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REAL TIME PATIENT MONITORING AND ANALYSIS SYSTEM USING IOT

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ABSTRACT

In recent era health is a level of useful and metabolic potency of living organism. It is the ability of a biological system to acquire, convert, allocate, distribute, and utilize energy sustainably. The presented system can keep track of the physiological parameters like heart rate, blood pressure, body temperature and ECG of the person by using Raspberry Pi and transmit above mentioned real time datato the cloud or the web server in real time manner. Cloud computing and password protected Wi-Fi module handles authentication, privacy and security of patient details by allowing restricted access to the database. If the system detects any abrupt change in any of the physiological parameters, then it alerts the authorized person by placing a call or by messages.

KEYWORDS: Internet of things (IoT), bio-sensors, Global System for Mobile Communication (GSM), Health monitoring system.

1. INTRODUCTION

The Internet of Things (IoT) is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators and connectivity which enables these things to connect, collect and exchange data, creating opportunities for more direct integration of the physical world into computer based systems, resulting in efficiency improvements, economic benefits, and reduced human exertions. It is a fastest growing technology in wireless communication. Using IoT, devices or objects are always stay connected to the real world which means that physical devices can be stay connected to the virtual world and can be accessed remotely through anywhere from the world. The real time applications of IoT are smart media, environment monitoring, smart manufacturing, intelligent medical and healthcare, smart building with home automation, energy management, transportation etc.

In recent era health is a level of useful and metabolic potency of living organism. It is the ability of a biological system to acquire, convert, allocate, distribute, and utilize energy sustainably. Keeping health standing of a person can be a troublesome task. Especially maturity parents ought to be occasionally monitored and their adored ones should get to learn concerning their health standing from time to time.

Our main objective of this proposal is to design an intelligent real time system to monitor human health with the assistance of sensors and Internet of Things (IoT). The IoT based system can keep track of the physiological parameters like heart rate, blood pressure, body temperature and ECG of the person by using Raspberry Pi. The above mentioned real time data is streamed to the cloud or the web server in real time manner.

There exist Real time streaming of proposed parameters to the cloud or to the web server. The above mentioned meta-information can be monitored by an authorized person, with the help of authorized ID and password. If the system detects any abrupt change in any of the physiological parameters, then it alerts the authorized person by placing a call or by messages. Hence, with the use of the proposed equipment, it is possible to implement a low cost mechanism to protect the valuable human life, as well as to provide a common platform for medical fields to incorporate their services to the remote locations. Also our proposed system will utilize all the technological advancement to the medical filed by accessing the facilities to the whole levels of community.

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The remainder of this paper is organized as follows: section 2 investigates the literature review of health monitoring systems, section 3 presents the system architecture and implementation of the proposed system, section 4 briefs the hardware description, section 5 discusses the experimental results and finally section 6 concludes the paper.

2. LITERATURE REVIEW AND RELATED WORKS

In the literature, there are several approach proposed to develop real time patient monitoring system. For instance, [1]proposes health monitoring system for patients in coma with the help of GSM and Internet of Things. Patients health condition is measured with the help of various bio sensors. The measured parameters are streamed to the cloud "ThingSpeak". In case ofabnormalities, alert will be send to authorised person with the help of GSM module.

In [2] the main goal of the proposed system is to develop a reliable patient monitoring system so that doctors can monitor the patients, who are either hospitalized or executing their normal daily life activities. Raspberry Pi 3 acquires the biological parameters from the sensors. These parameters are processed in Pi and if there is any variation in the acquired parameters, a message will be sent to the pre-defined number via a GSM module.

In [3] the health status of a patient is measured automatically with the help of sensors. Measured physiological parameters include body temperature, heart rate and blood pressure. These parameters are send as an emergency alert the doctor. This helps the doctor to know about the current health status of the patient even at remote location.[4] uses various sensors such as temperature sensor, respiration and heart rate sensor. Here various physiological parameters can be monitored in the monitor screen of computer using raspberry pi as well as monitoring from anywhere in the world using internet source.

In [5] the bio signals are measured using an ECG sensor. The signals are transferred to the cloud. From the cloud, doctor can access the information regardless of location. Thus, proper medication can be made available to patients at distant location.

