Sudan University of Science & Technology
College of Engineering
School of Electrical and Nuclear Engineering

Heartbeat and Temperature Monitoring System

نظام مراقب لنبضات القلب و درجة الحرارة

A Project Submitted in Partial Fulfillment for the Requirements of the Degree of B.Eng. in Electrical Engineering

Prepared By:

1. Adil Omer Hamid Mohammed

2. Ibrahim Ismail Ibrahim

3. Mohammed Abdalgader Yagob

4. Mohammed Abdulkarim Awnsa

Supervised By: T. Galal Abdalrahman Mohammed

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الاية

بسم الله الرحمن الرحيم

"إِنَّ فِي خَلْقِ السَّمَاوَاتِ وَالْأَرْضِ وَاخْتِلَافِ اللَّيْلِ وَالنَّهَارِ وَالْفُلْكِ الَّتِي تَجْرِي فِي الْبَحْرِ بِمَا يَنْفَعُ النَّاسَ وَمَا أَنْزَلَ اللَّهُ مِنَ السَّمَاءِ مِنْ مَاءٍ فَأَحْيَا بِهِ الْأَرْضَ بَعْدَ مَوْتِهَا وَبَثَّ فِيهَا مِنْ كُلِّ دَابَّةٍ وَتَصْرِيفِ الرِّيَاحِ وَالسَّحَابِ الْمُسَخَّرِ بَيْنَ السَّمَاءِ وَالْأَرْضِ لَآيَاتٍ لِقَوْمٍ يَعْقِلُونَ"

سورة البقرة 164

Dedication

We dedicate this project to our great families and friends who exerted valuable efforts to enrich our spirits and reinforce our wills and energies and constantly work to support us, to all the engineers whose knowledge and wisdom represented rich source of illumination and ideas for us and skillfully guided us through this project in the same way our families guided us through life, we highly appreciate their efforts and energies that they spent to raise and improve our skills and capabilities. To all those we forgot to mention Thank you.

ACKNOWLEDGMENT

Thanks first and last to ALLAH who enable us to complete this work with his grace and donated us strength. For all those who have stood by us, helped us in this research, we send our thanks and deepest gratitude. Special and deepest regards are to our supervisor Eng.: **T.** Galal Abdalrahman Mohammed for his assistance and supervision**.**

Sincere thanks to everyone who stood beside us &helped us with great faith Thank you all.

Abstract

This project is therefore designed to ease the burden on the doctors, nurses and patient in terms of watching and testing of body temperature and heartbeat. Equally it would be used to monitor the sick and the aged at home especially in the absence of guardian or a relative. The simulation of the GSM based heartbeat and body temperature circuit is done by the Proteus program the circuit is being designed which the data collected by the heart beat and LM35 sensors then are sent to Arduino Uno. The Arduino processes then transmits the data over the air via GSM to doctors, nurse's or a relative's phone and also displays the same information on LCD.

المستخلص

تم تصميم هذا المشروع للتقليل من العبء على الاطباء والمرضى لفحص ومراقبة درجة حرارة المريض ومعدل نبضات القلب وايضأ مراقبة المرضى عن بعد في المنازل والمناطق النائية أو عدم توفر الاطباء او الاقرباء بقرب المريض.تمت محاكاة الدائرة المراد تصميمها باستخدام برنامج موحسب لمحاكاة الدوائر الالكترونية.تم تصميم الدائرة بعد التاكد من نتائج المحاكاة واستخدام حساس لقياس درجة الحرارة واخر قياس معدل نبضات القلب لتجميع البيانات ومن ثم معالجتها باستخدام معالج رقمي يقوم بتحويل الاشارات من اشارات تناظريه الى اشارات رقميه ومن ثم عرضها في شاششة العرض وارسالها عبر تقنية النظام العالمي للموبايل للطبيب.

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LIST OF ABBREVIATION

LCD	Liquid crystal display
GSM	Global system for mobile communications
SMS	Short message service
CRT	Cathode – ray tube
ECG	Electric cardio graph
ICU	Intensive care unit
IDE	Integrated development environment
USB	Unique selling proposition
LED	Light emitting diode
BPM	Beat per minute
GPR	Ground- penetrating radar
TEMP	Temperature
IOT	Internet of things
ASCII	American Standard Code for Information Interchange

CHAPTER ONE

INTRODUCTION

1.1 General Idea

Cardiovascular disease is one of the main causes of death in many countries and thus it accounts for the over 15 million deaths worldwide. In addition, several million people are disabled by cardiovascular disease. The delay between the first symptom of any cardiac ailment and the call for medical assistance has a large variation among different patients and can have fatal consequences. One critical inference drawn from epidemiological data is that deployment of resources for early detection and treatment of heart disease has a higher potential of reducing fatality associated with cardiac disease than improved care after hospitalization. Hence new strategies are needed in order to reduce time before treatment. Monitoring of patients is one possible solution. Also, the trend towards an independent lifestyle has also increased the demand for personalized non-hospital-based care. Cardiovascular disease has shown that heart beat rate plays a key role in the risk of heart attack. Heart disease such as heart attack, coronary heart disease, congestive heart failure, and congenital heart disease is the leading cause of death for men and women in many countries. Most of the time, heart disease problems harm the elderly person. Very frequently, they live with their own and no one is willing to monitor them for 24 hours a day. In this proposed device, the heart beat and temperature of patients are measured by using sensors LM35 and heart beat sensor which is suitable for wireless transmission using SMS messages through GSM modem. Arduino device is used for temporary storage of the data used for transmission. For a patient who is already diagnosed with fatal heart disease, their heart rate condition has to be monitored continuously. This project proposes and focuses on the design of the heartbeat monitor that is able to monitor the heart beat rate condition of patient continuously. This signal is processed using the Arduino to determine the heart beat rate and body temperature per minute. Then, it sends short message service (SMS) alert to the mobile phone of medical experts or patient's family members, or their relatives about the condition of the patient and abnormal details via SMS. Thus, doctors can monitor and diagnose the patient's condition continuously and could suggest earlier precaution for the patients themselves. This will also alert the family members to quickly attend to the patient [1].

1.2 Problem Statement

As we know having someone to watch a critically ill person is very expensive and take a lot of manpower, these valuable resources can be used. Also patient monitoring devices usually exist in hospitals delivering a complexity in sequential testing through the day. The patient with heart problem facing a challenge living normal life because of the fear from heart attack that can cause death and high cost is one of the problems of continuous monitoring through wireless device.

1.3 Objectives

The objectives are divided into two subjects

1.3.1 General objective

To develop a cheap prototype of a system that can monitor heart beats and body temperature of the patient at home and send the data remotely through a GSM module to the monitor.

1.3.2 Specific objectives

- ❖ Design and implement a pulse heartbeat detector.
- ❖ Interface the LM35 temperature sensor.
- ❖ Design and implement a wireless communication circuit between the patient and physician.
- ❖ Simulate the circuit using proteus ISIS.
- ❖ Test and calibrate the circuit.

1.4 Methodology

The methodology starts by collecting information about the heart rate and temperature signals and how to deal with them, then the way to design and implement a circuit capable of detecting signals and best technology GSM to transmit the signals in SMS in text format. A simulation to the circuit is done to ensure that the design succeeds, then an implementation to the circuit was done with a test and calibration.

1.5 Layout

Chapter one includes the general idea introduction about the heart beat monitor system, and stating the problems and its objective and then methodology of the project. chapter two is a brief detail about the heart rate, body temperature, history of monitoring, GSM monitoring and past studies (literature review). While chapter three the modeling and circuit components, contains the hardware components and the flow chart of the system. Then chapter four this chapter explains the operation of the project, and shows the simulation. Finally, chapter five which contains the conclusion and the recommendation.

CHAPTER TWO
GENERAL INFORMATION

2.1 Introduction

Patient Monitoring System is a process in which a doctor can constantly supervise more than one person, in excess of one parameter at a time in a remote area [2]. Advancement in medical technologies have made rapid changes in e-health care system. An innovative and effective e-health monitor model with wireless technology can be a great help for the people of developing countries.

