ISSN No:-2456-2165

Embedded Smart Health Monitoring System-Wearable Devices

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Abstract:- This paper gives an insight towards current trends and employed methodologies in wearable device technology. In the present era it is essential to design a cost-effective healthcare system as it is essential to make the smart health systems available to all the people around the world. In this project we have developed a healthcare monitoring system which bears the track of patient's exercising postures, breathing patterns, glucose level detection along with the implementation of Peltier. With the advancement of technology and usage of Cloud computing, it becomes easy for updation of these measured data. This automatic updation of data prevents all the errors which can be caused by manually entering the data.

Keywords:- *Cloud, Wearable Device, Embedded Monitoring System, IoT.*

I. INTRODUCTION

With the limited number of resources in medical facilities, exponentially growing number of elderly people as well as people with health issues , the burden that conventional healthcare systems bear is tedious and also not very reliable. To address these issues, it is very important to develop smart healthcare systems which is cost-effective and also to increase the scalability of these systems. The aim of this embedded Patient Monitoring system is to have a quantitative assessment of the important physiological variables of patients during critical periods of biological functions. The objective of developing monitoring systems is to reduce health care costs by reducing physician office visits, hospitalizations, and diagnostic testing procedure.

As health care services are important part of our society, automating these services lessen the burden on humans and eases the measuring process. Also the transparency of this system helps patients to trust it. Many further improvements can be made in our system to make it better and easily adaptable such as adding more advanced sensors. The biometric information of the patient which is stored and published online can be given to scientists and researchers of medical fields to analyze the value and find patterns or for other research work. To simplify the hardware and reduce wiring we can have used wireless sensors. Instead of medical application we can use our system in industrial and agricultural application by using sensors like humidity sensors, fertility check sensors, etc.

The objective of developing monitoring systems is to reduce health care costs by reducing physician office visits, hospitalizations, and diagnostic testing procedure. The doctors can continuously monitor the health of the patients from any location.

II. OVERVIEW

A wearable health monitoring system are being beneficial to common people as well as the health care systems in maintaining the patient‟s activeness or fitness level and also for self-health tracking. The usage of embedded systems along the recent technologies such as IoT and Cloud Computing in healthcare systems has widened the scope of assessing the health of an individual patient‟s health conditions.

This methodology employs monitoring patients remotely and securely over sensor embedded network. The sensors embedded in this type of embedded environment is used to collect the behaviour and activity patterns for the purpose of detecting the patient‟s health changes. Patient monitoring system consists of equipment, devices and supplies that measure the specified parameters, display and record human characteristics, including body temperature, breathing activity, patient movements. The patient monitoring systems is one of the major improvements because of its advanced technology. A patient monitoring system for providing continuous monitoring of a data acquisition and the day-to-day activities are recorded which invariably helps in bearing track of the patient‟s health.

By monitoring the position of hand using sensor during exercise, position of hand is checked and updated to cloud. During consultation doctor can easily identify the correctness of exercise within no time by looking into the information present on the cloud pertaining to the particular patient. Using the same sensor patient falling can be detected and alert is sent.

A graph is generated in amazon cloud server. This graph can be viewed in the webpage created for the project. Any patient or doctor can read the graph and understand the exercise behaviour of the patient. This makes the doctor to communicate with the patient with short time. Patient can easily follow the doctor instruction and analyze the graph easily. This also maintains a transparency between the patient‟s and doctor‟s relationship.

ISSN No:-2456-2165

Peltier is a device used to regulate the body temperature which works on the principle of peltier effect. Peltier can generate warmness as well coldness depending upon environment temperature . This device will be placed inside the wearable jackets.

Glucose level detectors are also employed in this project. Glucose levels in bottles are measured and alert signals are given so that reversing blood doesn‟t occur during empty stage.

Breathing patterns of patient is also monitored using specific sensors so that it will be very easy for doctor to detect patient health issues. Even during exercises the breathing patterns must be maintained at prescribed level so all these data can be uploaded to cloud. It makes an easy process for doctors to detect faultiness in breathing.

Amazon Drive formerly known as Amazon Cloud Drive, is a cloud storage application managed by Amazon. The service offers secure cloud storage, file backup, file sharing and Photo printing.

Using an Amazon account, the files and folders can be transferred and managed from multiple devices including web browsers, desktop applications, mobile and tablets.

In present existing system the details of the patient is entered in data base manually. The manual efforts for entry of patient details will take time and hectic task. The drawbacks are reduced in proposed system by using concept of IoT.

