Chapter 1

Introduction

1.1 Background

With the increasing population it has become important that the details of the patient are maintained in a proper manner. Sometimes it becomes impossible for the patient himself to remember the treatments underwent by him and proper details to be conveyed. According to the recent World Health Organization's (WHO) publication regarding Patient safety, tens of millions i.e. roughly 1.4 million people around the world are injured or dead every year as a result of incorrect medical care. Some of medical errors arise due to:

- Miscommunication,
- Physician order Transcription errors,
- Incomplete Patient Medical Records,
- Overcrowded Situation.

The system proposed here solves all the problems which occurs and is discussed in the objectives mentioned below.

1.2 Objectives

The proposal in this project report focuses on the main objectives as mentioned below:

- To reduce the carrying load of the treatment details and the records.
- To develop a server and database where the medical records can be stored and updated
- To provide assistance to patients at home when there is no one beside them.
- To notify the relative of the patient and the nearest hospital so that they are there when needed

Chapter 2

Literature Review

2.1 Patient Monitoring System using GSM

This paper was reviewed by us for getting valuable information about monitoring a patient's health at home [1]. It gave us a novel method and inspiration for implementing our project. It efficiently monitored a patient's temperature and heart rate on a real-time basis, and sent a message to the nearest hospital services using the shortest path route networking protocol. We took ideas from this paper and implemented it with our new contributions to it.

The temperature and heat beat sensors constantly measured the values and provided input to the microcontroller [9]. Once these values extend a certain threshold, a GSM module sends a message to the nearest hospital services.

2.2 RFID Technology

Radio frequency identification (RFID) refers to the use of radio frequency wave to identify and track the tag implanted into an object or a living thing [2]. It is a wireless mean of communication that use electromagnetic and electrostatic coupling in radio frequency portion of the spectrum to communicate between reader and tag through a variety of modulation and encoding scheme. Modulation refers to the variation in the amplitude, frequency or phase of a high frequency carrier signal to convey information. Encoding is a process of converting information from one format to another. RFID system usually consists of RFID reader and tag. It is very useful because it can uniquely identify a person or a product based on the tag incorporated. It can be done quickly and this usually takes less than a second. RFID readers are usually used in case of entering into a secured facility for authentication purposes or for marking the attendance of a person at a workplace or at a college.

The RFID reader used in our project is a passive type which has maximum range of detection of around 5cm above the reader. It operates at frequency of 125 kHz and 12V power supply. The system has ability to uniquely patients with the help of their unique ID's. The doctors or nurses only need to place their RFID tag on the reader to to read the unique ID of a patient [3]. They do not need to go through the long list of patient records which are hand written and often poorly maintained. Hence, this method is very time efficient and also helps to maintain the records easily.

2.3 GSM Technology

GSM (Global System for Mobile Communications, originally Groupe Spécial Mobile), is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile phones, first deployed in Finland in July 1991[10]. As of 2014 it has become the de facto global Standard for mobile communications – with over 90% market share, operating in over 219 Countries and territories.2G networks developed as a replacement for first generation (1G) analog cellular networks, and the GSM standard originally described a digital, circuit-switched Network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution or EGPRS).

In this project, a SIM card of any carrier is planted into the GSM module. When the microcontroller commands the GSM module to send the emergency text messages, it will send the pre-written text messages which were programmed into it. Thus, a GSM module can be efficiently used to send messages in case of an emergency.

Chapter 3

Problem Statement

The project consists of a microcontroller which acts as the heart of the system. The heart beat sensor continuously senses the heart beat rate of the patient and feeds the output to the microcontroller which compares the output value to the pre-programmed threshold value. Similarly, the temperature sensor continuously monitors the body temperature of the patient and feeds the output to the microcontroller for comparing it to the threshold value.

If the outputs cross the threshold limits, the microcontroller commands the GSM module to send text messages to the nearby hospital emergency services and patient’s family members. At the hospital end, they have an RFID reader which will help to detect the unique ID of the RFID tag which was issued to the patient at the time of discharge. As soon as the unique ID is detected by the reader, the doctor or the nurse only needs to enter this unique ID on the webpage and the patient’s medical history will be retrieved from the database server.

This project would benefit the patient as the patient will no longer have to carry the hard copies of his/her medical history. This project will also be of immense help to the hospital staff because they can easily store and maintain each and every patient’s medical records on a database server and review and update them whenever required.

