SMART HEALTH CARE MONITORING BASED ON INTERNET OF THINGS (IoT)

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ABSTRACT: In this proposed work, real-time patient health monitoring system has been designed by using Internet of Things (IoT). Various parameters like body temperature, blood pressure (B.P), heartbeat, and ECG are monitored using sensors. Humidity of the patient surroundings has been monitored in the proposed work. In this paper, ARDUINO-NANO, GSM has been utilized for the design of the prototype. The main focus of the project is to monitor the important parameters of the patient in remote mode. IoT in healthcare is the key player in providing better medical facilities and it facilitates the doctors to monitor the patient’s health condition continuously. The proposed system consists of various medical devices such as sensors, mobile and web-based applications, which communicate via network connected devices to monitor and record patient’s health data and medical information in the remote mode. The collected information is used to analyze the patient’s health condition continuously such that some critical conditions can be avoided by knowing in the preliminary stage itself through the projected design.

KEY WORDS: Internet of Things, cloud server, Patient, Monitoring, Smart Health.

I. INTRODUCTION

A remote health monitoring system is an extension of a hospital medical system where a patient’s vital body state can be monitored remotely. Health care services such as medical monitoring, data access and communication with the health care provider in emergency situations through SMS is achieved.

Health monitoring is the major problem in today’s world. Due to lack of proper health monitoring, patient suffer from serious health issues. There are lots of IoT devices now days to monitor the health of the patient over internet [1-4]. Health experts are also taking advantage of these smart devices to keep an eye on their patients. With tons of new healthcare technology start-ups, IoT is rapidly revolutionizing the health care industry. Here in this project, we will make an IoT based health monitoring system which records the patient heart beat rate and body temperature and also send an email/SMS alert whenever those readings go beyond critical values. Pulse rate and body temperature readings are recorded over Thingview so that patient health care can be monitored anywhere in the world over internet. A buzzer is attached near to the patient to the kit so that the relatives of the person can know the patient’s critical condition. The proposed system mainly focuses on the situation where the doctors and patients are at distant location and it is very important to give the entire details about the heart beat and temperature of the patient to the doctor [5,6]. The IoT technology has the opportunities and challenges in accessing the medical data. The computing resources is a challenge since the data used is huge and that is Big Data, so the data need to be decentralized. More over the data is of heterogeneous in nature since the data is distributed data the software approach to deal this data is with the cloud computing platform. These are designed to coordinate with the hybrid data. A cloud platform is developed to deal the heterogeneous data [7,8]. An IoT for health care data is used for industrial applications. Data collections are done using sensors [9]. Data collection is done using a hard wired in assessing the operational performance. The data collected is correlated with the technician’s readings and thus the performance is checked and decided based on data [10].

II. EXISTING METHODS

At present patient’s health is monitored in hospitals by using corresponding instruments. The presence of doctor is compulsory in such cases. To overcome this, a number of researchers have proposed various models for IoT in Healthcare and the prediction of various types of diseases using various techniques. The sensors used here are Temperature Sensor, BP Sensor, and Heart Beat Sensor and ECG (electro cardio gram) sensor. This methodology has been earlier implemented using Arduino-Uno, raspberry-pi as the controller. In this work we have used ARDUINO-NANO.

III. PROPOSED METHODOLOGY

The proposed model’s block diagram is shown in fig.1. The block diagram shows all the components of the hardware connected to the ARDUINO NANO, which is linked with the processor. A Remote Patient Health Monitoring System (RPHMS) has been designed which has heartbeat detection, temperature detection, humidity detection, B.P measurement. A doctor or health specialist can use the system to monitor remotely of all vital health parameters of the patient or person of interest.
IV. SYSTEM ARCHITECTURE

![Block Diagram](image1)

Figure 1. Block diagram

V. ARDUINO NANO

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P from fig.2; offers the same connectivity and specs of the UNO board in a smaller form factor. The Arduino Nano is programmed using the Arduino software (IDE). Arduino boards are widely used in robotics, embedded systems, and electronic projects where automation is an essential part of the system. These boards were introduced for the students and people who come with no technical background. The design of Arduino-nano board is shown in fig.3

![Arduino Nano Connections On PCB](image2)

Figure 3. Arduino nano connections on PCB

VI. DHT11 TEMPERATURE/ HUMIDITY SENSOR

This DHT11 Temperature and Humidity Sensor features a calibrated digital signal output with the temperature and humidity sensor capability. It is integrated with a high-performance 8-bit microcontroller. Its technology ensures the high reliability and excellent long-term stability. This sensor includes a resistive element and a sensor for wet NTC temperature measuring devices. It has excellent quality, fast response, anti-interference ability and high performance. Each DHT11 sensor features extremely accurate calibration of humidity calibration chamber. The calibration coefficients stored in the OTP program memory, internal sensors detect signals in the process, we should call these calibration coefficients. The single-wire serial interface system is integrated to become quick and easy. Small size, low power, signal transmission distance up to 20 meters, enabling a variety of applications and even the most demanding ones. The product is 4-pin single row pin package. Convenient connection, special packages can be provided according to users need from fig.4.

