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SMART HEALTHCARE MONITORING SYSTEM USING RASPBERRY Pi ON IoT PLATFORM

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ABSTRACT

In recent developments, the internet of things (IoT) creates an interconnected network for all things and is later recognized as renew technology. The healthcare sector has improved with this technology. Health problems in cardiovascular failure, lung failure and cardiovascular diseases are increasing day by day. These problems require a lot of health monitoring from time to time. A modern concept of patient health oversees wireless devices. This is a big improvement in the field of medicine. A doctor can constantly monitor the patient health without physically interact. Health specialists and technocrats have developed a wonderful, with a low expensive healthcare monitoring system for whom is bearing with several diseases using popular technologies such as wearable devices, wireless channels, and other remote instruments. As per that, doctors can diagnose the patient's disease with the doctor's device screen about his / her health condition from the patient's device, thus eliminates the number of the patient's presence in the hospital, also it provides the time for better treatment. Therefore, doctors are able to save human lives by providing quicker services to them. In this paper, IoT has become the best platform for various application services. Here, the Raspberry Pi used to develop this, because which works as a sensor node and as a controller. In this paper, a simple health monitoring system has been proposed to achieve a one-step ahead.

Keywords: ECG, raspberry pi, internet of things, respirator sensor, temperature sensor, heart rate sensor, accelerometer sensor, BP sensor.

1. INTRODUCTION

In recent years, health risks are growing daily at high speed every day. Worldwide average births per year are 131.4 million and death rate is 55.3 million. Sources: population reference bureau & the world fact book. This is a big problem around the world. Hence, it is time to overcome such problems. The wireless sensor technology provides information on various wireless sensors by providing a change in diversity sensor technology. It receives data about the human body temperature (BT), blood pressure (BP), and heart beat (HB). This is undoubtedly more accessible via IOT platform through the Internet. The patient's health history will be examined and analyzed at any time and by any doctor. Patient health information permanently stored on the server. This paper provides a health monitoring system that identifies human body conditions such as blood pressure, body temperature, heart rate, ECG, respiration, accelerometer and more information on the IOT server via wireless network technology. In emergency situations, this system automatically sent a warning message/call to the patient's caregivers, to the hospital and also to the ambulance on if any strange data detected.

An uninterrupted health record can be used to identify the disease more effectively. Now-a-days, people are getting more attention to preventing the disease at the earliest stages. In addition, new generation mobile technologies, and their services have been discussed with different wireless networks.

Different sensors such as the ECG, BP, temperature, acceleration and pulse rate for a few seconds are used to gather body health parameter information for the diagnosis.

The use of Raspberry Pi and IoT is satisfactory in health supervision, and this paper gives the concept of both platforms. A popular Raspberry Pi platform offers a full Linux server on a small platform with IoT at a very low price. Raspberry allows interface services and mechanisms via the general purpose I/O interface. By using this combination, the proposed structure is more effective. An IoT is connecting the devices and which provides the human interaction to a better life. This paper, which provides an overview of health care management technology, protects patients from future health problems, and helps doctors to take the right measurements at the appropriate time on the patient's health.

2. LITERATURE SURVEY

Matthew *et al*. [1] have discussed the ECG, the rate of respiratory system, heartbeat and the temperature of the body. These sensors have been connected with a PIC16F887A micro-controller chip. Once data are collected from sensors, data are manually uploaded. This has been created an Android app and a web based interface.

Soumya *et al*. [2] monitor the patient's ECG waves using AT MEGA 16L Microcontroller. The ZigBee module has been used to transfer ECG waves and data sent to the nearest ZigBee connector.

Mohammad *et al* [3] oversees the OTG micro-controller in the world. Android app used to create an ECG monitoring system. The OTG micro-controller is used to connect the USB cable to the mobile phone (or) a wireless device. Once the data collected, that will be sent to the mobile application as ECG wave format.

Dohr *et al*. [4] oversees the level of blood pressure using a health care service kit (the Keep in

Touch. Here, the KIT is connected to the JAVA based mobile phone via communication. After KIT will gather the data and will send to the mobile phone. With the webpage will monitor the blood pressure levels of the patient.

Karandep *et al*. [5] is proposed to monitor the heart beat using the C8051F020 micro-controller and also the body temperature. We use to extract the data from sensors and it would be transferred to the controller. This has been connected with the ZigBee wireless device and then transfer data to the nearest receiver.