The technology provides assistance physicians to better diagnose and treat patients not physically presence on spot as sometimes it's crucial to provide remedy or treat patients who are unluckily away from well treatment. In modern era advanced medical technology effectively contributing in our personal lives. This assists on improving and saving countless lives all around the world. Medical technology is a broad field where innovation plays a crucial role in sustaining health [3].

2.2 Heart Rate

The number of heartbeats per unit of time, usually measured per minutes. The heart rate is based on the number of contractions of the ventricles. The heart rate may be too fast (tachycardia) or too slow (bradycardia). The pulse is a bulge of an artery from waves of the blood that course through the blood vessels each time the heart beats. The pulse is often taken on the wrist to estimate the heart rate. Heart rate is the speed of the heartbeats measured by the number of the contraction of the heart per minute (bpm the heart rate can vary according to the body's physical needs, including the need to absorb oxygen and extra carbon dioxide. It is usually equal or close to the pulse measured at peripheral point. Activities that provide change include physical exercise, sleep, anxiety, stress, illness, and ingestion include physical exercise, sleep, anxiety, stress, illness and ingestion of drugs. Many texts cite the normal resting adult human heart rate as ranging from 60_ 100 bpm. Tachycardia is a fast heart rate, defined as above 100 bpm at rest, Bradycardia is a slow heart rate, defined as below 60 bpm at rest. The normal resting adult heart rate is probably closer to a range between 50 during sleep a slow heartbeat with rates around 40_50 bpm is common and is considered normal. When the heart is not beating in a regular pattern, this is referred to as an arrhythmia. Abnormalities of heart rate sometimes indicate disease [4].

2.3 Body Temperature

Body temperature is also a common indication of body condition. Normal human body temperature is (98.6 ° F ± 0.7°F) and it differs activity of the person as well as place of measurement. When a person is excessively hot then the blood vessels in human skin inflate to transfer the excess heat to human skin surface. And because of this reason, the person starts sweating. Then the sweat evaporates and this process supports to cool human body. When a person is too cold, human blood vessels contracted so the blood flow in human skin gets reduced to preserve temperature of body. As a result, he/she starts shivering and it is an instinctive, rapid abbreviation of the muscles.[2]

Table2.1: Body temperature chart for children

Body temperature chart for children		
	Celsius	Fahrenheit
Hypothermia	< 35.0°	< 95.0°
Normal	35.8° – 37.5°	96.4° – 99.5°
Hyperthermia (low-grade fever)	> 38.0°	> 100.4°
Hyperpyrexia (high fever)	> 40.0°	> 104.0°

Table2.2: Body temperature chart for adults

Body temperature chart for adults		
	Celsius	**Fahrenheit**
Hypothermia	< 35.0°	< 95.0°
Normal	36.5° – 37.5°	97.7° – 99.5°
Hyperthermia (low-grade fever)	> 38.3°	> 100.9°
Hyperpyrexia (high fever)	> 41.5°	> 106.7°

2.4 History of Monitoring

To meet the increasing demands for more acute and intensive care required by patients with complex disorders, new organizational units—the ICUs—were established in hospitals beginning in the 1950s. The earliest units were simply postoperative recovery rooms used for prolonged stays after open-heart surgery. Intensive-care units proliferated rapidly during the late 1960s and 1970s.

Figure 2.1: Intensive-care unit in 1960s and 1970s

The types of units include burn, coronary, general surgery, open-heart surgery, pediatric, neonatal, respiratory, and multipurpose medical-surgical units. [5]

Analog-computer technology was widely available, as were oscilloscopes, electronic devices used to depict changes in electrical potential on a cathode-ray tube (CRT) screen. These devices were soon used in specialized cardiac-catheterization laboratories, and they rapidly found their way to the bedside. Treatment for serious cardiac arrhythmias (rhythm disturbances) and cardiac arrest (abrupt cessation of heartbeat)—major causes of death after myocardial infarctions—became possible. As a result, there was a need to monitor the ECGs of patients who had suffered heart attacks so that these episodes could be noticed and treated immediately. In 1963, Day reported that treatment of post myocardial-infarction patients in a coronary-care unit reduced mortality by 60 percent. As a consequence, coronary-care units—with ECG monitors—proliferated. The addition of online blood-pressure monitoring quickly followed. Pressure transducers, already used in the cardiac-catheterization laboratory, were easily adapted to the monitors in the ICU. With the advent of more automated instruments, the ICU nurse could spend less time manually measuring the traditional vital signs and more time observing and caring for the critically ill patient. Simultaneously, a new trend emerged; some nurses moved away from the bedside to a central console where they could monitor the ECG and other vital-sign reports from many patients. Maloney (1968) pointed out that this was an inappropriate use of technology when it deprived the patient of adequate personal attention at the bedside. He also suggested that having the nurse record vital signs every few hours was "only to assure regular nurse–patient contact" (Maloney, 1968, p. 606). [5]

Teams from several cities in the United States introduced computers for physiological monitoring into the ICU, beginning with Shubin and Weil (1966) in Los Angeles and then Warner and colleagues (1968) in Salt Lake City. Each of these teams developed its application on a mainframe computer system, which required a large computer room and special staff to keep the system operational 24 hours per day. The computers used by these developers cost over $200,000 each in 1965 dollars! Other researchers were attacking more specific challenges in patient monitoring. For example, Cox and associates (1972) in St. Louis developed algorithms to analyze the ECG for heart rhythm disturbances in real-time. The arrhythmia-monitoring system, which was installed in the coronary-care unit of Barnes Hospital in1969, ran on a relatively inexpensive microcomputer. Systems with database functions, report-generation systems, and some decision-making capabilities are usually called computer-based patient monitors.[5]

Today, systems with database functions, report generation systems, and some decision-making capabilities are called computer- based patient monitors, while the basic signal conversion and storage is built into monitors and considered “patient monitoring”.[5]

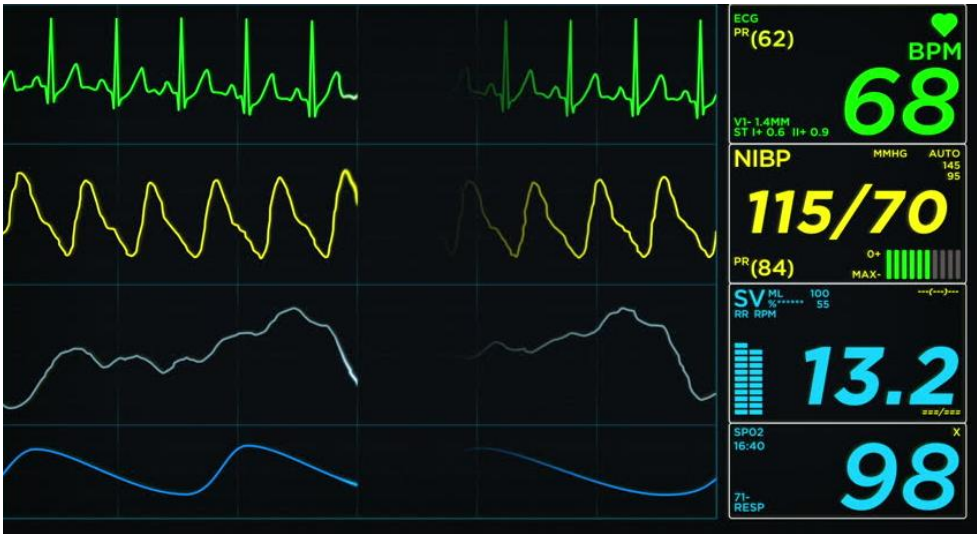

Figure2.2: ECG screen

2.5 GSM Monitoring

GSM based system using microcontroller and LM35 sensor which is low-cost and use-friendly. Here, a heartbeat sensor is used to detect the heart rate and an LM35 sensor to sense the body temperature. These signals are processed by a PIC microcontroller. Then an SMS alert will be sent to the medical expert by using a GSM module. Thus, doctors can monitor the health condition of a patient continuously from a remote place and can suggest the patient about taking an immediate remedy. As a result, we can save many lives by providing them a quick service using this system.

