M-Health Remotely Located Patient Monitoring System

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Abstract- *Automated healthcare system is the need and future of healthcare in India. The challenges in implementation of healthcare systems in developing country like India are technology, infrastructure, trained doctors and connectivity among all stakeholders. Due the rapid growth in population providing the healthcare services is becoming difficult day by day specially in rural areas. The remotely located patients are the patients away from doctor but needs his constant monitoring and support. Such as patients in ICU, at home or may be at distant places. The problems also lies in updating doctors of the monitoring parameters and the history of patients time to time. This paper presents the implementation of automated IoT based healthcare system for remotely located patients which helps doctors and guide them accordingly. The system provides alerts by the means of notifications in case of abnormal conditions observed in the monitoring parameters of the patient. It also takes care of supporting the decision making of severity of health conditions. An example of remote patient monitoring is taken for demonstration of the implemented system. The implemented system is successful to provide an interface among doctors, the nurses in hospitals and the relatives of the patient.*

Keywords- AD8232 ECG sensor, LM35 temperature sensor, Pulse rate sensor, Real-time patient analysis, Real-time database.

I. INTRODUCTION

The population of nation is exponentially increasing. The healthcare system constitutes of healthcare resources and people. Based on various demands of each person the healthcare system provide different services regarding healthcare. Currently medical expertise having massive knowledge of regarding treatments, analysis and diagnosis of diseases due to marvelous innovation and researches occur in the medical field. There is more need to give attention for elder people because senior population growing constantly.

The current healthcare systems placed in hospital premises give essential focus on treatment after disease diagnosis. The treatment cost and negative effect of medication increases because preventive healthcare services absence in hospitals. The increasing population causes challenges to existing healthcare systems. In this challenging era the major problem of death is heart disease due to stress problem and also patients don't get healthcare services on time. People don't get time for healthcare because they are busier in their career making. There is need to continuously monitor elder people living independently by reason of single family lifestyle. For getting systematic and proper health services on time is possible with real time health monitoring of person remotely.

The advancements in digital technologies increasing day by day. The wireless and mobile communication technologies possesses advantages alike availability, flexibility, high speed, reduce cost of wiring and simple use of technologies. The system generate alerts if result of data analysis is serious health issue of patient health. After surveying existing healthcare systems with drawbacks and benefits of emerging technologies we are going to propose an automated IoT based healthcare system for remote patient, doctors and caretakers remotely for patient.

II. PROPOSED SYSTEM

In project, modules play an important role such that through modules everyone get a clear idea about the project. The project is divided into different modules based on their purpose. Here the modules are mainly divided into three. They are:

- Patient Module
- Caretaker Module
- Doctor Module

A. Patient Module

The Patient details are entered initially which include patient name, age, location and caretaker details. Based on the details given patients are given a unique patient id in order to identify each one separately. The hardware components such as different sensors which includes Temperature, Blood pressure, ECG sensors modules are connected to the patient's

body. The real time readings produced by these sensors are uploaded to the database instantly. An Arduino uno microcontroller is used for connecting these external sensors to the computer for uploading data to the database. Google's firebase is used as the real time database the real time readings from the database is shown instantly in our mhealth android application. The given below flowchart gives the detail description of the patient module.

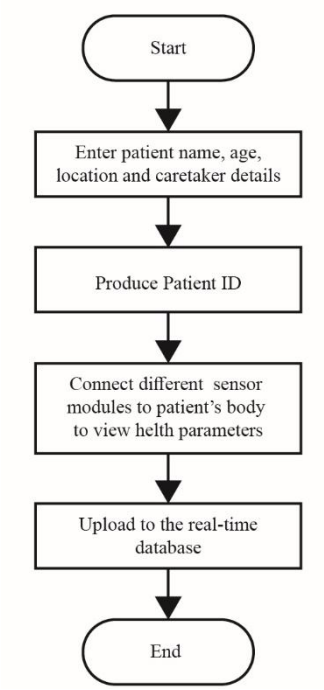

Fig 1.Patient module flowchart

B. Caretaker Module

The caretaker can Login by using the mail ID and password provided by the admin. Once the authentication process is verified, the caretaker can have access to the home page of the caretaker module. Doctor id and the patient id is needed to view the health status or parameter of the patient. The patient health parameters such as heart rate, pulse rate, temperature readings are shown in the page with the respective time and date stamp. when the vital readings go beyond the certain threshold set by the doctor a critical notification is enabled. The caretaker can contact doctor via means of start discussion and seek the response of doctor. The caretaker are the person to take care with the patient regarding the doctor's suggestions. The given below flowchart gives the detail description of the caretaker module.

