MOBILE TECHNOLOGY SYSTEM FOR HEALTH INTERVENTION (M-HEALTH)

Project report submitted in partial fulfillment of the requirement for the degree of

BACHELOR OF TECHNOLOGY

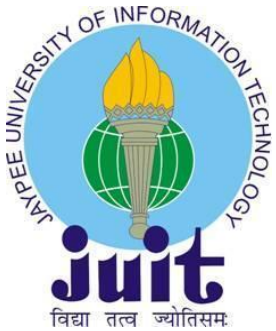
IN

ELECTRONICS AND COMMUNICATION ENGINEERING

By

SHRUTI SABHERWAL 151063
AADEESH JAIN 151089

UNDER THE GUIDANCE OF
Dr. Meenakshi Sood



JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
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(Established by H.P. State Legislative vide Act No. 14 of 2002)
P.O. Waknaghat, Teh. Kandaghat, Distt. Solan - 173234 (H.P.) INDIA
Website: www.juit.ac.in
Phone No. (91) 01792-257999
Fax: +91-01792-245362

CERTIFICATE

This is to certify that the work reported in the B.tech project report entitled **"Mobile Technology System for Health Intervention "** which is being submitted by **Shruti Sabherawal and Aadeesh Jain** in fulfillment for the award of Bachelor of Technology in Electronics and Communication Engineering by the Jaypee University of Information Technology, is the record of candidate's own work carried out by him/her under my supervision. This work is original and has not been submitted partially or fully anywhere else for any other degree or diploma.

Dr. Meenakshi Sood

Assistant Professor (Senior Grade)
Department of Electronics & Communication Engineering
Jaypee University of Information Technology, Waknaghat,

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Date : 20 May, 2019

DECLARATION BY THE SCHOLAR

I hereby declare that the work reported in the M-Tech thesis entitled **"Mobile Technology System for Health Intervention"** submitted at **Jaypee University of Information Technology,Waknaghat India,** is an authentic record of my work carried out under the supervision of **Dr. Meenakshi Sood**. I have not submitted this work elsewhere for any other degree or diploma.

Shruti Sabherwal (151063) and Aadeesh Jain (151089)
Department of Electronics and Communication Engineering,
Jaypee University of Information Technology, Waknaghat , India
Date : 20 May, 2019

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LIST OF SYMBOLS

SYMBOLS	SYMBOL NAME
°	**Degree**
C	**Celsius**
F	**Fahrenheit**
V	**Voltage**
+	**Positive**
-	**Negative**
I	**Current**

LIST OF ACRONYMS & ABBREVIATIONS

ADC	Analog to Digital
AREF	Analog Reference
BPM	Bits per Minute
ECG	Electrocardiography
GND	Ground
GPRS	General Packet Radio Service
IOREF	Input Output Reference
IOT	Internet of things
LED	Light Emitting Diode
MIT	Massachusetts Institute of Technology
PWM	Pulse Width Modulation
RXD	Receive Data
SPI	Serial Peripheral Interface
TWI	Two-wire Interface
TXD	Transmit Data
VCC	Voltage at common collector
WAN	Wide Area Network

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ABSTRACT

The developments in the new technologies has made a huge impact in the field of health care. One such technology is mobile health system. There has been tremendous increase in the research regarding the potential of mobile health systems. Due to this increase there have been a lot of attempts to analyse and record the benefits of mobile health, focusing mainly on mobile health devices and state of health of a person. The growth in computing power and mobile connectivity have created a foundation for mobile health (M-Health) technology that can transform the quality of health care on a large scale. Mobile health system is defined as usage of mobile devices to collect data from patients and storing the information on network servers. The database containing information about patients can then be easily accessed by doctors, medical staff, physicians, pharmacists, specialist etc. The incorporation of mobile health devices is important in obtaining information immediately to diagnose illness, track diseases and provide real time information. The improvement in technology as well as wireless communication offers the potential for smart miniature devices as well as wearable sensing, processing and communication. In this study, we combined an Arduino microcontroller with an Android-based smartphone to design a temperature and a heart rate monitor. The AD8232 Single Lead, Heart Rate Monitor, Pulse sensor and LM35 temperature sensor is the centerpiece of this design. The data is wirelessly transferred to mobile phones using bluetooth which is obtained on an app created using MIT App Inventor 2. The data received is used to monitor the heart rate of a person in beats per minute as well as temperature in degree celsius. The received data can be used to analyze the health conditions of the person under observation.

CHAPTER 1
INTRODUCTION

1.1 M-HEALTH

The growth in computing power and mobile connectivity have created a foundation for mobile health (M-Health) technology that can transform the quality of health care on a large scale. Mobile health system is defined as usage of mobile devices to collect data from patients and storing the information on network servers. The database containing information about patients can then be easily accessed by doctors, medical staff, physicians, pharmacists, specialist etc. The incorporation of mobile health devices is important in obtaining information immediately to diagnose illness, track diseases and provide real time information [1]. The improvement in technology as well as wireless communication offers the potential for smart miniature devices as well as wearable sensing, processing and communication.

1.2 DOMAINS OF M-HEALTH INTERVENTIONS

The use of versatile innovation in the health sector can possibly change the substance of worldwide health frameworks. Mobile devices have reached more people in developing countries than electricity and clean water. A rapid development in mobile technology, falling market prices of the mobile devices, increasing network coverage and an increase in use of cell phones are the positive driving factors that have enabled the healthcare delivery. Mobile health has a far-going administration range as enabling old and eager moms, chronic disease management as helping individuals to remember medicine timings, stretching out support of underserved territories and improving well being results and therapeutic framework productivity. Interventions, for example, tele-counsel, video discussion, appointment planning, SMS medicine administrations are among the broadly predominant spectra of healthcare service provision. Other normal application areas for M-Health are customer education, information accumulation and detailing, electronic health record, electronic decision support: information, patient group meeting, patient-provider communication, provider work arranging and planning, sensors and purpose of consideration diagnostics. Organizations among medicinal services and telecom suppliers have made the substitution of conventional consideration and extension of existing availability of health care feasible.The

objective of actualizing different M-Health applications are to upgrade the proficiency and the openness of human services frameworks and to lessen the mortality in developing nations.

1.3 M- HEALTH - IOT TECHNOLOGY

The Internet of Things has made possible to interface different embedded device to convey and receive data. IoT innovation in medical system has cast an extraordinary effect on backward nations where essential healthcare services are not accessible at doorsteps particularly in rural areas. Over the most recent couple of years, IoT based healthcare system pulled in consideration of a few analysts to research the potential, benefits and problems of eventual future of health-care system. The combination of wearable gadgets and frameworks in IoT gives better m-healthcare administrations. Medical devices creates information and sends to assigned computer servers. Patients can be dealt with remotely, in smart health unit, when doctors or authorities are not accessible. The doctor present at a distant site can connect with patient through web and doctor can get constant information of patient gathered by sensors utilizing cell phones and can propose medication or some other examinations. Eventually it will likewise help the patients who can not afford to not travel to far away emergency clinics for ordinary or standard checkup. Patient will only travel on doctor demand. This execution model will give the health aid facility at doorstep society with extraordinary practical effect on both government venture and open uses and on the whole on nation's economy.

Figure 1.1: Mobile Health System

CHAPTER 2
LITERATURE SURVEY

Sultan H. AlMotiri, Murtaza A. Khan, Mohammed A. AlGhamdi, (August 2016) Mobile Health (m-Health) System in the Context of IoT. This paper describes the mobile health (m-health) system within the context of Internet of Things (IoT). It discusses acquisition of mobile health information via medical gadgets and wearables and application of this data in observance numerous health conditions. The m-health system can benefit the patients in some ways like fast diagnosing, remote observance and residential rehabilitation.

Justin Turner, Chase Zellner, Tareq Khan, and Kumar Yelamarthi (May 2017) A Smartphone based Continuous Heart Rate Monitoring System

Health observation is a necessary need of everyday life for several individuals. During this study, the planning of a heart rate monitor with Bluetooth property is mentioned. The AD8232 Single Lead, Heart Rate Monitor is that the centerpiece of the planning. The information is wirelessly transferred to smartphone using Bluetooth. The Information received from the monitor is analysed to determine a heart rate in beats per minute. Massachusetts Institute of Technology App Inventor tool-2 is used to design the app to show the heart rate on Mobile.