S. Jassay *et al* [6] discussed about the human body temperature using the Raspberry Pi platform for the cloud. In this paper, Raspberry Pi monitors the patient's body temperature and then these data have been transferred via WSN. After that, the data has been added into the cloud.

Mansor *et al*. [7] discussed an LM35 sensor, this sensor can monitor body temperature using an Arduino UNO board and it uses a SQL database format. The Arduino UNO board is associated with the sensor for that website. Though, we can monitor body temperature.

Nithin *et al.* [8] is monitors the human body temperature, blood pressure, heartbeat. These sensors were embedded with micro-controller AT Mega 32. And this micro-controller yields a GSM. After, collection of data, we need to perform diagnosis. If the diagnostic value is lower than normal values, then the device can do an SMS to the doctor.

Rajeev Pyare *et al.* [9] were implemented for home appliances based on the Android mobile phone. The Arduino UNO board used to connect light, fan, etc. And also it can control and monitor domestic appliances anywhere in the world using this Android app.

Majdi Bsoul *et al.* [10] is implemented an "Apnea Med Assist" on an Android phone using support vector classifier (SVC). Which achieves F-measure 90% and 96% sensitivity after applies the efficient optimization in ECG processing.

3. DEVICES IN AN IMPLEMENTATION

In order to implement the health analysis system, it is necessary to identify the necessary health issues for maintaining them. Usually, these sensors like temperature sensor, BP sensor, heart rate sensor, an ECG sensor, acceleration sensor, raspberry Pi with GSM have discussed in the following.

A. ECG sensor

Electrocardiography (ECG) is used to record heat-beat activities through on the top of the skin. It can detect a change of an electric cylinder every minute on the top of the skin. An ECG amplifier is the responsibility to get qualified data. An electrocardiogram is a graphic tracing of voltage produced by heart muscle during heart rate. ECG is used to measure the heartbeat by using MCU. Heart rate calculation is the main focus by the electrodes is simplified to two connections, one for the right hand and the other for the other.

B. Heartbeat sensor

It is used to measure the heartbeat of the patient. Here, the heart rate sensor uses + 5V DC voltage. This gives the digital result, which is placed on the hand artery nerves. This works on the principle of light modulation through the blood flow of the arterial nerve at each pulse. The heart rate should be between about 60-100bpm.

C. Blood pressure sensor

Hypertension sensor measures blood pressure, including systolic, diastolic pressure and pulse rate of the body. This approach provides accurate and reliable results than the sphygmomanometer. The existed procedure used airborne gall bladder armor and a stethoscope to measure the blood pressure. In general, blood pressure sensors gather the blood pressure from the vessel walls or arteries.

D. Temperature sensor

This sensor measures the body temperature with a voltage. The sensor LM35 has an advantage about conversion from Kelvin to the centigrade, and is also suitable for wireless applications and which is better than the thermostat.

E. Acceleration sensor

The accelerometer sensor ADXL335 used here is a full -3-axis accelerometer with small, thin, low power, signal outputs. This measures the full range of acceleration (± 3g). This sensor is able to find the gravitational fixed-acceleration in various applications. The user sensor uses the X, Y and Z capacitors at XOUT, YOUT, and ZOUT pins. Bandwidths range from 0.5 Hz to 1600 Hz for X and Y axes, and range from 0.5 Hz to 550 Hz for Z Axis.

F. Respiration

This sensor is able to finds breaths per minute in humans. The regular respiratory rate of humans is 12 to 18 breaths per minute. Below the 10-year-old children will breathe 30 to 60 per minute. Here, two sensors used to measure the breath, which connected with the resistor bridge network. The bridge network terminals are used to connect the LM741 amplifier by an inverting input terminal.

G. Raspberry pi

This device works well as a multi-processor. It has a graphics card, a volatile memory, RAM, device interfaces and other external wireless device interfaces. This raspberry Pi is consuming very less power, but it is still cheap and powerful. It requires a keyboard to provide commands, display unit and power supplies as a standard PC. Here, Raspberry Pi used the SD card as a hard disk. Raspberry Piable to connect via a LAN / Ethernet or via a USB modem or via wireless. Raspberry Pi is supposed to support for various home and business applications. Raspberry Pi runs on a Linux-based OS and which operated by the Raspbian OS. Python is a programming language used to implement the Raspberry-Pi. It is capable of communicating with other external devices using

wireless communication technologies, cellular networks, NFC, ZigBee, Bluetooth etc.