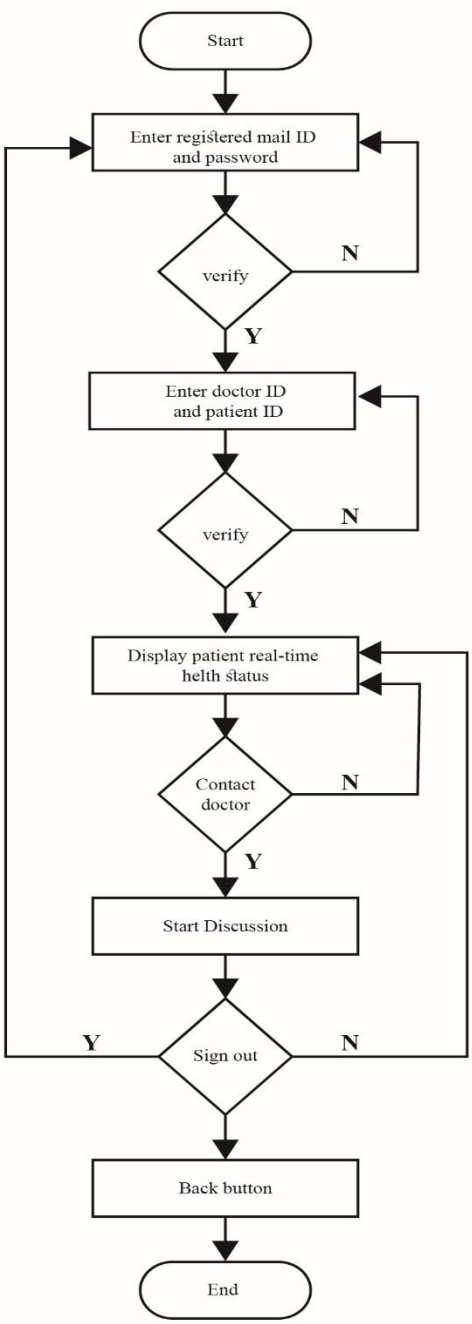

Fig 2.Caretaker module flowchart

C. Doctor Module

The doctor can login to the android application by using the doctor id and password. Once the authentication process is verified, the doctor can have access to the doctor home page. The home page will list the patients corresponding to the doctor. The vital parameters of each patient can be seen in a real time manner. date and time stamp are mentioned corresponding to each single instance reading. The doctor initially setup certain threshold for each readings inorder to understand the critical section. so the system checks the reading corresponding with each values and if any value go

beyond the certain threshold value a critical notification pops up with the time stamp when occurred so the doctor can do the essential. The doctor can contact caretaker when needed to update with the patient status. When it is needed the doctor can contact emergency that is ambulance service or other doctor services. The given below flowchart gives the detailed description of doctor module.

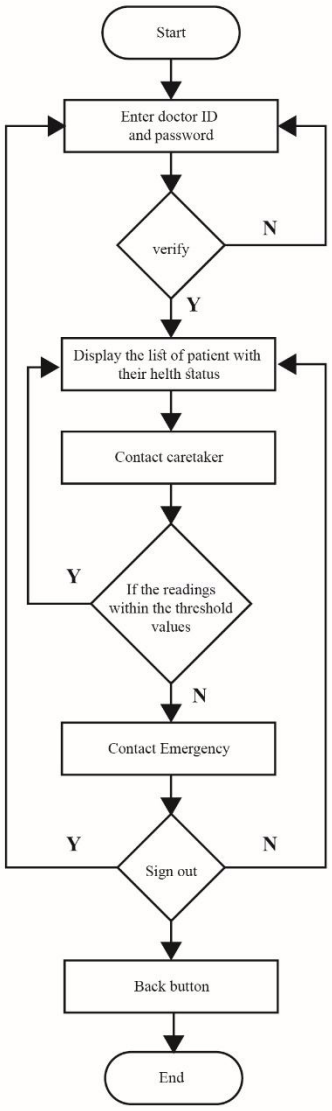

Fig 3. Doctor module flowchart

III. RESULTS AND DISCUSSIONS

The mhealth application aims to change the whole voting hospitality system. Presently the current hospital patient monitoring system is very slow and it costs too much. So to make all this process much comfortable and quicker mhealth can be a good solution. Patient can be monitored from home itself with the assistance of caretaker. The doctor can give the proper suggestion to the caretaker to take care of the patient. Critical situations can be easily identified and act accordingly. The system provides security for the data with 256-bit encryption at the server side. The new system is so user friendly that users can easily interact with it.