A. Dharma Teja1, Dr. K. Srihari Rao, (July 2018) A Smart Wearable System for ECG and Health Monitoring The smart ECG system will be worn by inpatients or outpatients and monitored in period of time. This method can be helpful particularly for senior citizens who live alone or have a incapacity. Therefore, this proposed system will be utilized for remote medical systems to help the aged patients, for self-testing diagnostics, or for physicians to diagnose diseases of the cardiovascular system. The projected system consists of electrocardiogram (ECG) that assesses the heart rhythm, diagnose abnormalities of heart and pulse measuring device that calculate the important parameters of the patient and store this information via Arduino Mega. This method would be useful as the patient's health condition is frequently checked while not the patient visiting the hospital for normal checkups.

Amna Abdullah, Asma Ismael, Aisha Rashid, Ali Abou-ElNour, and Mohammed Tarique, (May 2015) Real Time Wireless Health Monitoring Application Using Mobile Devices. The prime motive is to develop a reliable patient observation system in order that the aid professionals will monitor their patients, who are either at hospital or having their normal daily life activities. During this work we tend to present a mobile device based wireless aid observing system which will offer real time data about physiological conditions of a patient.

Rahul K. Kher, (July 2016) Mobile and E-Healthcare: Recent Trends and Future Directions. The paper aims at miniaturisation of sensors and devices and many health efficient solutions which are not only good but are affordable also. Wearable medical devices (WMDs) are capable of observing a number of physiological parameters. Thus, WMDs or WMD-based applications will facilitate each patients and doctors in daily health observance.

Syed Muhammad Waqas Shah, Maruf Pasha,(October 2016) Iot – Based Smart Health Unit. The paper aims at evaluating the varied IoT based health care system and their applications to supply intelligent health care. A wise health unit model has been projected during which the country's basic health system are changed into smart health aid system .The projected model presents a superimposed approach, which has sensing elements, network access and service repair layer that build the good communication potential with doctor and patients.

CHAPTER 3
METHODOLOGY

The smart health aid model incorporates three system module for collecting information, storing data and accessing person health information to the doctor. The designed model made by combining Arduino uno microcontroller with Wireless Body Sensor Network. The model uses Temperature sensor for body temperature, Pulse sensor for Blood pressure count, ECG sensor for Heart monitoring. Sensors are connected with different body parts which helps in getting the health information without interfering the daily routine of the people and the health information is transferred to physicians server using Mobile technology.

3.1. The Sensor module:

The fundamental system that connects with the patient's body is a device is known as a sensor. The module connects with the patient's body as well as application oriented layer. The extraordinary feature about the sensors is their capacity to change the information obtained from the external world into information for investigation. The sensor in this system collects the information like heart beat, heart monitoring graph, temperature level, pulse and considerably more. Data center layer will be responsive based on this detected data to take significant choices by the physicians. Sensors used in this module is used to detect the information from patient's body and furthermore from the environment of the patient's body using the health devices. Sensor layer cooperates with application oriented access layer through variety of conventions relying on the essential conditions. The methods to communicate in this layer is Bluetooth also different types of protocols and standards can also be used.

3.2. Internet Gateway Layer:

Central networking system is approached in this system. This module interfaces the health devices in the sensor module with service provider by utilizing various health devices, regulations and communication protocols that may incorporate 4G/5G associations. In health module system, information is gathered from patient's body and is transferred to the remote server network using mobile system. Numerous web service providers likewise give cloud administrations such as information stockpiling and query services to inquire about the

information present in the cloud storage. The network devices in the smart health devices transfers the information to a predetermined web server using the mobile over the Internet. The cloud storage can be accessed by the nearby hospitals, doctors or anyplace on the earth in order to get information about the patient. Indeed, even without specialist or therapeutic experts in tehsil area or locale headquarter emergency clinic patient will most likely speak with therapeutic experts on smart cell phones. We can likewise utilize virtual private system over public system to imitate the usefulness of being associated together in a single system. Virtual private network may likewise associate local medical clinics as well as nearby hospitals along with medical health devices in order to provide live help to the patient using health aid mobile devices.

3.3. Data center Layer:

Patient information can be retrieved from these local medical clinics or from anyplace with the help of unique application standards. The information present on the cloud storage will be used with the help of service layer by the specialists at the hospital or by the patient at any remote location. This layer will give the chance to straightforwardly interact with patient with the help of medical health devices through diverse video/audio applications like google Duo or health sessions through video lectures or messengers application. As web storage will store the information related to patient's health condition so this data can be received by medical clinics as well as hospitals through inquiry applications given by the web service providers. These web applications may likewise also generate instant cautionary messages if the patient is being monitored continuously.

Table 3.1: The three-layer system Model with protocols and its function

Layer	Participants	Function	Protocols
The Sensor Module	ECG, Pulse and Temperature sensor.	Data collection from the body.	Bluetooth etc.
Application oriented network Access Layer	Network Access Layer	WAN access, Access to cloud via a mobile phone.	MIT App ,Mobile phone data(3g/4g) and GPRs.
The Service Access Layer	Specialists at the hospital.	Service access interface.	SMS, Audio/Video app

CHAPTER 4

SYSTEM ARCHITECTURE

The system architecture consist of a microcontroller ATmega328P, AD8232 Heart monitor sensor, three-lead electrode pads, pulse sensor, LM35 temperature sensor, HC-05 bluetooth module. The hardware design is shown in Fig. 4.1.

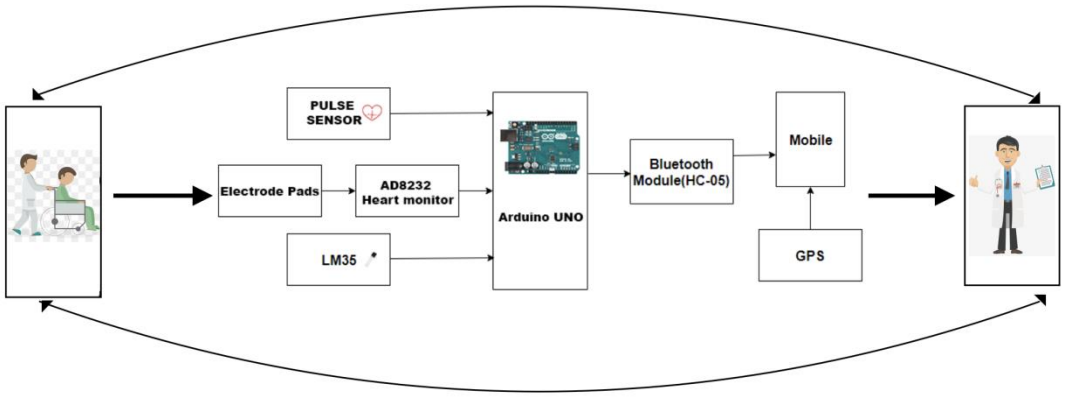

Figure 4.1: Hardware design

4.1 ECG Electrodes

The Electrocardiograph electrode is the device that is connected to the specific body parts of the patient — like cest , arm and legs — amid an ECG signal procedure. It calculate electrical impulses delivered at each point wherever the heart pulsates. The position and the number of electrodes can be changed along with the placement of electrodes on the body parts in order to get better functioning of ECG system. The electrical signal that an anode identifies is transmitted by means of wire to a machine, which is then interpreted into graphical lines that is recorded on a piece of paper. A variety of heart diseases can be analyzed with the help of ECG graphs obtained from the measurement of the electrical pulses.An ECG cathode is typically made out of a little metal plate encompassed by an adhesive cushion, which is covered with a leading gel that transmits the electrical signal.

4.1.1 Hardware:

AD8232 - Electrocardiogram System Module

3 pieces ECG Electrodes pads

3.5 mm Jack of ECG Electrode connector

4.1.2 Arduino Connection With AD8232:

Arduino Pin 3.3V with 3.3V Pin of AD8232

Arduino Pin 10 with L0+ Pin of AD8232

Arduino Pin 11 with L0- Pin of AD8232

Arduino Pin Analog 1 with output Pin of AD8232

Arduino Pin Gnd with Gnd Pin of AD8232

4.1.3 ECG Module (AD8232) Specifications:

The AD8232 is a solitary heart rate monitor front end incorporated circuit utilized for ECG and other body signals estimation applications. It is intended to quantify, enhance and filter small signals in the presence of noise. This structure takes into consideration a ultralow power analog-to-digital converter (ADC) or an installed microcontroller to procure the yield signal effectively [2]. The AD8232 board estimates electrical movement by setting electrode pads on our body. The AD8232 System module divides in to nine part association From the ic which you can patch pin to controller, or different connectors to the controller. GND, L0-, L0+, Output, SDN sends general output from this AD8232 to any Development board like Arduino and many others. More over this board provide additional pin Right leg (RL), Right Arm (RA) and Left Arm(LA) to connect and make your own custom sensor. Further, the LED light in AD8232 pointer the throb to the beat of a heartbeat.