Chapter 4

Design of the System

4.1 Interfacing Sensors and GSM Module with Microcontroller

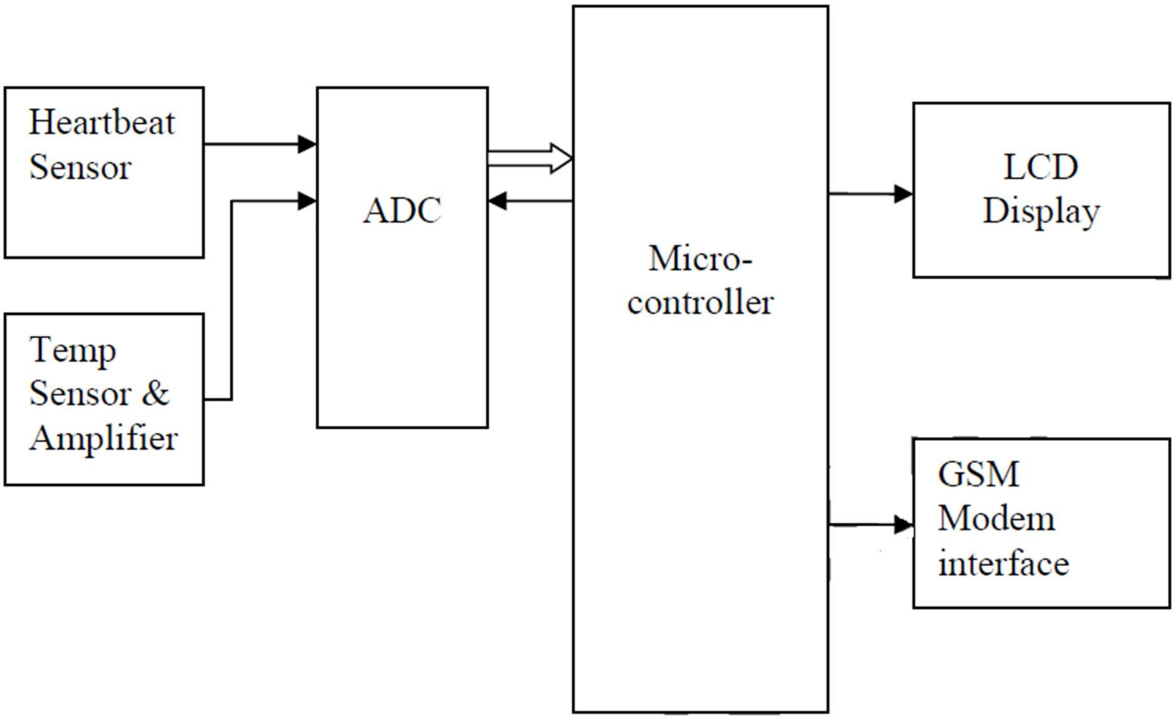


Figure 4.1.1 Block Diagram

4.2 Flowchart of Monitoring Patient's Health

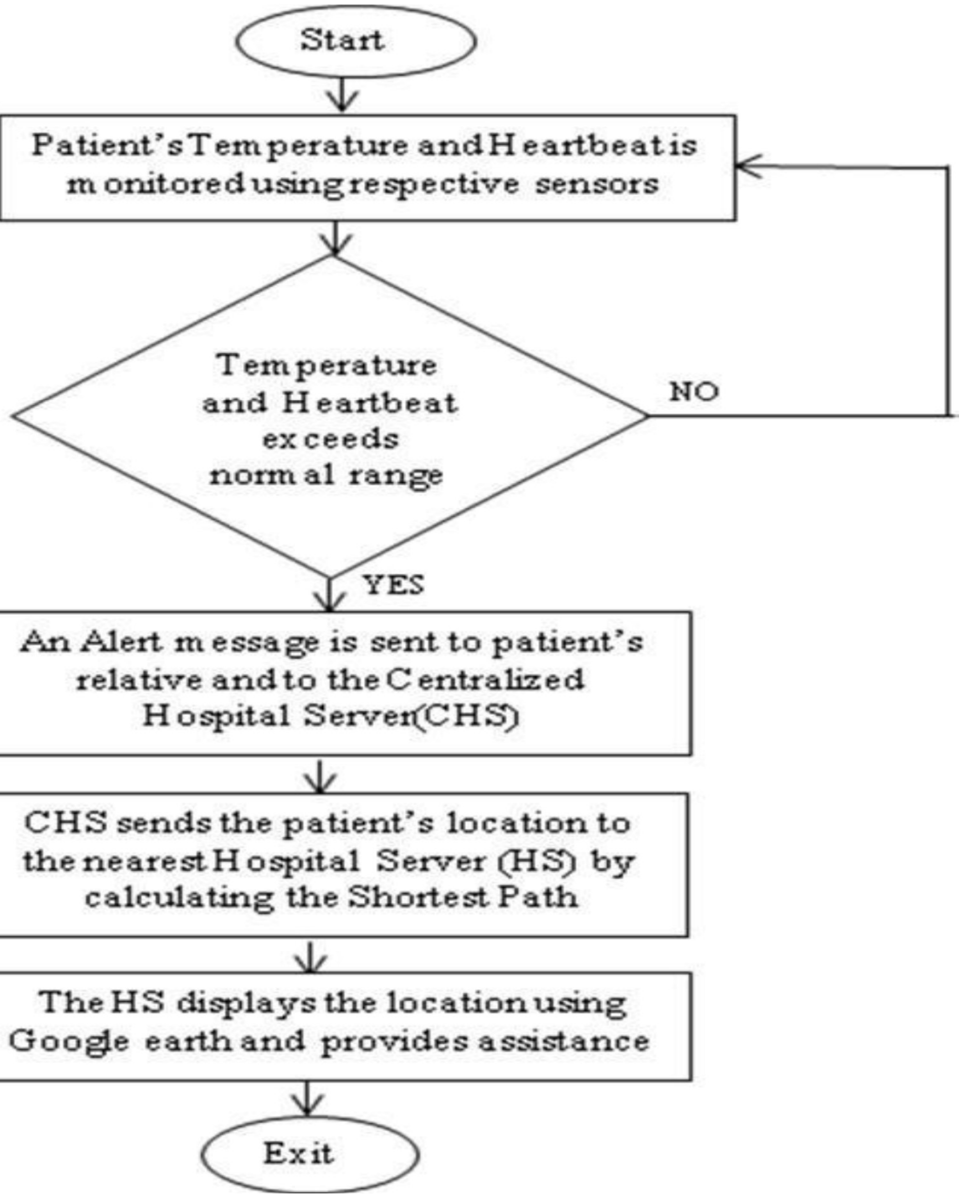
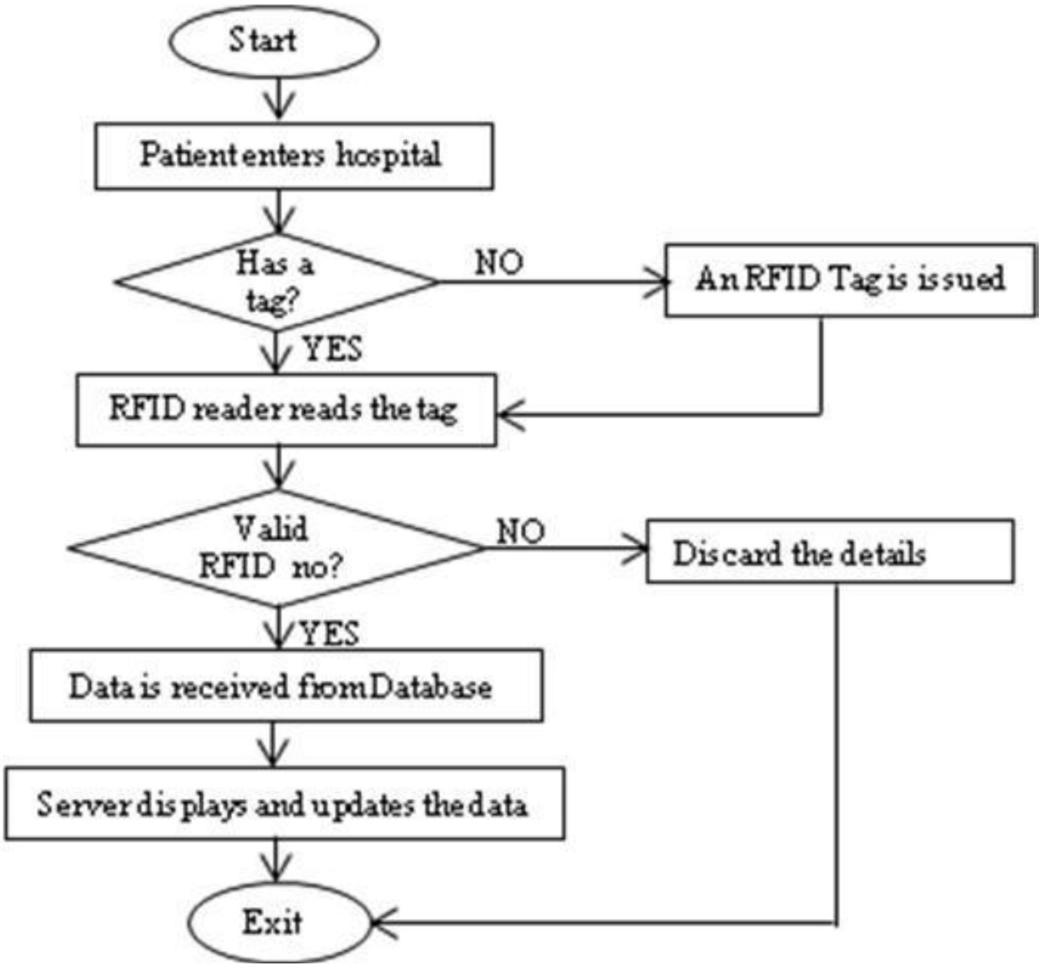


Figure 4.2.1 Flowchart of Monitoring Patient's Health

4.3 Flowchart of Tracking Patient’s Health Records



4.3.1 Flowchart of Tracking Patient’s Health Records

Chapter 5

Component Description

- Microcontroller Atmega8L
- RFID module
- GSM module
- Temperature Sensor
- Heart Beat Sensor