2.6 Microcontroller

The term microcontroller or microcomputer is used to describe a system that includes a minimum of a microprocessor, program memory, data memory, and input–output (I/O). Some microcontroller systems include additional components, such as timers, counters, analog-to-digital (A/D) converters, and so on. Thus, a microcontroller system can be anything from a large computer having hard disks, floppy disks, and printers to a single-chip embedded controller. Microcontrollers are dedicated to one task and run one specific program. The program is stored in ROM (read-only memory) and generally does not change.

Microcontrollers are divided into categories according to their memory, architecture, bits and instruction sets as follow

- *Bits:*

- 8 bits microcontroller executes logic & arithmetic operations. Examples of 8 bits micro controller is Intel 8031/8051.

- 16 bits microcontroller executes with greater accuracy and performance in contrast to 8-bit. Example of 16-bit microcontroller is Intel 8096.

- 32 bits microcontroller is employed mainly in automatically controlled appliances such as office machines, implantable medical appliances, etc. It requires 32-bit instructions to carry out any logical or arithmetic function.

- *Memory:*

- External Memory Microcontroller – When an embedded structure is built with a microcontroller which does not comprise of all the functioning blocks existing on a chip it is named as external memory microcontroller. For illustration- 8031 microcontroller does not have program memory on the chip.

- Embedded Memory Microcontroller – When an embedded structure is built with a microcontroller which comprise of all the functioning blocks existing on a chip it is named as embedded memory microcontroller. For illustration- 8051 microcontroller has all program & data memory, counters & timers, interrupts, I/O ports and therefore its embedded memory microcontroller.

- *Instruction Set:*

- CISC- CISC means complex instruction set computer, it allows the user to apply 1 instruction as an alternative to many simple instructions.

- RISC- RISC means Reduced Instruction Set Computers. RISC reduces the operation time by shortening the clock cycle per instruction.

- *Memory Architecture:*

- Harvard Memory Architecture Microcontroller.

- Princeton Memory Architecture Microcontroller.

2.7 Sensors

Sensor can be defined as an input device which provides an output (signal) with respect to a specific physical quantity (input). The term “input device” in the definition of a Sensor means that it is part of a bigger system which provides input to a main control system (like a Processor or a Microcontroller). Sensor can also be defined as device that converts signals from one energy domain to electrical domain

2.7.1 Classification of Sensors

There are several classifications of sensors. In the first classification of the sensors, they are divided in to Active and Passive. Active Sensors are those which require an external excitation signal or a power signal. Passive Sensors, on the other hand, do not require any external power signal and directly generates output response.

The other type of classification is based on the means of detection used in the sensor. Some of the means of detection are Electric, Biological, Chemical, Radioactive etc.

The next classification is based on conversion phenomenon i.e. the input and the output. Some of the common conversion phenomena are Photoelectric, Thermoelectric, Electrochemical, Electromagnetic, etc.

The final classification of the sensors is Analog and Digital Sensors. Analog Sensors produce an analog output i.e. a continuous output signal with respect to the quantity being measured. Digital Sensors, in contrast to Analog Sensors, work with discrete or digital data. The data in digital sensors, which is used for conversion and transmission, is digital in nature.

2.7.2 Different Types of Sensors

The following is a list of different types of sensors that are commonly used in various applications. All these sensors are used for measuring one of the physical properties like Temperature, Resistance, Capacitance, Conduction, Heat Transfer etc.

- Temperature Sensor
- Proximity Sensor
- Accelerometer
- IR Sensor (Infrared Sensor)
- Pressure Sensor
- Light Sensor
- Ultrasonic Sensor
- Smoke, Gas and Alcohol Sensor
- Touch Sensor
- Color Sensor
- Humidity Sensor
- Tilt Sensor
- Flow and Level Sensor

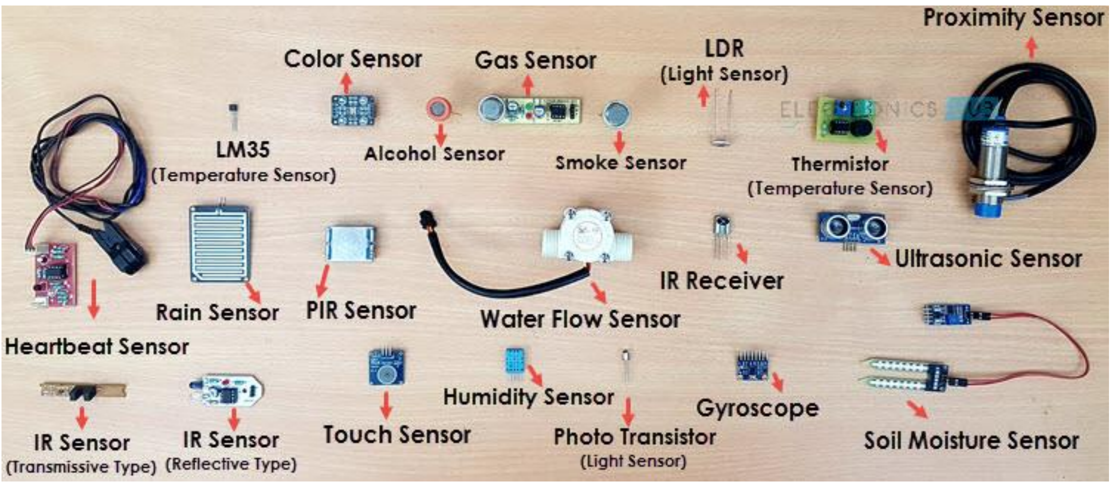

Figure2.3: Different types of sensors

2.8 Literature Review

This paper proposes a system to monitor the patient's conditions by monitoring the body temperature and pulse rate. The system consists of a pulse rate monitoring software and a wearable device that can measure a subject's temperature and pulse rate only by using a fingertip. The device is able to record the measurement data and interface to PC via Arduino microcontroller. The recorded data can be viewed as a historical file or can be archived for further analysis. This work also describes the preliminary experimental results of the selected sensors to show the usefulness of the sensors for the proposed patient monitoring system.[6]

An advanced technology has been created for patient monitoring those who are suffered from heart diseases & physical disorder. Therefore, heart rate sensor and temperature sensor are used for patient monitoring. Sensors gives accurate output therefore it rules out the use of traditional medical instruments such as thermometer and other devices. For continuously sending message from patient's location to medical advisory GSM modem used. This module provides relief to medical advisory for patient monitoring and also to patients for freedom of movement.[7]

CHAPTER THREE

MODELLING AND CIRCUIT COMPONENTS

3.1 Introduction

The main objective is to design such type of device which is used for continuous monitoring of patients. There will be few sensors like temperature sensor, pulse sensor to detect patient's temperature and heart rate. For implementing this system sensors are needed, Arduino UNO and a power source. The sensors dedicate the patient's temperature and pulse rate then transfer the data to the Arduino then to the LCD display and doctor's phone number through the GSM modem. GSM modem is used to make the device wearable. The patient can move from one place to another with the device and this will not cause the doctor any problem to monitor.[8]

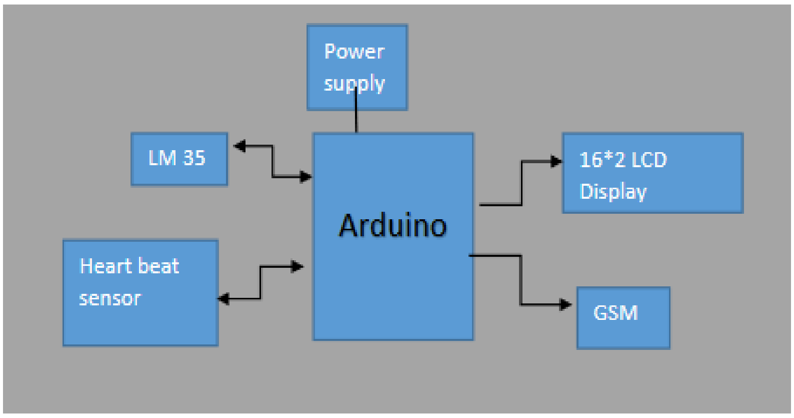

Figure 3.1: Block diagram of the system

3.2 Hardware Requirement

This system hardware requirements are as follows:

3.2.1 Arduino Uno

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on our computer, used to write and upload computer code to the physical board. The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – we can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package. The Arduino is a microcontroller board based on the ATmega8. It has 14 digital -input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a16 MHz ceramic resonator, 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 an AC-to-DC adapter or battery to get started.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.[8]