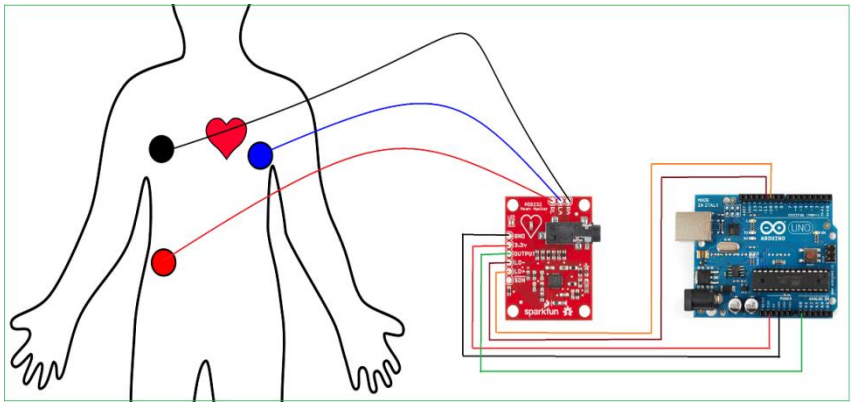

Figure 4.2: AD8232 Heart rate monitor experimental setup.

4.1.4 ELECTROCARDIOGRAM SIGNAL FRAMEWORK

The figure below presents one cycle of Electrocardiogram signal from a heart beat. The figure shows the heartbeat cycle which comprises of a P wave, then QRS wave until the T wave. The P wave can be used to interpret information about the propagation time of the impulses at the two atria. At that point, follows a flat graphical line known as the PR fragment. The PR segment is the outcome of propagation of the electric impulses from atria to ventricles. Moreover, the QRS complex wave consists of 3 little waves that is, little Q wave, the high R wave and the little S wave. The QRS graph provides information about the ventricular systole in the outcome of the impulse propagation to the Q wave, while the transmission to the entire tissue is brought about by the R wave and S wave. The QRS graph gives data about fibrillation and arrhythmia, it tends to be useful to analyze heart attacks. And afterwards ST interim is followed by the S wave incorporating with the T wave, that can bring up the ischemia occurrences. It shows the period amid which ventricles start contracting, which is the last phase of the heart cycle. The T wave grants one to have data about the cardiovascular hypertrophy, heart attacks, and ischemia. Beside other parameters, for example, the QT interim, allow further pathologies to be described. At last, the ECG signal finishes with a small peak, U wave.

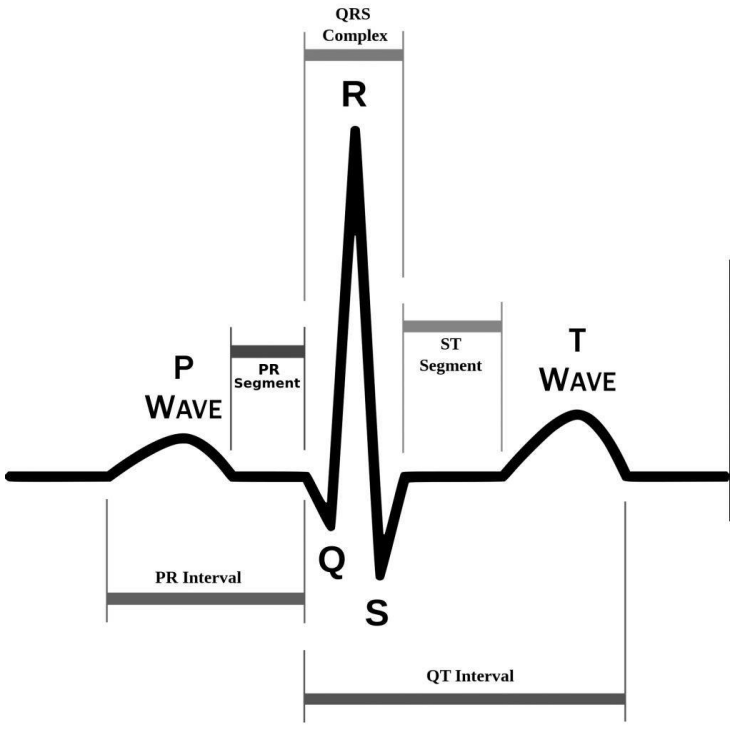

Figure 4.3: ECG signal parameter

4.2 PULSE SENSOR

Heartbeat Sensor is a fitting and-play pulse sensor for Arduino. It very well may be utilized by students, craftsmen, makers, creators, and amusement and versatile engineers who need to effortlessly join live pulse information into their activities.

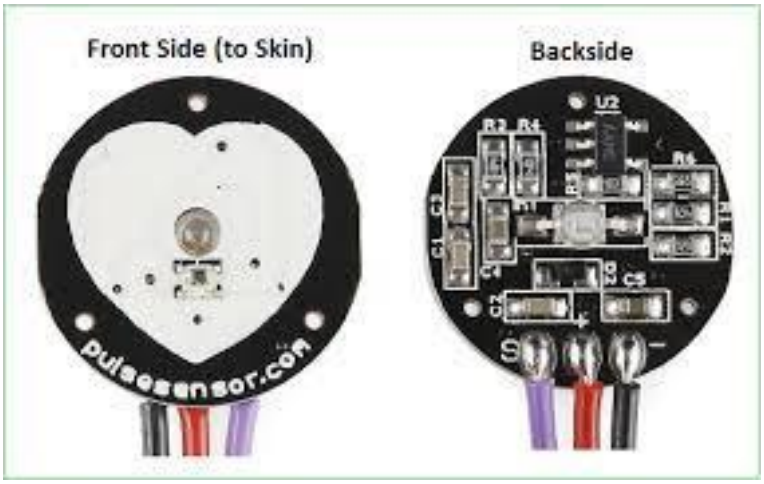

Figure 4.4: Pulse sensor

Pulse information is valuable in structuring an activity schedule, checking action or uneasiness levels or squinting shirt in a state of harmony with your heart beat. The heartbeat sensor will measure your pulse effectively!

It basically joins a basic optical pulse sensor with amplification and noise cancellation circuitry making it quick and simple to get reliable heartbeat readings from ear cartilage or fingertip. The 3 pin cable on the pulse sensor is ended with standard male headers so there's no welding required.

4.2.1 Working of Pulse Sensor

The point when a heartbeat occurs, blood is pumped through the human body and gets crushed into the capillary tissues. The volume of blood in these capillary tissues increments as the heartbeat continues. In any case, in the middle of the pulses (the time between two back to back pulses,) the volume inside capillary tissues diminishes. This change in volume between the pulses influences the measure of light that will transmit through these tissues. This change is exceptionally little however we can gauge it with the assistance of Arduino.

The pulse sensor module comprises of an LED which helps in estimating the heart rate of a person. When the finger of a person is placed on the pulse sensor, the light is reflected back.

This reflected light will change the volume of blood inside the capillary blood vessels. When the heartbeat takes place, the volume inside the capillary blood vessels will be high than it was before. The light that is reflected back during a heartbeat will be less in comparison with that of the time during which there is no heartbeat (during the timeframe when there is no heartbeat or the timespan between the pulses, the volume of blood inside the capillary vessels will be lesser. This will bring about higher reflection of light). The difference in light which is transmitted and the light which is reflected can be obtained as a heartbeat and is taken as the output of pulse sensor. This heartbeat can be then conditioned to gauge heartbeat and after that modified appropriately to read as heartbeat count.

4.2.2 Hardware connections

The connection of Arduino with Pulse sensor:

- The A(0) pin to Signal pin 'S'
- The Pulse vcc(+) Pin to arduino 5V Pin
- The pulse Gnd Pin to arduino Gnd.

