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# A Review on IoT based Healthcare Monitoring

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ABSTRACT

IoT (Internet of Things) can effectively be used in healthcare monitoring. Nowadays due to increase in population and increase in chronic diseases, there is a need for efficient healthcare monitoring of the patients. IoT has now taken up the present world in almost every fields, it can even be extended to healthcare monitoring for the well-being of the people. Thus by implementing healthcare monitoring using the IoT applications the pressure on the hospitals and healthcare providers can be reduced to a great extent. In this approach the parameters of the patients are sensed using sensors, sensed parameters are collected, sent to healthcare center as real time data and then the solution for the detected problem is sent to patients by physicians via internet.

Keywords: IoT (Internet of Things), Healthcare, Healthcare Monitoring.

## I. INTRODUCTION

Ageing populations has lead to increase in serious health issues and also increase in chronic diseases and so increased pressure on the healthcare centers. In present life healthcare monitoring is very important to maintain the wellbeing of the people especially for the elderly people. In the rural areas the doctors are either unwilling to serve in such sort of location or not available 24/7. The healthcare models available at present are time consuming, the patients have to wait in queues in order to get the consultancy, thus the time is consumed both while travelling and waiting in queues. Risk of life loses occurs if the solution is not provided on time. In the fast moving world one cannot afford to lose his life just because the timely solution is not obtained. Thus by implementing an user friendly IoT based healthcare monitoring system which senses the body parameters of patients and sends the collected data to healthcare system, instant solution can be obtained. By using efficient healthcare monitoring systems the pressure on the healthcare centers can be reduced, healthcare costs can be reduced and home caring is increased. Many works have been done on IoT based healthcare monitoring, in this paper we provide an overview of existing technologies that support IoT based applications.

## II. SURVEY ON METHODOLOGIES USED

### *[1] Remote Patient Monitoring (RPM)*

Remote patient monitoring (RPM) is a technology to enable monitoring of patients outside of conventional clinical settings (e.g. in the home), which may increase access to care and decrease healthcare delivery costs. Incorporating RPM in chronic disease management can significantly improve an individual's quality of life. It allows patients to maintain independence, prevent complications, and minimize personal costs. RPM facilitates these goals by delivering care right to the home. In addition, patients and their family members feel comfort knowing that they are being monitored and will be supported if a problem arises. This is particularly important when patients are managing complex self-care processes such as home hemodialysis. Key features of RPM, like remote monitoring

and trend analysis of physiological parameters, enable early detection of deterioration; thereby, reducing number of emergency department visits, hospitalizations, and duration of hospital stays. The need for wireless mobility in healthcare facilitates the adoption of RPM both in community and institutional settings. The time saved as a result of RPM implementation increases efficiency, and allows healthcare providers to allocate more time to remotely educate and communicate with patients.

### *[2] Healthcare Communication*

Health communication is the practice of communicating promotional health information, such as in public health campaigns, health education, and between doctor and patient. The purpose of disseminating health information is to influence personal health choices by improving health literacy. Because effective health communication must be tailored for the audience and the situation, research into health communication seeks to refine communication strategies to inform people about ways to enhance health or to avoid specific health risks. Academically, health communication is a discipline within communication studies.

Health communication may variously seek to:

- increase audience knowledge and awareness of a health issue
- influence behaviors and attitudes towards a health issue
- demonstrate healthy practices
- demonstrate the benefits of behavior changes to public health outcomes
- advocate a position on a health issue or policy
- increase demand or support for health services
- argue against misconceptions about health

### *[3] Interactive m-Health System (ImHS)*

mHealth (also written as m-health) is an abbreviation for mobile health, a term used for the practice of medicine and public health supported by mobile devices. The term is most commonly used in reference to using mobile communication devices, such as mobile phones, tablet computers and PDAs, and wearable devices such as smart watches, for health services, information, and data collection. The mHealth field has emerged as a sub-segment of eHealth, the use of information and communication technology (ICT), such as computers, mobile phones, communications satellite, patient monitors, etc., for health services and information. mHealth applications include the use of mobile devices in collecting community and clinical health data, delivery of healthcare information to practitioners, researchers, and patients, real-time monitoring of patient vital signs, and direct provision of care (via mobile telemedicine).

