Web Based ECG Monitoring System

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In partial fulfillment of the
Requirements for the degree of Bachelor of Computer Systems Engineering

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CERTIFICATE

It is to certify that the following students have completed their project on

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ABSTRACT

Telemedicine services increase the quality and accessibility of healthcare services. In this project named “Web Based ECG Monitoring System” we develop ECG monitoring which has potential to address diverse diseases in human body and by increasing the quality of treatment. Monitor Patients in remote area where clinical services such as ECG are not available. Off the shelf Arduino based shields can be deployed to monitor patients ECG in a cheaper way at home, military camps, remote non clinical areas and small size hospitals, home and middle class communities comparatively to the conventional clinical system. Use of already existing Internet is a major breakthrough in our idea. More than 100 diseases and their abnormalities in human body can be detected by remote physician using this implementation. In data acquisition module, programming Arduino based shields to acquire data from electrical activities of heart or muscles sending data using USB interfacing which will be stored in PC and upload on website named “www. hostpkdesgins. com” where doctor can visually see this information and complete prescriptions can be given by doctor. Here doctor can also serve more patients than conventional ECG systems.

Use of same technology implementation we can develop system based on electromyogram, electroencephalogram and many more but the problem is during implementation these Arduino based shield are highly effected by temperature and results also changed due to high temperature.

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ABBREVIATIONS AND SYMBOLS

ECG: Electrocardiogram

SOP: Statement of Purpose

WWW: World Wide Web

DAM: Data Acquisition Module

PC: Personal Computer

TCP/IP: Transmission Control Protocol/ Internet Protocol

USB: Universal Serial Bus

UML: Unifind Modeling Language

SQL: Structured Query Language

EKG: Electrocardiogram

IP: Internet Protocol

DNS: Domain Name System

BP: Blood Pressure

LCD: Liquid Crystal Display

CMS: Content Management System

EMG: Electromyogram

EEG: Electroencephalogram

IDE: Integrated Development Environment

PC: Personal Computer

SRAM: Static Random Access Memory

EEPROM Electrically Erasable Programmable Read Only Memory

PWM: Pulse Width Modulation

OS: Operating Systems

COM: Communication

PA: Passive Electrode

Chapter 1

ITRODUCTION

1.1 STATEMENT OF PRROBLEM

Telemedicine services increase the quality and accessibility of healthcare services. In this project we program ECG which has potential to address diverse diseases in human body and by increasing the quality of treatment. Monitor Patients in remote area where clinical services for ECG are not available like homes, military camps, ships. Whenever a patient is recommended for his/her electrocardiogram he/she has to pass through certain set of protocols and formalities apart from this for ECG analysis patient has to be present at hospital. Most of the times it is difficult to bring patient to hospital and same ways many of the under developed regions do not has clinical services inside their regions. Also conventional ECG system has less record management capabilities as it uses thermal paper for real time multichannel signal plot. So there is a need to design such system which can overcome portability, time and record management and other conventional ECG systems flaws. So that patient can be monitored through World Wide Web by doctor [1]-[3].

1.2 OBJECTIVE

As it is proposed in SOP of our project conventional ECG system has many limitations we need to design as system such that

- Patient's ECG can be monitored from anywhere using WWW.
- Improve citizens health security reduce health inequalities.
- Cost of the system should be as low as anyone can afford it.
- Doctor can save his time and serve more patients.
- Web Interface should be as simple as a layman can use it.
- System should be designs in such a way if it is going to be used by a hospital it .will be much like that in hospital's needs.

- System should be secured is such a way that no intrusion can access or manipulate the records.
- All systems modules should be in strong control of an administrator. Only defined rights given to supervisor and computer operator. Doctor and patient has only formal link to one another.
- Promote telemedicine/health care.

1.3 STRUCTURE OF OUR THESIS

We have organized our thesis work in a way as anyone who is interested in Telemedicine/Health Care field could easily get help form this and learn as many things as he is interested. Firstly we introduced genuine problems here about conventional ECG system in hospitals and our work is to overcome those negative impacts on human life. In second chapter we gave almost complete overview from scratch to implementation of our Internet Based ECG Monitoring System. Further chapters gave detailed description about every module which you will see from top in second chapter. Third chapter described the significance of ECG and its application on human body its parameters and all of the nuts and bolts about Electrocardiogram and why we are interested in ECG Fourth chapter is about management of our project its dynamics and requirement engineering. Fifth chapter gives you the details of our project base which is called Arduino and its use here, its types and quick installation and use of its software platform and peripherals to Arduino. Sixth chapter is about ECG acquisition Module. Seventh chapter is complete introduction design and development of web interface for doctor and patient and its control Eight is assembly of hardware modules. Ninth chapter but not the least gave you details of executing Web Based ECG Monitoring System. Tenth chapter is organized to give idea of future work and part of the chapter will describe the milestones and achievements.