5.1 Atmega8L

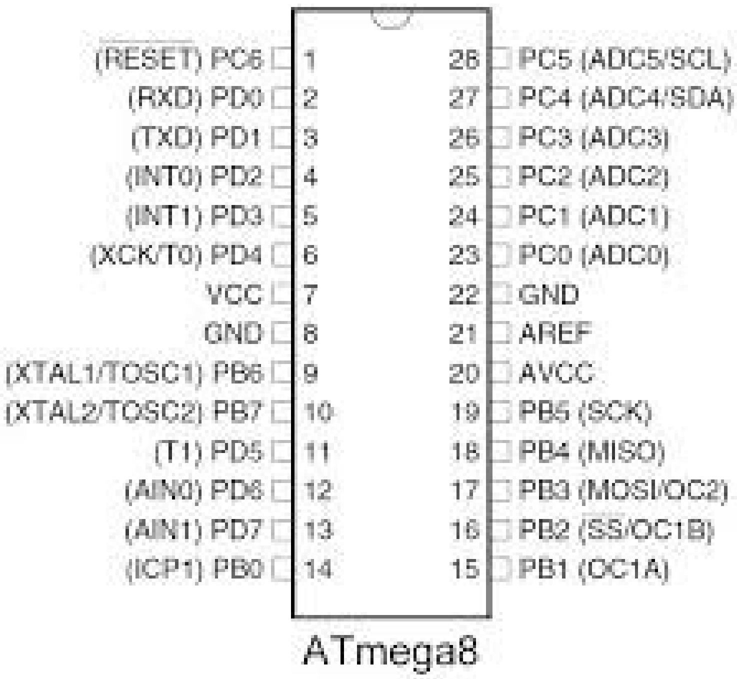


Figure 5.1.1 Atmega8L

Features [15]

• High-performance, Low-power Atmel®AVR® 8-bit Microcontroller

• Advanced RISC Architecture

– 130 Powerful Instructions – Most Single-clock Cycle Execution

– 32 × 8 General Purpose Working Registers

– Fully Static Operation

– Up to 16MIPS Throughput at 16MHz

– On-chip 2-cycle Multiplier

• High Endurance Non-volatile Memory segments

– 8Kbytes of In-System Self-programmable Flash program memory

– 512Bytes EEPROM

– 1Kbyte Internal SRAM

– Write/Erase Cycles: 10,000 Flash/100,000 EEPROM

– Data retention: 20 years at 85°C/100 years at 25°C(1)

– Optional Boot Code Section with Independent Lock Bits

In-System Programming by On-chip Boot Program

True Read-While-Write Operation

– Programming Lock for Software Security

• Peripheral Features

– Two 8-bit Timer/Counters with Separate Prescaler, one Compare Mode

– One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture

Mode-

– Real Time Counter with Separate Oscillator

– Three PWM Channels

– 8-channel ADC in TQFP and QFN/MLF package

Eight Channels 10-bit Accuracy

– 6-channel ADC in PDIP package

Six Channels 10-bit Accuracy

– Byte-oriented Two-wire Serial Interface

– Programmable Serial USART

– Master/Slave SPI Serial Interface

– Programmable Watchdog Timer with Separate On-chip Oscillator

– On-chip Analog Comparator

• Special Microcontroller Features

– Power-on Reset and Programmable Brown-out Detection

– Internal Calibrated RC Oscillator

– External and Internal Interrupt Sources

– Five Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, and

Standby

• I/O and Packages

– 23 Programmable I/O Lines

– 28-lead PDIP, 32-lead TQFP, and 32-pad QFN/MLF

• Operating Voltages

– 2.7V - 5.5V (ATmega8L)

– 4.5V - 5.5V (ATmega8)

• Speed Grades

– 0 - 8MHz (ATmega8L)

– 0 - 16MHz (ATmega8)

• Power Consumption at 4 MHz, 3V, 25□C

– Active: 3.6mA

– Idle Mode: 1.0mA

– Power-down Mode: 0.5µA

5.2 RFID Module

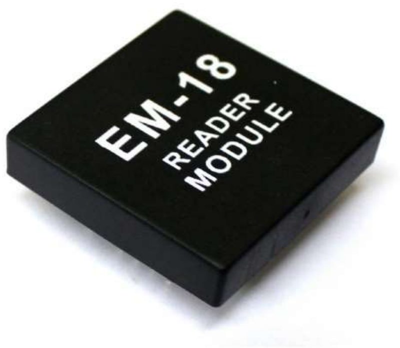


Fig 5.2.1 RFID Module

EM-18 RFID Reader Module is the one the most commonly used module for Radio Frequency Identification Projects [5]. It features Low Cost, Small Size, Low Power Consumption and Easy to use. It can be directly interfaced with microcontrollers using UART communication. Software UART can be used for microcontrollers having no UART modules.

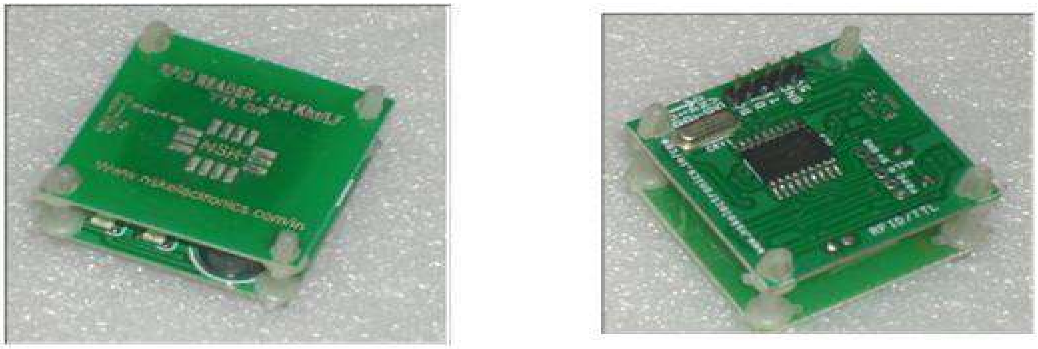


Fig 5.2.2 RFID Reader with the built-in micro-controller

An RFID Reader can read through most anything with the exception of conductive materials like water and metal, but with modifications and positioning, even these can be overcome [6]. The RFID Reader emits a low-power radio wave field which is used to power up the tag so as to pass on any information that is contained on the chip. In addition, readers can be fitted with an additional interface that converts the radio waves returned from the tag into a form that can then be passed on to another system, like a computer or any programmable logic controller. Passive tags are generally smaller, lighter and less expensive than those that are active and can be applied to objects in harsh environments, are maintenance free and will last for years.

5.3 GSM Module

Fig 5.3.1 GSM Module

This is a GSM/GPRS-compatible Quad-band cell phone, which works on a frequency of 850/900/1800/1900MHz and which can be used not only to access the Internet, but also for oral communication (provided that it is connected to a microphone and a small loud speaker) and for SMS's, the GSM900 device integrates an analog interface, an A/D converter, an RTC, an SPI bus, an I^2C, and a PWM module. The radio section is GSM phase 2/2+ compatible and is either class 4 (2 W) at 850/ 900 MHz or class 1 (1 W) at 1800/1900 MHz. The TTL serial interface is in charge not only of communicating all the data relative to the SMS already received and those that come in during TCP/IP sessions in GPRS (the data-rate is determined by GPRS class 10: max. 384(kbps), but also of receiving the circuit commands (in our case, coming from the microcontroller) that can be either AT standard.

