An IoT Based Smart Health-Care System

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***Abstract*— Health-related issues are one of the major areas of concern of today's fast moving life. People often ignore keeping track of their daily activities, which later affects their own health, and which directly make a huge impact on quality of life. Among all the other monitoring systems, Health monitoring system using IoTs is relatively very new. IoT acts as a lifeline for the healthcare sector. By using IoT, Doctors can keep a track of patient's health. The aim of this seminar is to have a system, which can track the health of a patient using an IoT device. In this System, sensors are used to collect data, and transmits it to the embedded system i.e Raspberry Pi. This Data is then processed and analyzed by the Raspberry Pi module and then stored in the cloud for scalability and flexibility purpose. Results of the analysis are then automatically sent to the doctor when a critical condition occurs. Further Doctors can use this Data meaningfully to monitor the health of a patient. This is one of the better ways where the doctors are able to certainly and quickly use the relevant patient information with the help of internet of things to take suitable actions. This can help a lot of patients who are needed to keep the track of their health on a regular basis.**

***Index Terms*—Internet of Things, Raspberry Pi Model 2, healthcare.**

I. INTRODUCTION

The Internet of Things (IoT)can be described as an embedded system, or they are just some embedded devices which can communicate with each other. As for the reason that they can communicate with each other, these devices are considered as smart and flexible. The advancement of the technology had a substantial influence over health-care sector. An IoT device uses Sensors, actuators and other components for collecting useful data. Using IoT is a blessing for the healthcare sector, if we had computers that knew everything there was to know about things using data they gathered without any help from us, we would be able to track and count everything, and greatly reduce waste, loss, and cost. This will be helpful to tackle any health issue, prior to it leading to any severe problem for patients. This technology can also help in reducing human errors, which can ultimately lead to reducing the human errors to a very great extent. We can rely on a perfectly performing IoT device and use the data gathered by the IoT device for the further betterment of someone's health.

IoT ensures the personalization of healthcare services by maintaining the digital identity for each patient. Due to unavailability of ready to access healthcare systems, many health problems have been getting undetected in conventional health-care systems. But pervasive, non-invasive, powerful IoT based systems have been helpful in monitoring and analysing the patient data easily. In IoT based health-care, various distributed devices gather, analyse and pass real-time medical information to the cloud, thus making it possible to collect, store and analyse the big data streams in several new forms and activate context dependent alarms. This innovative data acquisition paradigm allows continuous and ubiquitous medical device access from any connected device over the Internet.

II. MOTIVATION

Traditionally, the ECG is detected through large and stationary equipment in professional medical institutions. The kind of equipment usually employs twelve electrodes to collect ECG data due to their good performance in short-term measuring. However, the equipment is unlikely to be portable, which means that patients' activities are severely limited during the period of data collection. Moreover, as these devices are usually too expensive for home use, patients have to go to hospital frequently, which will inevitably increase the burden for them. Since it has become possible to utilize the advancements of Computation and Internet of Things in the domain of health care to support senior citizens at homes, athletes, and people from all walks of life. So with the development of this system the elder patients will have the facility to get them diagnosed from the comfort of their home without travelling to hospitals.

III. RELATED WORK

In literature, several systems for same have been proposed but they met few limitations.

Swaleha Shaikh, Vidya Chitre 2017 [1] *"Healthcare Monitoring System Using IoT"* Many further upgrades can be made in the proposed system to improve it and make it effortlessly versatile, for example, including more propelled sensors. The system is expected to track and sense the ongoing (real time) information with the assistance of various sensors and help to enhance the nature of healthcare.

Ravi Kishore Kodali, Govinda Swamy and Boppana Lakshmi 2015 [2] *"An Implementation of IoT for Healthcare"* The Authors have demonstrated IoT based medical device is a combination of XBee S2 module interfaced with LM35 temperature sensor. Intel Galileo Generation 2 board connected with another XBee S2 module acts as gateway for the over all healthcare system. This gateway is used to gather, analyse, store and communicate the medical data to the cloud over a secure connection.

Bahar Farahani, Farshad Firouzi, Victor Chang, Mustafa Badaroglu, Nicholas Constant, Kunal Mankodiya [3] *"Towards fog-driven IoT eHealth: Promises and challenges of IoT in medicine and healthcare"* The Authors had demonstrated a complete

survey of various published papers on IoT eHealth and proposed a holistic eHealth ecosystem covering those layers where various applications can be mapped to those layers, which include mobile health, assisted living, e-medicine and implants, early warning systems, and population monitoring. Despite the advantages offered by IoT eHealth, many challenges need to be tackled.