Figure 3.2: Arduino UNO

3.2.2 GSM module (SIM900A)

We are using GSM (Global System for Mobile Communication) module SIM900A. SIM900A is in control for communicating between microcontroller unit and mobile station. SIM900A is a complete dual-band GSM module in a SMT (Surface Mount Technology) type which is beneficial for small dimensions and cost-effective solutions. With a tiny configuration of 24mm ×24mm×3mm and low power consumption, SIM900A can fit almost all space requirements especially for slim and compact demand design.[3]

Figure 3.3: GSM (SIM900A)

We interface GSM (SIM900A) with the Arduino by implementing the following connection

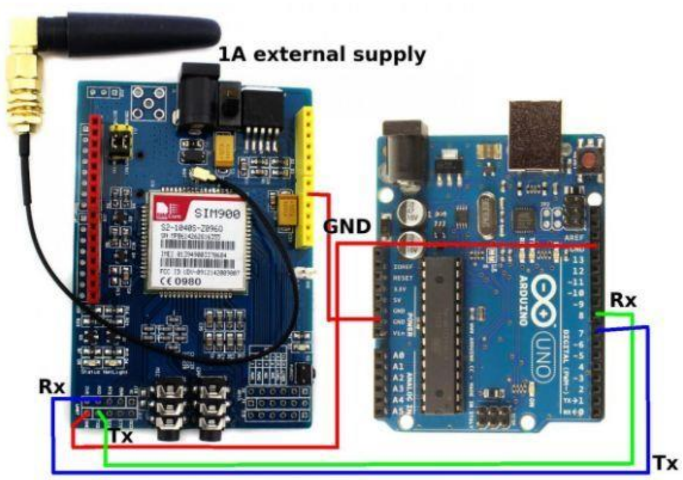

Figure 3.4: Interfacing Arduino with GSM (SIM900A)

The table below shows the hardware connection between Arduino and GSM pins

Table 3.1: The connection between Arduino UNO's pin and GSM (SIM900A) pins

Arduino pin	SIM900A pin
+5V	VCC
GND	GND
Pin No. 10	TX
Pin No. 11	RX

3.2.3 IC LM35 temperature sensor

The LM35 is a popular and inexpensive temperature sensor. It provides an output voltage of 10.0mV for each degree Centigrade of temperature from a reference voltage. The output of this device can be fed to A/D Converter; any microcontroller can be interfaced with any A/D Converter for reading and displaying the output of LM35. The circuit should be designed, so that output should be at 0V when the temperature is 0 degrees Centigrade and would rise to 1000mV or 1.0V at 100 degrees Centigrade. To get the temperature value accurately, output voltage must be multiplied with 100. For example, if we read 0.50V that would be 50 degrees Centigrade.[8]

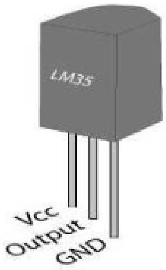

Figure 3.5: LM35 temperature sensor

We interfaceLM35 with the Arduino by implementing the following connection

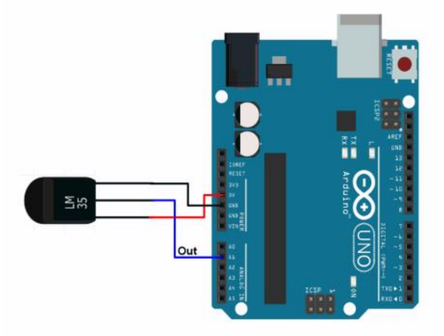

Figure 3.6: Interfacing Arduino with LM35

The table below shows the hardware connection between Arduino and LM35 pins

Table 3.2: The connection between Arduino UNO's pin and LM35 pins

Arduino pin	LM35 pin
+5V	VCC
GND	GND
A0	OUTPUT

3.2.4 Heartbeat sensor

A Heartbeat sensor is a monitoring device that allows one to measure his or her heart rate in real time or record the heart rate for later study. It provides a simple way to study the heart function. This sensor monitors the flow of blood through the finger and is designed to give digital output of the heartbeat when a finger is placed on it. When the sensor is working, the beat LED flashes in unison with each heartbeat. This digital output can be connected to the microcontroller directly to measure the Beats per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse. The Pulse Sensor is a well-designed plug and-play heart-rate sensor for Arduino. It also includes an open-source monitoring app that graphs your pulse in real time.[2]

Figure 3.7: Heartbeat sensor

We interface GSM (SIM900A) with the Arduino by implementing the following connection

Figure 3.8: Interfacing Arduino with heartbeat sensor

The table below shows the hardware connection between Arduino and heartbeat sensor pins

Table 3.3: The connection between Arduino UNO's pin and Pulse sensor's pins

Arduino pin	Pulse sensor pin
+5V	VCC
GND	GND
A1	OUTPUT

3.2.5 LCD display

Unit liquid crystal display (LCD) modules that display characters such as text and numbers are the cheapest and simplest to use of all LCDs. They can be purchased in various Sizes, which are measured by the number of rows and columns of characters they can display. Any LCD with an HD44780-or KS0066-compatible interface is compatible with Arduino. A 16x2 LCD display is very basic electronic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs because they are economical, easily programmable, has no limitation of displaying special and even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.[8]

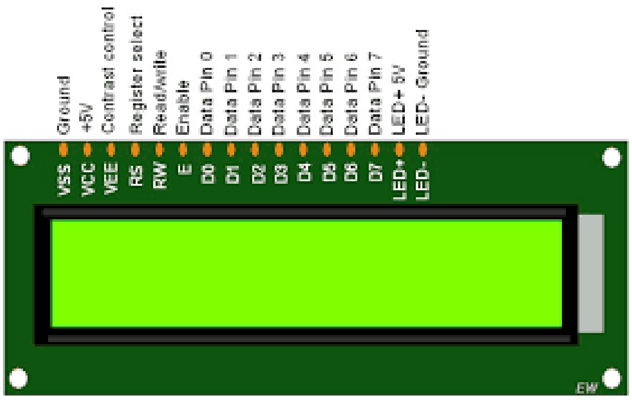

Figure 3.9: 2*16 LCD display

We interface GSM (SIM900A) with the Arduino by implementing the following connection

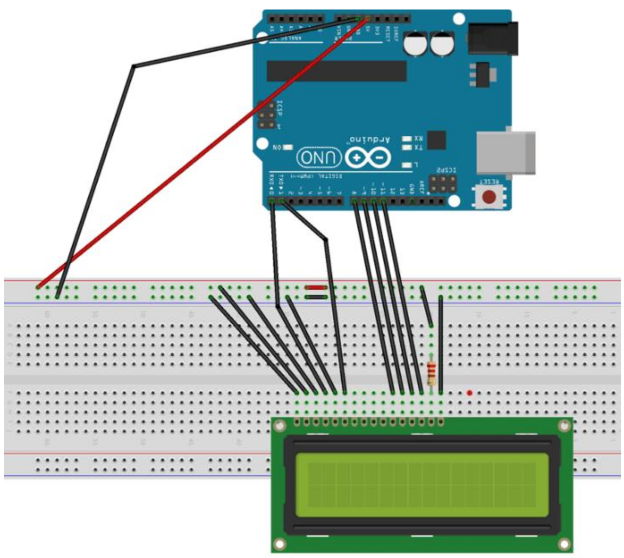

Figure 3.10: Interfacing Arduino with LCD display

The table below shows the hardware connection between Arduino and LCD pins

Table 3.4: The connection between Arduino UNO's pin and LCD display pins

Arduino UNO pin	2*16 LCD display
+5V	VCC
GND	VSS
GND	VEE
GND	RW
Pin No.9	RS
Pin No.8	E (Enable)
Pin No.7	D4
Pin No.6	D5
Pin No.5	D6
Pin No.4	D7
+5V	LED +
GND	LED -

3.2.6 Connecting wires

A Wire is a single usually cylindrical, flexible strand or rod of metal. Wires are used to bear mechanical loads or electric and telecommunication signals. Wire is formed by drawing the metal through a hole in a die or draw plate.[3]

