

A Comprehensive Study On Healthcare Applications using IoT

G.Kalaiselvi ¹

¹(Assistant professor and Head, Department of Computer Science, Krishnasamy College of Science, Arts and Management for Women, Cuddalore, India)

Abstract: The Internet of Things(IoT) is a process of interlinked computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers. IoT can transfer data over a network without the help of human-to-human or human-to-machiner interaction. A thing in the IoT, can be a person with a heart monitor implant, a farm animal with a biochip transponder or anyother natural or artificial object that possess IP address and ability to transfer data over a network. Applications of IoT technology plays vital role in agriculture, building management, telehealth, connected car, wearables, smart grids, smart retail and transportation. The concept of connected healthcare system and smart medical devices bears enormous potential. The applications of IoT in digital healthcare are real time location services, predicting the arrival of patients in PACU, hand hygiene compliance, tighten budgets and improve patient journey, from remote monitoring to smart sensors, and medical device integration. IoT technology is very much useful in open aps closed loop insulin deliver, connected inhalers, connected contact lenses, reporting mood and cognition and coagulation testing. In the next coming days, its amazing to hear the interaction of android apps with our medicine grows with massive power.

Keywords: Connected medicine, Open APS, Real Time Location system, remote sensor, wearables.

I. Introduction

The IoT has great impact in the healthcare industry and improve the lives of millions of people all over the world. IoT refers to a network of internet- enabled devices or things being able to connect and communicate with each other. The practical difficulties faced by the patients in diagnosing diseases, maintaining diet, controlling blood pressure and blood sugar level, coagulation Testing, etc., can be monitored and guided remotely.

This paper surveys emerging ideas in IoT based healthcare technologies and reviews the importance of those applications. This paper analyses the IoT technologies in patients healthcare through remote sensor in tracking informations of cancer patient, sentiment analysis through mood aware wearables, monitoring blood sugar level through interscatter communication, Warfarin used in coagulation testing, Real Time Location system to monitor the temperature level, etc., From the literature review its clear that IoT technology not only possess capability to safeguard patient's health but also improve physician to deliver the care as well. This paper analyzes the innovative revolution made in healthcare with modem technologies using IoT.[3]

II. Literature Review

From the literature review, the concept of IoT and its role in healthcare applications, devices used for implementing IoT technologies are clearly revealed. This paper focuses on the difficulties faced by the patients and solutions through various devices in monitoring and tracking the diseases through digital medicine.

Advanced technologies in IoT such us cloud computing, Big data, grid computing, soft computing, etc., can be used in handling connected devices for monitoring and guiding patients health. Blood pressure and body temperature monitoring, electrocardiogram monitoring, wheel chair management, glucose level sensing, emergency healthcare can be provided through connected devices anywhere in the world.

From the reviews, devices like Warfarin, Wearables, automated wheel chair, wireless transmitters and receivers, Kit,etc.,can be highlighted. This paper proposes the IoT technologies used for remote monitoring healthcare, challenges and obstacles faced by IoT.

III. IoT Technologies

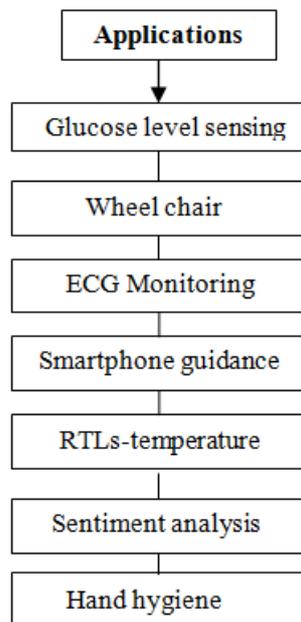
The massive growth in developing technologies can make anything possible. The Iot based technologies serves lot to the betterment of medical society and for the patients requiring telemedicine.

Healthcare applications can be handled efficiently with the IoT technologies such as cloud computing for offering services on request, grid computing for better network through medical sensor nodes, big data for monitoring and diagnosing diseases, ambient intelligence for continuous assessment of human behaviour through devices, wearables for engaging patients all the time for connected information and population health information. .etc.,[4]

IV. Research Proposal

Emerging technologies in medical world could not provide that much benefit for the patients who are in need of remote guidance and security for their healthcare. IoT technologies and applications satisfies the needs and necessities of patients under cancer treatment, diabetes, blood pressure,etc., through connected devices.

This paper proposes potential benefits of mobilization of healthcare applications using IoT for the betterment of patients and shows the advancement in the information technology to the society. Figure captions appear below the figure, are flush left, and are in lower case letters. When referring to a figure in the body of the text, the abbreviation "Fig." is used. Figures should be numbered in the order they appear in the text.