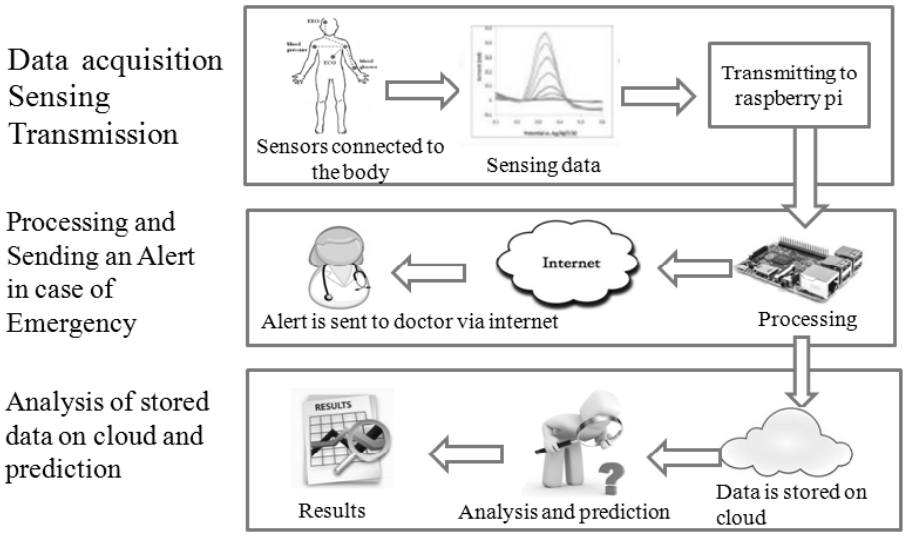
Q Durga Amarnath M. Budida, Dr. Ram S. Mangrulkar 2017 [4] *"Design and Implementation of Smart HealthCare System Using IoT"* Author tries to emphasize on a healthcare system which is enabled with IoT technology that not only realizes the illustration and traceability of healthcare actors but guarantee the improved health care services. The key motive behind the proposed system is to provide better and effcient health services to the patients by implementing networked information so that experts and doctorscan make use this data and could provide fast and effcient solution.

Kavita Jaiswal, Bhabendu Kumar Mohanta 2017. [5] *"IoT-Cloud based framework for patients data collection in smart healthcare system using Raspberry-pi"* The Authors proposed solution is based on how data is integrated with IoT based healthcare system using a raspberry pi and docker container. Raspberry Pi collects and stores the medical data through the sensors attached. The received data can be transferred to the user through mobile apps. The information provided through apps improves the health of the patients. Potential future work may include Location Aware Applications for mobile devices which exploit location information for patients, to provide personalized information or alerts regarding the patient

IV. IMPLEMENTATION OF PROPOSED SYSTEM

The System works on three basic steps. These Steps are :-

1. Data Acquisition
2. Processing and Sending Alert
3. Analysis of stored data on cloud and Predictions



1. Data Acquisition:-

This is nothing but a perception level. Here all the sensors are connected to the human body. Using all the sensors the Data assets of the body are collected. These data are of Body temperature, Heart Rate, Blood Pressure, ECG. There is also an Accelerometer Sensor which can detect all the motion of the body. This Sensor Detects the movement of the body and records the physical activity done by the body. This can be useful to calculate the amount of exertion the body has undergone. All this Data is collected with very high accuracy. This Data is further sent to the IoT Device. Here That IoT Device is Raspberry Pi. All the Data is sent to the Raspberry Pi.

2. Processing and Sending Alert :-

This step is purely for processing the generated data and making out some results from it. Here, in this step the Data collected from the step 1 i.e. the data collected by all the sensors is given to the IoT device, Raspberry Pi. The Raspberry Pi then processes all the data recieved. It converts that data in the Digital signals. Here, it checks all the parameters like whether the collected data is in the perfect range or not. It checks whether the collected readings from the temperature sensor is in the safe range or not. Similarly, it checks for the data from other sensors too. It compares the data with the safe and permissible range of the body assets. Further results are generated from these data. And if the results are severe and alert is generated. This alert notfies the personal Doctor and

Fig 1: Implementation of the ECG Monitoring System

the close relatives. Who can later help the individual suffering with some health issue.

3. Analysis of stored data on cloud and Predictions:-

After the processing and doing other necessary jobs, these datasets are sent to the cloud for its storage in the individuals record. All this collected data gets stored on the cloud. Storing this data is important as these datasets can prove to be helpful in future. This data is analysed properly and the reports are generated by the IoT System and the algorithms. This analytics can be very helpful in the predictions. A person gets to know about what exactly the state of his body is, and how his body is gonna get affected. This is also helpful for doctors to keep a track of the patients history, and also he can predict the health of body in coming future. The doctors are supposed to give the correct medication here to avoid such health situation and keep the patient healthy.

A] Hardware Components

This system contains the following hardware components.

1) Raspberry Pi

The Raspberry Pi Model 2is a small sized mini-computer of the second generation developed by Raspberry pi foundation in the UK. Though it is the cheap yet really effective and powerful tool for interfacing with many devices at the same time. Based on the latest ARMv7 32-bit processor it is powerful and faster than the previous models. Raspberry pi 2 model used in our system have the following technical specifications-

Features	Raspberry Pi 2
CPU	Broadcom BCM2836 32bit Quad Core
Clock	900 MHz (Can be Overclocked)
Ram	1GB SDRAM
GPIO	40 pin
USB Port	4x USB 2.0
Flash	None
Storage	micro SD
Network	10/100

2) AD8232 ECG Sensor

ECG stands for Electrocardiogram which sense the heart's electrical pulse also called bio-signals which then helps to plot graph of heart rate. The AD8232 Single Lead Heart Rate Monitor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram and outputs it as an analog reading. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op amp to help obtain a clear signal from the PR and QT Intervals easily.

