

Internet of Things in Telemedicine: a Discussion Regarding to Several Implementation

¹REHAN SHAMS, ²FOZIA HANIF KHAN ³MUHAMMAD AAMIR AND
⁴FAIZAN SALEEM

^{1,4}Department of Telecommunication Engineering, ²Department of Mathematics, ³Department of Electronic Engineering, Sir Syed University of Engineering and Technology

¹r.shams@hotmail.com, ²ms_khans2011@hotmail.com, ³muaair5@yahoo.com,
⁴mfaizan2001@yahoo.com

ABSTRACT

With the increase of health requirement, the idea of telemedicine turns in to reality. By the help of effective audiovisual and data communication, the process of practice of medical care that includes the delivery of medical care, consultation and treatment, diagnosis, transferring of medical data as well as health education is termed as Telemedicine [1]. Most of the actual implementation of telemedicine system is done by traditional video conference tool, which is somehow becomes not very supportive as far as the complex medical activities are concerned. So this paper discusses the effects of different implementation regarding to telemedicine by the internet of things. There are many ways of telemedicine which are implementing according to the available sources of Internet of things (IoT), the idea of this paper is to highlight those ways and discusses that how much these available procedures are useful for the remote areas. Comparison will be done as a conclusion of this paper.

Keywords: IoT, telemedicine, healthcare, remote areas.

1. Introduction

Considered as the third wave of information technology after internet and mobile cellular system, telemedicine is categorized as comprehensive interoperability and intelligence. Electric Product Code (EPC) and International Telecommunication have introduced this terminology [2]. Initially there was online information and the people were able to connect through email and social networking sites. But today, there is a requirement that each object has to connect through internet and that is the main achievement of Internet of things (IoT) [3]. Internet of things refers that every object can be connected to internet and the information of this object can be globally shared by means of internet that makes it able to access from remote places [4].

IoT plays a crucial role in healthcare, there are so many ways in which IoT may be used, like in hospitals the number of patients can be tracked, indentifying the appropriate medicine for the patient as well as monitoring the patient's health from remote places, and this is termed as Telemedicine [5]. Previously developed researchers have given the ideas that the availability of telemedicine allows rural areas to cover wide variety of healthcare services which improves the quality of telemedicine [6, 7] and helpful in the retention of expert. The focus of this research is to highlight the available technologies in IoT for Telemedicine together with the analysis of availabilities of these sources in terms of their cost, available resources and most importantly, the quality or output of these technologies [8].

This topic is very vast and it is almost impossible to discuss all the available technologies in IoT for telemedicine. However this study is intend to provide the brief information about the topic together with the comparative result and discussion.

1. Need of Telemedicine in Developing Countries and rural areas:

Telemedicine is not a commonly known terminology till few years back because it became a decade that that telemedicine has been introduced. Telemedicine is nothing but the future of healthcare in advanced cities and under developed cities, although these facilities are easily available to the citizens of advanced cities [9]. However in under developed cities or in rural areas healthcare facilities in case of emergency are not easily available for the citizens. They are unable to get qualified staff and physicians, they have to depend upon the nurses and paramedical staff who are not that much qualified to handle those serious conditions where expert opinions are required. Therefore there is serious

requirement of telemedicine that can provide access to healthcare, with the reduction of outcome of healthcare costs and full fill the shortage of expert staff. In short online medical help in future will revolutionize the entire healthcare. Figure 2 is showing architecture of IoT for telemedicine.

2. Infrastructure of Telemedicine:

The most important factor for introducing telemedicine is an application is a high speed, secure and reliable telecommunication network that have sufficient transmission capacity which facilitates both economic and practical viability. As the telecommunication is the essential factor for introducing telemedicine applications. There should be zero tolerance infrastructure for telemedicine, however in most underdeveloped countries there is either absolute infrastructure or do not exist. Transmission capacity is a major challenge for telemedicine which is constant pressing need for advance and reliable technology [9]. A strong and reliable telemedicine centre must possess a satellite unit that should be run with high bandwidth, dedicated servers and high capacity routers that makes telecommunication networks one of the robust solutions.