Figure 3.11: Jumping wires

3.3 Flow Chart

A flowchart is a picture of the separate steps of a process in sequential order. It is a generic tool that can be adapted for a wide variety of purposes, and can be used to describe various processes

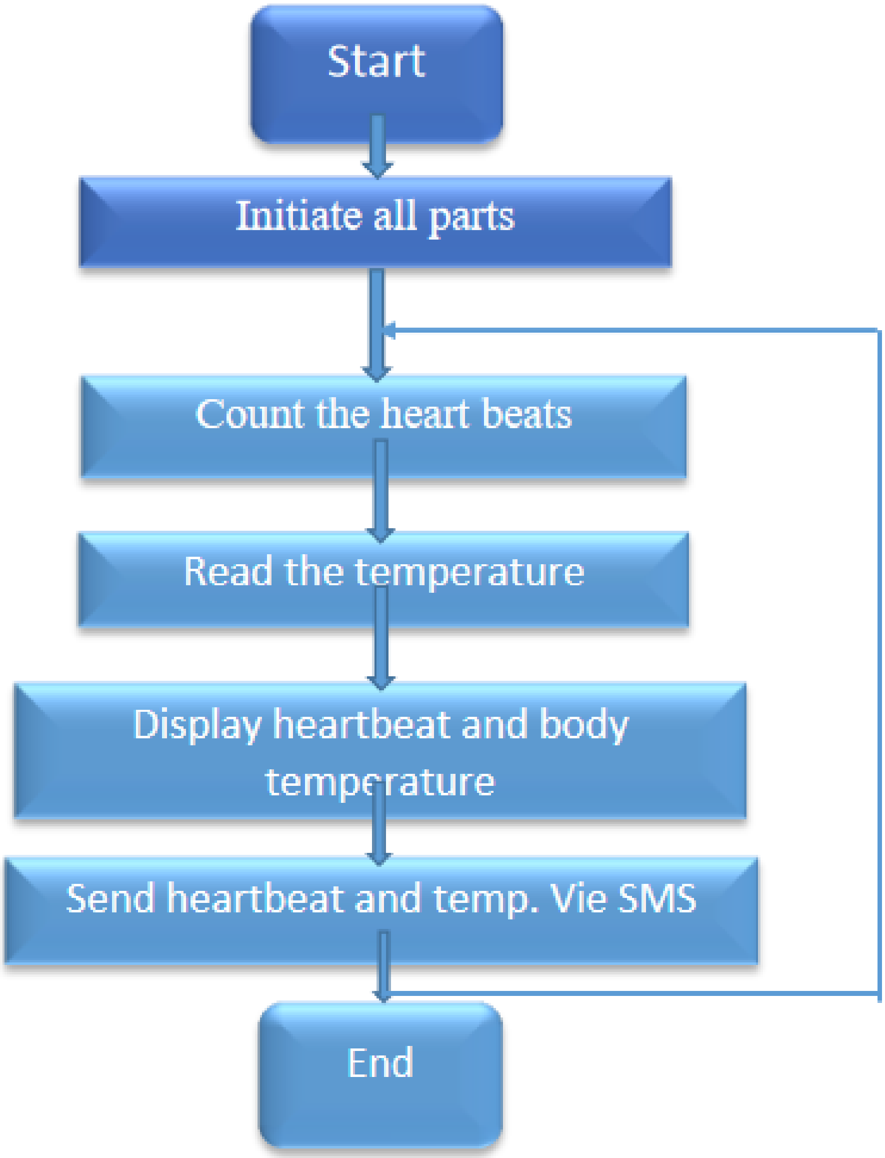

Figure 3.12: Flow chart of the system

CHAPTER FOUR

SIMULATION AND PRACTICE

4.1 Introduction

There will be few sensors like temperature sensor pulse sensor to detect patient's temperature and heart rate. For this we will need sensors, Arduino uno and a power source. After taking the reading from the patient, the data will be sent to the database through GSM module. All data along with patient's, would be displayed in the LCD. Both the patient and the doctor mobile application will show the patient's, state use this system. GSM modem is used to. The patient can move from one place to another with the device and this will not cause the doctor any problem to monitor. And the system is simulated in proteus to make sure the circuit is working.

4.2 Simulation

The Proteus Design Suite is a Windows application for schematic capture, simulation, and PCB (printed circuit board) layout design. It can be purchased in many configurations, depending on the size of designs being produced and the requirements for microcontroller simulation. All PCB Design products include an autoroute and basic mixed mode Spice simulation capabilities. The proteus contain

- ISIS is the software used to draw schematics and simulate the circuits in real time. The simulation allows human access during run time, thus providing real time simulation.
- ARES is used for PCB designing. It has the feature of viewing output in 3D view of the designed PCB along with components.
- The designer can also develop 2D drawings for the product.

Figure 4.1 the proteus interface

ISIS has wide range of components in its library. It has sources, signal generators, measurement and analysis tools like **oscilloscope**, voltmeter, ammeter etc., probes for real time monitoring of the parameters of the circuit, switches, displays, loads like motors and lamps, discrete components like resistors, capacitors, inductors, transformers, digital and analog Integrated circuits, semi-conductor switches, relays, microcontrollers, processors, sensors etc.

ARES offers PCB designing up to 14 inner layers, with surface mount and through hole packages. It is embedded with the foot prints of different category of components like ICs, transistors, headers, connectors and other discrete components. It offers Auto routing and manual routing options to the PCB Designer. The schematic drawn in the ISIS can be directly transferred ARES.

Starting New Design:

Step 1: Open ISIS software and select New design in File menu

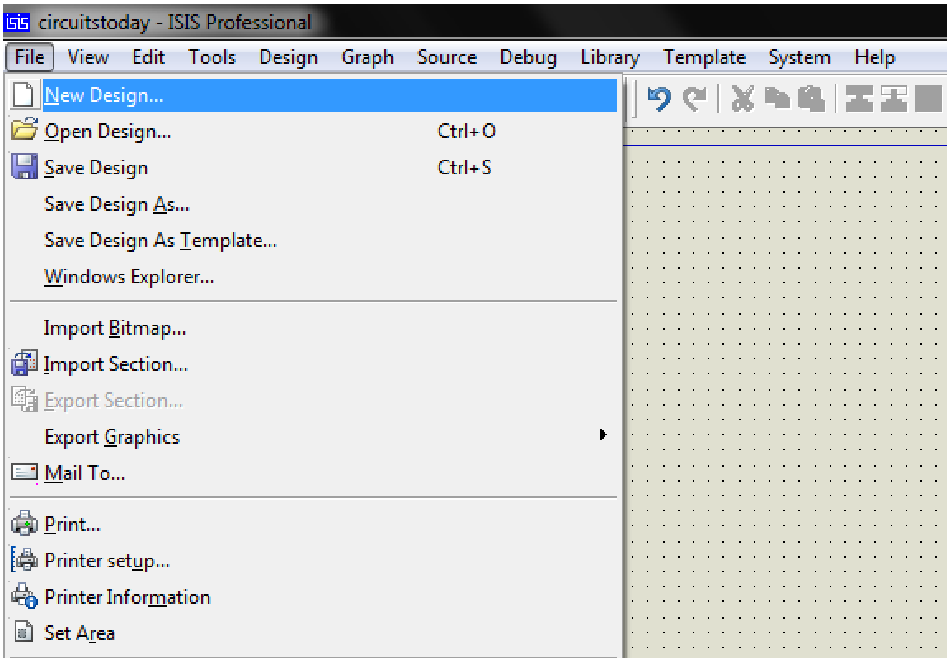

Figure4.2 Proteus File Menu

Step 2: A dialogue box appears to save the current design. However, we are creating a new design file so you can click Yes or No depending on the content of the present file. Then a Pop-Up appears asking to select the template. It is similar to selecting the paper size while printing. For now, select default or according to the layout size of the circuit.