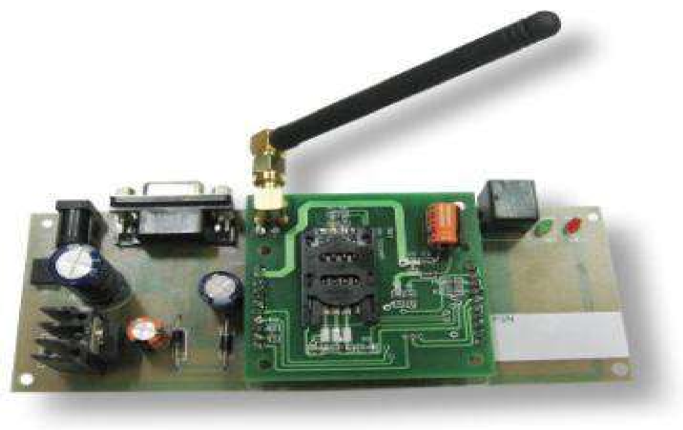


Fig 5.3.2 GSM MODEM

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it may be a mobile phone that provides GSM modem capabilities [10].

5.4 Temperature Sensor

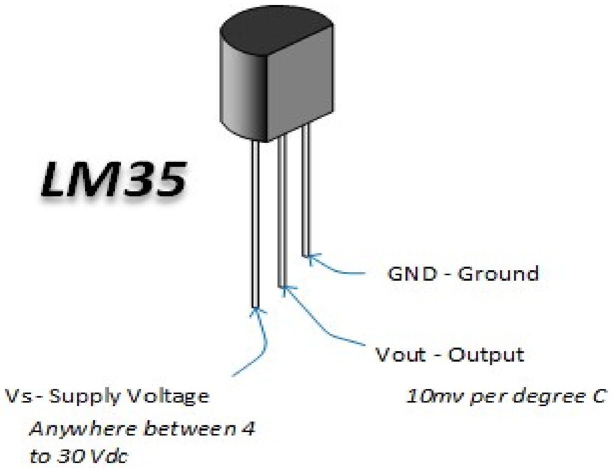


Fig 5.4.1 Temperature Sensor

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the water level. The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 µA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a −55°C to 150°C temperature range, while the LM35C device is rated for a −40°C to 110°C range (−10° with improved accuracy).

The LM35-series devices are available packaged in hermetic TO transistor packages, while the LM35C, LM35CA, and LM35D devices are available in the plastic TO-92 transistor package. The LM35D device is available in an 8-lead surface-mount small-outline package and a plastic TO-220 package.

5.5 Heart Beat Sensor

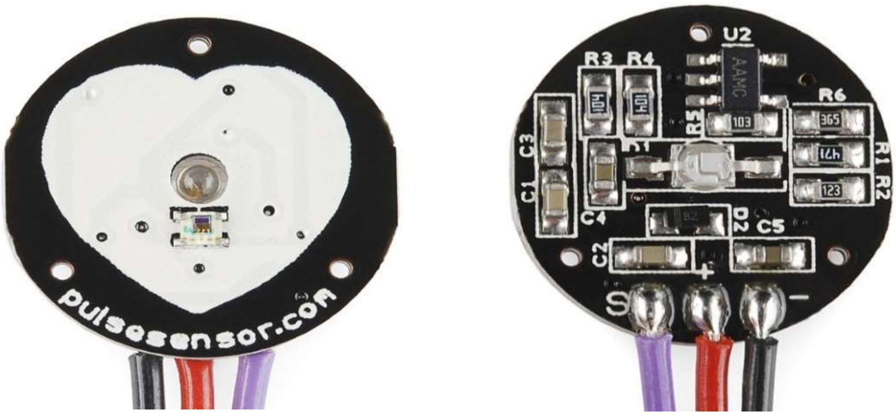


Fig 5.5.1 Heart Beat Sensor

Heart rate data can be really useful whether you're designing an exercise routine, studying your activity or anxiety levels or just want your shirt to blink with your heart beat. The problem is that heart rate can be difficult to measure.

Doctors measure our heart rate manually. By holding our hands they feel the pulse in the nerve and look at their watch to count our heart beats per minute. Even we also can feel the pulse on our finger when our heart pumps blood into our blood vessels. This pulse is felt due to the expansion and contraction of blood vessel when blood enters and leaves it. Our heart does this around 72 to 84 times a minute for a healthy person.

What we do to measure the heart rate is, first we will detect the heart beat/pulse and count the pulses for one minute to get the beats per minute. So in order to detect the pulse we will pass light (using an LED) from one side of the finger and measure the intensity of light received on the other side (using an LDR). Whenever the heart pumps blood more light is absorbed by increased blood cells and we will observe a decrease in the intensity of light received on the LDR. As a result the resistance value of the LDR increases. This variation in resistance is converted into voltage variation using a signal conditioning circuit.

The signal is amplified enough to be detectable by the microcontroller inputs. The microcontroller can be programmed to receive an interrupt for every pulse detected and count the number of interrupts or pulses in a minute.

The count value of pulses per minute will give you the Heart rate in bpm (Beats Per Minute). Alternatively to save time, only the number of pulses for ten seconds are counted and then multiplied by 6 to get pulse count for 60 seconds/1 minute.

The Pulse Sensor Amped is a plug-and-play heart-rate sensor. It essentially combines a simple optical heart rate sensor with amplification and noise cancellation circuitry making it fast and easy to get reliable pulse readings. Also, it sips power with just 4mA current draw at 5V so it’s great for mobile applications. The 24" cable on the Pulse Sensor is terminated with standard male headers so there’s no soldering required.

Chapter 6

Patient Health Records

6.1 MySQL Database

MySQL is an open-source relational database management system (RDBMS). Its name is a combination of "My", the name of co-founder Michael Widenius' daughter, and "SQL", the abbreviation for Structured Query Language. The MySQL development project has made its source code available under the terms of the GNU General Public License, as well as under a variety of proprietary agreements. MySQL was owned and sponsored by a single for-profit firm, the Swedish company MySQL AB, now owned by Oracle Corporation. For proprietary use, several paid editions are available, and offer additional functionality.

MySQL is a central component of the LAMP open-source web application software stack (and other "AMP" stacks). LAMP is an acronym for "Linux, Apache, MySQL, Perl/PHP/Python". Applications that use the MySQL Database include: TYPO3, MODx, Joomla, WordPress, phpBB, MyBB, and Drupal. MySQL is also used in many high-profile, large-scale websites, including Google (though not for searches), Facebook, Twitter, Flickr, and YouTube.

In our patient database website, we display the data from the MySQL Database, and provide the options to update or edit the previously existing records. We have individual patients' name, age, contact, gender, address, blood group, and all the past medical records stored in out database. All these data can be updated or edited whenever required.

However, only the system admin will be able to access the MySQL database, thereby providing security to the patient database and assuring that no sensitive information of a patient is leaked or misused.

