A Smart Patient Health Monitoring System Using Raspberry Pi 3

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***Abstract*—With the advancement in technology today IOT makes all objects interconnected and it has been recognized as the next technical revolution. And it is being used in different methodologies like smart home automation, traffic control, vehicle parking, smart environment, agriculture fields and patient health monitoring system etc. Among with these approaches a very useful approach is to monitor the health situation of a patient and screen it to the doctors and other paramedical staff through the IOT. As we know that it is very difficult to screen the patient for 24 hour. So here the status of patient health i.e Pulse rate, Body Temperature, Position of the body, ECG, and Blood pressure and so on. All of these parameters can be measured by utilizing some sensors. The collected data through the sensors is then transferred to the internet. And Via internet this data is transferred to computers which are registered to the server of the database as well as the smartphone of the doctors. After analysing the data doctors can then prescribe the medication based on the data results shown by the system. This prototype will minimize the burden on patients to visit the doctors every time for monitoring of these health parameters.**

***IndexTerms*—ECG, IOT , Raspberry Pi 3 , Temperature sensor .**

I. INTRODUCTION

In current scenario on the earth, health related problems are increasing day to day . 151,600 people are dying per day. This graph can be reduced by modernization in the techniques used for patient monitoring. In the traditional approach the healthcare professionals play the major role. They need to visit the patient's ward for necessary diagnosis and advising. There are two basic problems associated with this approach. Firstly, the healthcare professionals must be present on site of the patient all the time and secondly, the patient remains admitted in a hospital, bedside biomedical instruments, for a period of time. In order to solve these two problems, the patients are given knowledge and information about disease diagnosis and prevention. Secondly, a reliable and readily available patient monitoring system (PMS) is required [1]. In order to improve the above condition, we can make use of technology in a smarter way. In recent years, health care sensors along with raspberry pi play a vital role. Wearable sensors are in contact with the human body and monitor his or her physiological parameters. We can buy variety of sensors in the market today such as ECG sensors, temperature sensors, pulse monitors etc. The cost of the sensors varies according to their size, flexibility and accuracy [2]. The Raspberry Pi which is a cheap, flexible, fully customizable and programmable small computer board brings the advantages of a PC to the domain of sensor network [3]. In our system we are measuring patient's parameters (ECG, temperature, heart rate, pulse, etc) different available sensors. These sensors collected data i.e. biometric information is given to raspberry pi and then it is transferred to server. The data stored in a database and can be displayed in a website that can be accessed only by authorized personnel [4]. The doctors, RMOs, patient or his family members can be given authorization. The system even facilitates the doctor to view the patient's previous history from the data in memory.

II. LITERATURE REVIEW

HasmahMansor et al [5] monitors body temperature using LM35 temperature sensor. The LM35 temperature sensor is connected to the Arduinouno board. Afterthat creating a website in SQL database format. Arduinouno board is connected to that website. Then sensor output is send to the website. Using this website anybody can monitor body temperature in login process.

Junaidmohammed et al [6] monitors patient's ECG wave anywhere in the world using IOIO- OTG Microcontroller. Android application is created for ECG Monitoring. IOIOOTG microcontroller is connected to android phone using USB cable (or) Bluetooth dongle. After collecting data, the wave is send to android application. Monitor and store ECG waves in that android based application.

Dohr et al [7] monitors blood pressure level using Keep In Touch (KIT) and closed loop healthcare services. In KIT method, KIT is connected to the JAVA based mobile phone with the help of near field communication. It works on magnetic , inductive coupling and then the distance is short. After touching the KIT, the data is send to mobile phone. In closed loop services, the data is getting from mobile phone, then the data is send to the secure website. Using this website anybody can monitor patient's blood pressure level.

III. SYSTEM ARCHITECTURE

The interconnection between different components is explained using the architecture of system. Architecture diagram is shown in figure 1. The patients connect the sensors to their body and the other end of the sensors is connected to Raspberry Pi. The data acquired by sensors is stored in the Raspberry pi 3. The data values (i.e. Biometric data) are shown on monitor display and at the

same time. The values stored are sent to server. All the values are stored on the server and the most recent value is displayed on webpage. The doctor along with their login credentials can login and see the patient data. Doctors can see all previous records of a patient and suggest medicines and changes in prescription. Also patients are given unique user id and password to view their records.