3. Technologies Regarding to Iot In Telemedicine:

There are many applications in IoT domain such as healthcare, telemedicine, supply chain management, defense and agriculture. It plays a major broad range role in healthcare applications, managing chronic diseases at one end of the spectrum and preventing diseases at the other end [3]. The purpose of this research is to indicate the issues involved in the implementation of IoT technologies for telemedicine.

3.1 Telemedicine and Broadband:

Several numbers of cutting-edge approaches regarding to healthcare is facilitated by broadband. Of these most of them are expected to vast individual and national cost saving to increase the availability of healthcare services [10]. Particularly, in rural areas where the patients who generally do not have the access of quality doctors and staff as well as the advanced medical equipments can be greatly benefited from broadband-enabled telemedicine. It was initially started to linkup the rural patients with technically advanced hospitals and clinics for making these two places come closure. Furthermore broadband become more advanced in terms of its service qualities in their respective areas. Broad band helps in reducing the number of physicians needed in rural areas and setting up facilities where patients can be seen by their doctors remotely or consult with a specialist based in an

urban center. Provide physicians with an opportunity to continue their medical education via chat groups, videoconferencing, and Internet-based continuing education programs based in urban healthcare facilities as shown in figure 1.



Figure 1: Telemedicine through broad-band

4.2 Telemedicine and WSN and RFID:

The patient's health status is periodically sensed using RFID and sensors. "The doctor from a remote location provides medical assistance based on the information received. This technique encompasses a wide range of tools and services, including the use of sensors to record movements and the use of wireless devices to monitor vital signs and symptoms. Telemedicine is the delivery of clinical **care at distance** using electronic communications and information technologies practiced on the basis of real-time (synchronous), and store-and-forward (asynchronous) interaction [11]. It enables the retrieval of patient data from the medical equipment and remote change settings of device parameters, exchanging medical and context-related information objects among sites. Real-time telemedicine ranges from a simple telephone call to a robotic surgery, requires the presence of both parties at the same time and a real time communication link between them. Personalized healthcare might be seen as an abstraction layer of IOT. The power line communication and field bus enabled systems transforms the electrical energy distributions networks into the valuable components of the IOT. Wireless sensors gather real-world data, body- and ambient- sensor network services generate both behavioral and biological data.

Unobtrusive service delivery through computers and consumer electronic devices with various interfaces distributed throughout the home, and proactive human-machine interfaces (HMI) with context-aware sensing, motivate health-conscious behavior. Several sensors are available for tele-monitoring services. By combining RFID cell phones and RFID sensors with cellular networks or the Internet, the patient becomes empowered to read RFID sensor tags anywhere for almost any application. RFID reader interacts with the tag and sends a signal to someone for further elaboration RFID tag is a smart device equipped with an electronic chip and a smart antenna. RFID tag is a physical object, applied to a real world object in order to identify it, but it enable to gather additional knowledge about it. Recent examples include glucose monitoring, cardiac monitoring, UV monitoring, and biomarker skin test patches. RFID-enabled system [12] interprets the data about the physical objects and takes decisions locally or remotely, after communicating digital objects". The above-said transforming might be used to move physical objects vs. the Internet of Things as shown in figure 3.

4.2.1. Remote Monitoring:

In rural areas there are so many people who get suffered due to unavailability of active health monitoring. Now it is possible by means of small but powerful wireless sensors connected through IoT for the monitoring those patients. These sensors securely collect the patient's data and analyzing the data by complex algorithms and wirelessly share this information to the concerned health professionals for expert opinions and suggestions. As an example if any patient have cardiovascular diseases and treated with digitals can be easily monitor 24/7 for preventing drug intoxication. Arrhythmias on EKG could be easily detected, and for faster detection of cardiac issues, EKG data indicating heart hypoxemia is very successful [13] [8]. "The data collected may also enable a more preventive approach to healthcare by providing information for people to make healthier choices."