6.2 PHP, CSS & HTML Programming

PHP

PHP is a server-side scripting language designed primarily for web development but also used as a general-purpose programming language. Originally created by Rasmus Lerdorf in 1994, the PHP reference implementation is now produced by The PHP Development Team. PHP originally stood for Personal Home Page, but it now stands for the recursive acronym PHP: Hypertext Pre-processor [11].

PHP code may be embedded into HTML or HTML5 mark-up, or it can be used in combination with various web template systems, web content management systems and web frameworks. PHP code is usually processed by a PHP interpreter implemented as a module in the web server or as a Common Gateway Interface (CGI) executable. The web server software combines the results of the interpreted and executed PHP code, which may be any type of data, including images, with the generated web page. PHP code may also be executed with a command-line interface (CLI) and can be used to implement standalone graphical applications.

The standard PHP interpreter, powered by the Zend Engine, is free software released under the PHP License. PHP has been widely ported and can be deployed on most web servers on almost every operating system and platform, free of charge.

The PHP language evolved without a written formal specification or standard until 2014, leaving the canonical PHP interpreter as a de facto standard. Since 2014 work has gone on to create a formal PHP specification.

CSS

Cascading Style Sheets (CSS) is a style sheet language used for describing the presentation of a document written in a mark-up language. Although most often used to set the visual style of web pages and user interfaces written in HTML and XHTML, the language can be applied to any XML document, including plain XML, SVG and XUL, and is applicable to rendering in speech, or on other media [14].

Along with HTML and JavaScript, CSS is a cornerstone technology used by most websites to create visually engaging webpages, user interfaces for web applications, and user interfaces for many mobile applications.

CSS is designed primarily to enable the separation of document content from document presentation, including aspects such as the layout, colors, and fonts. This separation can improve content accessibility, provide more flexibility and control in the specification of presentation characteristics, and enable multiple HTML pages to share formatting by specifying the relevant CSS in a separate. css file, and reduce complexity and repetition in the structural content.

Separation of formatting and content makes it possible to present the same mark-up page in different styles for different rendering methods, such as on-screen, in print, by voice (via speech-based browser or screen reader), and on Braille-based tactile devices. It can also display the web page differently depending on the screen size or viewing device. Readers can also specify a different style sheet, such as a CSS file stored on their own computer, to override the one the author specified.

Changes to the graphic design of a document (or hundreds of documents) can be applied quickly and easily, by editing a few lines in the CSS file they use, rather than by changing mark-up in the documents.

The CSS specification describes a priority scheme to determine which style rules apply if more than one rule matches against a particular element. In this so-called cascade, priorities (or weights) are calculated and assigned to rules, so that the results are predictable.

HTML

Hypertext Mark-up Language (HTML) is the standard mark-up language for creating web pages and web applications. With Cascading Style Sheets (CSS) and JavaScript it forms a triad of cornerstone technologies for the World Wide Web. Web browsers receive HTML documents from a webserver or from local storage and render them into multimedia web pages. HTML describes the structure of a web page semantically and originally included cues for the appearance of the document [12].

HTML elements are the building blocks of HTML pages. With HTML constructs, images and other objects, such as interactive forms, may be embedded into the rendered page. It provides a means to create structured documents by denoting structural semantics for text such as headings, paragraphs, lists, links, quotes and other items. HTML elements are delineated by tags, written using angle brackets. Tags such as <img /> and <input /> introduce content into the page directly. Others such as <p>...</p> surround and provide information about document text and may include other tags as sub-elements. Browsers do not display the HTML tags, but use them to interpret the content of the page.

HTML can embed programs written in a scripting language such as JavaScript which affect the behaviour and content of web pages. Inclusion of CSS defines the look and layout of content.

Finally, using HTML, CSS and MySQL, we have created a website which allows efficient editing and updating of a patients' health records. This website is provided security against SQL injections which are aimed to hack into the databases. Furthermore, we have also provided a secure and authorised access into the database, so that only the doctors are authorised to login to the system and view and update a patients' records as required. This website helps to meet our goal of providing a hassle-free and a secure way to store and update patients' records.

Chapter 7

Result

The figure below shows the setup of our project. It shows a GSM module, an RFID reader, a 16*4 LCD and an Atmega 8L microcontroller mounted on a zero board. Two sensors i.e. temperature sensor and pulse sensor are connected to the IC and will be constantly monitoring the patients’ temperature and heart beat rate. The RFID reader is connected to a computer and displays the RFID tag number on the software. The GSM module is commanded by the microcontroller to send a text message whenever the temperate or a patients’ heart rate exceeds a certain threshold value.

