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Patient Monitoring System Using IOT

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ABSTRACT

The Internet of Things (IoT) is intercommunication of embedded devices using networking technologies. The IoT will be one of the important trends in future; can affect the networking, business and communication. The healthcare system, which is further worsened by the lack of tools for communication between the specialists, stimulates the need of functional interoperability to ameliorate this coordination. A major aspect in the healthcare system is the monitoring of the patient's vital signs such as temperature, and heart rate. In this paper, proposing a remote sensing parameter of the human body which consists of pulse and temperature. The parameters that are used for sensing and monitoring will send the data through sensors. Adding a web based observing helps to keep track of the regular health status of a patient. The sensing data will be continuously collected in a database and will be used to inform patient to any unseen problems to undergo possible diagnosis. Experimental results prove the proposed system is user friendly, reliable, economical.

Keywords: Arduino Uno, heartbeat sensor, temperature sensor, patient, illness, cloud.

1. INTRODUCTION

The Internet of Things is the internetworking of physical devices, vehicles buildings and other items. Embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data.

1.1 Arduino

The Arduino Uno is a microcontroller board based on the ATmega328. Arduino is an open-source, prototyping platform and its simplicity makes it ideal for hobbyists to use as well as professionals. The Arduino Uno has 14 digital input/output pins (of which 6can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

1.2 Features of the Arduino Uno Board

1. It is an easy USB interface. This allows interface with USB as this is like a serial device.
2. The chip on the board plugs straight into your USB port and supports on your computer as a virtual serial port. The benefit of this setup is that serial communication is an extremely easy protocol which is time-tested and USB makes connection with modern computers and makes it comfortable.
3. It is easy-to-find the microcontroller brain which is the ATmega328 chip. It has more number of hardware features like timers, external and internal interrupts, PWM pins and multiple sleep modes.
4. It is an open source design and there is an advantage of being open source is that it has a large community of people using and troubleshooting it. This makes it easy to help in debugging projects.
5. It is a 16 MHz clock which is fast enough for most applications and does not speeds up the microcontroller.

1.3 Heartbeat Sensor

The heartbeat sensor is based on the principle of photo phlethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ (a vascular region). In case of applications where heart pulse rate is to be monitored, the timing of the pulses is more important. The flow of blood volume is decided by the rate of heart pulses and since light is absorbed by blood, the signal pulses are equivalent to the heart beat pulses.

1.4 Two Ways to Measure a Heartbeat

Using a sensor:

Heart Beat can be measured based on optical power variation as light is scattered or absorbed during its path through the blood as the heart beat changes.

1.5 LM35 Temperature Sensor

Temperature is one of the most commonly measured parameter in the world. They are used in your daily household devices from Microwave, fridges, AC to all fields of engineering. Temperature sensor basically measures the heat/cold generated by an object to which it is connected. It then provides a proportional resistance, current or voltage output which is then measured or processed as per our application

1.6 Cloud computing

It is an information technology (IT) paradigm that enables ubiquitous access to shared pools of configurable systems resources. Cloud computing relies on sharing of resources to achieve coherence and economies of scale, similar to a public utility.

2. RELATED WORK

Why Do We Need a Remote Human-Health Monitoring System? A Study on Predictive Analytics for Heart Failure Patients- Mohammad Pourhomayoun et al

Body area networks and remote health monitoring systems allow for collecting physiological data from patients, and provide a platform to utilize analytics algorithms to predict medical conditions. It is the prediction for patients with Congestive Heart Failure (CHF) and based on the physiological data collected in last days of hospital stay. We examine the proposed algorithm on the Electronic Health Records (EHR) of UCLA Hospital containing over 10 million clinical measurements collected from approximately 10,000 patients hospitalized at the UCLA Medical Center.

Remote Human-Health monitoring System through IoT- Ananda Mohon Ghosh et al.

The parameters that are used for sensing and monitoring will send the data through wireless sensors. Adding a web based observing helps to keep track of the regular health status of a patient. The sensing data will be continuously

collected in a database and will be used to inform patient to any unseen problems to undergo possible diagnosis. Experimental results prove the proposed system is user friendly, reliable, economical.