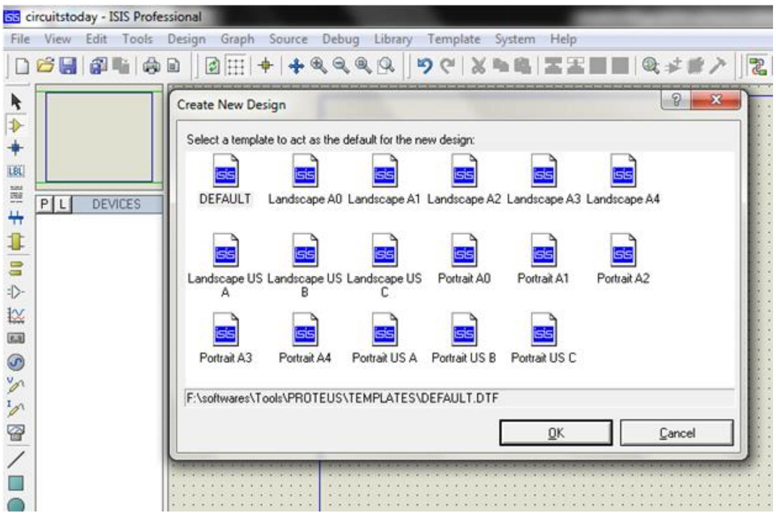

Figure4.3 Proteus Default Template Select

Step 3: An untitled design sheet will be opened, save it according to your wish, it is better to create a new folder for every layout as it generates other files supporting your design. However, it is not mandatory.

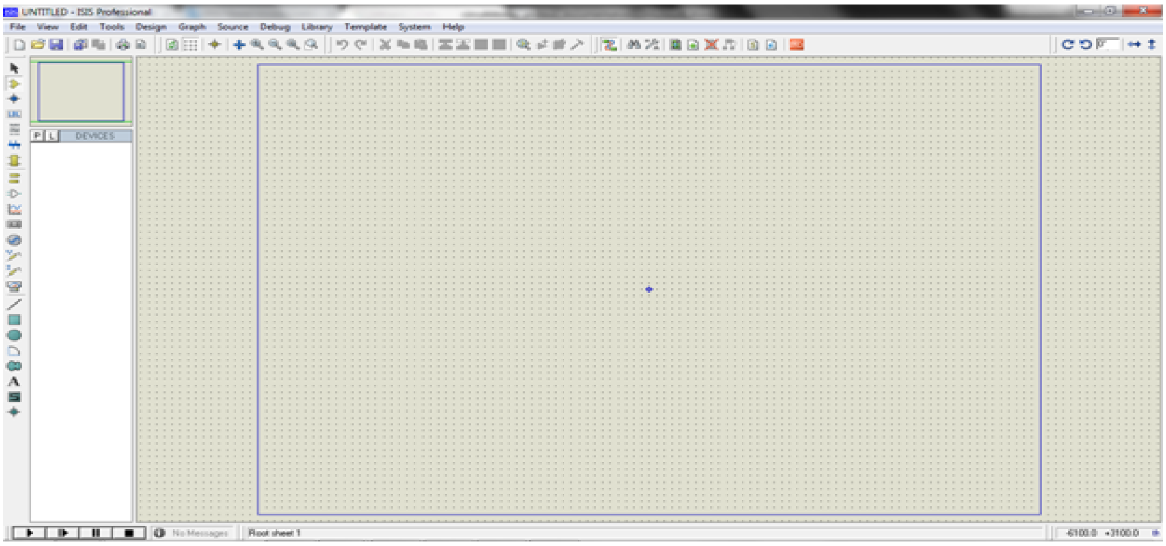

Figure4.4 Proteus Design Sheet

Step 4: To Select components, Click on the component mode button.

Step 5: Click on Pick from Libraries. It shows the categories of components available and a search option to enter the part name.

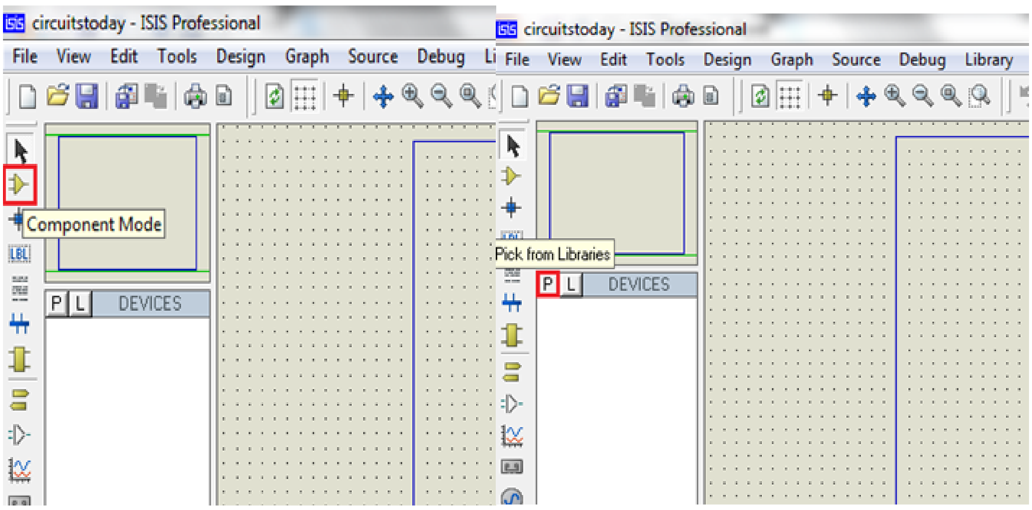

Figure4.5 Component Mode & Pick from Libraries

Step 6: Select the components from categories or type the part name in Keywords text box.

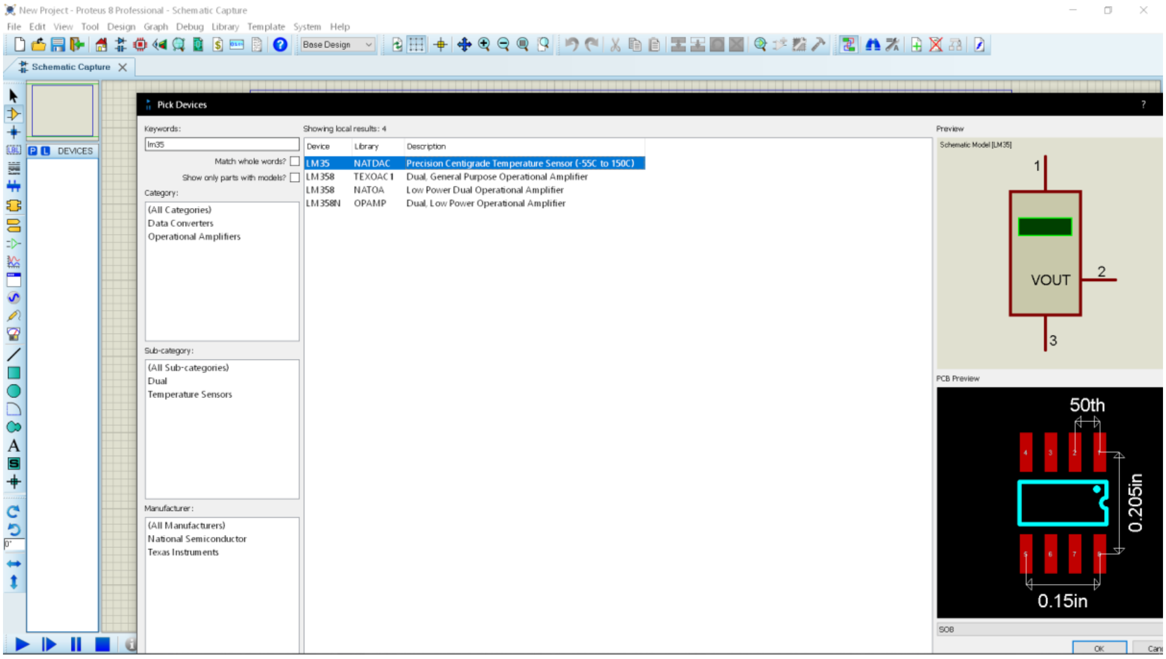

Figure4.6 LM35 Selection

Step 7: The selected components will appear in the devices list. Select the component and place it in the design sheet by left-click.