III. PREVIOUS METHODOLOGIES

The promising potential of the emerging Internet of Things (IoT) technologies for interconnected medical devices and sensors has played an important role in the next-generation healthcare industry for quality patient care. Because of the increasing number of elderly and disabled people, there is an urgent need for a real-time health monitoring infrastructure for analyzing patients‟ healthcare data to avoid preventable deaths. Healthcare Industrial IoT (HealthIIoT) has significant potential for the realization of such monitoring. HealthIIoT is a combination of communication technologies, interconnected apps, things (devices and sensors), and people that would function together as one smart system to monitor, track, and store patients‟ healthcare information for ongoing care[1].

Currently, HealthIIoT is still in its preliminary stages with regards to design, development, and deployment; however, IoT-based solutions are presently displaying a remarkable impact, and carving out a growing market in today‟s healthcare industry and tomorrow‟s emerging IIoT-based healthcare monitoring solutions. IoT has the potential to save 50,000 people each year in the US by avoiding preventable deaths due to hospital error[2]. It promises patient well-being and safety by coordinating critical patient information and synchronizing related resources instantly through interconnected devices and sensors. Research reveals that IoT in the healthcare industry can facilitate better care with reduced costs, reduced direct patient-healthcare interaction, and ubiquitous access to quality care[3].

In this article, collaboration of IoT, Cloud Computing and embedded system results in developing an effective smart healthcare system.

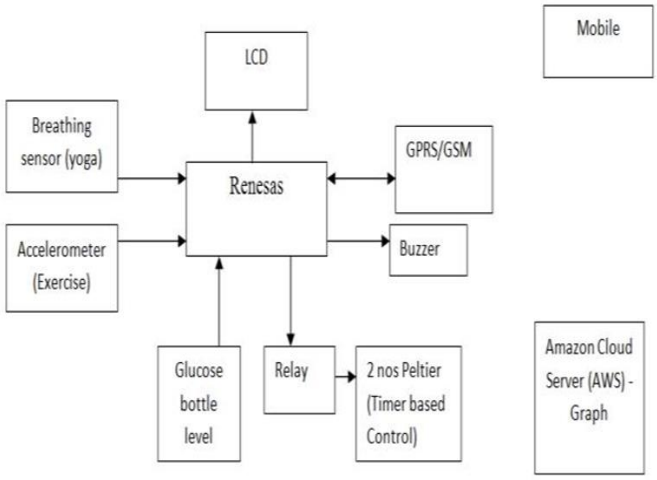

Fig 1:- Experimental Setup

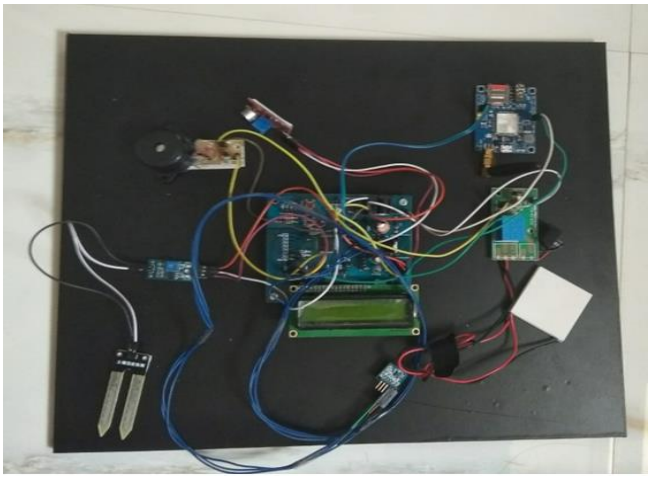

Fig 2:- Snapshot of the Hardware

1. This project consists of Renesas microcontroller R5F100LE, LCD, GSM/GPRS, sensors.
2. Sensor‟s detects the present temperature, breathing variations, joint movement.
3. The Breathing sensor sends breathing variations of the patient continuously through GSM/GPRS to the Amazon cloud server in predefined delay.
4. This values are plotted in a 2D graph with comparison to the threshold value which helps the doctor to detect faults or variations in exercise and breathing patterns.
5. The glucose level sensor is used to send an SMS alert of the patient to the nurse indicating the change of bottle, thus preventing the backward flow of blood.

ISSN No:-2456-2165

6. The peltier interfaced here gives the desired warmness or coolness regualting it to the body based on the external temperature.
7. The LCD and Buzzer are for user-friendly communication which displays specific information about the parameters to be measured.

IV. RESULTS

Fig 3:- LCD Display

The LCD displays the array in the format as shown above i.e; "B000 E000 G0", where

- B represents the breathing sensor value.
- E represents the accelerometer value indicating the angle change in the posture of the body.
- G represents the glucose level indication.