Sensor Based Healthcare Information System- K. SundaraVelrani et al.

Proposes a novel, IoT-aware, smart architecture for automatic monitoring and tracking of patients from their home itself. Staying true to the IoT vision, we propose a Automation Healthcare System (AHS). The proposed AHS is to investigate advanced home health care services. Data produced in AHS shared with doctors and patients through IoT. The system utilizes IoT telemetry to transmit data from sensors to a remote monitor.

A Real-Time Human-Health Monitoring System for Remote Cardiac Patients Using Smartphone and Wearable Sensors- Priyanka Kakria et al.

A real-time heart monitoring system is developed considering the cost, ease of application, accuracy, and data security. The system is conceptualized to provide an interface between the doctor and the patients for two-way communication. This study is to facilitate the remote cardiac patients in getting latest healthcare services which might not be possible otherwise due to low doctor-to-patient ratio. The developed monitoring system is then evaluated for 40 individuals (aged between 18 and 66 years) using wearable sensors while holding an Android device

Web Based Human-Health monitoring System- Y.R.Risodkar et al.

A physiology signal monitoring system can help medical staffs to monitor and analyze human's physiology signal effectively, such that they can not only monitor the patients' physiology states immediately, but also reduce medical cost and save a lot of time of patients to visit hospital's doctors. Meanwhile, the proposed system also developed a friendly web-based interface that is convenient to the observation of immediate human physiological signals. Moreover, this study also proposes an intelligent data analysis scheme based on the modified cosine similarity measure to diagnose abnormal human pulses for exploring potential chronic diseases. Therefore, the proposed system provides benefits in terms of aiding long-distance medical treatment, exploring trends of potential chronic diseases, and urgent situation informing for sudden diseases.

3. PROPOSTED SYSTEM

To monitor different ECG values automatically, updating the database of website continuously and alerting the doctors by a message. Message is sent to doctors through the GSM module connected to RS232 serial port and alerting the people there through a buzzer connected to GPIO pins. MySQL dB module has been used to update the website database continuously. A display monitor can be connected to IoT through HDMI port and the website can be examined directly.

3.1 Advantages

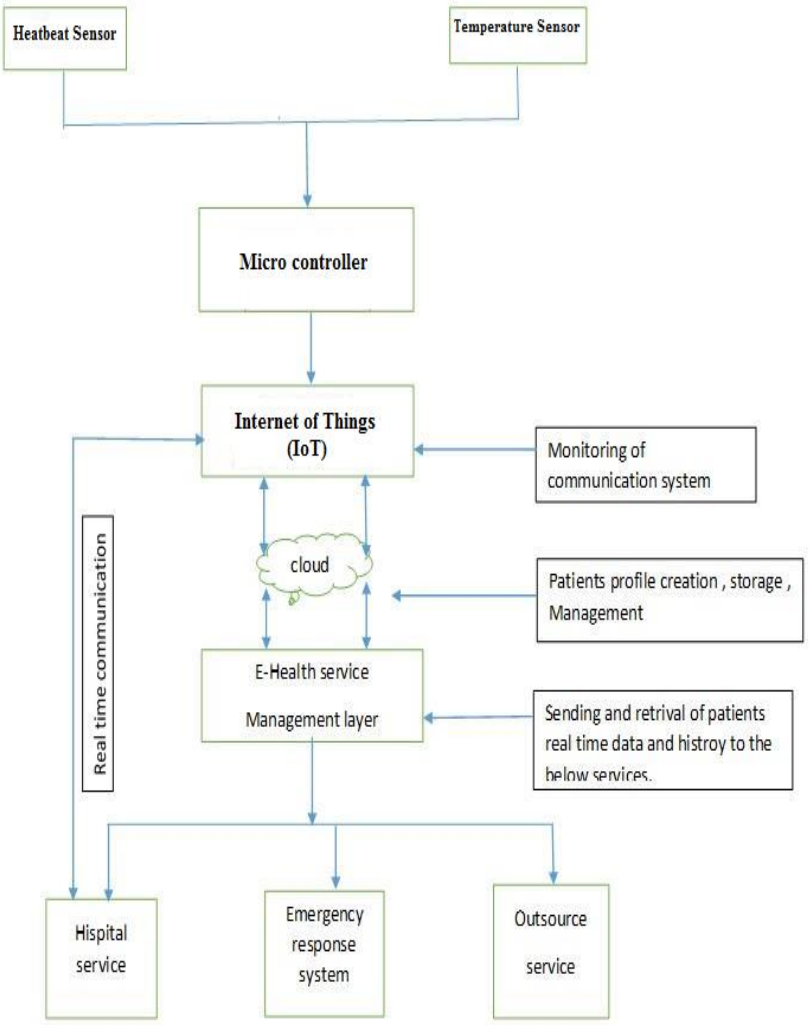
1. IOT Monitoring proves really helpful when we need to monitor & record and keep track of changes in the health parameters of the patient over the period of time. So with the IOT health monitoring, we can have

