Somov, A. R. Biswas, and K. Moessner, "Enabling smart cities through a cognitive management framework for the internet of things," IEEE Communications Magazine, vol. 51,no. 6, pp. 102-111, 2013.
14. N. Zhu, T. Diethe, M. Camplani, L. Tao, A. Burrows, N. Twomey, D. Kaleshi, M. Mirmehdi, P. Flach, and I. Craddock, "Bridging e-Health and the Internet of things: the SPHERE project," IEEE Intelligent Systems, vol. 30,no. 4, pp. 39-46, 2015.
15. A. Bijalwan and E. S. Pilli, "Crime Psychology Using Network Forensics," Computer Engineering & Information Technology, vol. 2014, 2015.
16. A. Bijalwan, N. Chand, E. S. Pilli, and C. R. Krishna, "Botnet analysis using ensemble classifier," Perspectives in Science, vol. 8, pp. 502-504, 2016.