Chapter 2

OVERVIEW OF WEB BASED ECG SYSTEM

2.1 TELEMEDICINE AND ECG

Since telemedicine is use of telecommunication to provide clinical services and treatments from remote ends it is producing a great impact in today's society as everyone has more or less essential knowledge of telecommunication. Everyone is trying to be served at his own home or residence and in some cases it is not the only need but it is a constraint. Telemedicine is a vast domain but here we have chosen electrocardiogram analysis from remote end Figure-1 shows the general method of web based ECG system, it is well known fact that more than 100 diseases can be detected from ECG of a patient [4]. Some of those are given below

- Stream of blood to heart muscles
- Uneven heart beats
- Heart pumping problems
- Heart dilation or muscles thickness
- Birth faults in hearth
- Heart valves complication
- Cardiac rate

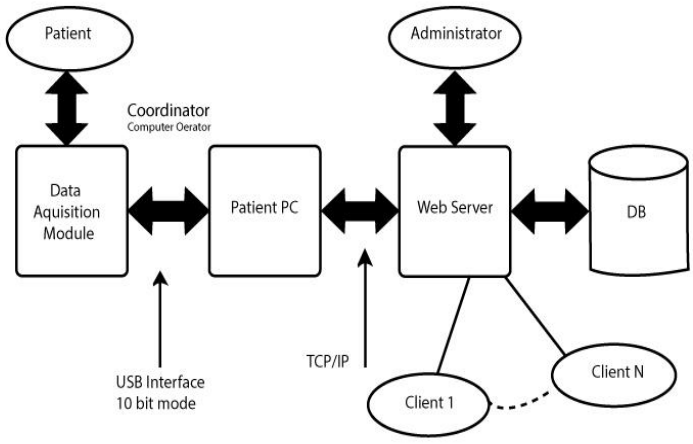


Figure-1: Block diagram of web based ECG system

- Arrhythmia
- Atrial fibrillation
- AV block
- Bundle branch block
- To detect cardiac position
- Evaluate effects of drugs
- Hormonal & electrolyte imbalance etc.

In Figure-2 we show block diagram where oval named patient which represents the domain of those patients which are under inspection of electrocardiogram (Cardiac Patients). Secondly a connection showed between DAM and patient here DAM is actually our Arduino based ECG shield which will be represented in latter chapters. Moving forward there is patient PC which is any kind of Personal Computer having windows, MacOs or Linux operating system. Here USB connection between DAM and PC which is serial data transfer keep in mind all of preceding chapters contain complete illustration of this model so if you skip something here no worry, everything is individually explained latter. Between patient PC and Web Server there is TCP/IP protocol suit which is responsible for carrying traffic from local to remote PC,s and vice versa[1]. Web services are completely under the control of an Administrator and many clients request server for different services e. g uploading ECG data, viewing ECG data by doctor, taking appointments etc. Last but not the least there is a database which is used for hosting of ECG data and patients records.

2.2 ECG ACQUISITION

ECG acquisition denoted by DAM in our web based ECG system which takes data (Electrical Activity of Heart) from patient's body and send it to PC using serial port. Detailed description of these components is given in chapter 5 here we are just giving you the idea of what methods we are going to implement. Here EKG shield, electrodes and Arduino used to get data from patient, USB interface for serial data transfer towards PC where Electric Guru decode that data and a third party software used to take snap of ECG signal and store these snaps into a PC directory. Figure-3 show plotting of Electric Guru.