### *[4] Tele monitoring*

Tele monitoring, defined as the use of information and communication technologies to monitor and transmit items related to patient health status between geographically separated individuals, permits home monitoring of patients (living at home or in nursing or residential care homes) using external electronic devices in conjunction with a

telecommunications system (landline or mobile telephone, cable network or broadband technology). TM allows frequent or continuous assessment of HF signs and symptoms measured by patients, family or caregivers at home, while allowing patients to remain under close supervision. Symptoms reported by patients can be remotely reviewed by a health-care professional and appropriate action can be initiated. Telephone support is another form of remote management that can be provided through structured telephone contact between patients and health-care providers (with or without home visits) and reporting of symptoms and/or physiological data. Cardiovascular implanted monitoring devices such as modern pacemakers, implantable cardioverter defibrillators or cardiac resynchronisation devices are also capable of delivering remote physiological monitoring, often without the need for a patient to trigger the transmission of data.

### *[5] Low cost sensors with IoT*

A sensor is a device that is able to detect changes in an environment. By itself, a sensor is useless, but when we use it in an electronic system, it plays a key role. A sensor is able to measure a physical phenomenon (like temperature, pressure, and so on) and transform it into an electric signal. These three features should be at the base of a good sensor:

- It should be sensitive to the phenomenon that it measures
- It should not be sensitive to other physical phenomena
- It should not modify the measured phenomenon during the measurement process

There is a wide range of sensors we can exploit to measure almost all the physical properties around us. A few common sensors that are widely adopted in everyday life include thermometers, pressure sensors, light sensors, accelerometers, gyroscopes, motion sensors, gas sensors and many more. A sensor can be described using several properties, the most important being:

- Range: the maximum and minimum values of the phenomenon that the sensor can measure.
- Sensitivity: the minimum change of the measured parameter that causes a detectable change in output signal.
- Resolution: the minimum change in the phenomenon that the sensor can detect.

### *[6] Ontology based automating design*

In computer science and information science, an ontology encompasses a representation, formal naming, and definition of the categories, properties, and relations between the concepts, data, and entities that substantiate one, many, or all domains.

Every field creates ontologies to limit complexity and organize information into data and knowledge. As new ontologies are made, their use hopefully improves problem solving within that domain. Translating research papers within every field is a problem made easier when experts from different countries maintain a controlled vocabulary of jargon between each of their languages.

Since Google started an initiative called Knowledge Graph, a substantial amount of research has gone on using the phrase knowledge graph as a generalized term. Although there is no clear definition for the term knowledge graph, it is sometimes used as synonym for ontology. One common interpretation is that knowledge graph represents a collection of interlinked descriptions of entities – real-world objects, events, situations or abstract concepts.

### *[7] Smartphone based health monitoring technology*

A compact biosignal monitoring unit (BMU) and interfaced it wirelessly with a smartphone through the Bluetooth network. Mostly the smartphone has a Bluetooth port. The smartphone sent data to a remote laptop computer that served as a healthcare server. The smartphone could also receive commands from the server. Multiple users, each of whom had the BMU and smartphone, were monitored by the remote server. Therefore, a person who has a BMU installed and has a smartphone can receive a service. Even an individual who does not have a smartphone can have the service as long as the smartphone is available within a Bluetooth communication range. This example may be the case of an emergency room where a medical doctor can view vital signs of several patients simultaneously. Another example may be an elderly care center. The vital signs of elderly people should be monitored, and it is sufficient if only a nurse in charge has a smartphone. In both cases, it may be burdensome if each individual has to carry a smartphone as well as the BMU. At present each smartphone can monitor up to eight people because of the limitation of a Bluetooth network's capability.