Table 4.1: Pulse Rate in BPM

Age	18-25	26-35	36-45	46-55	56-65	65+
Athlete	49-55	49-54	50-56	50-57	51-56	50-55
Excellent	56-61	55-61	57-62	58-63	57-61	56-61
Good	62-65	62-65	63-66	64-67	62-67	62-65
Above Avg.	66-69	66-70	67-70	68-71	68-71	66-69
Average	70-73	71-74	71-75	72-76	72-75	70-73
Below Avg.	74-81	75-81	76-82	77-83	76-81	74-79
Poor	82+	82+	83+	84+	82+	80+

4.3 TEMPERATURE SENSOR

The temperature of a body is proportional to the amount of heat we eliminate from our body. The normal body have a nature of keeping the body temperature under a protected range, with the atmospheric change unacceptable to the body. When a person feels excessively hot, the vessels inside the skin broaden to convey the overabundance of heat to the skin's surface.

Eventually the person will begin to sweat. Once the perspiration vanishes, it helps cool the body. When the person is excessively cool, the blood vessels become narrow. The blood flow in the skin is reduced in order to save body heat and eventually the person begins to shudder. At the point when the muscles tremble along these lines, it makes more heat.The temperature of the body can be checked at multiple spots of human body. The common body parts use to check the body temperature are the rectum, the ear, the mouth, the armpit. we can also check or notice the temperature on our forehead. The body temperature recorded in thermometers is either degree Fahrenheit (°F) or degree Celsius (°C), which verry on the body area and requirement of doctor. In most part of world, temperatures is frequently calculated in degree Celsius (°C). This is likewise standard in most of the nations.

4.3.1 Normal body temperature

The mostly acknowledged normal body temperature is orally via mouth which is calculated 37°C or 98.6°F. It is the general body temperature at normal environment. An individual's ordinary body temperature may truly be 1°F(.6°C) or progressively above or underneath this. We can examine that, the general body temperature varies at a range of 0.6°C (1°F) in the midst of the day, depending upon the individual body symptoms and what climate of the place. Body temperatures are touchy to hormone levels. So it is examin that a woman's body temperature could be lower or higher when she is having her menstrual period or the ovulating . The ear and a rectal temperature examining will be more or higher degree than an orally via mouth. Also temperature examin at the armpit will be a slightly lesser than an orally via mouth. The best way to measure the correct temperature is the temperature taken from our rectal perusing.

4.3.2 Fever

In many people, the abnormal body temperature or fever occurs at an axillary or an oral temperature of 37.6°C that is 99.7°F whereas the ear or rectal temperature is 38.1°C or 100.6°F. A person having a fever when his or her body temperature varies at 38°C (100.4°F) or more then limit or the axillary temperature is examined at 37.6°C (99.7°F) or higher. Infant children under three months old with a body temperature at 38°C or 100.4°F or more than limit or the axillary temperature is examined at 37.3°C (99.1°F) or higher are need to recommend to the doctor or an expert.

4.3.3 The Hypothermia or Low body temperature

The hypothermia or low body temperature can be very dangerous and serious. Low body temperature or hypothermia usually occurs when the person is being in cold or un moderate atmosphere. In any case, it may in like manner be achieved by alcohol or medicine use, going into stun, or certain disarranges, for instance, diabetes or low thyroid. A hypothermia or low temperature only occur with a malady. This is most essential in newborn children, progressively settled person, or people who are sensitive. An awful infection, for instance, sepsis, may in like manner cause an unordinary low body temperature.

4.3.4 The heatstroke or High body temperature

Heatstroke happens only when the body unable to control its very own body temperature and temperature keeps increasing. The reaction of heat stroke causes mental changes for instance, perplexity, obviousness or dizziness and skin that is dry, red or hot, even under the armpits. Heatstroke can also cause death. It needs prompt restorative treatment. It causes genuine absence of hydration and also affect the body organ to stop functioning. We have examined the two sorts of heatstroke. Great heat stroke can occur only when a person isn't doing so much, as long as it's hot and the body isn't equipped for cooling itself by sweating. The individual may even stop sweating. Exemplary heatstroke may create in a couple of days. Newborn children, increasingly settled person, and people who have endless medicinal issues have the most genuine risk of this kind of heatstroke. Exertional heat stroke could occur when a person is working or rehearsing in a hot spot. The person could sweat a lot, yet the body still makes more warmth than it can lose. This will result in the temperature climbing to abnormal states.

Table 4.2: Body Temperature Chart

Name	Temperature in °C	Temperature in °F
Hypothermia	<35.0°C	95°F
Normal	36.5-37.5°C	97.7-99.5°F
Fever	>37.5 or 38.3°C	99.5-100.9°F
Hyperpyrexia	>40.0 or 41.5°C	104-106.7°F

4.3.5 LM35 Temperature Sensor

The LM35 is a coordinated circuit sensor that can be utilized to gauge temperature with an electrical yield corresponding to the temperature (in °C).It can measure temperature more precisely than a thermistor. The sensor hardware is fixed and not expose to oxidation.The LM35 creates a higher yield voltage than thermocouples and may not necessitate that the output voltage be amplified.The LM35 has a yield voltage that is relative to the Celsius temperature.The scale factor is .01V/°C.The LM35 IC has 3 pins-2 for the power supply and one for the analog output. The low voltage IC utilizes around +5VDC of power.The output pin gives analog voltage output that is directly relative to the Celsius (centigrade) temperature. Pin 2 gives a output of 1 millivolt for every 0.1°C (10mV per degree).

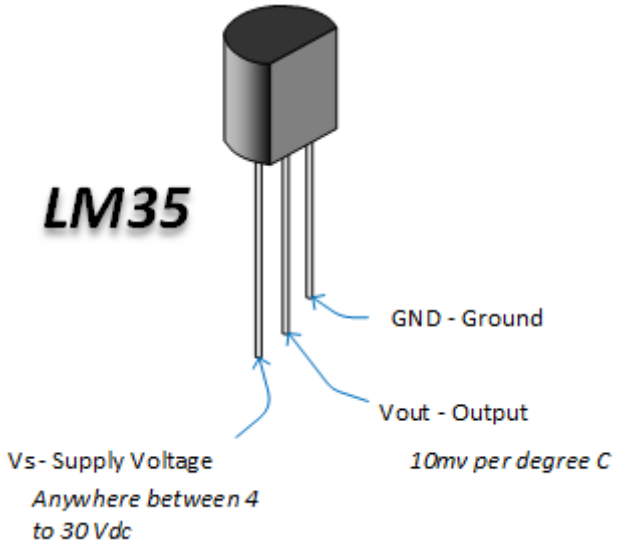

Figure 4.5: LM35 Temperature Sensor

4.3.6 Hardware connections

The circuit connections are made as follows:

- Pin 1 of the LM35 goes into +5V of the arduino
- Pin 2 of the LM35 goes into analog pin A0 of the arduino
- Pin 3 of the LM35 goes into ground (GND) of the arduino

4.4 BLUETOOTH MODULE

Bluetooth is an innovation for remote correspondence. It is intended to replace cable connections. It utilizes serial communication to speak with gadgets. It speaks with microcontroller utilizing serial port (USART). More often than not, it interfaces little gadgets like cell phones, PDAs and TVs utilizing a short-range remote association to exchange documents. A 2.45GHz frequency band is used. The association can be point-to-point or multipoint where the greatest range is 10 meters. The exchange rate of the information is 1Mbps. The HC-05 is a bluetooth module that is designed to connect to various devices via a wireless communication setup. The bluetooth module is used to communicate between arduino and other devices like mobile phones, laptop etc. The HC-05 allows switching mode between master and slave mode.

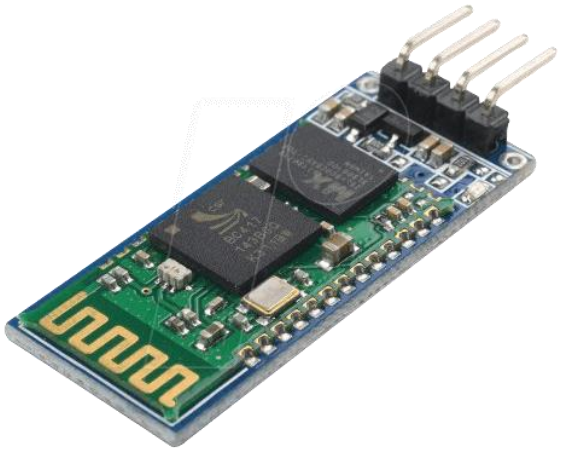

Figure 4.6: HC-05 Bluetooth module

4.4.1 Pin Description

Key/EN: It is accustomed to bring Bluetooth module in AT commands mode. As a matter of course this pin works in information mode. Key/EN pin ought to be high to work Bluetooth in command mode. The default baud rate of HC-05 in command mode is 38400 bps and 9600 in data mode.HC-05 module has two modes,

- Data mode: Information exchange between devices. Baud rate is 9600 bps in data mode.
- Command mode: AT commands are used to change settings of HC-05. Baud rate is 38400 bps in command mode

VCC: Connect 5V or 3.3 V to this Pin

.