This paper was implemented on a fast network as 4G with the cellular network. Raspberry can be used for many applications and so, it has many opportunities in the future.

4. ARCHITECTURAL DESIGN

The connection between the different elements is discussed with the following structure of the system. This system designed in two parts. Hardware and software; in the hardware unit consist of transmitters and receivers, and the software unit includes, software languages like Python, MATLAB, and their interface. Here we discussed useful IoT applications for health monitoring. An IoT application's simple operation stages A. Collecting the data, B. Processing the data, C. Storage the data and D. Transfer the data. Each app may have the processing of first and last steps, but storage does not apply or apply to certain applications.

As shown in Figure-1 the general architecture of IoT has many components included radio transceivers, low power multi-radio chips, RF component for wireless connectivity etc.

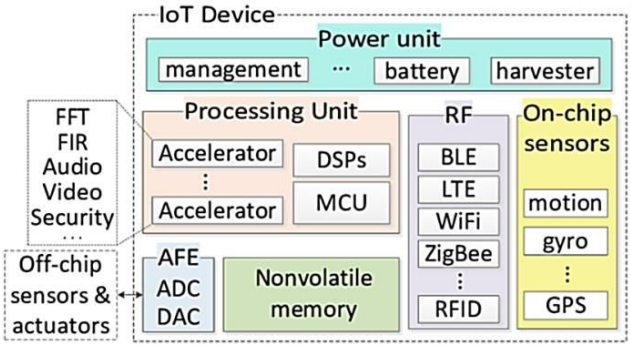

Figure-1. General architecture of IoT.

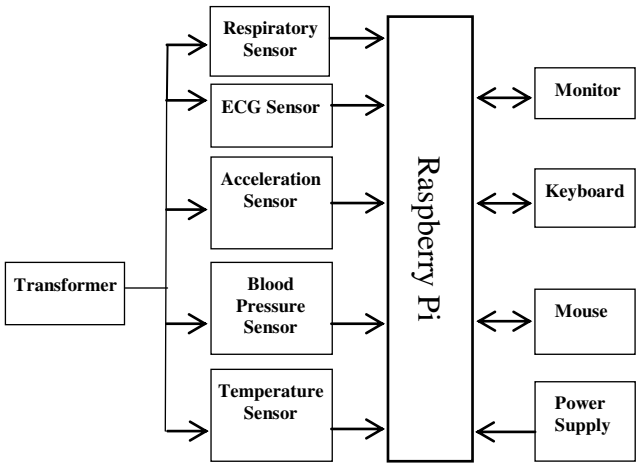

Figure-2. Architectural design with raspberry pi.

As in the Figure-2 architectural diagram, above the sensors have been connected with the patient's skin and the other end has been connected with The Raspberry Pi board. Every sensor(s) value(s) is/are stored in the server and also displayed very recent values. The doctor/patient/guardian may see the patient's data along with their corresponding login details. A doctor can see the patient's history records and suggest changes in drugs and prescription. Special IDs and passwords for patients can see their records.

This application adopted the Raspberry tool, due to the multi-capacity efficiency of low power consumption. The system can be easily installed at the end party and can be obtained from the database. And this data is very valuable.

The system is mainly focused to know the patient's health condition: The health parameter and get the perfect result. A doctor regularly checks-up the patient's health condition using some essential parameters. This system is also useful for hospitals and clinics because the system values parameters in real time. Through this system, the doctor can be calibrated the patient's body temperature, ECG, heart rate parameter efficiently and the Raspberry device can store data temporarily. We are receiving heart rate in the form of pulses; body temperature in the form Celsius, ECG received in the form of a percentage, and is displayed on a special health care device or website.

Import all modules 'information to MySQL DB using serial communication: Communicate ECG with the raspberry device and find a heart rate from input source. The updated information has been replaced at every periodic time, this information has been used to check the heartbeat is the normal range or not, if not alert to the authorized person, the hospital ambulance via GSM modem with an automatic call, otherwise it will supervise continuously.