[6] presents the design and implementation of an IoT-based health monitoring system for emergency medical services which can demonstrate collection, integration, and interoperation of IoT data. The proposed model enables users to improve health related risks and reduce healthcare costs by collecting, recording, analysing and sharing large data streams in real time and efficiently. The idea of this paper is to reduce the headache of patient to visit to doctor every time he need to check his blood pressure, heart beat rate, temperature etc.

3. SYSTEM ARCHITECTURE

A. Client

The client section consists of Raspberry Pi 3, Blood Pressure Sensor (Model No. 1437), Temperature Sensor(DS18B20), ECG Sensor (AD8232) and GSM Module (SIM 900A). The blood pressure sensor is fixed on the wrist of the patient and a digital temperature sensor is used which communicates to Raspberry Pi 3 with I2C interface. A 3 lead analog ECG sensor AD8232 is used here. MCP3008 is used for interfacing AD8232 to the Raspberry Pi 3. MCP3008 is an 8-channel, 10-bit ADC with SPI interface. Raspberry Pi 3 acquires the biological parameters from these three sensors. These parameters are processed in Pi and if there is any variation in the acquired parameters from the threshold value, a message will be sent to the pre-defined number via a GSM module. Python is used as programming language in the client section.

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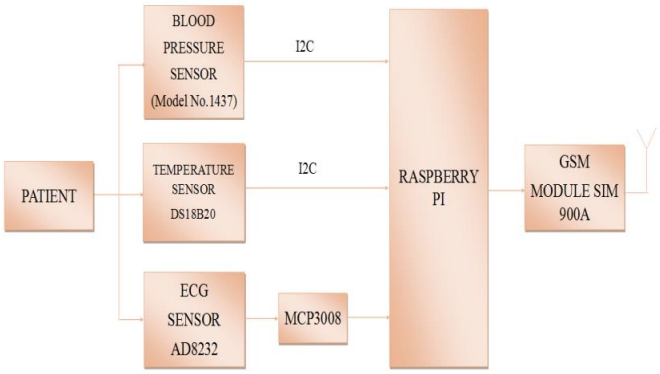

Figure 1: Client section

B. Server

The physiological parameters which is streamed in a real time manner from Raspberry Pi is stored in the cloud or webserver. This feature enables the authorized person to access the medical history of the patient regardless of time and location. These data can be monitored using internet or the application named "Thing Speak". The python client posts the biological parameters acquired from the sensors in the server. HTTP is used as the communication protocol for client and the server.The client submits an HTTP request message to the server. The server returns a response message to the client. PHP is used as the server-side scripting language. The server stores these values in the MySQL database. The server side provides the facility to the end users to monitor the patients requested parameters along with the date and time.

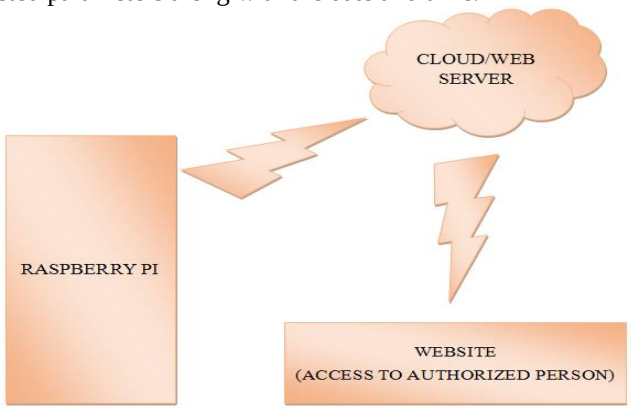

Figure 2: Server Section

4. HARDWARE DESCRIPTION

A. Blood Pressure Sensor

Blood pressure is the pressure of the blood in the arteries as it is pumped around the body by the heart. When your heart beats, it contracts and pushes blood through the arteries to the rest of your body. This force creates pressure on the arteries. Blood pressure is recorded as two numbers— the systolic pressure (as the heart beats) over the diastolic pressure (as the heart relaxes between beats). The unit which measures this is called Sphygmomanometer. The blood pressure sensor used here is Model No. 1437. The sensor reads blood pressure and heart rate and outputs at 9600 baud rate. The output reading from sensor is 8 bit value in ASCII format fixed digits, from 000 to 255 and it is given to USB to TTL UART adapter.

Pin out Configurations:

- TX-OUT: Transmit output. It outputs serial data of 3V logic level. It is connected to RXD pin of Raspberry Pin.
- +5V: Regulated 5V supply input. It is connected to the +5V pin of Raspberry Pi.
- GROUND: Board Common Ground. It is connected to the 39th pin of Raspberry Pi.