The values of the measured parameters of the patient body is displayed on the LCD as shown in figure 3. The values followed by B and E represents the breathing intensity and the angle at which the joints of a body part is bent respectively, while exercising . The „0" following the letter G on LCD indicates that the glucose bottle is not empty. If the value changes to „1", a buzzer goes on and then a message is sent to the nurse indicating that the glucose level is low and the bottle needs to be changed.

The B and E values are updated to cloud server in predefined relay. The user can log in to the server with appropriate credentials to view the updated values and also to view the graph as shown in the figure 4.

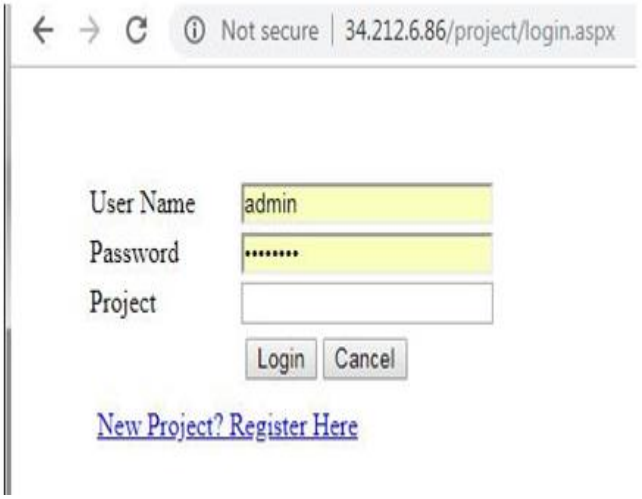

Fig 4:- Cloud Server

Once the doctor or patient logins to the server by entering proper credentials, the data can be viewed. A tabular column representing the date, time, values of the measured parameters and the patient number can be viewed. A graph is also generated taking into consideration the breathing patterns of the patient which makes it easy to analyse for the doctor.

Time	Date	PatientNo	Breath	Exersize
15.01.47	2019-05-21	125	000	000
17.23.21	2019-05-20	125	029	180
17.22.53	2019-05-20	125	028	180
17.22.21	2019-05-20	125	029	181
17.21.51	2019-05-20	125	029	192
17.21.23	2019-05-20	125	030	166
17.20.50	2019-05-20	125	000	000
17.19.22	2019-05-20	125	000	000
17.17.13	2019-05-20	125	028	170
17.16.41	2019-05-20	125	000	000
17.14.09	2019-05-20	125	000	000
17.13.10	2019-05-20	125	030	170
17.12.38	2019-05-20	125	000	000
17.10.21	2019-05-20	125	000	000
17.09.12	2019-05-20	125	029	171

12

Fig 5:- Tabular Column updated on cloud

As shown in figure 5, the data of the measured parameters along with the proper date and appropriate time is updated to the cloud.

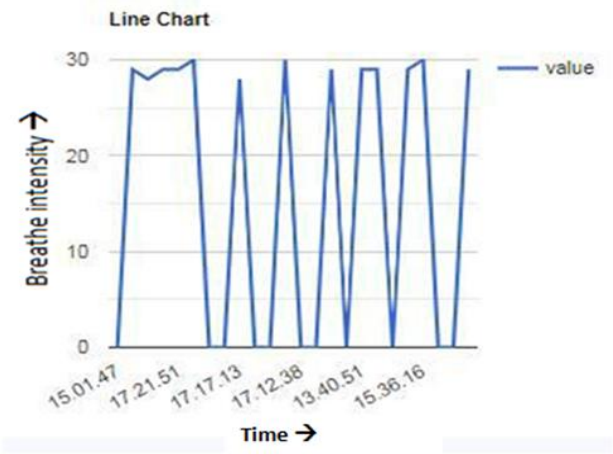

Fig 6:- Line graph representing the breathing patterns

A line graph is generated representing the breathing patterns of the patient as shown in figure 6. This representation allows the doctor and patient to analyze the data with ease.

V. CONCLUSION

As health care services are important part of our society, automating these services lessen the burden on humans and eases the measuring process. Also the transparency of this system helps patients to trust it. When threshold value is reached, the alarm system that consists of buzzer and LED alerts the doctors and he can act more

quickly. The GSM technology helps the server to update the patient data on website.

In future, we can make this project as user friendly and durable, we need to make it compact and cost effective. Many further improvements can be made in our system to make it better and easily adaptable such as adding more advanced sensors.

ACKNOWLEDGMENT

We extend our sincere gratitude to our project guide Vidyashree. C for motivating and co-operating with us to complete this project succesfully.

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