GND: Ground Pin of module.

TXD: This pin is connected with RXD pin of Microcontroller. Transmit Serial information (remotely gotten information by Bluetooth module transmitted out sequentially on TXD pin)

RXD: This pin is connected with TXD pin of Microcontroller. Received information will be transmitted remotely by Bluetooth module.

State: It shows the status of module whether it is connected or not.

4.4.2 Hardware Connections

- VCC of HC-05 goes to 5V of Arduino
- GND of HC-05 goes to GND of Arduino
- TXD of HC-05 goes to Arduino Pin RX
- RXD of HC-05 goes to Arduino Pin TX
- KEY of HC-05 is connected to the air for communication mode

4.5 ARDUINO UNO

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). The low power, high performance 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities. The ATmega328P is a single chip microcontroller which operates between 1.8-5.5 volts. It has 14 digital input/output pins (out of which 6 can be utilized as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB association, a power jack, an ICSP header and a reset catch. It contains everything expected to help the microcontroller; essentially interface it to a PC with a USB link or power it with an AC-to-DC connector or battery to begin.

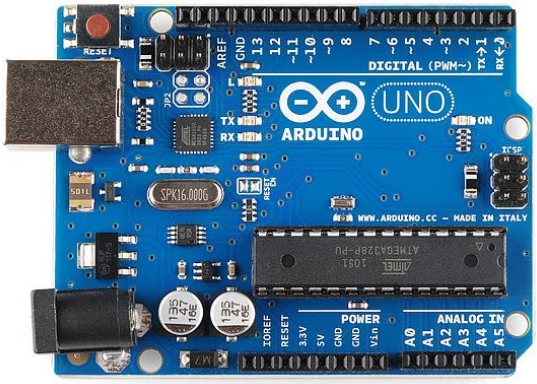

Figure 4.7: Arduino Uno

4.5.1 Pin Description

There are a few I/O digital and analog pins put on the board which works at 5V. These pins accompany standard working operating ratings between 20mA to 40mA. Inner draw up resistors are utilized in the board that confines the current surpassing from the given working conditions. In any case, an excess of increment in current makes these resistors pointless and harms the gadget.

LED : There is a built-in LED in the Arduino which is associated through pin 13. Giving a HIGH value to the stick will turn it ON and LOW will turn it OFF.

Vin : It is the input voltage given to the Arduino Board. It is different in relation to 5 V provided through a USB port. This pin is utilized to supply voltage. In the event that a voltage is given through power jack, it tends to be gotten to through this pin.

5V : This board accompanies the capacity to give voltage guideline. 5V stick is utilized to give yield managed voltage. The board is controlled by three different ways for example USB, Vin pin of the board or DC control jack. USB bolsters voltage around 5V while Vin and Power Jack bolster a voltage extending between 7V to 20V. It is recommended to work the board on 5V. It is imperative to take note of that, if a voltage is provided through 5V or 3.3V pins, they bring about bypassing the voltage guideline that can harm the board if voltage outperforms from its breaking point.

GND : There are more than one ground pins provided on the board which can be used as per requirement.

Reset : This pin is consolidated on the board which resets the program running on the board. Rather than physical reset on the board, IDE accompanies an element of resetting the board through programming.

IOREF : This pin is helpful for giving voltage reference to the board. A shield is utilized to read the voltage over this pin which at that point can select the best possible power source.

PWM : PWM is provided by 3,5,6,9,10, 11 pins. These pins are configured to provided 8-bit output PWM.

SPI : It is known as Serial Peripheral Interface. Four pins 10(SS), 11(MOSI), 12(MISO), 13(SCK) provide SPI communication with the help of SPI library.

AREF : It is Analog Reference. It provides a reference voltage to the analog inputs.

TWI : It is called Two-wire Interface. TWI correspondence is gotten to through Wire Library. A4 and A5 pins are utilized for this reason.

Serial Communication : Sequential correspondence is helped out through two pins called Pin 0 (Rx) and Pin 1 (Tx). Rx spin is utilized to get information while Tx pin is utilized to transmit information.

External Interrupts : Pin 2 and 3 are used for providing external interrupts. An interrupt is called by providing LOW or changing value.

CHAPTER 5

DATA TRANSFER AND ANALYSIS

Central networking system is approached in this system. This module interfaces the health devices in the sensor module with service provider by utilizing various health devices, regulations and communication protocols that may incorporate 4G/5G associations. In health module system, information is gathered from patient's body and is transferred to the remote server network using mobile system. Numerous web service providers likewise give cloud administrations such as information stockpiling and query services to inquire about the information present in the cloud storage. The network devices in the smart health devices transfers the information to a predetermined web server using the mobile over the Internet. From storage information patient will be received by remote Tehsil Head Quarter Hospital, District Head Quarter Hospital or anyplace on the earth. Indeed, even without specialist or therapeutic experts in tehsil area or locale headquarter emergency clinic patient will most likely speak with therapeutic experts on smart cell phones. We can likewise utilize virtual private system over public system to imitate the usefulness of being associated together in a single system. VPN may likewise associate DHQ, THQ medical clinics and health device for giving live help to the patient using health aid device.

5.1 Pulse Sensor Analysis

Pulse sensor analysis was done by connecting the pulse sensor at the tip of finger and readings were observed as shown in the figure given below. The heartbeat readings were obtained in beats per minute at different time intervals. The normal heartbeat readings of an adult should be in the range of 60 to 100 beats per minute. The pulse rate fluctuates according to the different activities the person is doing.

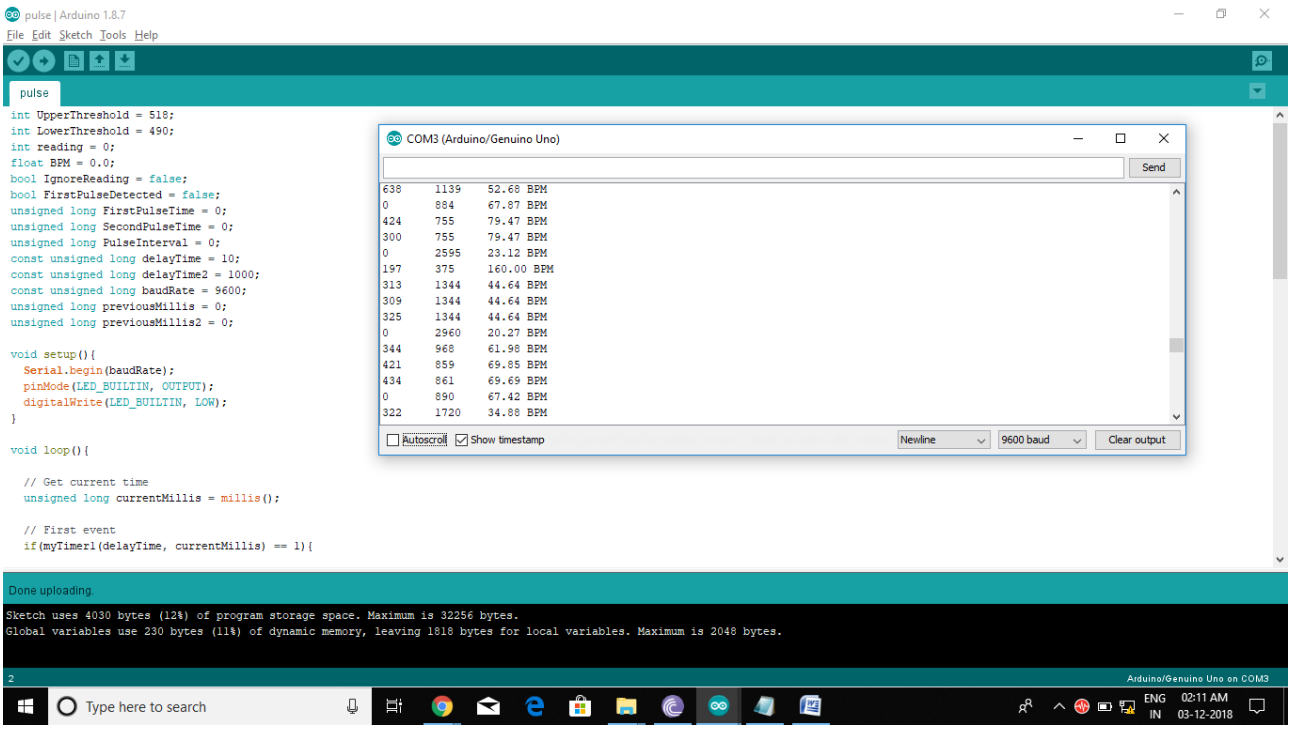

Figure 5.1: Arduino code and output for pulse sensor.