Fig(ii)-Healthcare applications using IoT technologies

1. Applications of IoT:

Few applications of IoT in healthcare mentioned in Fig (i) is summarized as follows:

1.1 Open APS :

Open APS stands for Open Artificial Pancreas system. Using open source software patient can continuously monitor the glucose level through connected device. Due to security and practical difficulties such connected devices have taken some time to come to market.[4]

1.2 Hand Hygiene Compliance:

Maintaining hand hygiene is a inexpensive prevention measure to avoid increasing number of deaths, extra days of hospital stay and costs. Healthcare Acquired Infections(HAI) are infections that are neither present nor incubating when a patient is admitted to hospital. These are risks that hospitals must control to manage the healthcare economically safety for patients. These can be preventable by Hand Hygiene(HH) practice by professionals.[4]

In Gambification, the use of game elements and game designs used to motivate and stimulate them to maintain hygiene. Especially in ICU ward ,group of nurses can engage in funny games to motivate the patients to maintain hygiene.

1.3 Tracking During Cancer Treatment :

Informations about patients will be collected with the help of activity trackers. Patients will wear an activity tracker for some period of months till the treatment over. This type of trackers helps to measure the activity level, logging appetite level and all data will be saved to patients smart phones through specific app.[5]

This will help in diagnosing the patient's conditions every minute and treatment can be improved much better. This device tracking is particularly useful for cancer treatment.

1.4 Connected Inhalers:

IoT here allows doctors to keep accurate track of whether patients are strictly adhering the treatment or not. Devices connected to mobile apps allow patients to receive **informations**. Propeller's Bruzhaler device connects its digital platform through a sensor. This type of connected inhalers provide great motivation for patients.[6]



Fig(iii)-Connected Inhaler

1.5 Real Time Location Services:

Real Time Location systems have the ability to track the specified location of people within a certain area through wireless network. Doctors can use real time location services and track the devices for monitoring patients. Medical apparatus and devices like nebulizers, wheel chairs, scales, defibrillators, pumps or monitoring equipments can be connected with sensors and located easily with IoT.[7]



Fig(iv)-Temperature monitoring sensors

RTLs can provide better patient care, less waste of resources and bring more income for the organization. Benefits of RTLs on hospitals includes optimizing patient and staff flow, utilizing inventoried equipment and reducing redundant assets, etc.,[7] Some RTLs temperature monitoring system can sense temperature and humidity level of hospitals, refrigerators, freezers and operating rooms. Temperatures can then be tracked from one specified location remotely .RTLs ensure the safety of a patient rather than administrative duties that is cost effective.

1.6 Connected Contact Lenses:

The technology called “interscatter communication”, works by converting Bluetooth signals to wifi signals. This is based on existing method of communication called backscatter which allow devices to exchange information. Interscatter communication allows Bluetooth signals and wifi signals to talk each other .It would allow devices such as contact lenses to send data to other devices.

In order to implement interscatter communication ,the engineers designed a contact lens equipped with a tiny antenna and Bluetooth signal coming from smartwatch. The antenna on the contact lens was able to manipulate that Bluetooth signal, encode data from contact lenses and convert it into a wifi signal that could be read by another device. Monitoring blood sugar levels is important for patient with diabetes that can be done with connected contact lenses.[9]

1.7 Sentiment Analysis:

Using sentiment analysis, one can analyse the mood of every human with help of text analytics. In digital medicine, mood-aware wearables will monitor the mental health and well being. Moreover it instruct the depression mood and help patient to recover from it. The number of connected devices growing massively and designed to bring positive behavioral change. Statistical report says that in 2015, 4.9 billion connected things in use and it will reach 25 billion by 2020.[10]

To respond value and positively change our lives, these devices need to be context aware. Emotion chip is attached to the connected devices that possess optical sensor. It can read emotions, facial expressions, tone of voice and physiology of a person. To make these things possible, one should make their devices emotion enable. The next wave in computing will be emotionally intelligent and mood-aware internet of things.[10]

1.8 Coagulation Testing:

Coagulation is measured by recording the thickness of blood at 100 millisecond intervals after adding a reagent called thromboplastin that initiates coagulation. This is measured in lab by scattering light to a blood sample. A company named MicroVisk introduces a home testing kit with a pair of cantilevers, which are immersed in a blood sample and vibrated quickly. Warfarin is used to treat patients suffering from pulmonary embolism and heart conditions clotting.[11]



Diet, alcohol consumption, infection and exercise can also influence warfarin's effectiveness and body's ability to form clots. To avoid risks of clotting, drug doses should be managed carefully through regular monitoring of blood coagulation. For this the device consists of micro-electromechanical sensors and will come to market within three years.[11]

1.9 Wheelchair Management:

Many researches made for smart wheelchairs with full automation for disabled people. This application provide chair vibration control and monitor the status of the wheel chair user. This development shows that 'things' can evolve into connected machines controlled by data. The device can monitor the patient, user surroundings for location accessibility.[4]