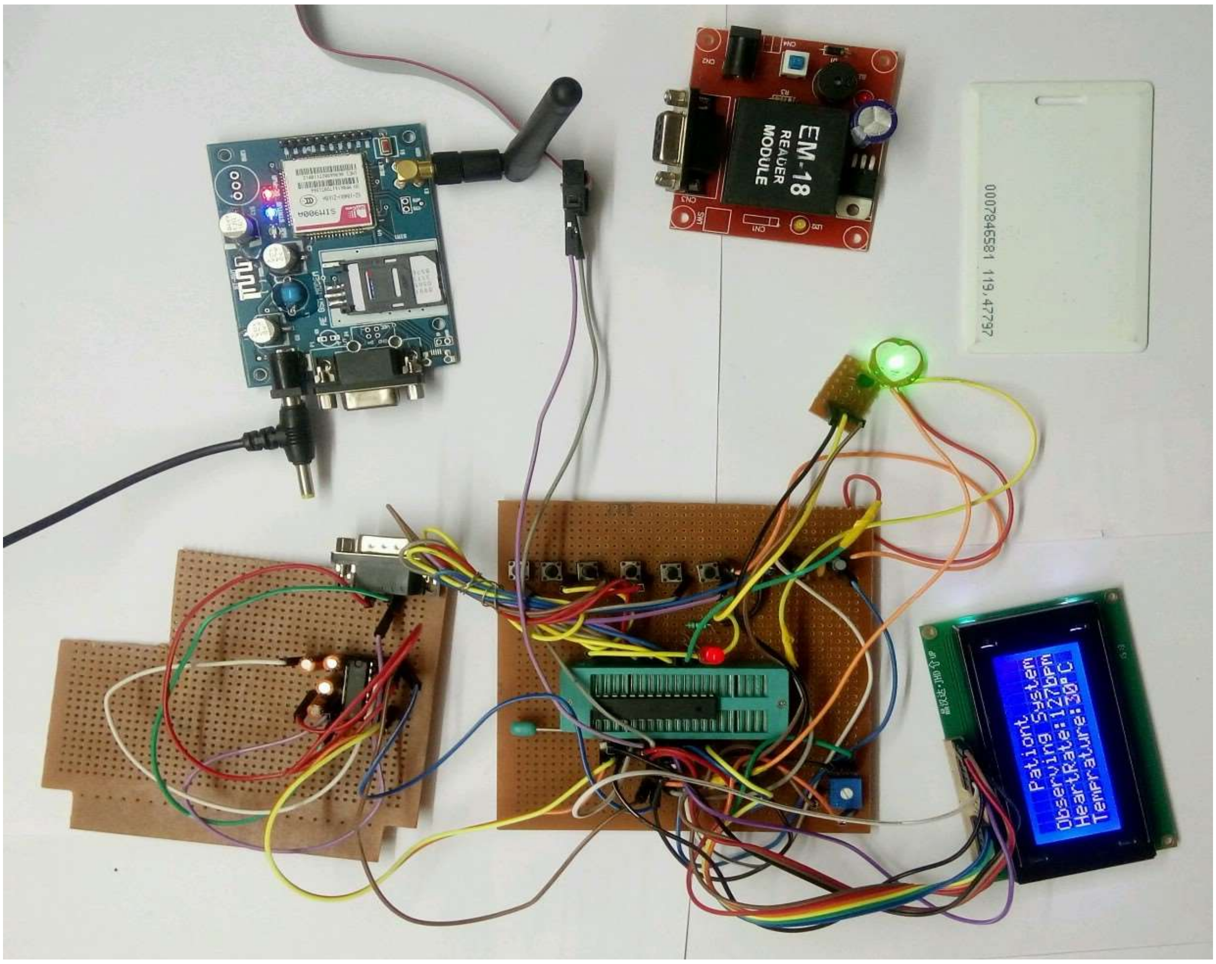


Fig 7.1 Project Setup

First, we set the required threshold values of the temperate and heart rate using the on-board switches.

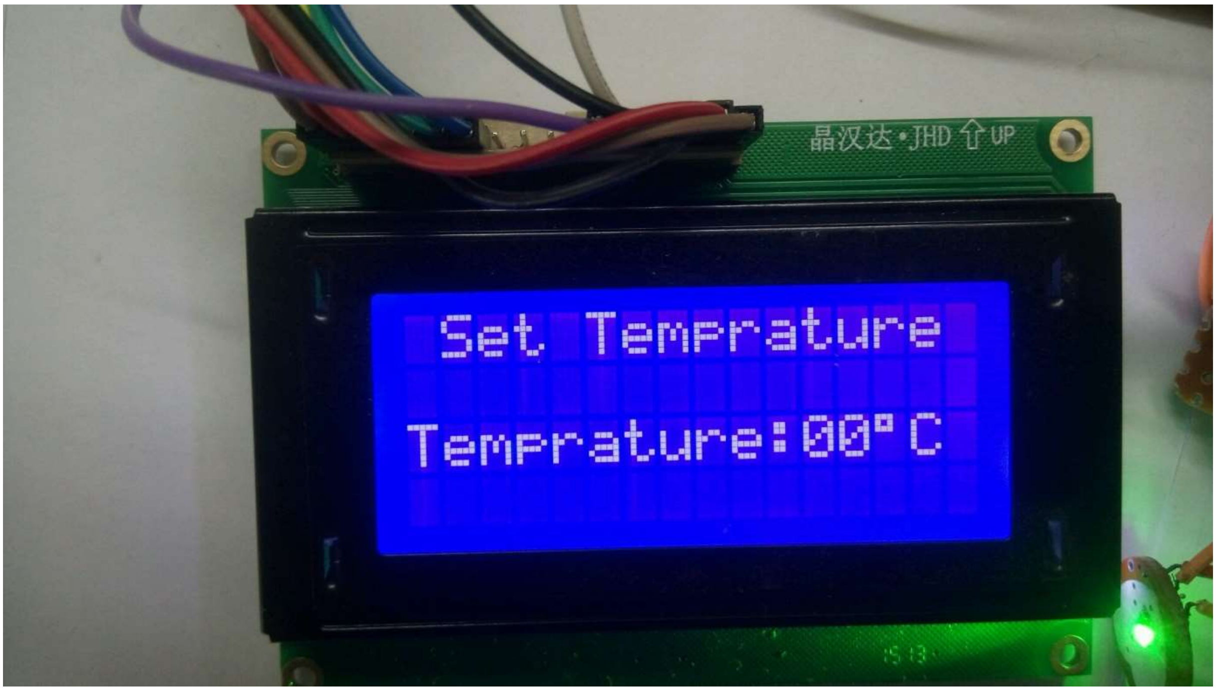


Fig 7.2 Setting Temperature

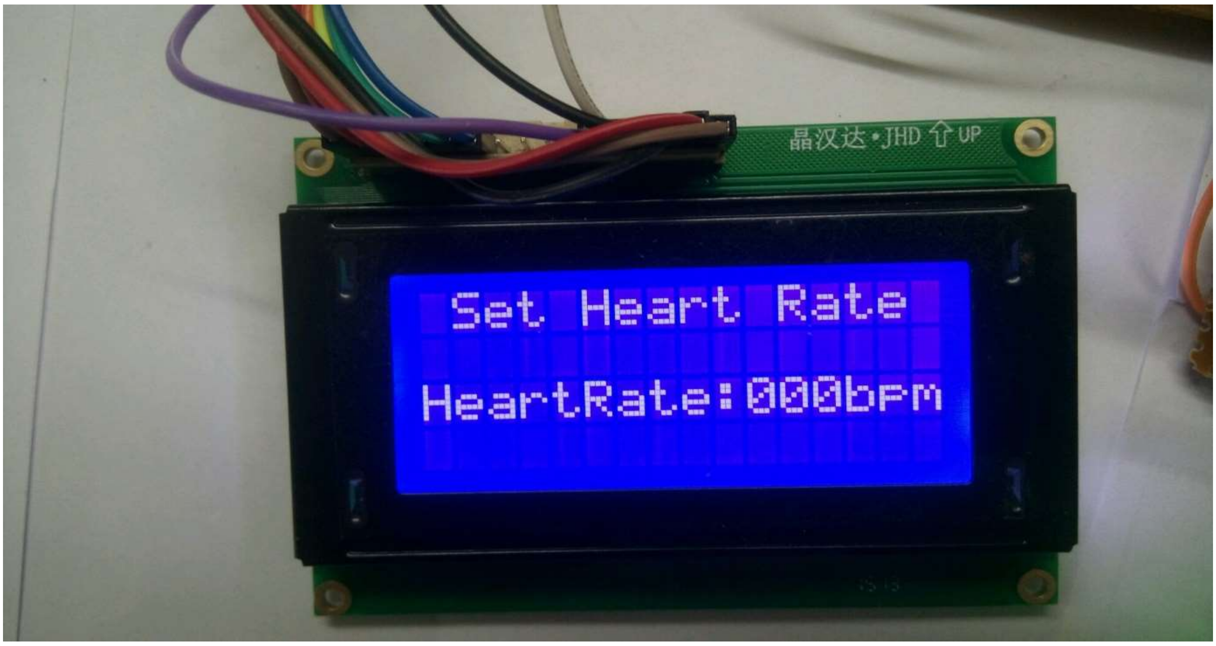


Fig 7.3 Setting Heart Rate

After setting the values, the sensors are put to work and the LCD will constantly display the real-time values of the patients' temperature and heart beats per minute.