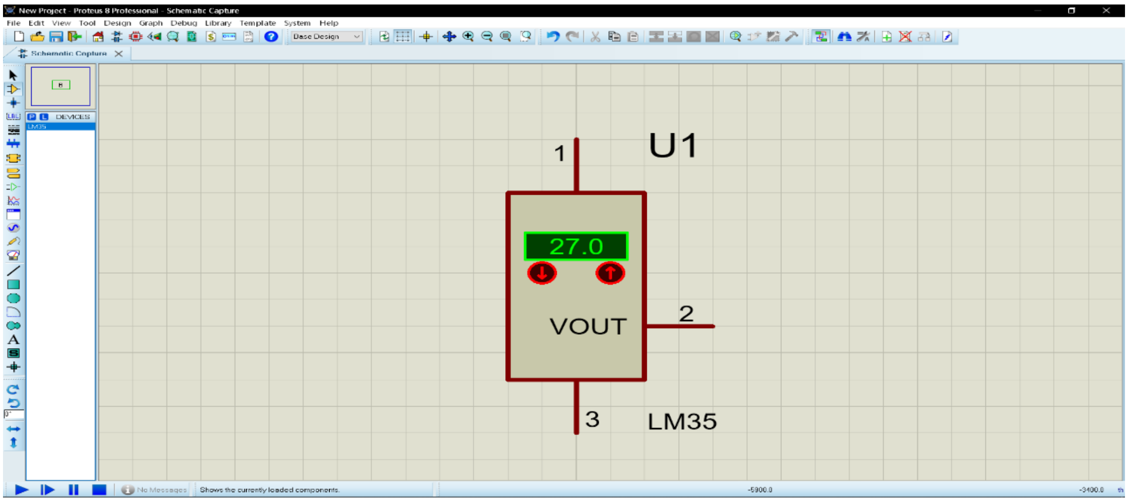

Figure4.7 Component Selection

After Place all the required components and route the wires i.e., make connections. Double click on the component to edit the properties of the components and click on Ok.

Step 8: After connecting the circuit, click on the play button to run the simulation.

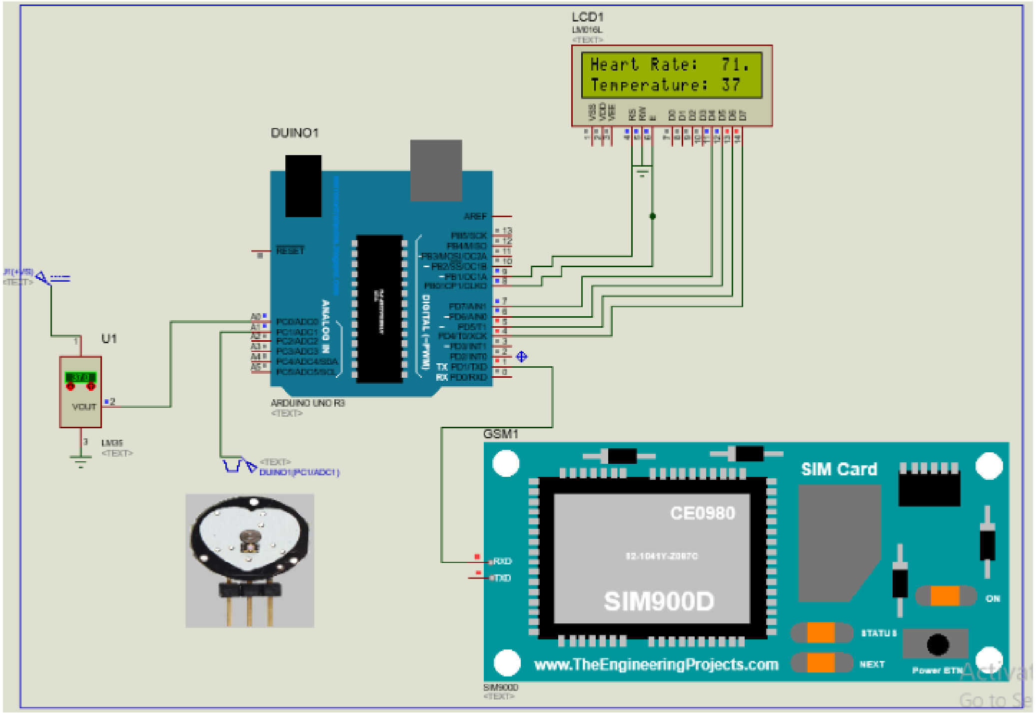

Figure4.8: Simulation of the system

4.3 System Implementation

Since the pulse sensor is simply a plug and play sensor it does not require much calculation after the data is received. The pulse sensor has three pins as well. One pin is for the signal coming from the sensed data and the other two pins are 5volts and Ground.

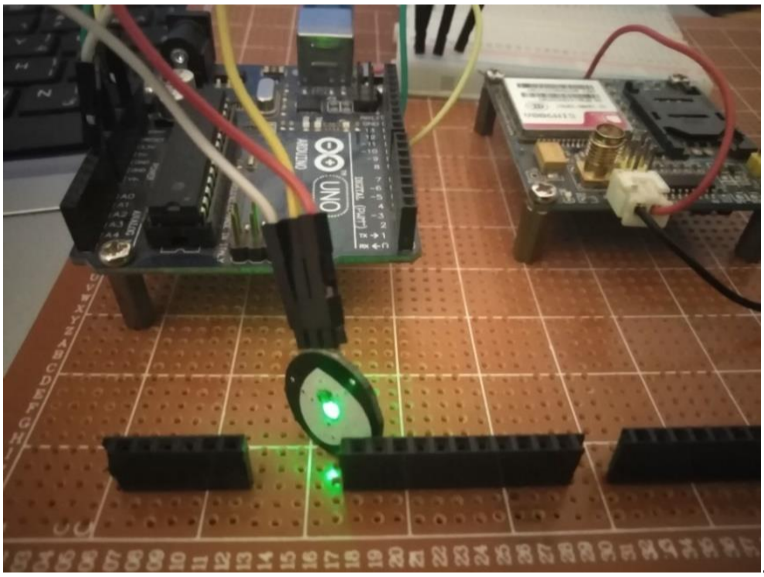

Figure 4.9: Arduino configured with pulse sensor

The LM35 temperature sensor has three pins, the first pin is connected with the ground, the second pin is connected with the output pin in the Arduino board., which basically gives the temperature result. The last pin is connected with the 5volt pin in the Arduino. LM35Temperature requires One Wire and LM35Temperature libraries in the Arduino library folder as well.

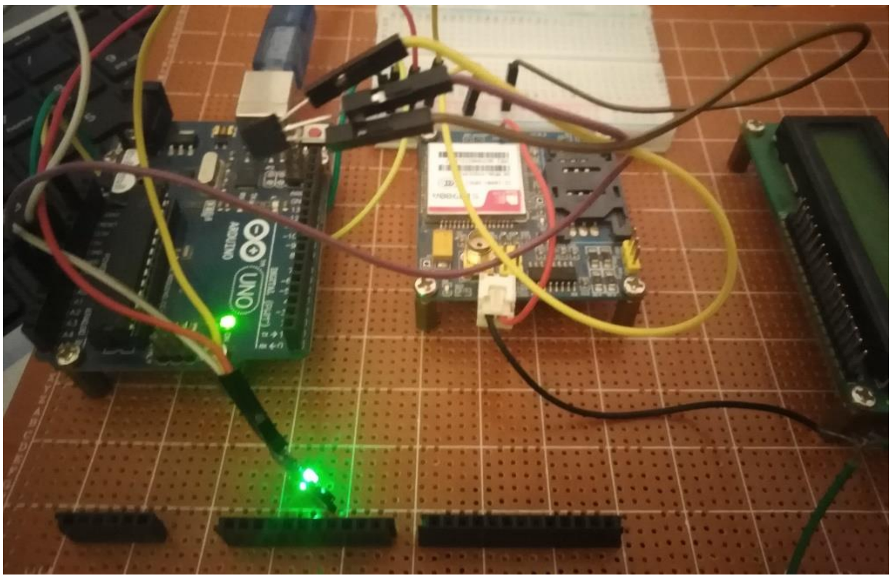

Figure 4.10: LM35 interface with Arduino

The GSM modem, SIM900A used in our project is first configured with the Arduino so that it is able to send data over the internet connectivity. A GSM modem works like any other typical mobile phone. Since our GSM SIM900A also comes with GPRS enable it has the criterion to provide inter connectivity. We have inserted a sim card activated with internet connectivity in the GSM modem. GSM modem sends data over the internet connection to a database created by us. The database is stored in a webserver which has a particular address. When the GSM modem is put together with the Arduino in the Arduino IDE software, the address of that particular webserver is mentioned there so that the data can be transmitted to exactly the webserver we want it to. The ground pin is connected with the ground. Pin coming from Arduino. The Arduino and GSM modem need to be supplied power which can be given by either connecting those to batteries or using adapters.