IoT technology promises huge potential and benefits in the domain of personalised healthcare. The wireless body area network that consists of wearable sensing devices and communication modules have become the key enablers. Whereas patients' health condition can be remotely monitored in real time, emergencies can be identified accurately, and associated stakeholders such as doctors and family members can be informed when needed. Thereby, research in this area has been extensive, whilst challenges still exist, as discussed in the following section.

Biomedical signal monitoring often requires operating on a 24/7 basis; however, it is still uncomfortable and obtrusive for people to attach a number of sensors on some parts of the body round the clock and in the long term. On the other hand, sensors often with limited computing and storage capability, whilst they are generating massive amount of the data , not only significantly increase the memory and computational requirement, but also dramatically increase the complexity of the data analysis process. Hence, a more intelligent sensor data-filtering mechanism must be developed, in order to precisely retrieve the most valuable information. Therefore, a more sophisticated data transmission strategy can be an alternative solution , where the data transmission frequency can be minimised whilst maintaining or optimising the overall performance of the system . Firebase real-time database has been the promising technique for personalised healthcare; therefore, more attention must be paid to the security, privacy, reliability, and robustness of the network.

IoT is gaining an increasing attention in recent years, which enables seamlessly integration of heterogeneous intelligent devices, such as sensors, smart phones, smart TVs, and many others. Wearable IoT is one of the branches of IoT, which emphasises the connection and communication of any wearable devices. In the meantime, healthcare has become one of the potential applications of wearable IoT, which provides the infrastructure that facilitates medical data transmission and communication. It is expected not only to revolutionise the healthcare system, but also to reduce the healthcare cost. Few issues remain problematic, such as the development of a cost-effective wearable IoT platform, ensuring the scalability, robustness, security, privacy, and so on.

The data mining module must be further developed, which must be able to accurately discover the patterns of certain diseases from the historical data, and ideally predict the possible disease that may develop in a foreseeable future.

Machine learning-based approaches can be adopted, for example, the support vector machine (SVM), the neural networks, and deep learning. Moreover, physical activity recognition is another key avenue to extend the WISE system, as the active level of an individual is also crucial to someone's health status. Hence, the recognition of such information is also fundamental for the detection, forecasting, and diagnosis of potential diseases.

Several issues must be addressed in terms of real-time service delivery. Adaptive personalised and user-friendly services must be developed for both patients and their families, carers, and doctors. For example, carers can specify in what situation and which type of notification should be triggered. Secondly, the issue of dynamic service discovery and mapping must be addressed. For example, in the detection of the situation that the patients suffer from a sudden heart attack, what action should be taken? A medical related ontology library can be developed to identify the most proper and available services in the detection of certain conditions.

IV. CONCLUSION

We presented the design and implementation of a Remote Patient Monitoring System based on wireless technology using real time database. This indeed is an easy, practical, inexpensive and yet very effective way for transmitting vital information to the healthcare staff and healthcare providers. The limitations of existing systems are overcome with automated IoT based healthcare system for monitoring of remotely located patient. The remote patient healthcare monitoring is achieved with developing android application and storing real time health parameters on web servers database with IoT. The system is generating alerts in form of notifications when health status is not in normal condition. The alert is generated when health status result of decision support system in risk condition. The system will be useful for predicting other diseases with changing sensors requirements like ECG, EEG, activity monitoring sensors etc. The tracking of person with GPS will be possible in emergency help condition. The ensemble learning method i.e. stacking for combining more than one classification algorithm of different type will be helpful to enhancing performance of algorithms for prediction of disease. To achieve high accuracy the ensemble learning method will be use with proposed system.

All the information obtained from the human body from sensors and ECG filter circuit is then transmitted to the micro controller system as digital values. The values obtained from like ECG, heart rate, and temperature is also displayed on the application screen with date and time stamp. In this conclusion we consider how this system can be further improved in future, may be by adding new type of sensors as well as using new approaches for the security and triggering alarm.

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