5.2 ECG Sensor Analysis

ECG sensor analysis was done by using the four-lead ECG pads. The ECG electrodes are connected at right arm (RA), left arm (LA), right leg (RL), left leg (LL) of the patient. Right leg is neutral and is usually not used in measurements. ECG sensor analysis was done by using matlab code for ECG and pulse rate was obtained from different regions of heart at different time intervals. The figures shown below indicate the pulse rate in beats per minute with a sampling frequency of 1024 Hz. The electrical activity of the patient is measured for the lateral and inferior view of the heart and is calculated in mV.

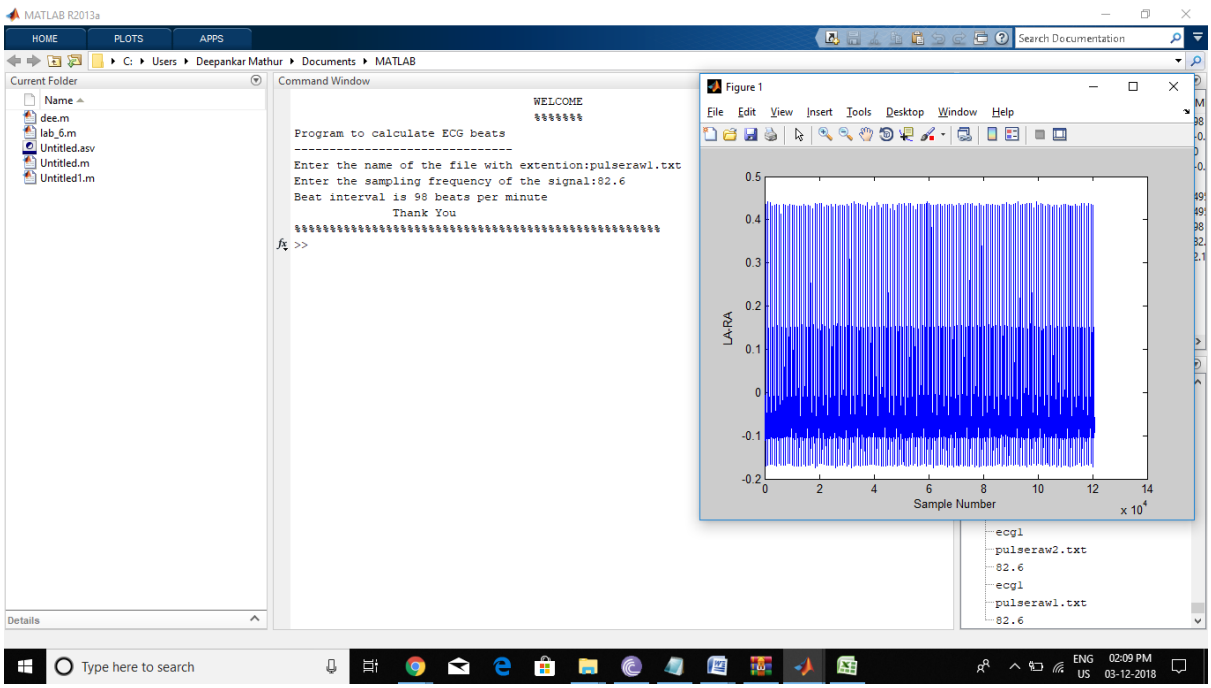

Figure 5.2: Matlab code and output for lateral view (LA-RA)

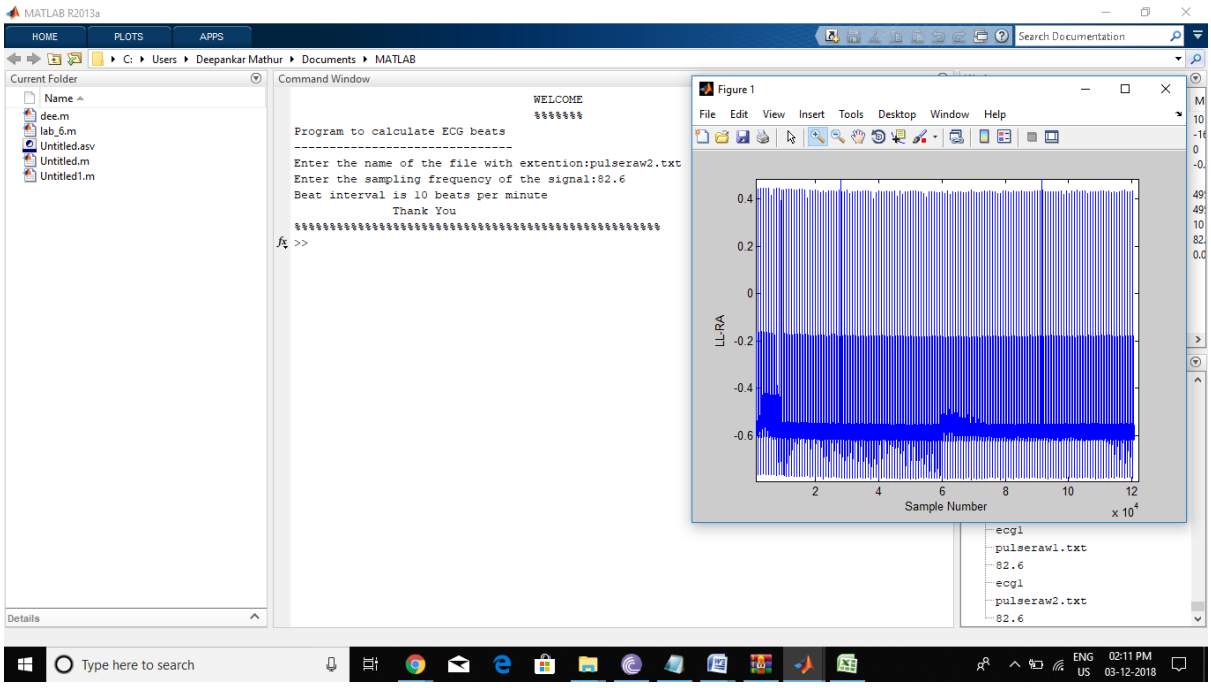

Figure 5.3: Matlab code and output for inferior view (LL-RA)

5.3 Temperature Sensor Analysis

Temperature sensor analysis was done by using LM35 temperature sensor. The Arduino code was uploaded in the microcontroller and readings were obtained in degree celsius at different time intervals. The normal temperature range for an adult is between 36.4°C to 37.36°C. The normal temperature readings vary depending on the person's age and sex, activity levels, food and fluid intake as well as methods of measurement. Temperature readings taken from various body parts give a scope of body temperatures that doctors consider as ordinary. Rectal readings are higher than oral readings, and armpit readings will in general be lower. On the off chance that an individual has a surprisingly high or low temperature, they should look for medicinal consideration right away.