**Specification**
- Supply Voltage: +5 V
- Temperature range: 0-50 °C error of ±2°C
- Humidity: 20-90% RH ± 5% RH error
- Interface: Digital

![Temperature and Humidity Sensor](image3)

Figure 4. Temperature and humidity sensor
VII. HEARTBEAT SENSOR

The heartbeat sensor is also called as pulse sensor. Pulse Sensor is a well-designed plug-and-play heart-rate sensor for Arduino. The sensor clips onto a fingertip or earlobe and plugs right into Arduino. It also includes an open-source monitoring app that graphs your pulse in real time. The front of the sensor is covered with the Heart shape logo. This is the side that makes contact with the skin. On the front you see a small round hole, which is where the LED shines through from the back, and there is also a little square just under the LED. The square is an ambient light sensor, exactly like the one used in cellphones, tablets, and laptops, to adjust the screen brightness in different light conditions. The LED shines light into the fingertip or earlobe, or other capillary tissue, and sensor reads the amount of light that bounces back. That’s how it calculates the heart rate. The other side of the sensor is where the rest of the parts are mounted. Pulse Rate Sensor Pulse Sensor is a well-designed plug-and-play heart-rate sensor for Arduino from fig. 5. The sensor clips onto a fingertip or earlobe and plugs right into Arduino. It also includes an open-source monitoring app that graphs your pulse in real time.

Figure 5. Heartbeat sensor

VIII. ECG (Electro Cardiogram) SENSOR

The ECG Signal is divided into three fundamental intervals, the PR interval, ST and the QT interval mentioned below.

Figure 6. ECG waves and Heart interval Time Slots Notation

<table>
<thead>
<tr>
<th>IC AD8232 ECG</th>
<th>Pinouts</th>
<th>Pin Connection with Arduino</th>
</tr>
</thead>
<tbody>
<tr>
<td>GND</td>
<td>Ground</td>
<td>GND</td>
</tr>
<tr>
<td>3.3 Volts</td>
<td>3.3V Power Supply</td>
<td>3.3Volts</td>
</tr>
<tr>
<td>OUTPUT Pin</td>
<td>Output Signal</td>
<td>A0</td>
</tr>
<tr>
<td>LO (minus)</td>
<td>Leads off Detect minus</td>
<td>11</td>
</tr>
<tr>
<td>LO (plus)</td>
<td>Leads off Detect plus</td>
<td>10</td>
</tr>
<tr>
<td>SDN</td>
<td>Shut down</td>
<td>Not used</td>
</tr>
</tbody>
</table>

Table 1. Pin description
The very closer the chest pads are, the better the measurement is possible moreover to use the jelly for body quick respond purpose. The cables were color coded to give determine the correct orientation based on Einthoven's triangle as shown in the below table.2. And they can be placed on the chest very closer to the arms and above the lower right abdomen, as shown on the below fig.9 on the right-side image in the below diagram.

<table>
<thead>
<tr>
<th>Table2. Cable Color of ECG sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
</tr>
<tr>
<td>Blue</td>
</tr>
<tr>
<td>Red</td>
</tr>
<tr>
<td>Black (Left Arm)</td>
</tr>
<tr>
<td>Blue (Right Arm)</td>
</tr>
<tr>
<td>Red (Right Leg)</td>
</tr>
</tbody>
</table>

IX. BLOOD PRESSURE SENSOR

This pressure sensor is a BMP-180 from fig.10 based digital barometric pressure sensor module and is functional compatible with older BMP-085 digital pressure sensor with less power consumption smaller in size and more accurate. BMP-180 combines barometric pressure, temperature and altitude. The I2C allows easy interface with any microcontroller. On board 3.3V LDO regulator makes this board fully 5V supply compatible. BMP-180 can measure pressure range from 300 to 1100hPa (+9000m to -500m relating to sea level) with an accuracy down to 0.02hPa (0.17m) in advance resolution mode. BMP-180 is an improved replacement for BMP-085 sensor. BMP-180 uses piezo-resistive technology for high accuracy, linearity, EMC robustness and stability for a longer period of time.

X. THINGVIEW - THINGSPEAK VIEWER

According to its developers, “Thingview is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via Local Area Network from fig.11. Thingview enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates.

Figure10. Blood pressure sensor

Figure11. Thingview app

Figure11(b). Sample graphs (X axis: time, Y axis: temperature, pulse)
The hardware design of the proposed methodology is shown in fig.12.

![Figure 12. Hardware kit](image)

**XI. RESULTS AND DISCUSSIONS**

The corresponding code has been uploaded to arduino-nano. The system is set up for home use by patients who are not in a life-threatening situation but need to be monitored in a timely manner by the doctor or the family. As per the paper work, the design of the health monitoring system is based on the idea to meet the needs of patient’s health condition. The values obtained in the mobile are shown in fig.13. All these parameters are also displayed on LCD.

![Figure 13. Obtained parameter values in mobile.](image)

**XII. CONCLUSION**

In this work, Patient Health Monitoring system has been designed and it took less than a minute to monitor the parameters- ECG, blood pressure, heart beat and temperature. The values are obtained from the mobile in the form of SMS and also parameters ECG, temperature, heart beat has been viewed through ThingView application in the form of graphical representation. The proposed design has major advantage to monitor the condition of the patient in remote mode.

**REFERENCES**


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