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B. Temperature Sensor

The DS18B20 Digital Thermometer provides 9 to 12-bit (configurable) temperature readings which indicate the temperature of the device. It consists of a Vdd, GND and Data pin. Information is sent to/from the DS18B20 over a 1-Wire interface, so that only one wire (and ground) needs to be connected from a central microprocessor to a DS18B20. Because each DS18B20 contains a unique silicon serial number, multiple DS18B20s can exist on the same 1-Wire bus. Applications where this feature is useful include HVAC environmental controls, sensing temperatures inside buildings, equipment or machinery, and process monitoring and control.

Pin out Configurations:

- GROUND (Black): It is connected to 6th pin of Raspberry Pi 3.
- DATA (Yellow): It is connected to GPIO4 (pin 7) of Raspberry Pi 3.
- POWER (Red): It is connected to 1st pin of Raspberry Pi 3 (3v3).

C. ECG Sensor

The AD8232 is an integrated signal conditioning block for ECG and other biopotential measurement applications. It is designed to extract, amplify, and filter small biopotential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement. This design allows for an ultralow power analog-to-digital converter (ADC) like MCP 3008 or an embedded microcontroller to acquire the output signal easily.

Pin out Configurations:

- GROUND: It is connected to ground pin.
- POWER: It is connected to 3.3V.
- OUTPUT: It is connected to CH0 of MCP3008.

The biological parameters from these sensors are processed in the Raspberry Pi 3 and if there is any variation in the parameters collected, then a message will be sent to the pre-defined number via a GSM Module.Here SIM 900 A module is used. It is a dual- bandGSM/GPRS module that works on frequencies 850 MHz, 900 MHz.

5. EXPERIMENTAL RESULTS

The website displays the real time biological parameters along with the patient ID. The website can be accessed by any medical expert across the world for diagnosis. It provides the facility to analyse the record of the patients. The acquired parameters is processed in Raspberry Pi 3 and if there is any abnormality in the acquired parameters, then a message is sent to the pre-defined number via a GSM module.

Figure 3: GSM Output

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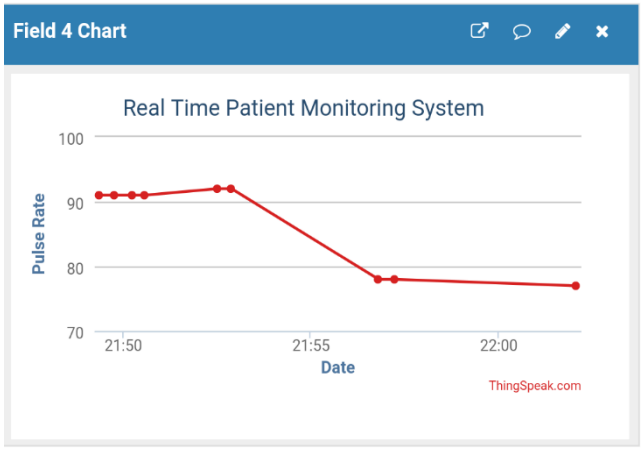