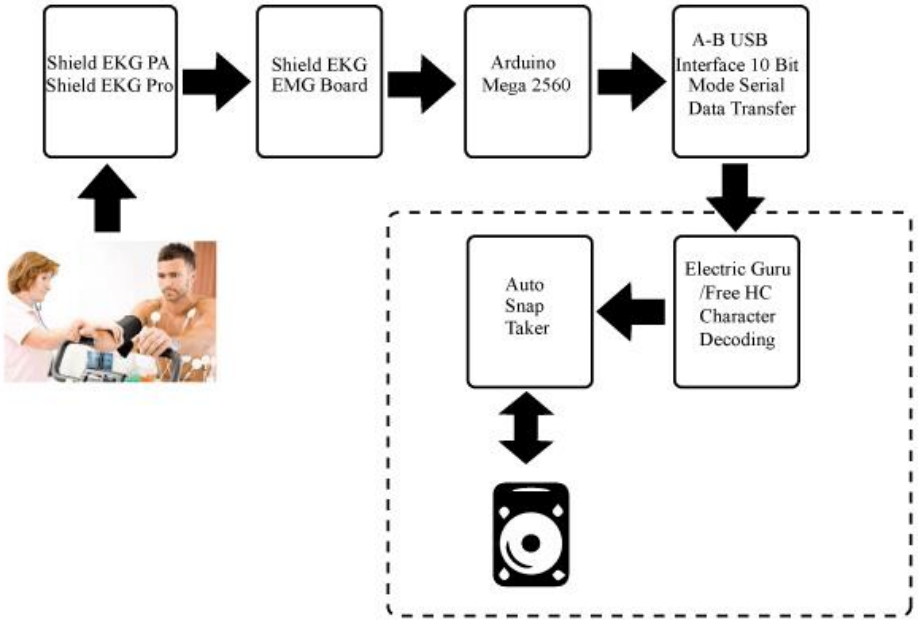


Figure-2: Block diagram of data acquisition module

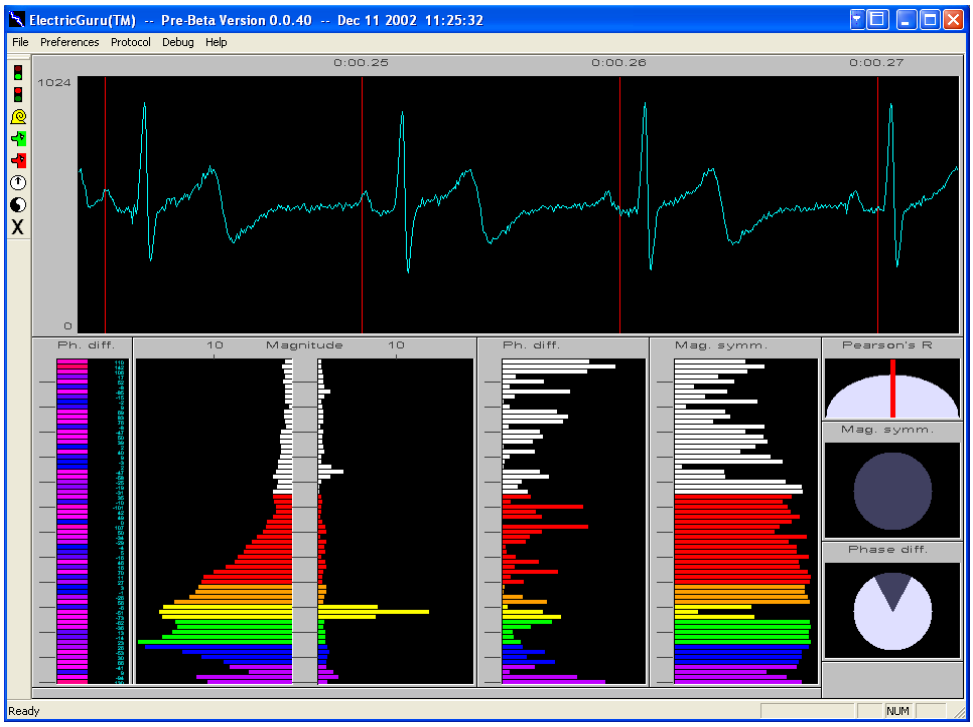


Figure-3: Electric guru plotting electrocardiogram channel 1

2.3 ECG STORAGE

We can also use automated third party snap taker which take screen shot after defined interval of time and how many to take also programmable. This way we get ECG snaps of patient now they are ready to upload for doctor's reviews but using which platforms it is defined in coming section, Figure-4 show screen shot of Electric Guru ECG channel plot.

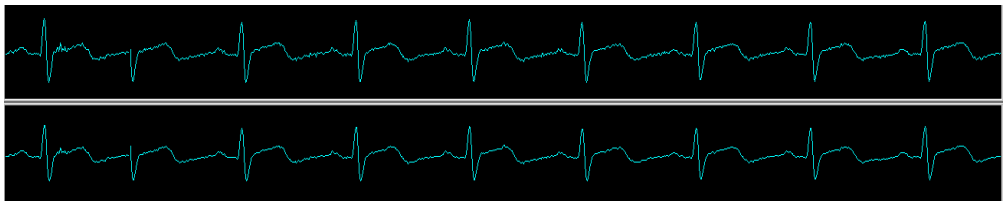


Figure-4: ECG snap shot using third party S/W

2.4 WORLD WIDE WEB AND INTERFACES

Data acquisition from patient is a challenge but storing is not going to end here real challenge is ahead. Designing a web interface for our project is a challenging work we have done a lot of requirement engineering to satisfy the ECG program of telemedicine. Finally we conclude to design website for our system and label it's association with Health Care.

2.4.1 Website UML Design

Figure-4 shows requirement engineering efforts and their refined results called UML design of our Website.

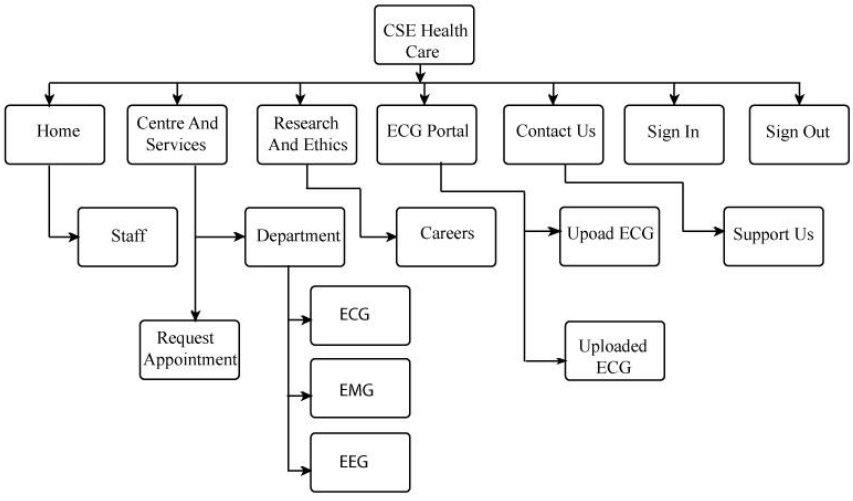


Figure-5: Website unified modeling language design representing menus

These are menus of web site front end given in a parent child relationships, actually these are dynamic linked pages to database having original content for patient and doctor support provided by Administrator.