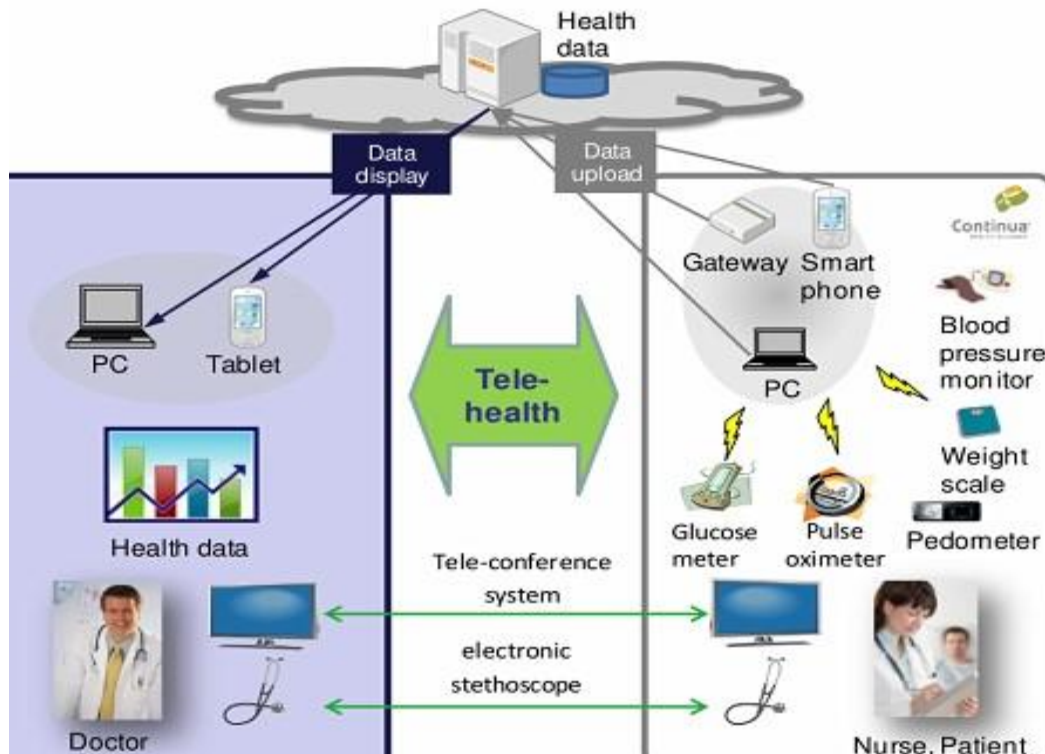


Figure 2: Architecture of IoT for telemedicine

4.3. Ability to Digitize Health Communication via Web-Based Services:

With the limitation of time and space conducting medical procedures face serious issues, with telemedicine technologies, where the practice of health communications and services provided in virtual domain. Particularly by the help of web-based medical and pharmaceutical companies (e-health sites) which provides worldwide information for every condition, such as drugs and other treatments. Anyone can be conveniently access these services and get the instant information. Otherwise this information could be obtained by physical visit and communication with medical practitioners [14].

In the same pattern several health care companies offers essential and wide variety of health information to internet surfers. Another way is to communicate with medical practitioners through e mail, due to this there is a direct correspondence and patients can stays at their homes and treat them by taking the direct advises. Some healthcare companies provide home delivery services and they will provide whatever you required on just a phone call or by e mail. This

will reduce the travelling cost as well as the time. Studies have prove that the demand of such facilities have increased sufficiently. By the above fact we can say that the demand of medical staff will be noticeably decrease in future, but in fact it has not done yet.