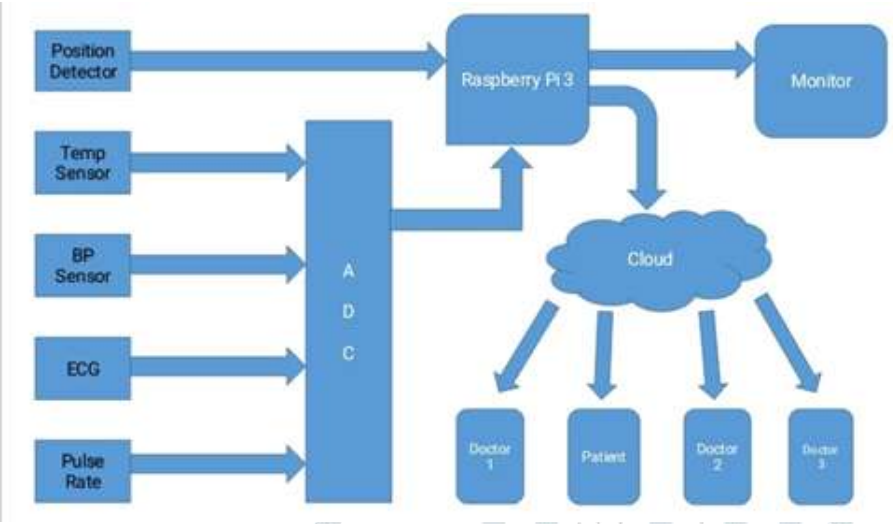

Figure.1 System Architecture

IV. DESIGN METHODOLOGY

Design of the system is divided into two parts: Hardware components and software components.

Hardware Components

A. Raspberry Pi

It is a powerful, low cost, and a small card sized device which is a perfect platform for interfacing with many devices. The board contains a processor, graphics chip, RAM memory, interfaces to other devices and connectors for external devices, of which some are necessary and some are optional. There are much versions of Raspberry Pi but the CPU (BCM2835) of all the models of Raspberry Pi remains same. The CPU is somewhat cheap, powerful and efficient and it does not consume a lot of power. It works in the same way as a standard PC requiring a keyboard for giving commands, a display unit and power supply. Here, in Raspberry Pi, SD card is used in the same way as the hard disc in the computer. The connectivity of raspberry pi to the internet may be via a LAN (Local Area Network) cable / Ethernet or via a USB modem. The main advantage of Raspberry Pi is that it has a largenumber of applications.

Figure.2 Raspberry Pi 3

B. ECG Sensor

Electrocardiography (ECG) is the process of recording the activity of the heart for a period of time using electrodes placed on the skin. These electrodes detect even a small electrical change on the skin that emerges from the heart muscle's pattern. The fundamental component of ECG is the Instrumentation Amplifier, which is responsible for taking the voltage difference between leads and amplifying the signals.

C. Blood pressure sensor

The blood pressure sensor is designed to measure human blood pressure. It also measures the systolic and diastolic pressure and pulse rate is also recorded by this sensor. It is more accurate and reliable than the sphygmomanometer, the instrument attached to

inflatable air bladder cuff and used with a stethoscope for measuring blood pressure in an artery. In simple word, pressure of blood against blood vessels walls or arteries is measure using blood pressure sensors.

D.Temperature Sensor-LM35

This sensor used to sense the temperature more accurately having an accuracy of +/-0.4°C and works on the principal of thermocouple. It has better accuracy than that of the thermistor and does not undergo any oxidation as it is sealed. It does not need amplifying the output voltage. It is an analog type of device. It gives the output voltage proportional to the °C temperature.

E. Pulserate Sensor

It is used to measure the heartbeat of the patient. It gives a digital output of heart beat when a finger is placed on it. It is compressed in size. The working voltage of heart beat sensor is +5V DC. It works on the principle of light modulation by blood flow through finger at each pulse. Heart beat sensor is used to measure heart beat which normally lies between 60-100bpm.