### *[8] Remote sensing and intimation*

Remote sensing is the process of gathering information about an object without any physical contact or by being situated in remote location from the object of interest. Now the remoteness or the distance may vary from one context of use to another. Before we actually see the multitude of **use of remote sensing in healthcare** we must have an understanding of the basic functional properties of remote sensing and how it is employed in different contexts. According to the deployment of the technology to gather information from an object remote sensing is classified grossly into two types, respectively as passive remote sensing and active remote sensing. While in passive remote sensing the sensors on itself does not emit any radiation or signals to detect the objective information and only works through detection of the natural radiation from the object. Incase any emergency situation is detected an alert can be sent to the patient's caretakers.

### *[9] Pre Diagnosis of disease*

Pre diagnosis is the process of determining which disease or condition explains a person's symptoms and signs. It is most often referred to as diagnosis with the medical context being implicit. The information required for diagnosis is typically collected from a history and physical examination of the person seeking medical care. Often, one or more diagnostic procedures, such as diagnostic tests, are also done during the process. Sometimes posthumous diagnosis is considered a kind of medical diagnosis. Diagnosis is often challenging, because many signs and symptoms are nonspecific. For example, redness of the skin (erythema), by itself, is a sign of many disorders and thus does not tell the healthcare professional what is wrong. Thus differential diagnosis, in

which several possible explanations are compared and contrasted, must be performed. This involves the correlation of various pieces of information followed by the recognition and differentiation of patterns. Occasionally the process is made easy by a sign or symptom (or a group of several) that is pathognomonic. Diagnosis is a major component of the procedure of a doctor's visit. From the point of view of statistics, the diagnostic procedure involves classification tests.

***[10] Handheld device***

The handheld device Blue Box, capable of collecting and wirelessly transmitting key cardiac parameters derived from three integrated biosensors: 2 lead electrocardiogram (ECG), photoplethysmography and bioelectrical impedance (bioimpedance). Blue Box measurements include time intervals between consecutive ECG R-waves (RR interval), time duration of the ECG complex formed by the Q, R and S waves (QRS duration), bioimpedance, heart rate and systolic time intervals. In this study, we recruited 24 healthy subjects to collect several parameters measured by Blue Box and assess their value in correlating with cardiac output measured with Echo-Doppler. Linear correlation between the heart rate measured with Blue Box and cardiac output from Echo- Doppler had a group average correlation coefficient of 0.80.

## III. IoT BASED APPLICATIONS IN HEALTHCARE

IoT based healthcare monitoring is needed especially for patients with chronic diseases, persons with disabilities and elderly people who needs continuous monitoring. By this system remote monitoring can be done and timely solution can be given to the patients without spending the time on consultancy and travelling time to hospitals and also the need that the patient should be admitted in hospitals can be averted.

### *A) MONITORING OF CHRONIC PATIENTS*

Considerable analysis centered on developing in-home monitoring systems for patients with chronic conditions. Continuous watching of significant signs of patients helps to scale back re-hospitalizations by early detection, permitting appropriate and timely interventions. Some systems measure cardiography (ECG) and transmit the collected information to medical unit via web or wireless communication. Questionnaire method can also be used to collect the health related status of the patients. Thus in monitoring of health related parameters of the patients and giving the best solution to the patients the concept of care at distance is achieved.

### *B) AGED CARE MONITORING*

The telecare monitoring is especially needed for elderly people for them to lead their life more safely and independently. Telecare can much effectively support the daily needs of elderly people. Since the aged people are not able to take care of themselves effectively due to age related problems, by using IoT based healthcare monitoring their regular activities can be monitored and an effective solution can be rendered on time, they can even be remained regularly to take medicines regularly with the IoT based applications. The care takers cannot afford to be with elderly people at all the times and so such 24 hours monitoring can be done by telecare systems.

### *C) EMERGENCY APPLICATIONS*

Emergency applications involving IoT is needed so that at correct time emergency services may be alerted. A model was developed which does the task of watching the patient's health via medical devices, then personal devices analyze the data collected by the devices and detect the emergency case and immediately transfer the data to medical systems. Once such emergency case is detected ambulance will reach out to the patient's location. Meanwhile the hospital prepares for the clinical treatment and so the medical personnel send situation aware directions for providing aid.