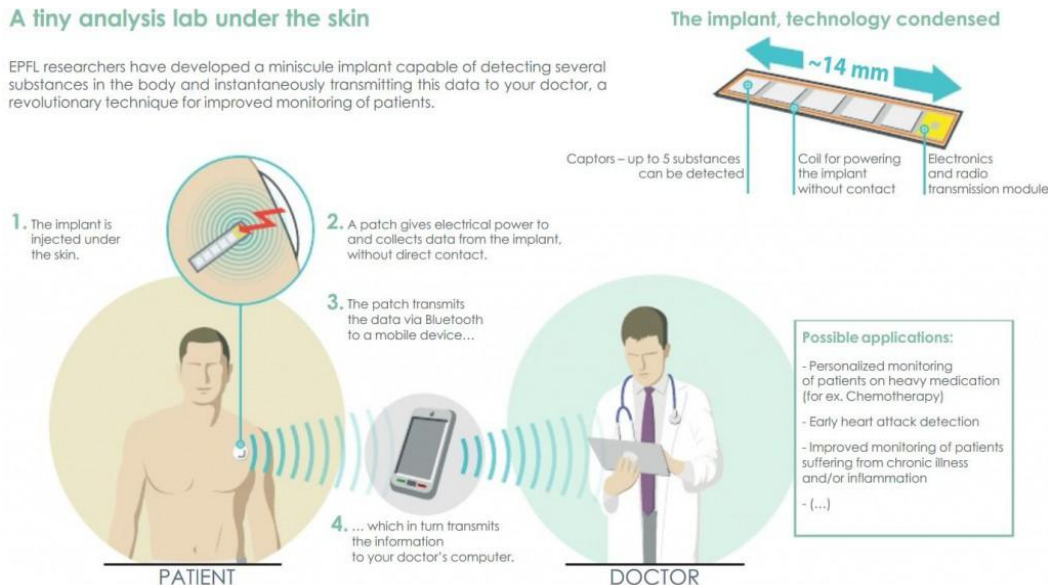


Figure 3: RIFD transformation from skin patch

4. Issues and Challenges in the Implementation of IOT technologies for Telemedicine:

As we have described earlier this study will not only highlight the IoT technologies in Telemedicine but this session will indicate those challenges and issues which can arise in the implementation of these technologies. Though IoT has been a boom in many ways, but still there are many challenges that have to overcome for the better results in telemedicine. Awareness of benefits of telemedicine among users and adaptation of technologies by health professionals is necessary [3] [2]. On the other hand it is also very important that the lay man should also adopt these facilities and benefits for the success of telemedicine through IoT. People should aware with the devices and equipments like sugar testing device and other patient monitoring devices for blood pressure and cardiac devices. Government should take a positive step for the deployment of any type of telemedicine services in different remote areas.

Now a day's everybody is using internet through different mobile cellular services. But very fewer of them are aware with the health care facilities which

Internet of Things in Telemedicine: a Discussion Regarding to Several Implementation

are available through internet. To avail these facilities people should be enough educated with the different available telemedicine technologies programme.

Another main issue is the privacy and reliability of confidential data, in case of RFID, any vehicle attached with RFID tag leads to lack of privacy for the passenger in the vehicle. It could be dangerous in such a sense that data present in health status could be mishandled by any intruder, have giving the doctor wrong information. Similar case can be applied for wireless sensor networks (WSN), any person can mishandled the data to generate false information. There should be a proper laws and policies to prevent the misuse of IoT technologies.

Table 1: showing the performance of different IoT technologies for telemedicine

IOT Technologies	Easily available	Awareness to users	Secure	Expensive	Easily deployed	Easy to apply	Out put
Broad band	Yes	Yes	Moderate	Depends	Yes	Yes	Moderate
WSN	Moderate	Not really	No	Moderate	Yes	Moderate	Better
RIFD	Yes	Moderate	No	Moderate	Yes	Moderate	Good
Web Base services	Yes	No	No	No	Yes	Yes	Moderate
Patient monitoring devices	Moderate	Moderate	Yes	Depends	Yes	Moderate	Better