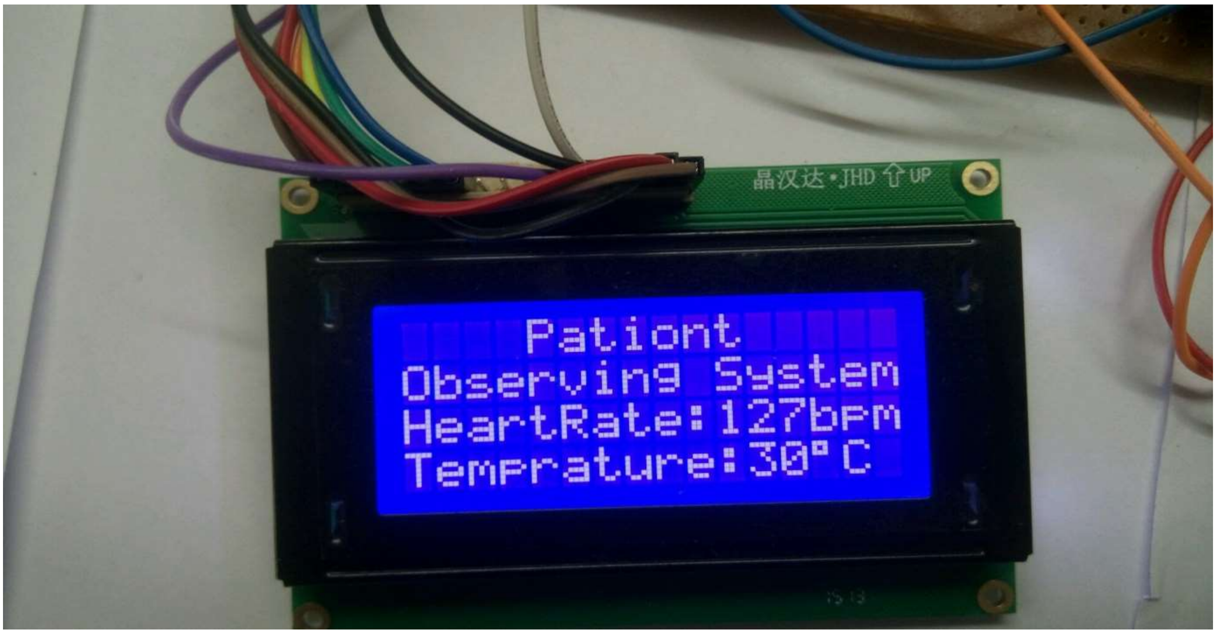


Fig 7.4 Real Time Output

Now, if the heart rate or temperature exceed the specified value, the GSM will send a text message to the specified emergency services and the LCD will also display a message prompting that the threshold values have been crossed.

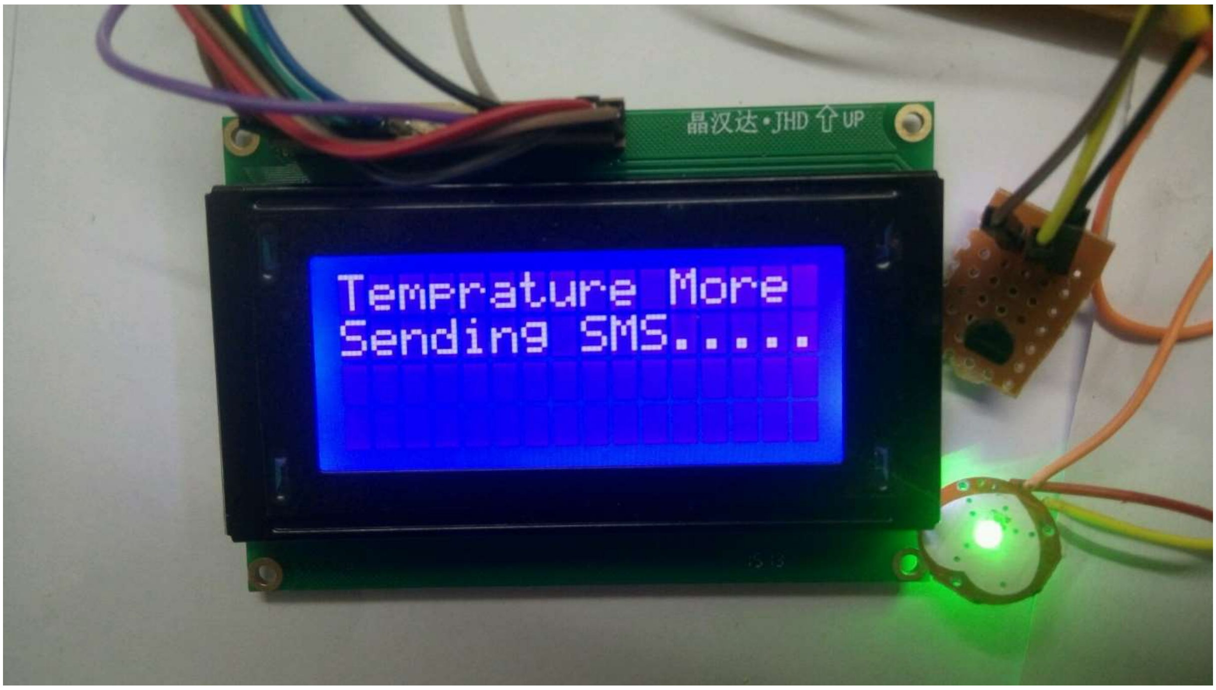


Fig 7.5 Displaying Emergency Message

After reaching the hospital, the RFID reader will read the tag issued to the patient and this unique ID will be entered in the patient database to view and update a patient's records as required. To ensure a secure and authorized access into the system, an authorized doctor is needed to login to the system by entering his/her username and password.

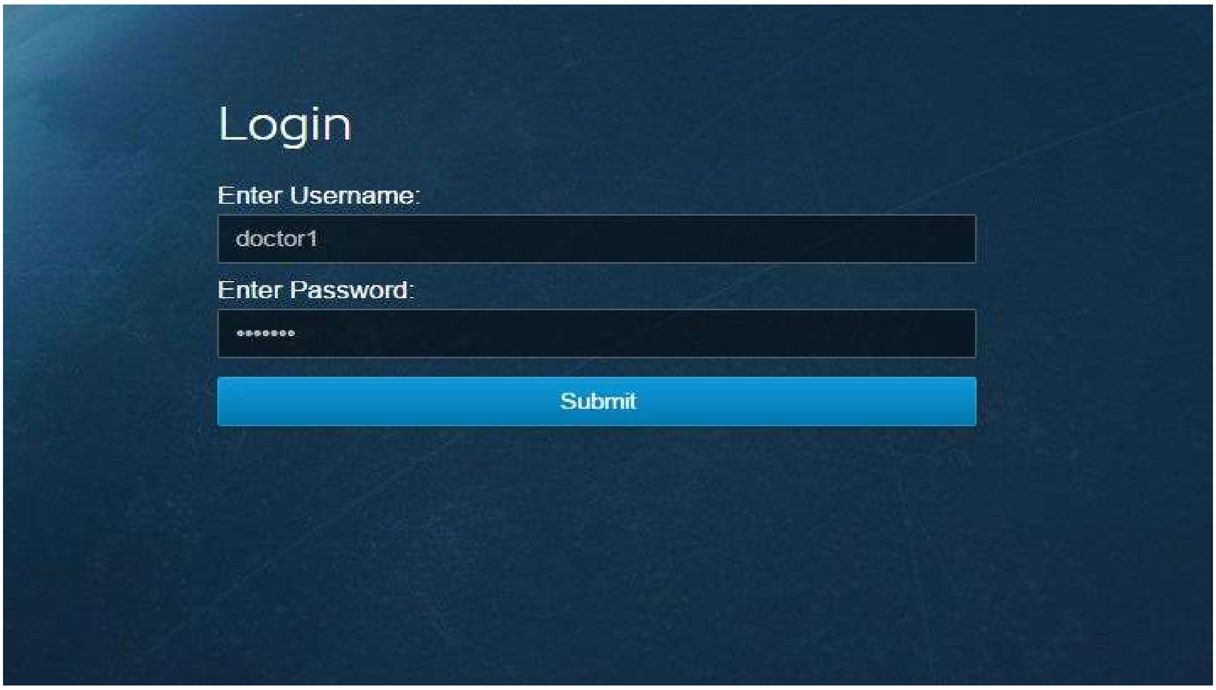


Fig 7.6 Doctor Login Page

After logging into the system, the following page is displayed.