5. THE PROPOSED METHOD

The proposed system has been connected sensors within their respective ways. The device receives the data from the sensors, and integrated these with the board. Raspberry Pi is the major tool in the proposed system; it is connected to all other sensors. Raspberry Pi works at 5V DC power supply. All sensors do not use the same power; here we supposed to use transformers for handling them. In this, we used a step down the transformer with (0-9, 15-0-15) V/1A values. These could be converted from the voltage 230V is into 0-9V and 15-0-15V and then it sends to switch mode power supply (SMPS). There are three ICs in this circuit, namely 7805, 7812, 7912 and also used + 5v, + 12v, -12v volts respectively. Then these diodes are used to change the wavelength from AC to DC. So there is a 1000uf capacitor to get electricity supply and then the sensor power supply is connected.

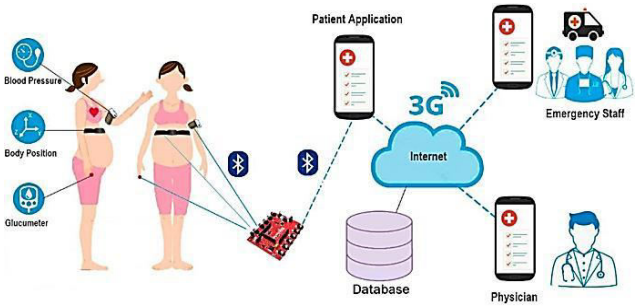

Figure-3. The virtual architectural model of IoT.

IR transmitter and receiver used to measure the heartbeat. The normal heart rate for healthy humans is 60 to 100 bpp. Pulse rate sensor infrared rays will pass over blood nerve, where the IR transmitter and receiver will check the blood flow between them. LM324 OP-AMP is used to amplify the signal. Then the TTL voltage is given to the base of a signal BC-557 (PNP) and BC547 (NPN) conversion transistors to change the 0 to 5v level. Finally, the TTL output is given to the Intersection of the 7414 IC in the digital form to invade the pulse. Then the last square wave signal is given to the raspberry.

The device is connected to the IoT server system, which is connected to various sensors, and provides services and controls over the network. The temperature sensor, heart rate sensor, an ECG sensor, an acceleration sensor and a pressure sensor device, all are interconnected with this device. The generated results are displayed on LCD monitor at every span of time on the user's and doctor's device via internet; this could be synchronized frequently, shown in Figure-3.

In this paper, the thermistor resistor is used to measure human body temperature. This thermistor resistance value decreases as the temperature value increased. Potential divider $V_{out} = V_{in}\ R_2 / (R_1 + R_2)$; R_1 resistor value 4.7K and R_2 thermistor. If the resistor R2 temperature is obtained, the value of the input voltage added to the resistor and this value is computed from the value of the temperature. Then the value goes to the MCP 3208 IC and this work will use the analog to digital (ADC) form and vice versa.

Respiration is several breaths per minute; these are different age to age. The normal respiratory rate for all humans is 12 to 18 breaths per minute. Below ten years children will breathe 30 to 60 breaths per minute. In this respiration measure, two surgeons are used to measure respiration, which are connected to the resistor Bridge Network. Bridge Terminals Input Terminals of Operating Amplifier LM741 are connected with inverters and inverts. A thermostat is used for respiration and the other is used as a measurement room temperature. The next phase of the difference amplifier, voltage Om-AMP will filter errors and its converged output voltage varies by 12v to -12v square wave pulse computer. Transistor-Transistor Logic (TTL) passes the pulse (BC547), and final pulses are forwarded to the raspberry monitor on a storm rate.

The device is connected to the IoT server system, which is connected with several sensors, and provides services and controls over the network. The temperature sensor, heartbeat sensor, an ECG sensor, an acceleration sensor and a pressure sensor device, all are interconnected with the Raspberry Pi device. It generated information at every span of time and this displayed on LCD user devices and also on the doctor's device, those should be synchronized with the server system. Initially, which will collect the data, process it and store information on the Raspberry Pi memory after that, this is transferred to the IoT server.

After receiving the sensor's data, healthcare monitoring device will be processed clinical test accordingly and the result should be in the safe range, otherwise the device is issued SMS to the official caregiver, specified physician and hospital.

6. SUMMARY AND CONCLUSIONS

In this research analyzed the Raspberry-based health monitoring system through IOT. There are two ways to connect and operate the raspberry device; one is directly connecting peripherals and the other way is to connect the computer after install the putty software with IP address, subnet mask, gateway to that system. If any abnormalities notice in the patient health, this will directly report to the authorized or guardian via GSM over the network. The proposed method is modelled for impressive features like easy to use; power consumption is very less and understandable. This system is a good communicator between patient and the doctor. As per that we implemented this project and finds the output results have been successfully validated.

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