2.4.2 Web Domain

Every published website has its domain name which is alphabetical address of IP address of your host where web server is managing your database content. An intermediary popular term now days called Wordpress [5] is a content management system which plays an important role in accessing database content and presenting to client using any kind of web browser. Figure-5 shows domain name and hosting server relation through CMS.

Figure-6: Wordpress content management system as an intermediary server between DNS and hosting platform

But the concept here is how IP address linked to our web domain and we are accessing it using domain name too. Here is the role of DNS.

2. 4. 3 DNS

These are domain name servers used to keep track of which IP is linked to which domain name. So we are able to access our website using alphabetical domains. Figure shows the block diagram of DNS and Hosting server hierarchy [6]. We have purchased domain from *http://www.namecheap.com* and hosting server from cPanel. Figure-7 shows DNS as an intermediary server between SQL database and domain [7].

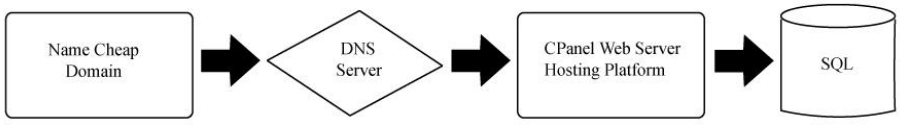


Figure-7: Domain name server as intermediary server b/w domain and database

SQL is a query language which almost by all of the database servers to implement request response relationship between client and web server. General block diagram of our doctor patient relationship on website is given in Figure-8 show general description of our Doctor/Physician Patient relationship.

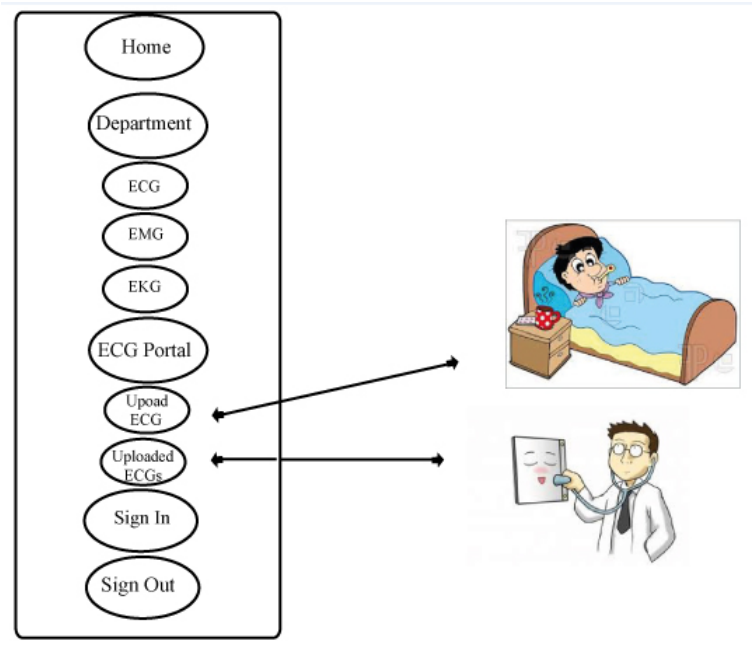


Figure-8: Doctor patient relationship using website our problem statement and it's solution

Chapter 3

ELECTROCARDIOGRAM

3.1 INTRODUCTION

Electrocardiogram is a test to see your electrical activity of heart and tracing that line on a paper or anything else which a cardiologist can visually see. It measures how electrical impulses move through heart muscles when heart contracts and dilate. Tracing those impulses have spikes and dips walled wave [1].

3.2 WHY ECG Done

ECG is done for number of purposes is given below in list.

- Check your heart's electrical activity.
- Finding pain in your chest which is undetermined and pressure due to heart attack or infection around your heart areas.
- Finding cause and symptoms of heart disease including breath shortness, dizziness and fainting etc.
- Heart beats that are rapid and irregular (palpitations).
- Finding walls of heart too thick.
- Check to see how well medicine is performing and either having side effects on heart.
- Check the status of mechanical devices i.e. pace maker working well or not?
- Check to see health of your heart when other diseases are present including diabetes, high B. P, smoking and some other genetic inherited diseases [1].

3.3 INTERPRETATION OF ECG

ECG signal with basic heart autonomy is given below in Figure-9. P wave mentioned in Electrocardiogram zoomed section is record electrical action through top heart components named as Atria. QRS record electrical activity of lower heart region called as ventricles. ST part represents ventricle is shrinking but there is no electrical activity through it. It is a straight line between QRS and T wave. T wave representing heart chambers are going to reset here and are prepare for next muscle shrinking [4].

