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Patient Monitoring and Spontaneous alerting system using ADT

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Abstract

Background/Objectives: Delay in communication between patient and doctor would lead to loss of patient's life. To overcome this problem, we have designed a prototype which reduces the delay by identifying the available doctor automatically. **Methods/Statistical Analysis:** Maintaining the database and mobile App are the key factors while monitoring the patient. **Findings:** In this paper we have designed a prototype with a set of sensors implemented on the patient's body and the data collected from sensors is then sent to the mobile. We have used a mobile app to display his/her temperature, BP, and heartbeat. The mobile is connected to the server and the whole data is updated in the server. To alert the doctor, we used the GSM module for sending the message. Whenever the patient's health is in critical condition, the doctor can react immediately and visit the patient. **Applications/Improvements:** With this prototype, we can monitor all the patients in the hospital and their records are stored in the database. Whenever we require a particular patient's details we can retrieve the records in the server.

Keywords: Android Development Tool (ADT), Blood Pressure Sensor, Heartbeat Sensor, Temperature Sensor, Patient Monitoring

1. Introduction

Proper healthcare of the patient is the most important aspect for any doctor. Currently, the wireless technology is helping the mankind in various ways. In many hospitals, wireless technology is widely used to serve the patients. In the recent times wearable sensors[1] are used to know the status of the patient. These sensors[2] sense the signals and transmits to the other end and also eliminates the manual errors. Various sensors like heartbeat sensor[3], temperature sensor[4] and blood pressure sensor[5] are used to know the current status of the patient.

Technology keeps on changing based on the user requirements. Mobile plays a crucial role in our day-to-day life. Usage of mobile has increased drastically in the recent years. With the entry of android into the mobile field, lots of user applications are being developed.

Android application design is a field where one can develop various user applications and earn in the online market. It suits for 'work from home' approach. There is lots of demand in the market for the application developers. If anyone familiar with Eclipse ADT and Java programming, one can convert one's idea into a wonderful App. One can develop a mobile application[6] for medical purpose and can connect to the doctor. This application helps in informing the doctor about the patient's current health status and the doctor can attend the patient immediately.

Patients kept in the Intensive Care Unit require continuous monitoring[7] by the doctors. Doctors may be busy in handling other patients. If any patient's condition is critical, a doctor's attention is needed immediately. A prototype which can alert the doctor in emergency cases will greatly reduce the response time of the doctor and the patient can get treatment early. Such prototype can be developed by using the sensors and mobile app to reach the doctor. In the first step, we will connect the sensors to the patient and the sensors will read the corresponding signals. Next, these signals are then forwarded[8] to the

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mobile app and it will display the readings to the doctor. Also the readings are updated to the server database[9].

The structure of the paper is as follows: Section-2 provides the brief overview of the prototype. Section-3 is about the proposed architecture and Section-4 shows the prototype implementation and results and Section-5 gives the conclusion of the prototype.

2. System overview

2.1 Heart Beat Sensor

The heartbeat sensor works with the simple concept of LED and LDR. The LED light preferably red colored one is considered and it is focused on the Light Detector (LDR). At the instant where the sensor is attached to the patient's finger, the blood flow cuts the LED light falling on the LDR. The blood flow causes changes in the amount of light falling on the LDR and this variation is transformed as pulse of the patient. A person aged 18 in a normal condition will have heart rate of 60-100 bpm. The bpm will vary[10] with the age, gender and the physical and mental situation he/she is facing.

2.2 Blood Pressure Sensor

Blood pressure (BP) is the amount of pressure applied by the blood cells on the blood vessels. Whenever we hear about blood pressure something strikes in our mind like 120/80. It is nothing but the readings of a normal BP. Here the value 120 represents the systolic pressure and 80 represents the diastolic pressure. The BP value is to be read as 120 over 80 mm Hg, where mm Hg is the unit representation of the BP. Based on our emotions, the BP varies and leads to hypotension and hypertension.

2.3 Temperature sensor

In this project, we are using LM35 as the temperature sensor. This sensor is available in the transistor package. With this LM35 we can measure the temperature directly in Celsius. Using this sensor will be a benefit since it gives more accurate value than the thermistor and it ranges from -55° to +150° C. Usually the temperature of a healthy human body is 36.5°C.

2.4 GSM Module

The GSM module works with the SIM card similar to the mobile phone. Through the GSM module we can access internet and we can also send SMS and MMS. In this project we use GSM to send the patient's health status to the doctor. With the GSM network we can get connected to world and roam around the world. The service will not get disconnected since many network providers have the mutual agreement for the service.

2.5 Android App

Smartphone made our life smarter with the android apps. There are wide sources available in the market to create an app. We can design numerous android apps by using eclipse Android Development Tool (ADT)[11] software and java language for programming. There are many versions available in the android Operating System (OS). We develop an app to display the patient readings in the smartphone.

2.6 Structured Query Language (SQL)

SQL allows us to store and retrieve the data by maintaining a table and we are able to create a database and maintain record of each patient individually. The data collected from the sensors are uploaded to the server and stored. We can also have the backup of our database so that loss of data is eliminated.