## IV. COMPARISON OF REVIEW PAPERS

This comparison table which gives the review of three different IoT based applications, based on their methodology and performance. This table explains about pros and cons of the each application in detailed manner.

TABLE .1 COMPARISON OF TYPES OF APPLICATION

| Type of Application | Strength | Weakness |
|---|---|---|
| Monitoring | ➢ Allows monitoring patients continuously and remotely.<br>➢ Allows accessing patient's health data in real time via internet.<br>➢ Provides accurate detection. | ➢ Monitoring without follow up.<br>➢ Some systems are manual such that the measurements and results recording are performed by patients. |
| Self-care | ➢ Provides high accuracy in diagnosis capability.<br>➢ Provides medicine management at home with excellent performance. | ➢ Clinically validated advice and instructions are not provided sufficiently.<br>➢ Patient's involvement in the care process is still limited. |
| Clinical support | ➢ Allows early detection of clinical exacerbation.<br>➢ Provides personalized diagnosis.<br>➢ Provides high accurate prediction models. | ➢ Clinical support algorithms are underutilized.<br>➢ Data are not mined effectively for high level outcome. |

## V. CONCLUSION AND FUTURE WORK

The health issues that traditional healthcare models are facing in our ageing society was outlined, including the increase in chronic diseases and rise in hospital and clinical services costs. To decrease pressure on hospital systems and healthcare providers, improve the quality of care and reduce healthcare costs, effective and efficient medical systems need to be developed. Remote healthcare monitoring systems based on IoT technology has tremendous potential. This paper reviewed recent IoT studies. The results of the review show self-care, data mining and machine learning as areas where next generation of IoT applications for healthcare should focus on. Future work will focus on data collection and analysis for the development of the falls detection and prevention system based on IoT approach.

## REFERENCES

[1] MD. Ashraf Uddin, Andrew Stranieri, Iqbal Gondal, And Venki Balasubramanian, "Continuous Patient Monitoring With a Patient Centric Agent: A Block Architecture" , 2018.

[2] Shreyaasha Chaudhury, Debasmita Paul, Ruptirtha Mukherjee and Siddhartha Haldar, "Internet of Thing Based HealthCare Monitoring System", 8th Annual Industrial Automation and Electromechanical Engineering Conference (IEMECON), 2017.

[3] S. H. Chang, R. D. Chiang, S. J. Wu, and W. T. Chang, "A Context- Aware, Interactive M-Health System for Diabetics," IT Professional, vol.18, 2016.

[4] R. Dierckx, P. Pellicori, J.G.F. Cleland, and A.L. Clark, "Telemonitoring in heart failure: Big Brother watching over you," Heart Fail Reviews, vol.20, pp. 107-116, 2015.

[5] F. Jimenez, and R. Torres, "Building an IoT-aware healthcare monitoring system," 34th International Conference of the Chilean Computer Science Society (SCCC), 2015, p.1-4

[6] P.Elanthiraiyan et al, "Smart Medicine and Physical Health System Using IoT", International Journal of Computer Science and Mobile Computing, Vol.4 Issue.3, March- 2015, pg. 333-338 .

[7] M. Suh et al., "WANDA B.: Weight and Activity with Blood Pressure Monitoring System for Heart Failure Patients," in 2010 IEEE International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM), 2010, p.1-6.

[8] S. Huang, H. Chang, Y. Jhu, and G. Chen, "The Intelligent Pill Box Design and Implementation," 2014 IEEE International Conference on Consumer Electronics Taiwan (ICCE-TW), 2014, p.235-236.

[9] I. Bisio, F. Lavagetto, M. Marchese, and A. Sciarrone, "A smartphonecentric platform for remote health monitoring of heart failure," International Journal of Communication Systems (Int. J. Commun. Syst), vol.28, pp. 1753-1771, 2015.

[10] M. M. Baig and H. GholamHosseini, "A Remote Monitoring System with Early Diagnosis of Hypertension and Hypotension," in 2013 IEEE Point-of-Care Healthcare Technologies (PHT), 2013, p.34-37.