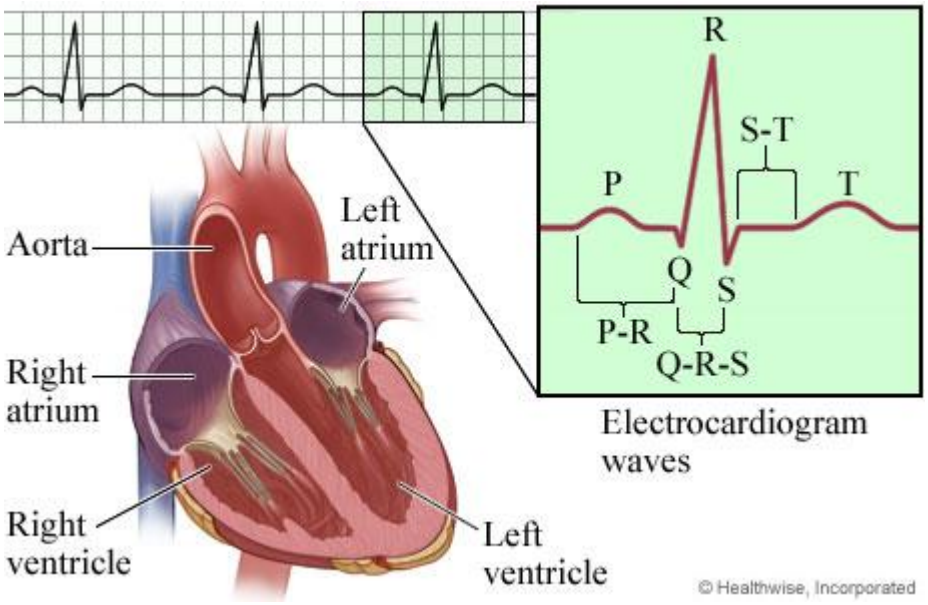


Figure-9: Parts of heart and ECG signal relationship

3.4 RESULTS OF ECG

Results of ECG are categorized into normal and abnormal as given below.

3.4.1 Normal Results

Heart beat is a regular rhythm around 60 to 100 pulses every movement. The tracing looks normal [6].

3.4.2 Abnormal Results

Heart pulsate too moderate e. g. below 60 pulses for each moment. Heart pulsate too quick e. g. more than 100 pulses every moment. Heart rhythm looks irregular. ECG recording does not look as normal as must be.

3.4.2.1 Abnormal Results Mean

Abnormal results may have following consequences

- Determine degree of versatility in electrolytes i. e K and Ca in the blood.
- Intrinsic heart's deformity.

- Dilation of heart structure.
- Swelling or fluid in the pouch around your heart.
- Inflation of the heart.
- Heart past or current undergoing assault.
- Heart corridors receive poor blood surplus.
- Abnormal heart cadence i. e arrhythmias.
- Atrial ripples.
- Disappointment of your heart.
- Multifocal atrial tachycardia.
- Paroxysmal supraventricular tachycardia.
- Sick sinus disorder.
- Harm or changes to your heart components.
- Wolff-Parkinson-White syndrome.

3.5 PRECAUTIONS DURING ECG TEST

In order to get precise outcomes following precautions must be kept in mind [1].

- Electrodes are not safely affix to your skin including chest, wrists, ankles etc.
- Motion during ECG and talking disallow precise ECG acquisition.
- Do not breathe rapidly or too slow.
- Keep calm during test.
- Avoid touching scups during operation.
- Noiseless environment recommended.
- Lie on bed or table.

3.6 DISEASES DETECTED BY ECG

Following diseases detected by ECG [1].

- The size and location of your heart are understood and their versatilities are constrained.
- Every muscle cell displays a particular type of activation; depolarization is trailed by repolarization after more or less 0. 2-0. 4 seconds.

- The dispersion speed of the initiation in different parts of the heart muscle is known
- The conduction framework has an overwhelming impact over initiation front.
- The relation of muscle load and muscle hypertrophy is known here.
- Number of reasons for solid over-burden that is known using ECG.
- The electrophysiological effects by ischemia on your heart known.
- The area of emptiness or localized necrosis is represented by the life structures of the coronary channel.
- Predetermined number of intrinsic heart variations from the norm.

3.7 RISK

ECG is completely safe test. There is no strong reason why you could not get your ECG. Electric current does not passed through your body during ECG as electrodes only determine vibration of you minor pulses and change it to voltage referenced towards recording machine that is too small and in that phenomenon no electric shock will pass from your body so you are perfectly safe to do it.

Chapter 4

PROJECT MANAGEMENT

4.1 REQUIREMENT ENGINEERING

Developing a web based ECG system has number of requirement which must be fulfill in order to hit our milestone without any kind of vagueness. We divide these requirements into four sections. Here we describe only refined requirements

- Hardware requirements.
- Software Requirements.
- World Wide Web requirements.
- Engineers Requirements.

4.1.1 Hardware Requirements

Hardware requirements are given below in Table-1.