3. Proposed Architecture

Sensors start working as soon as they are attached to the patient. Data sent by the sensors are in analog form. So we use Analog to Digital Converters (ADC)[12] since LPC2148 takes digital values. Next the digitalized signals are then forwarded to the controller and the values are displayed on the Liquid Cristal Display (LCD) screen.

Whenever the patient's Heartbeat and the Temperature crosses the given threshold value, the readings will be sent to the mobile app. Before that, Care should be taken while updating the IP address. If the IP address or the port number is not updated properly in the code, the connection maybe lost. Now the mobile app will then forward the values to the doctor in the form of a message. Here Gingerbread Operating System (OS) compatible android application is used.

The whole process can be observed in Figure 1. If the doctor wants to check a particular patient's record, simply he can retrieve the records from the database by writing a query with the patient name.

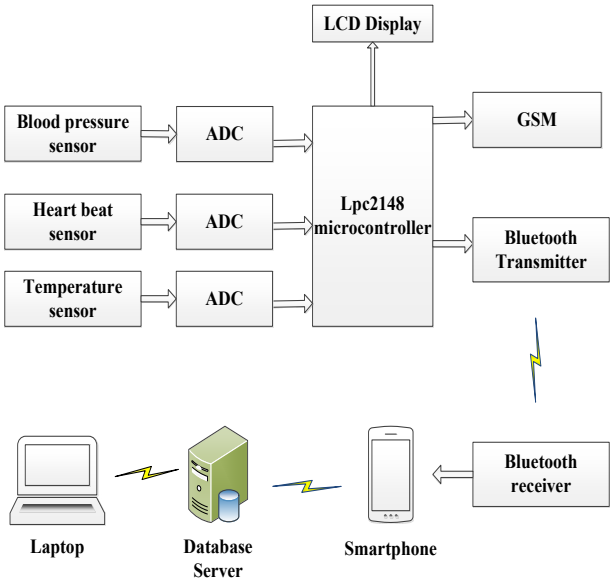


Figure 1. Proposed prototype architecture.

3.1 Flowchart

The whole working of the prototype is simply explained by using the flow diagram of Figure 2. In the earlier stage, we initialize the sensors and then check for conditions like temperature exceeds and heartbeat falls. In any case if the decision is yes, immediately the GSM module will send an SMS to the Doctor. If the decision is No, the corresponding readings are sent to the mobile App. Next the mobile App is launched and check for valid login credentials.

Next, corresponding values are displayed on the App and we need to press the submit button provided below. Then the readings are sent to the doctor and is stored in the database. Once the details are saved in the database, whenever the doctor wants to check a patient's details, he simply retrieves the records and verify them.

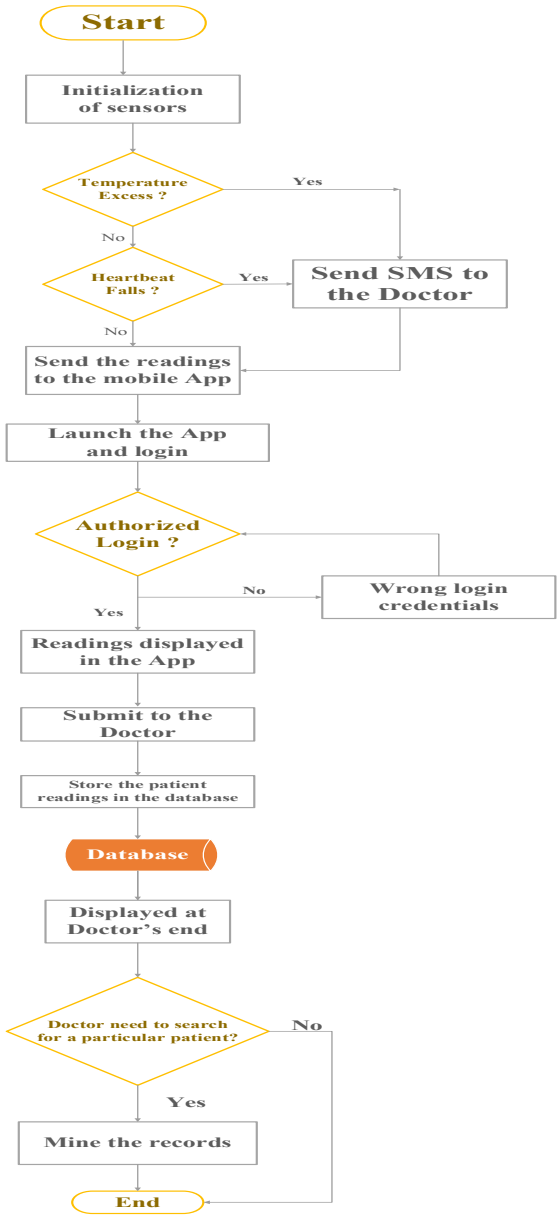


Figure 2. Flowchart of the prototype.

4. Implementation and Results

The moment the sensors are attached to the patient's body, the sensors receive the signals and send them to LCD display as shown in Figure 3.

Then the readings are forwarded to the mobile App. We have to login with authenticated username and password.