5. Conclusion and Discussion:

The proposed study is the brief discussion about the IoT technologies for telemedicine. Which features of IoT are available for telemedicine and how much they are useful for the people in remote areas. Technologies like RIFD and WSN, broadband plays a vital role in many IoT applications like telemedicine and healthcare, agriculture smart building etc. but this study has mainly emphasized on telemedicine. Telemedicine through broadband as compare to WSN and RIFD is better in terms of its expenses cost and security. Our analysis is based upon the availability of these technologies, awareness to lay man, easy to access and apply and last but not the least security and output. Table 1 categorized these technologies according to the earlier mentioned points. In the end we have given the detailed analysis about the feasibilities of these technologies and what are

lacking about these technologies regarding to their implementation. In this study we have made the conclusion that although IoT is useful in so many domains, but its journey towards the destination is not very smooth. Several problems and issues are still there, that needed to be address. As an output we can say that in health monitoring devices like WSN and RIFD are providing better performance as compare to other technologies. If the above mentioned issues are properly handled than IoT will definitely be the global mantra.

References

- [1] X. Ming Zhang and C. Xu, "A Multimedia Telemedicine System in Internet of Things", 2010 2nd International Conference on Information and Multimedia Technology (ICIMT 2010) IPCSIT vol. 42 (2012) © (2012) IACSIT Press, Singapore, DOI: 10.7763/IPCSIT.2012.V42.28.
- [2] Yinghui Huang, Guanyu Li,"Descriptive Models for Internet of Things", International Conference on Intelligent Control and Information Processing, August, 2010 - Dalian, China.
- [3] D. Jain, P. V. Krishna and V. Saritha, "A Study on Internet of Things based Applications",
- [4] Daqiang Zhang, Laurence T. Yang, Hongyu Huang, "Searching in Internet of Things: Vision and Challenges", Ninth IEEE International Symposium on Parallel and Distributed Processing with Applications, (2011).
- [5] A. J. Jara, M. A. Zamora and A. F. G. Skarmeta." An ambient assisted living system for telemedicine with detection of symptoms". Third International Work-Conference on the Interplay between Natural and Artificial Computation. Lecture Notes, pp.75-84, 2009.
- [6] W. Dong, C. Liu, Design of Intelligent Telemedicine Monitoring Data Transmission Network", Proceedings of the 2nd International Conference On Systems Engineering and Modeling (ICSEM-13), Published by Atlantis Press, Paris, France.© the authors, (2013), 0834.

- [7] M. V. M. Figueredo, J. S. Dias, “Mobile Telemedicine System for Home Care and Patient Monitoring”, Proceedings of the 26th Annual International Conference of the IEEE EMBS San Francisco, CA, USA • September, pp. 1-5, (2004).
- [8] B. E. Whitacre, “Estimating the Economic Impact of Telemedicine in a Rural Community” *Agricultural and Resource Economics Review* 40/2, pp. 172-183, (August 2011).
- [9] R. Ebad, “Telemedicine: Current and Future Perspectives”, *IJCSI International Journal of Computer Science Issues*, Vol. 10, Issue 6, No 1, November (2013).
- [10] C. M. Davidson and M. J. Santorelli, “The Impact of Broadband on Telemedicine”, A Study Commissioned by the U.S. Chamber of Commerce, (2009), 1615 H Street, NW Washington, DC 20062-2000, www.uschamber.com.
- [11] S. Meystre, The current state of Telemonitoring: a comment on the literature, *Telemed.&e-health* vol.11, n.1 (63-69), (2005).
- [12] K. Finkenzeller, *RFID handbook* 2nd Edition, Willey, (2003).
- [13] Commission communication “Telemedicine for the benefit of patients, healthcare systems and society”, COM(2008) 689, final, 4.11.(2009). http://ec.europa.eu/information_society/activities/health/policy/telemedicine/index_en.htm.
- [14] J. Matusitz and G. M. Breen, “Telemedicine: Its Effects on Health Communication”, *HEALTH COMMUNICATION*, Vol. 21(1), pp. 73–83, Copyright © 2007, Lawrence Erlbaum Associates, Inc.