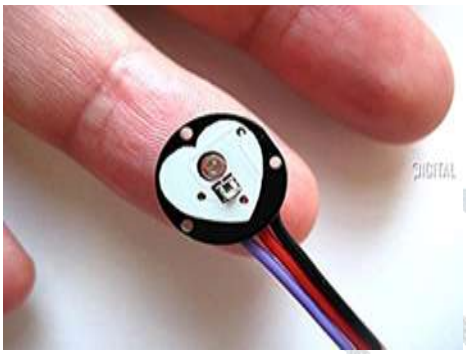

Figure.3 Pulse Rate Sensor

Software Requirement

A. PYTHON

Python is a widely used general-purpose, high-level programming language. Its design philosophy emphasizes code readability, and its syntax allows programmers to express concepts in fewer lines of code than would be possible in languages such as C++ or Java. The language provides constructs intended to enable clear programs on both a small and large scale. Python supports multiple programming paradigms, including object-oriented, imperative and functional programming or procedural styles .It features a dynamic type system and automatic memory management and has a large and comprehensive standard library.

B.THING SPEAK

Open source data platform and API for the Internet of Things The Internet of Things provides access to a broad range of embedded devices and web services. ThingSpeak is an open data platform and API for the Internet of Things that enables you to collect, store, analyze, visualize, and act on data from sensors or actuators, such as Arduino®, Raspberry Pi™, Beagle Bone Black, and other hardware. For example, with ThingSpeak you can create sensor-logging applications, location-tracking applications, and a social network of things with status updates, so that you could have your home thermostat control itself based on your current location.

Figure.4 Thing Speak

V. RESULT

The graphical representation of the information of the patient-1 is demonstrated i.e. body temperature, Heartbeat, body position, ECG, are as showed up in the fig-10 which is observed by signing into the Thingspeak server through a personal computer which has Time in x-axis and the parameter in y-axis. Though, fig-5 demonstrates the information of the patient that is seen through the android. versatile application, which gives more point by point data, a it demonstrates the most extreme and minimum values including the time stamps.

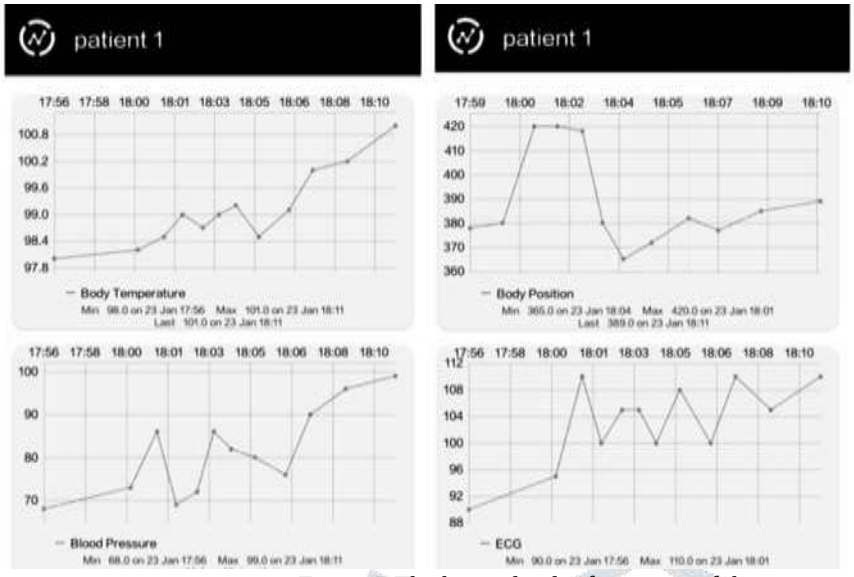

Figure.5 The biomedical information of the patient in the Thingspeak

VI. CONCLUSION AND FUTURE WORK

Process is developed to monitor the current status of the patient irrespective to the presence of the doctor. This paper concentrates on calculating the parameters like ECG, Heartbeats, and Blood Pressure Monitoring altogether on a single kit, with the help of server doctors as well as patient collect the information of the patient. With the right information at the right time, the sensor based medical system can help medical patient to easily track and monitor their health record.

Instead of medical application we can use our system in industrial and agricultural application by using sensors like humidity sensors, fertility check sensors, etc.

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