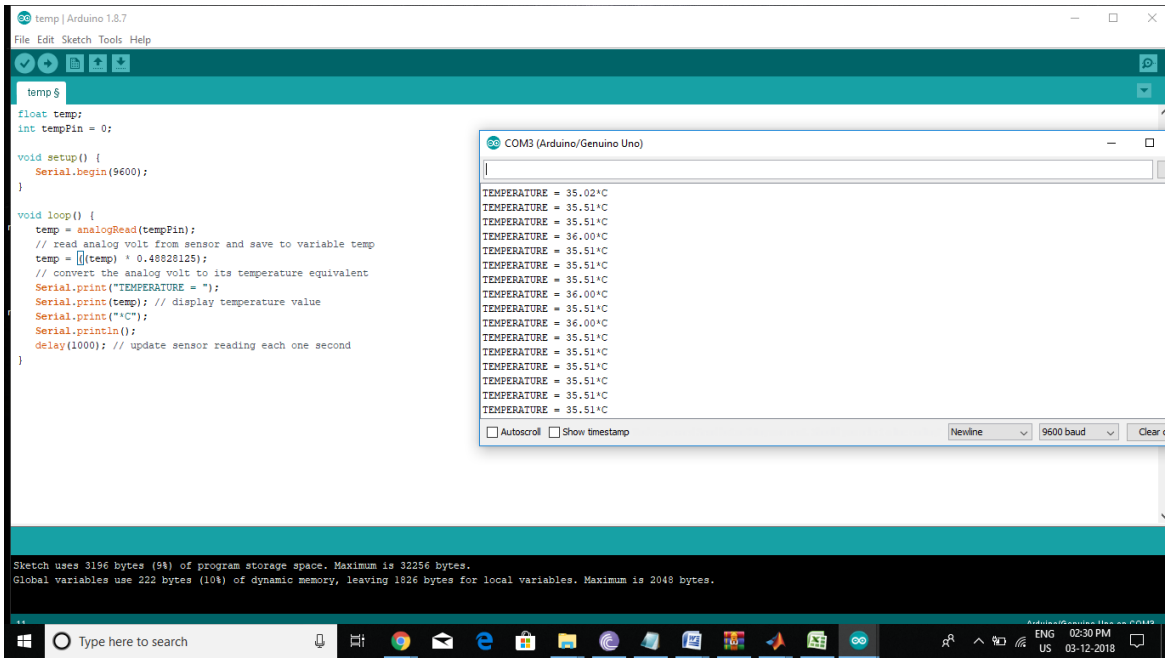

Figure 5.4: Arduino code for temperature sensor

CHAPTER 6

SERVICE ACCESS LAYER

Patient information can be retrieved from THQ, DHQ medical clinics or from anyplace utilizing unique application oriented conventions. Patient's cloud information will be used with the help of service layer by the specialists at the hospital or by the patient at any remote location. This layer will give the chance to straightforwardly interact with patient in the health aid device through diverse video/audio applications like google Deo or health sessions through video lectures or messengers application. As web data storage will store the patient's health data so this data can be received on brilliant device at THQ/DHQ through inquiry applications given by the web service providers. Cloud administrations may likewise incorporate auto choice actions and caution message generation.

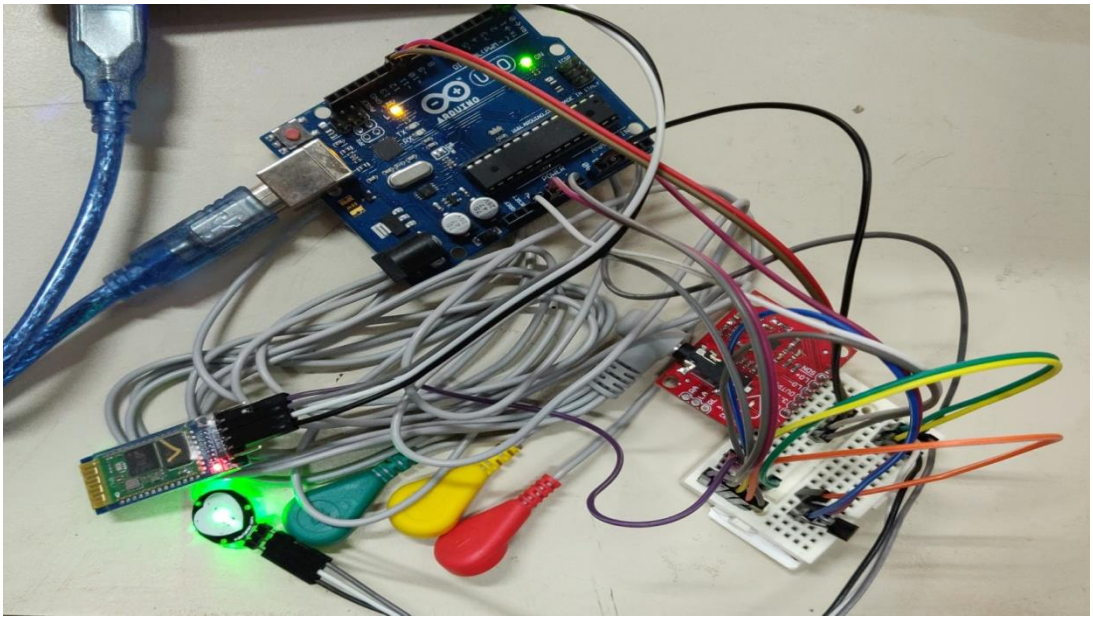

Figure 6.1: Experimental setup for acquiring a pulse, temperature and ECG signal.

6.1 Smartphone App

The application was designed using MIT App Inventor 2. MIT App Inventor 2 is an application that allows us to build apps using programming illustration. It is an open-source web application which uses graphical interface and block-based coding programs which allows users to create applications that can be used on smartphones. Once the app is created it starts by selecting the bluetooth module. When bluetooth is connected, buttons will appear which can be selected by the patient to read the data from the ECG sensor, pulse sensor and temperature sensor. After selecting the required sensor the app will extract data from the arduino and show it on the screen. Fig.5. Shows the programming logic to receive sensor readings.

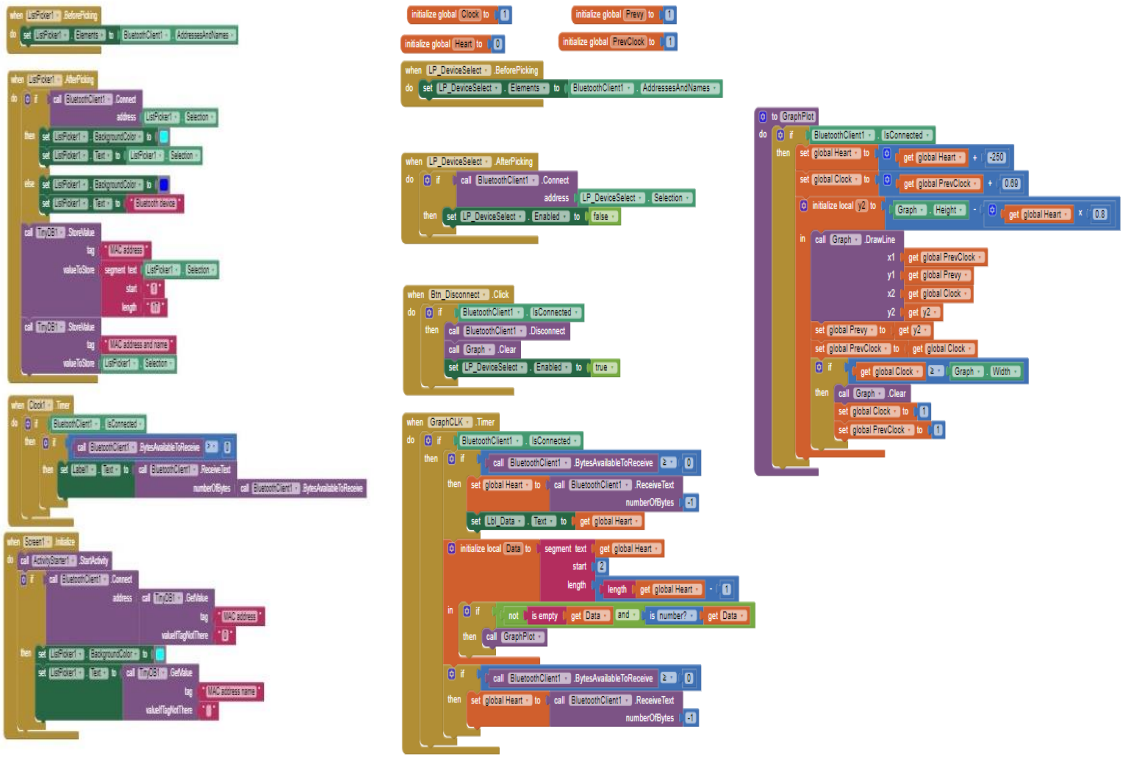

Figure 6.2: Smartphone App for temperature sensor, pulse sensor and ECG sensor.