The AD8232 is an integrated signal conditioning block for ECG and other bio potential measurement applications. It is designed to extract, amplify, and filter small bio potential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement.

Below is the AD8232 ECG Wired Sensor.

3) Temperature Sensor :-

-It is the Sensor used to measure Temperature.

-The LM-35 series are accuracy coordinated integrated circuit temperature sensors, whose output voltage is directly related to the Celsius (Centigrade) temperature.

-It can measure the temperature with more accuracy and precisely than thermostats.

4) Blood Pressure Sensor:-

- The Blood Pressure sensor is fully automatic, easy to operate, intelligent device which shows systolic, diastolic and pulse readings.
- Its Compact style fits on the wrist and is very effective to give perfect and exact readings.

5) Heart Rate Sensor:-

- This sensor Give a digital output when a finger is placed on it.
- This sensor is easy to use and gives accurate and perfect readings.

B) Software Components

Linux-based operating system named Raspbian OS is installed on the device Raspberry Pi using micro-SD and in Arduino, application code is written in Arduino programming language. The application code is written in IDE (Integrated Development Environment) of Arduino. IDE contains the text editor to write the application code according to requirement. The codes written in

IDE are also known as sketches and .ino file extension is used to save these sketches. After compiling, the codes are uploaded to Arduino board.

V. EXPERIMENTAL EVALUATION

In today's fast moving and swiftly changing world, the people are getting advanced day by day. So, there is always a need to be advanced in this era of technologies, day by day technologies are getting advanced too. The main motto of this device is to allow people's health tracking system to get dependent on technology. We have studied that, there are many positives when we are switching our health tracking system to automatic systems, like IoT. This System allows the user to rely on technology, which can track all the major assets of the body, and which can give the individual a complete idea about how his/her body is reacting at a specific instance. This allows an individual to find out how his/her body is reacting at the moment, and what should be done to get the body in the safe range. Here, this can also help him by alerting him and his doctor, who in return can take some actions if there is a problem.
We have connected health tracking system with IoT, making the health tracking more reliable, easy, time-saving, safe and working with the cloud. Making the health tracking more advanced and automated.
In this System we are using Rapsberry pi model B+, Temperature Sensor, Blood Pressure Sensor, Heart Rate Sensor, ECG Sensor, Accelerometer, Buzzer, LEDs and a software component like Server.

This System work as given Below:-
Temperature sensor is used to estimate the hotness or coldness of any body. In health care, using temperature sensor data, the patient health condition can be estimated. If the temperature crosses particular threshold, the physician can be alerted regarding an appropriate treatment of the patient.
Basic principle to calculate Temperature:
Temperature sensor is a p-n junction diode, manufactured with ISFET by employing CMOS technology. The forward current for the p-n junction diode is represented by equation 1

$$I_f = exp^{\frac{qvf}{nkt}} \quad \text{…….(1)}$$

The voltage drop across the p-n junction diode corresponding to the temperature is given by equation 2. When the temperature sensor is subjected to a constant current source, the generated voltage is proportional to temperature.

$$V_f = \ln(I_f)\ \frac{nkT}{q} \quad \text{…….(2)}$$

Finally the temperature measured proportional to the generated voltage is given by equation 3

$$T = q \times \frac{V_f}{nk\ \times\ \ln(I_f)} \quad \text{……..(3)}$$

This is how temperature is calculated using the Temperature Sensor. This Data is then sent to the Raspberry Pi Model B+. The Raspberry Pi then analyses the data processes it according to the algorithms. And if the the Data is out of the safe range then it generates an alert to the user and the Doctor. This helps in suitable treatment for the problem. This reduces the work of a professional and allows the user to check everything by himself.
Similarly the other parameters are also calculated. Other Parameters like Heart Rate, ECG, Blood Pressure etc. This data is sent to the Raspberry Pi, who will process and analyse the data and do the necessary alert generations. All this data is then Sent to the cloud, and stored in the patients personal health account. Doctor can analyse the results stored on the cloud and can suggest the medication to avoid further health problems. This is how the Health is monitored in a safe and advanced way.

VI. CONCLUSION

In this Seminar, As health care administrations are essential piece of our society, computerizing these services reduces the weight on people and facilitates the measuring procedure. Additionally the easy of access of this system helps patients to rely on it. The goal of creating such a system is to decrease health mind costs by diminishing doctor office visits, hospitalizations, and demonstrative testing method. Many further upgrades can be made in the proposed system to improve it and make it effortlessly versatile, for example, including more propelled sensors. The system is expected to track and sense the ongoing (real time) information with the assistance of various sensors and help to enhance the nature of healthcare.

VII. FUTURE-SCOPE

The statistical measurements can be developed from the proposed platform when deployed in the physical world. Moreover, the accuracy of the proposed system can be compared with gold-standard investigation methods used by medical professionals. Lastly, this methodology can serve in future as the theoretical foundation for providing better healthcare services in the digital world.

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