Table-1: Hardware requirements

Qty	Requirement	Use	Availability
1	ECG-GEL-ELECTRODE	Transducer	Shipped from USA
1	ECG-PRO-3-WAY-CABLE	Transducer	Shipped from USA
1	ECG-CLIP	Transducer	Shipped from USA
1	SHIELD EKG EMG PRO	Transducer	Shipped from USA
1	ECG-SCUP	Transducer	Shipped from USA
2	USB-A-B-CABLE	Serial Data Transfer	Shipped from USA
1	Arduino Mega 2560	Base of EKG	Available in Pakistan
1	Arduino Uno	LCD Display	Available in Pakistan
1	SHIELD EKG-EMG	Getting ECG data	Shipped from USA
2	LCD 16x2	Display	Available in Pakistan
1	Wooden Cage	Device Protection	Hand made
1	Cooling fan	Maintain Temp.	Available in Pakistan
1	5V Adapter	Power Supply	Available in Pakistan
3	9V Energizer Battery	Power	Available in Pakistan
2	Laptop/PC	Patient ECG snap storage and upload	From Group members

4.1.2 Hardware Requirements

Software requirements are given below in Table-2.

Table-2: Software requirements

Qty	Requirement	Use	Availability
1	Arduino 1. 6. 5 Programming Platform	Programming Arduino	Available at http://www. Arduino. cc
1	Electric Guru	Plotting ECG	Available from http://www. Olimex. com
1	SnapCrab	Take ECG Shot	Third party availability
1	FreeHC	Research Purpose	Free Available
1	Auto Snap Taker	Take ECG Shot Automatically	Free Available

4.1.3 WWW Requirements

World Wide Web Requirements given below in Table-3.

Table-3: World wide web requirements

Qty	Requirement	Use	Availability
1	Hosting Server	Managing Database	From “cPanel”
1	Domain Name	DNS	From “namecheap”
1	CMS	Managing Content	Worpress/joomla

4.1.4 Engineers Requirement

Engineers Requirements are given below in Table-4.

Table-4: Engineers requirements

Qty	Requirement	Use	Availability
1	Supervisor	Monitoring work performance	Available in CSE Staff
1	Arduino Programmer	Programming Arduino Mega 2560/Uno	Team Member
1	Web Develpers	Developing Website	Team Member
1	Computer Operator	Recoding ECG	Team Member
1	Website Administrator	Managing Web Content	Team Member
1	Hardware Assembler	Manage dimensions of H/W	Team Member

4.2 PROJECT DESIGN STEPS

1. Design web interface for doctor/Physician and patient.

    - Word press

- cPanel/Domain name

2. Testing phase of website either operating as required or not?

3. Designing operational model of Data Acquisition Module

- Electrocardiography Arduino programming for shield EKG
- USB port Session programming
- Plotting serial data real time on PC screen

4. Integrating Web and DAM

- Patient and Doctor reliable connection establishment

5. Testing phase of operational model (DAM and web interface) with test data inputs.

6. At last, project will be completely in run

7. Maintaining prototype(wooden box) for exhibitions

4. 3 PROJECT DYNAMICS

Table-5 shows time management for projects.

Table-5 Time management for project completion

Sr.#	Time Required	Breakthrough	Realization
1.	20 Days for Design 10 Days for Testing	Web Interface Design Generating Documentation	Web interfaces for Doctor/Physician, Patients and Administrator Documentation
2.	15 Days for Design 15 Days for Testing Parameter	Designing Data Acquisition Module Generating Documentation	DAM operational Module Documentation
3.	20 Days for Design 10 Days for Testing	Integrating Web and DAM using own strategy	Operational Model of Project Combined Documentation
4	1 Month	Testing viability And hundreds of	Testing Results

		parameters change	
5	3 days	Hardware Protection box design	Complete Prototype

Chapter 5

ARDUINO

5.1 INTRODUCTION

Arduino is a platform of open source electronics that currently has captured the market of electronics and is being used in electronics small scale projects massively. It consists of Arduino board and Atmel AVR processor and on same board has I/O capability. Software platform of Arduino is freely available and can be installed on almost every kind of operating system you have licensed under Microsoft, MacOs and Linux. Arduino board programmed using programming language similar to C++ and its own IDE [9].

5.2 BACKGROUND

Arduino project started in Italy 2005 just for the purpose of controlling cost of electronics based projects and build an easy programmable environment. Time came when 120,000 board were delivered. Arduino name coined that time in reference to the local bar name of its developers [10].

Cut that long story to short Arduino is and easy environment for beginners who have little knowledge about electronics. It can be programmed in C++ or C++/Arduino wiring based language.

5.3 WHY TO USE ARDUINO

Arduino can be considered as brain of every electronics project today. It is relatively cheaper to other electronic circuit. Arduino programming is flexible. Open source software and hardware.

5.4 ARDUINO USED IN THIS PROJECT

We used Arduino Mega 2560 for acquiring ECG data from EKG shield and Arduino Uno for LCD display.

5.5 ARDUINO MEGA 2560

Arduino Mega 2560 is called so because it has AtMega2560 Microcontroller shown in Figure-10 with 54 digital pins, 16 analog pins, USB connection with PC [9].