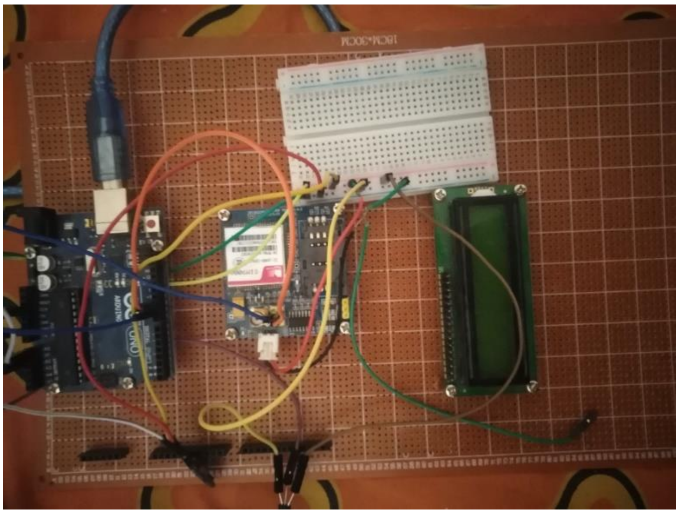

Figure 4.11: Arduino configured with GSM

And we connect the LCD to the Arduino as shown inTable3.1

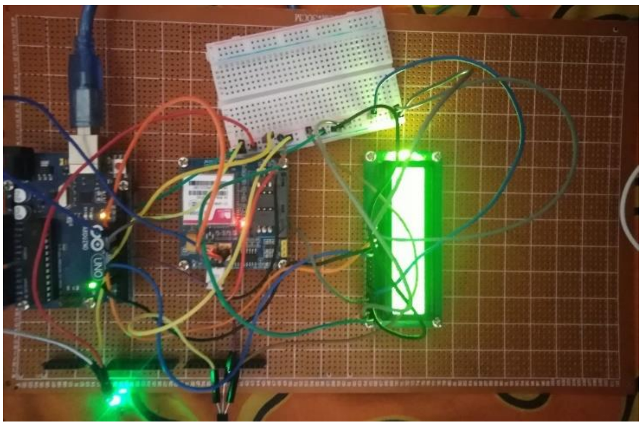

Figure 4.12: LCD connection

4.4 Operation

After connecting the circuit, with the patient the vital signals have been detected by the sensors and then the data has been sent to specified phone number (the monitor's number) and shown in LCD display.

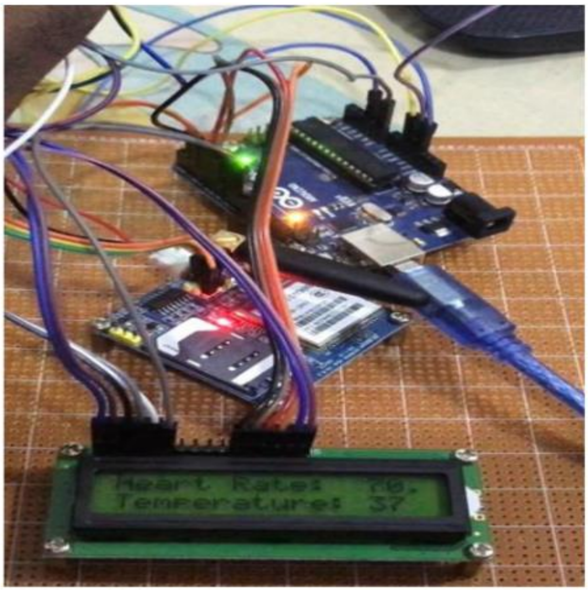

Figure 4.13: Circuit result

The figures (4.13) and (4.14) showing the result of the system of heartbeat and body temperature.

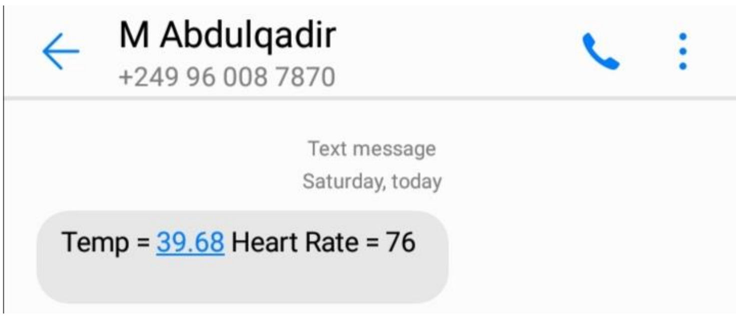

Figure 4.14: Result in monitor's phone (SMS)

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The system was implemented also the simulation was done all according to the theoretical concept of the problem which includes the heart most common problems and body temperature, the hospitals monitoring routines and the history of monitoring, the microcontroller and the sensors which the system was based on, all briefly. To implement the system a heartbeat (pulse) sensor, temperature sensor (lm35) and Arduino Uno were used, first the simulation was done by using proteus program then the system which detect body temperature as an analog signal to the Arduino analog to digital converter, and then the data is transmitted via GSM to the monitor's phone was designed and tested. The results of the system weren't accurate due to a noise occurred in the sensors. The cost of the system was satisfying and approximately 10 times cheaper compared to the cost of the specialized monitor devices.

5.2 Recommendation

- More accurate results can be detected by using the original pulse sensor from **www.pulsesensor.com** for better quality with less noise.
- IOT platform can be used to view and store the data for more flexibility.

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APPENDIX

System Code

```
#include <LiquidCrystal.h>

#include<SoftwareSerial.h>

void Send_an_sms(void);

int HR = 0;

SoftwareSerial gsm(12, 13); //RX, TX

int oldA = 0;

int oldC;

unsigned long T;

unsigned long oldT;

unsigned long Dur;

double HR1;

double temp;

const int rs = 9, en = 8, d4 = 7, d5 = 6, d6 = 5, d7 = 4;

LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

void setup()

{

Serial.begin(9600);

gsm.begin(9600);

lcd.begin(16, 2);

lcd.setCursor(0, 0);lcd.print("Heart Rate: ");
```

```
lcd.setCursor(0, 1);lcd.print("Temperature: ");
}
void loop()
{
int B = analogRead(0);
temp = (B * 5) / 10.23;
int A = analogRead(1);
int C = (A > 355);
int C2 = ((double)C - (double)oldC)>0.5;
if(C2 == 1)
{
  T = millis();
  Dur = T - oldT;
  HR1 = 60000/Dur;
  if(HR1 > 50 && HR1 < 150) HR = HR1;
  Serial.println(HR);
  oldT = T;
}
double Rem1 = millis() % 500; // Control Sending duration
//Serial.print("Rem= "); Serial.println((int)Rem);
if((int)Rem1 < 25)
{
```

```
lcd.setCursor(13, 0); lcd.print("   ");

lcd.setCursor(13, 0);lcd.print(HR);

lcd.setCursor(15, 1); lcd.print("   ");

lcd.setCursor(13, 1); lcd.print((int) temp);

}


double Rem = millis() % 2000; // Control Sending duration

//Serial.print("Rem= "); Serial.println((int)Rem);

if((int)Rem < 25){

  Serial.println("Sending");

  Send_an_sms();

  Serial.println("Sent");

}

oldA = A;

oldC = C;

delay(50);

}

void Send_an_sms(void)

{

 delay(100);

 gsm.println ("AT+CMGF=1");

  delay(200);
```

```
gsm.println("AT+CMGS=\"+249117076852\"\r");

delay(200);

gsm.print("Temp = ");

delay(200);

gsm.print(temp);

delay(200);

gsm.print(" Heart Rate = ");

delay(200);

gsm.println(HR);

gsm.println((char)26);//the ASCII code of the (0x1A)

delay(10000);

}
```