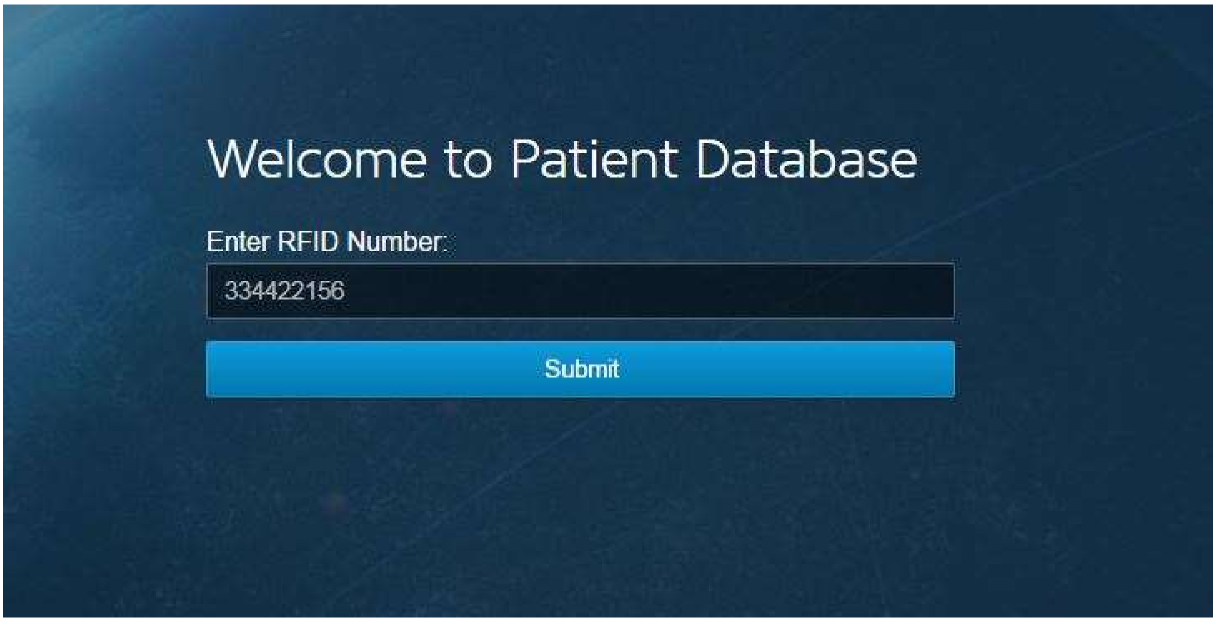


Fig 7.7 Entering RFID Number

The patient's records are displayed as shown in the figure given below.

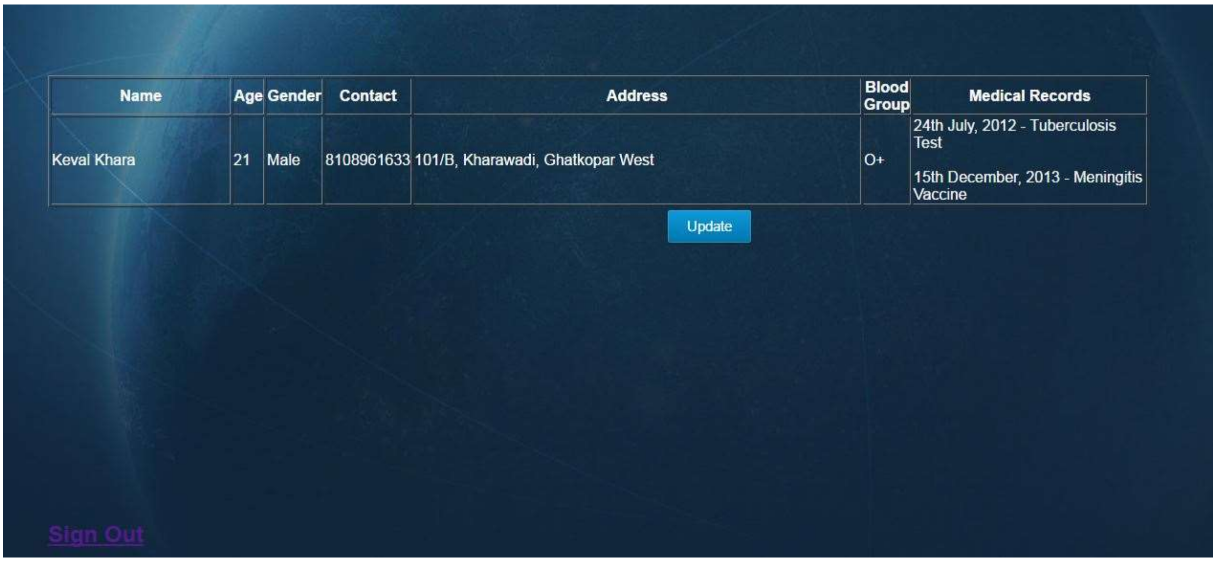


Fig 7.8 Displaying Patient's Record

The update button takes us to a new page where the patient's records can be updated.

Fig 7.9 Updating the Records

Chapter 8

Conclusion

This patient monitoring system with the help of GSM module is a very efficient and a fast method to intimate the hospital services and the family members in case of an emergency. The heart beat and the temperature sensors work continuously and provide the outputs to the microcontroller in real time for comparing the outputs to the threshold values. Hence, this method is very practical and can be applied in case of patients which are discharged from the hospitals but need constant monitoring. Furthermore, the RFID module helps to maintain and update the medical history of the patients easily and efficiently. This is also a practical approach in this day of internet where large amounts of data can be stored on online servers and can be reviewed and updated whenever necessary. Thus, we come to a conclusion of our project where our target was to help the patients who are at home all alone and have got no one to take care of them. We also achieved the objective of providing them assistance in the case of an emergency and to reduce the procedure of carrying the bulk of papers and records during every visit to hospital.

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Acknowledgement

This project consumed huge amount of work, research and dedication. Still, implementation would not have been possible if we did not have the support of many individuals and research work and projects on the internet.

Firstly, it is our privilege to express our sincerest regards to our project guide, Mr. Amit Tiwari for his valuable inputs, able guidance, encouragement, whole-hearted cooperation and constructive criticism throughout the duration of our project.

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We take this opportunity to thank all our lecturers who have directly or indirectly helped us in the completion of our project. We pay our respects to our parents and our mentors for their support and encouragement throughout the completion of this project. Last but not the least, we express our thanks to our friends for their patience and support whenever required.