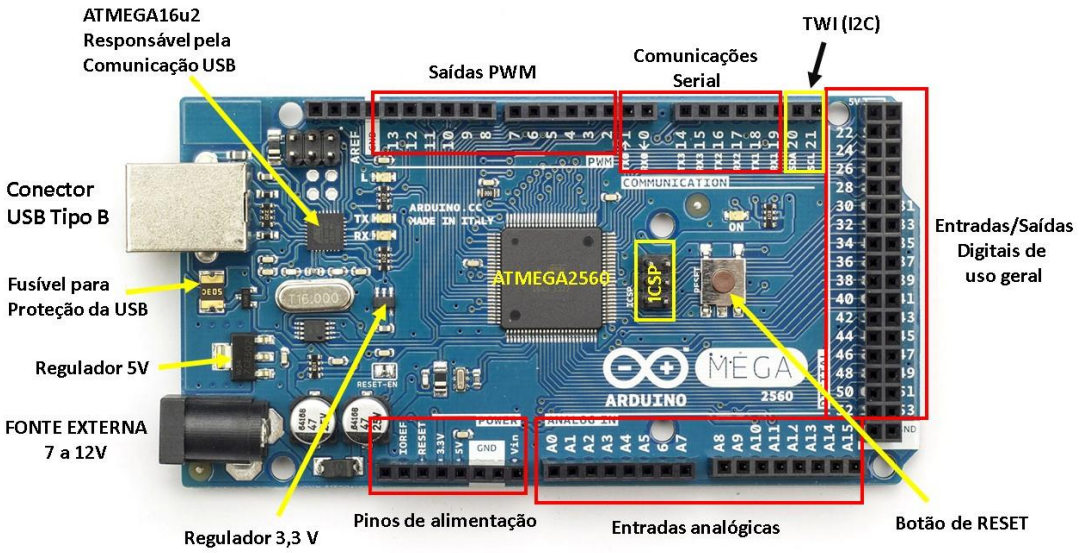


Figure-10: Arduino mega 2560 pins grouping

5.5.1 Power Up Arduino Mega 2560

Arduino Mega 2560 can be powered up by three different methods using USB connection, power adapter or by external source of power shown in Figure-11. If voltage is less than 5V then it collapse and if voltage is greater than 12v then it may get harm. Cut the results into short Arduino Mega 2560 has working voltage from 7V to 12V [9].

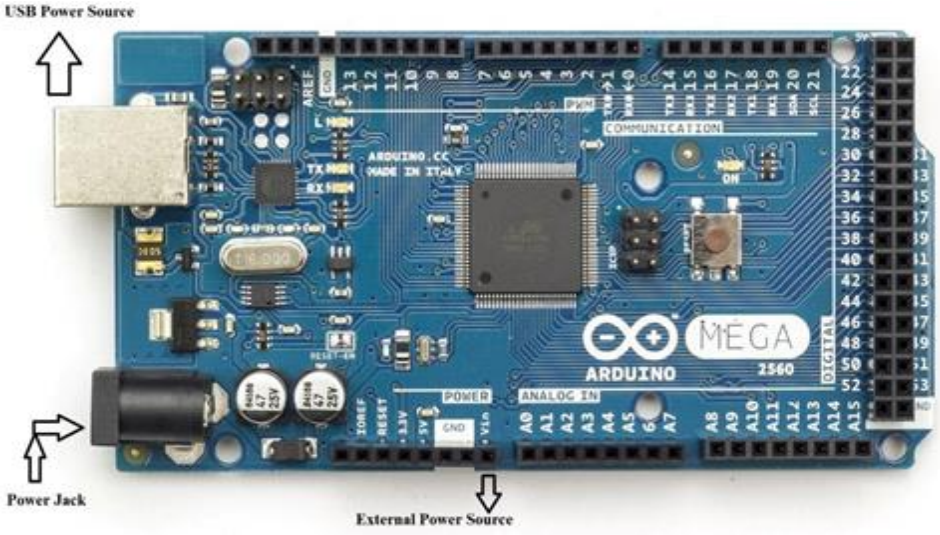


Figure-11: Power up options of Arduino mega 2560

5.5.2 Mega 2560 Memory Statistics

- 256 KB Flash
- 8 KB boot loader setup
- 8 KB of SRAM
- 4 KB EEPROM

5.5.3 Mega 2560 I/O Figure-12

- 16 analog input/output pins
- 54 input output digital pins
- 15 PWM pins

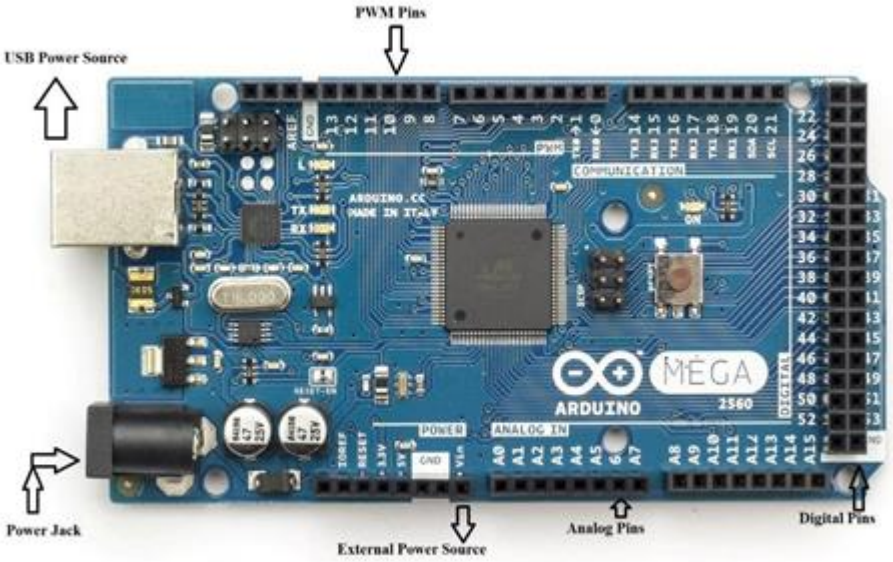


Figure-12: I/O pins of Arduino mega 2560

5.5.4 Pin Mapping of ATMega2560

AtMega2560 is mounted on Arduino Mega2560 floor has various pins like basic, automated, PWM and power pins showed in Figure-13 below [1].