the database of these changes in the health parameters. Doctors can take the reference of these changes or the history of the patient while suggesting the treatment or the medicines to the patient.

2. Hospital stays are minimized due to Remote Patient Monitoring.
3. Hospital visits for normal routine checkups are minimized.
4. Patient health parameter data is stored over the cloud. So it is more beneficial than maintaining the records on printed papers kept in the files or even the digital records which are kept in a particular computer or laptop or memory device like pen- drive.
5. Because there are chances that these devices can get corrupt and data might be lost. Whereas, in case of IOT, he cloud storage is more reliable and does have minimal chances of data loss.

4. SYSTEM ARCHITECTURE

The sensors Temperature and Heartbeat are connected to the Arduino board. The values from the Microcontroller are given to the Web Server using IoT. The parameter values can be viewed by doctors using Website.



4.1. Microcontroller

A microcontroller is a computer present in a single integrated circuit which is dedicated to perform one task and execute one specific application. It contains memory, programmable input/output peripherals as well a processor. Microcontrollers are mostly designed for embedded applications and are heavily used in automatically controlled electronic devices such as cell phones, cameras, microwave ovens, washing machines, etc.

4.2. Internet of Things

Internet of Things (IoT) is an ecosystem of connected physical objects that are accessible through the internet. The 'thing' in IoT could be a person with a heart monitor or an automobile with built-in-sensors, i.e. objects that have been assigned an IP address and have the ability to collect and transfer data over a network without manual assistance or intervention. The embedded technology in the objects helps them to interact with internal states or the external environment, which in turn affects the decisions taken.

4.3. Cloud

Cloud computing provides a simple way to access servers, storage, databases and a broad set of application services over the Internet. A Cloud services platform such as Amazon Web Services owns and maintains the network-connected hardware required for these application services, while you provision and use what you need via a web application.

4.4. Hospital Service

In hospital, patience is monitored using IoT sensor and data are stored in cloud by Wi-Fi automatically. This can be managed by the admin in the hospital. Message is sent to doctors through the GSM module connected to RS232 serial port and alerting the people there through a buzzer connected to GPIO pins.

4.5. Emergency response system

To monitor different ECG values automatically using GSM technology. It updates the data to the database and alerts the doctors for any abnormal condition in patient health. So this avoids continuous observation with doctor.

4.6. Outsource Service

All the data are stored in cloud and the updates are given for every 5 seconds. Message can be also given to n number of persons like friends and family members. Moreover this data is much valuable, by that doctors can view the patient's history and recognize the condition of the patient.

4.7. ALGORITHM

IoT is installed with an operating system; Arduino supports all programming languages like C, Dot net etc. Programming language is used for the communication with ECG machines and updating website database using MySQL db.

1. Import all the modules required for Serial Communication, MySQL db.
2. Communicate with the ECG's connected to Arduino.
3. Find the heart beat from the input data. Update the website database with new health parameters.
4. Check if the heart beat is in the normal range.
5. If heart beat is not in normal range alert the authorized person by sending SMS through GSM module and alert in the hospital through buzzer sound.
6. Delete the message in SIM card to make space.
7. If heart beat is in normal range monitoring continues.