Figure 4: Pulse Rate Result for IoT

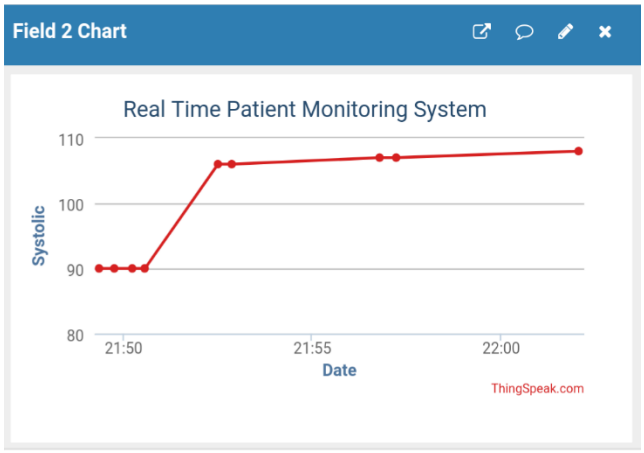

Figure 5: Systolic Pressure Result for IoT

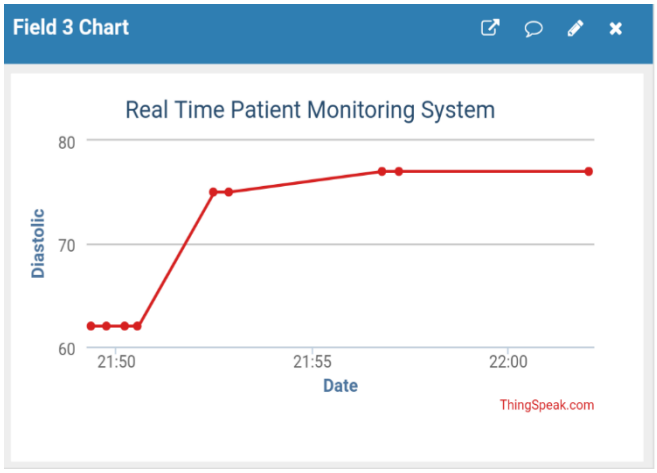

Figure 6: Diastolic Pressure Result for IoT

Fig.4, Fig.5 and Fig.6 shows the result of the IoT data for the pulse rate sensor,Systolic Pressure and Diastolic Pressure respectively.The sensed data was successfully sent to the cloud of Thingspeak. As seen in the Figures, the sensed data is plotted with respect to time. When the system is not in use, it will not plot anything therefore when the next value is plotted, it will join the last value with the new sensed one with respect to time. Whenever

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an abnormal condition is detected such as if the pulse sensor rate, systolic or diastolic pressure rate is above or below the reffered value, it will trigger the alert message thus respective messages will be sent to the doctor.

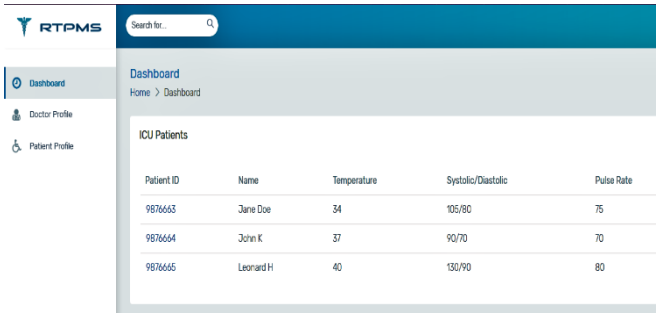

Figure 7: Front End of Website

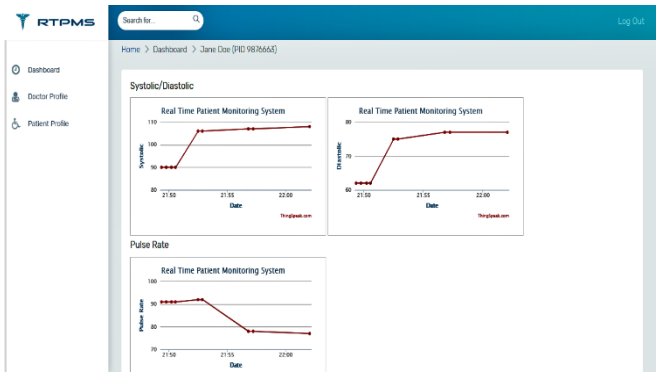

Figure 8: Sensor readings imported from ThingSpeak

It provides the facility to add or delete the patients and also the details of the existing patients can be updated through this website.

6. CONCLUSION

The proposed system can be employed as a solution for many prevalent problems in the medical sector. The ever existing issues like need of human presence around the clock, timely checking of physiological parameters, lack of intelligent patient monitoring system can be solved to an extent. Physiological parameters like body temperature, blood pressure and ECG are measured with the help of sensors. As the measured data is streamed to cloud, this data can be accessed by the medical expert using mobile phone or PC over Wi-Fi, regardless of location. The remote monitoring and analysing of the physiological parameters makes the system more reliable and intelligent. If there is any hike in any of the physiological parameters, an alert will be sent in the form of call or message to the authorized person. The authorized person is more likely to be the staff in the nursing station, so that they can take immediate action regarding the situation. The health status of the patient can be monitored more accurately as the physiological parameters are updated every now and then. Thus, by integrating IoT with medical field an era of smart health care can be created in our country.

Hence, it is possible to implement a low cost mechanism for monitoring the health of patients. Moreover, the proposed system will utilize all the technological advancement in the medical field.

7. ACKNOWLEDGMENT

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