Figure 4(a) shows the login page of the app and Figure 4(b) indicates the successful login credentials. After the login, the App will display the Patient's Heartbeat, Temperature and Blood Pressure.

In the Figure 5, Heartbeat readings are shown in beats per minute (bpm) and Temperature is shown in Fahrenheit(°F). Now if submit button below is pressed, the readings will be sent to the database and to the doctor.

In the Figure 6, the tabular values represent the database of each patient admitted to the hospital. We can also get the GPS position of the out-patient who is under observation.

This facility will be useful when the patient is in some other location and suddenly if his heartbeat falls, we can trace the patient and provide the treatment.

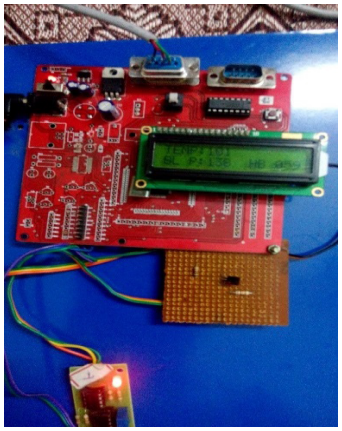
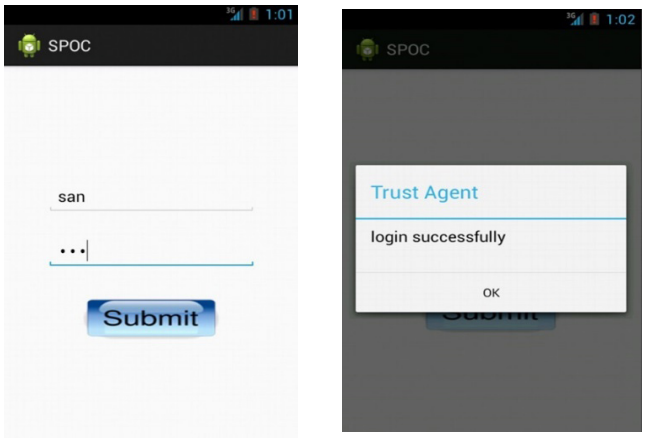


Figure 3. Hardware displaying the readings on the LCD screen.



(a) (b)

Figure 4. Screenshots of the mobile App displaying the Login page.

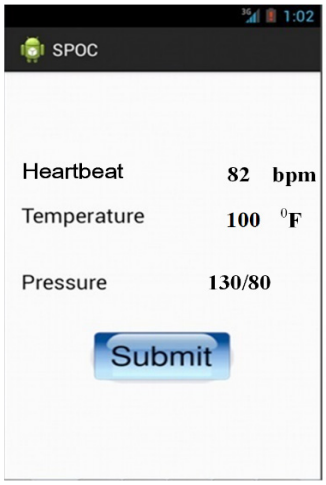


Figure 5. Readings of the patient on mobile App.

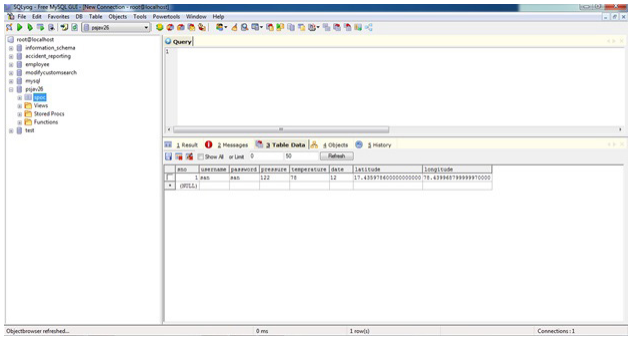
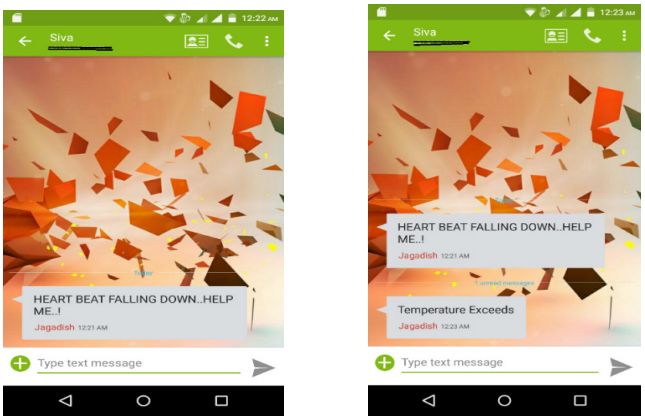


Figure 6. Patient details stored in the database.



(a) (b)

Figure 7. Screenshots of the message received by the doctor.

Whenever the heartbeat and temperature of the patient goes beyond the threshold value, SMS will be sent to the doctor for immediate treatment. Figures 7(a) and 7(b) shows the message received by the doctor.

5. Conclusion

The patient health status is observed with this prototype and doctor can respond immediately when the patient's status is in critical condition. By using this prototype, we can save the patient's life. Mobile app and database plays the crucial role in designing the prototype. The doctor can monitor the patient by accessing the database at any time and in any emergency situations the doctor is informed with the SMS.

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