5. WORKING PRINCIPLE

1. Processing Unit
2. The Lm35Temperature(Thermo) Sensor
3. Heartbeat Sensor
4. Web Login
5. Monitoring the Patient's Data

5.1 Processing Unit

In our system Arduino Uno Board is used. The microcontroller is connected with all other hardware units in the module. This module takes analog parameters from the sensors attached to patient, Process it and convert them in digital output. This module also contains IoT device which sends the sensors converted data to the Cloud.

5.2 The Lm35Temperature (Thermo) Sensor

The LM35 series are precision integrated circuit LM35 temperature sensors, whose output voltage is linearly proportional to the temperature in Celsius (Centigrade). The LM35 sensor thus has an advantage over linear temperature sensors, calibrated in °Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient centigrade scaling.

The LM35 sensor does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°Cover a full -55 to +150°C temperature range. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air.

5.3 Heartbeat Sensor

Heart beat sensor is designed to give digital output of heat beat when a finger is placed inside it. This digital output can be connected to Arduino directly to measure the Beats per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger each pulse. IC LM358 is used for this sensor. Its dual low power operational amplifier consists of a super bright red LED and light detector. One will act as amplifiers and another

will be used as comparator. LED needs to be super bright as the light must pass through finger and detected at other end. When heart pumps a pulse of blood through blood vessels, finger becomes slightly more opaque so less light reach at the detector. With each heart pulse, the detector signal varies which is converted to electrical pulse.

5.4 Web Login

Web login module is the cloud platform for connecting hardware and software solutions to remotely monitor, control, and automate processes for healthcare Applications. The Cloud server has three distinct components: storage, analytics, and visualization. The system is designed for long term storage of patient's biomedical information as well assisting health professionals with diagnostic information. Here we are using the real time cloud platform for monitoring the patient's information. To monitor the data, the user have to login with their account which is already configured with our IoT Devices.

5.5 Monitoring the Patient's Data

This is the Visual Interface module, which makes regular web server invocations. Doctor can remotely track both Heartbeat and temperature sensor values of the patient. Connecting healthcare devices with patients to central IoT platforms monitor by using cloud server. The Doctor can track the patient's record both numerical and graphical data. By using the graphical data, doctor can easily diagnose the patient's health condition. Meanwhile the doctor can check the history of the patients. So that, whenever the doctor wants to see the patient's old data, he/she can easily track the record which is stored in the cloud server.

5.6 Doctor's prescription

In this module, the doctor receives patient's profile from the Cloud server and identifies the problem. Doctor will set the auto medical prescription in the web server according to the patient's health. The doctor can set the threshold value for the patient's heart beat and temperature data after diagnosing the patient's health condition. If the patient temperature/heartbeat is crossing the threshold value, the medicine information will be automatically send to patient's guardian mobile and nearby medical center mobile, so that the patient can receive and intake the medicine whenever they need. The doctor can change the medicine information and medical center number and threshold values of the patient's health data whenever he wants.

6. RESULT AND DISCUSSION

Developed a system that measures and detect Human Heartbeat and body temperature of the patient, sends the data to user or server end by using microcontroller with reasonable cost and great effect. Use two different sensors and these are mainly under the control of microcontroller. For Human Heartbeat measurement use fingertip, it's in bpm (beats per minute). These calculated rates will have stored in server by transferring through Wi-Fi module via internet. Liquid crystal display has been used to display the calculated human heart beat rate. To measure the human body temperature, use LM35 sensor, the measured data is given to transmitter module, it interns transfer these data to server through wireless system due to this notice avoided use of wires. Finally, the stored data in server

will be displayed for further analysis by physician or specialist to provide better aid. From Experimental results, proposed system is user friendly, reliable, economical. Further research work can be carried out for the following issues:

1. In Real-time heath monitoring system using ARDUINO can be integrated or implemented in hardware using various types of sensors to detect the human-health conditions of the patients in critical sites continuous Observing of health can be made and the data's will be stored in database.
2. In future, a portable Human-Health monitoring system can be designed using Arduino.

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