Fig(vi)-Automated wheel chair

1.10. Electrocardiogram Monitoring:

Monitoring electrocardiogram is the electrical activity of the heart recorded by electrocardiography includes heart beat rate, identifying basic rhythms, diagnosing myocardial ischemia, etc. Wireless acquisition transmitter, a wireless receiving processor and wireless detection algorithm can be used for monitoring ECG signals.[4]

V. Results And Discussion

During 2000 and 2002, India introduced eHealth policy to promote information technology in medical field. Between 2003 to 2005 recommendations made for upliftment of telemedicine. The Indian government has allocated Rs. 70.6 billion in the current budget to develop 100 smart cities in the country and plans to create a \$15 billion IoT industry in India by 2020 to increase the number of connected devices from around 200 million to over 2.7 billion.

The security requirements for IoT based healthcare are

- Confidentiality
- Integrity
- Authentication
- Availability
- Fault tolerance
- Data freshness

Challenges for secure IoT healthcare services such as

- Power consumption
- Storage limitations
- Mobility
- Scalability
- Communication media
- Dynamic network
- Dynamic security updates

This paper explains clearly about the mobilization of healthcare with IoT based technologies and remote sensors. All the countries put together their hands in creating more awareness and conducting campaigns in motivating ICT in medical society.[5]

VI. Conclusion

The IoT has made tremendous changes in the medical industry. Revolutions in research emerges As per from all over the world for enhancing solution to the patients by mobilizing healthcare through connected devices and telemedicine. This paper reveals the usage of various healthcare applications Iot based technologies. In order to provide depth knowledge about ongoing advances in sensors, devices, internet applications and other technologies have motivated healthcare through remote service. As per market research, compound annual growth rate of 37.6% in the healthcare, Internet of things between the years 2015 and 2020. To make this fruitful, IoT provide healthcare services such as ambient assistant living, community health care, wearable device access, indirect emergency healthcare, children health information, etc., IoT offers endless possibilities of bringing a macro shift in the way we live or work. Ofcourse IoT should overcome certain obstacles associated with it inorder to familiar with healthcare environment. IoT based security requirements and challenges are discussed for future enhancement in the research field of digital medical industry.

References

- [1]. H.Sundmaeker, P.Guillemin, P.Friess, S.Woelffle – Vision and challenges for realizing the Internet of things, Cluster of European Research Projects on the Internet of Things – CERP IoT, 2010.
- [2]. Ahmed, Mobyen Uddid, Begum, Shahina, Raad, Wasim, Internet of Things Technologies for Healthcare, Third International Conference, Healthy IoT 2016, October 18-19,2016
- [3]. Catarina I.Reis,Marisa da silva Maximiano, Internet of Things and Advanced Application in Healthcare, Oct 2016, ISBN13: 9781522518204
- [4]. S.M.Riazul Islam, Daehan Kwak, MD.Humaun Kabir, Mahmud Hossain , The Internet of Things for Health care: A Comprehensive Survey , IEEE Journals and Magazines, published in: IEEE Access, 01 June 2015
- [5]. Ben Davis @ Econsultancy, 10 examples of the Internet of Things in healthcare, published 13 March 2017
- [6]. N Bui, M Zorzi - Healthcare Applications: a solution based on the Internet of things, 2011
- [7]. D Bandyopadhyay, J Sen, Internet of Things: Applications and Challenges in Technologies and standardization, Springer 2011.
- [8]. Julie Long , Benefits of Real time Location system on hospital wireless networks, July 18, 2013
- [9]. Sara G.Miller , Smartphone, Connected Contact Lenses Give New Meaning to 'Eye Phone', Aug 19, 2016
- [10]. Rana Elkaliouby, Gabi Zijderveld - The Mood Aware Internet of Things
- [11]. Duncan Graham Rowe, A Portable, Cheap Blood Clotting Test, MIT Technology Review.
- [12]. Miller, Internet of Things The: How smart TVs, Smart cars, Smart Homes and Smart cities are changing the world, Kindle Edition.
- [13]. Y.Sang, H.Shen, Y.Ingnoguchi, Y.Tan, N.Xiong, Secure data aggregation in wireless sensor networks: A Survry, 2006.
- [14]. A.Gluhak, S.Krco, M.Nati, D.Pfisterer, N.Mitton, T.Razafindralambo, A survey on facilities for experimental Internet of Things Research, IEEE Communications Magazine 49, 2011
- [15]. L.Haiyan, C.Song, W.Dalei, N.Stergiou, S.Ka-Chun, A remote markless human giat tracking for e-healthcare based on content-aware wireless multimedia communications, IEEE Wireless communications 17 (2010).