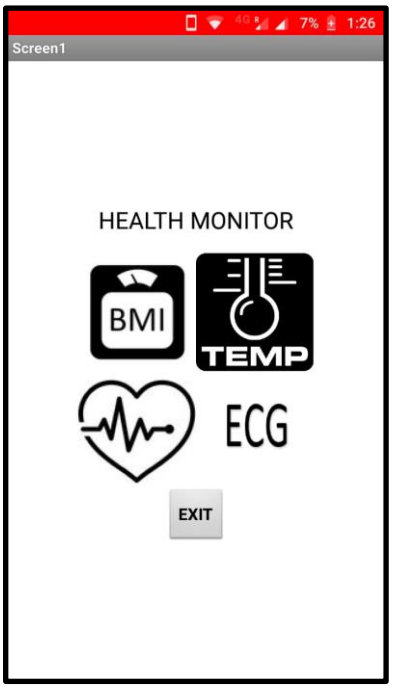

Figure 6.3: M-health android App.

6.2 RESULTS

The smartphone app starts working when the HC-05 bluetooth module is selected. Once the bluetooth is connected, after 10 seconds the app starts reading the data. A picture of hardware setup of the project is shown in Figure 6.1. Figure 6.4 is the view when the user is required to enter the weight and height for calculating the BMI. Once the button is pressed the app shows the BMI of the person and also analyzes it. After calculating the BMI, the temperature sensor button is pressed. Figure 6.4 is the view when the app displays the temperature of the person. Next the pulse sensor button is pressed. Figure 6.4 is the view when the app displays the heart rate of the person in beats per minute. Lastly, ECG sensor button was pressed. Figure 6.4 is the view which displays the ECG graph of the person under observation. Overall our program and app worked properly and accomplished all goals proposed by our design.

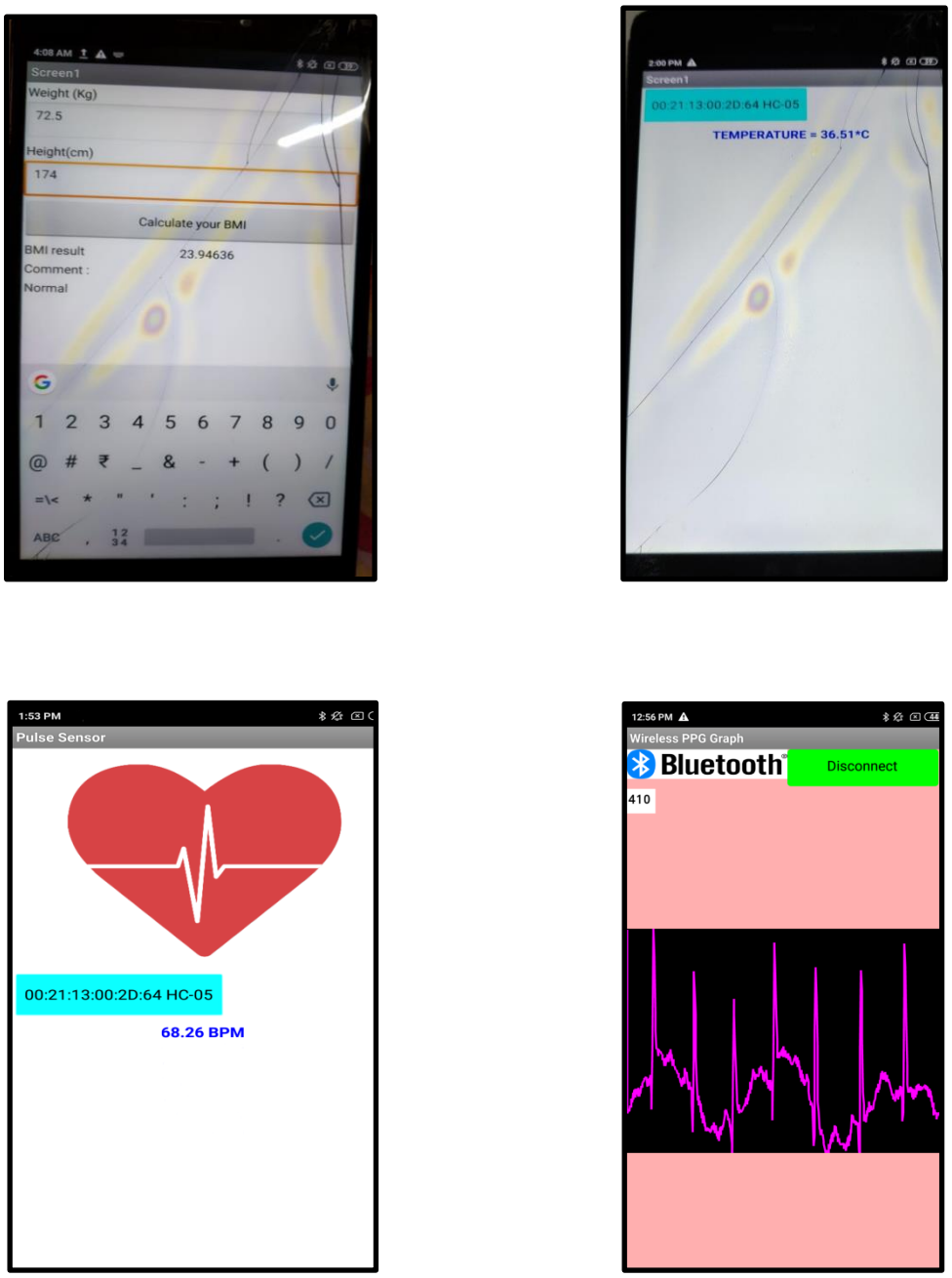

Figure 6.4: App showing real time data.

A sample report of a patient is shown in Table 6.1. The report contains personal information about the patient along with heart rate and body temperature of the patient. The report shows a comparison between the normal values and the calculated result. According to the data calculated it can be analyzed that the same results were obtained as that of the normal values of heart rate and temperature from our system. The ECG graph is not much clear due to the noise generated by electrical components used in the project. Also another issue with the system was the efficiency of pulse rate monitor while detecting the readings from the patient. Another major concern with the project is security because bluetooth allows anyone to

connect to the application and thus get information about the patient. However if the device proves to be helpful then security issues can be alleviated.

Table 6.1: BMI, Heart Rate and Body Temperature of the patient.

Personal Information	
Name: Nakshatra Gautam	Date: 22/Feb/2019
Sex: Male	Time: 1:00pm
Hight: 174cm	Weight: 72.5kg

Normal Values		
BMI	Heart Rate	Body Temperature
(18.5-25)	(60-100) BPM	37.4°C

Test Results		
BMI	Heart Rate	Body Temperature
23.9	**68** BPM	**36.5**°C

Figure 6.5: App sending patient data to the doctor

CONCLUSION

In this project a smartphone based mobile health monitoring system has been presented. In mobile health system data is recorded and transferred through wearable gadgets. The patient information can be accessed by the doctors to monitor, diagnose and advice patients from any location at any time. It is a simple system consisting of sensors connected with a smartphone. The system can be easily used and is fast as well as cost efficient. The system can also store data for future health analysis. In this project, the app performs real-time heart rate estimation, temperature calculation and also shows ECG graphs of the patient. At the end it can be concluded that although the project is a very basic design but with more advanced products the project can work more effectively.

PAPER PUBLICATION

MOBILE TECHNOLOGY SYSTEM FOR HEALTH INTERVENTION (M-HEALTH)

Shruti Sabherwal, Aadeesh Jain*, Deepankar Mathur and Meenakshi Sood
Department of Electronics and Communication Engineering
Jaypee University of Information Technology
Waknaghat, Solan, Himachal Pradesh, India
(aadeesh101, shruti.sabherwal, dmathur09)@gmail.com, meenakshi.sood@juit.ac.in

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http://informaticsindia.co.in/

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LINKs

MIT App Inventor *http://appinventor.mit.edu/explore/ai2/tutorials.html*, *last accessed 2019/04/27.*

Pulsesensordata *https://www.generationrobots.com/media/DetecteurDePoulsAmplifie/PulseSensorAmpedGettingStartedGuide.pdf* .

Microcontroller *https://en.wikipedia.org/wiki/ATmega328*.

Pulse sensor and ECG sensor with Arduino *https://www.instructables.com/*

Body temperature *https://www.healthlinkbc.ca/medical-tests/hw198785*