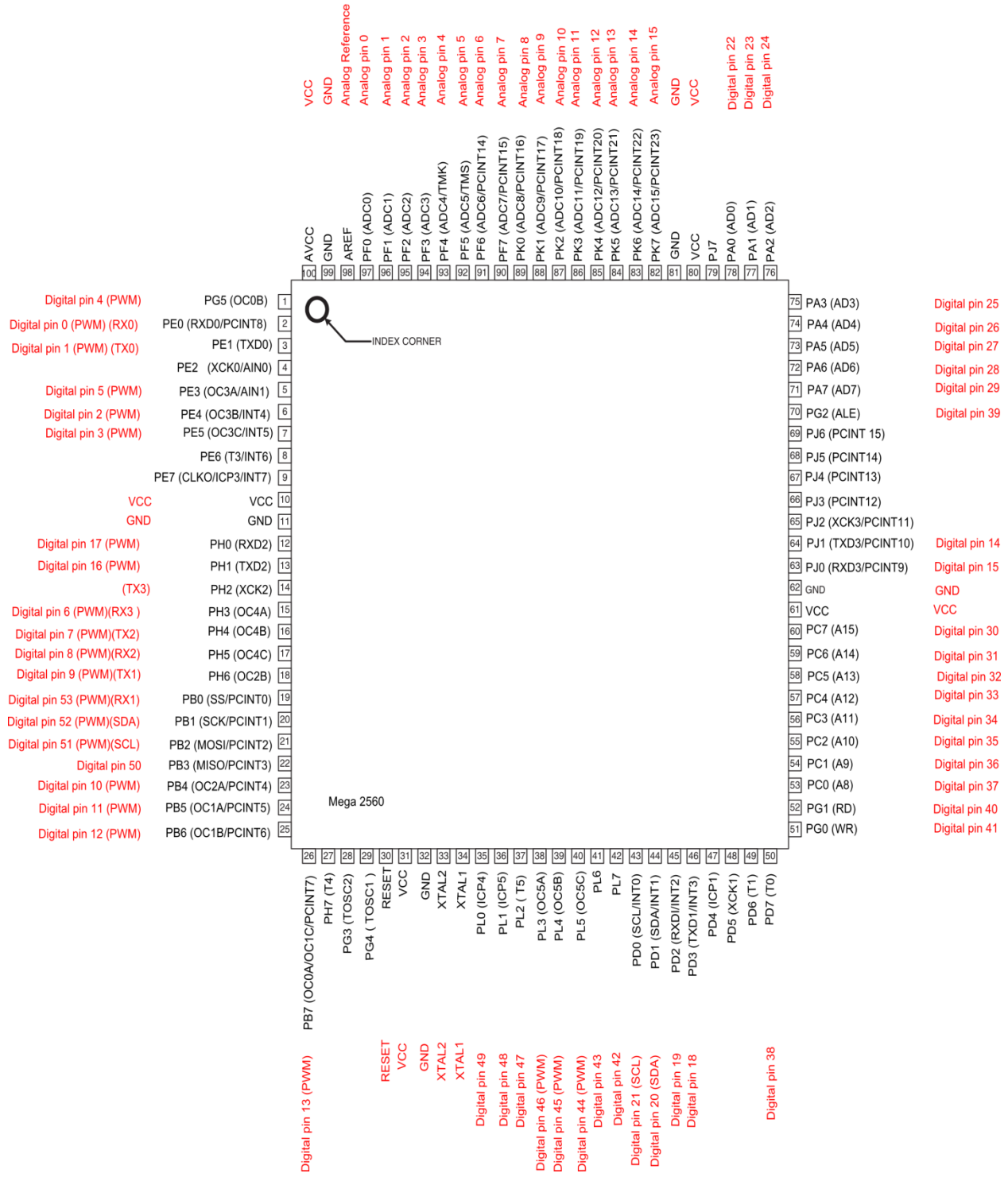


Figure-13: ATMega 2560 pin layout schematic diagram

5.6 ARDUINO UNO

ArduinoUno Microcontroller of with 54 digital pins,16 analog pins, USB connection with PC [9].

5.6.1 Powering up Arduino Uno

Arduino Uno can be powered up same as Arduino Mega 2560. The board can be operated under external supply from 6 to 20 volts [9].

- USB Connection
- Non USB power connection

5.6.2 Memory of Arduino Uno

- 32 KB (0. 5 KB reserved)
- 2 KB of SRAM
- 1 KB of EEPROM

5.6.3 Arduino Uno I/O

- Digital I/O Pins 14 (of which 6 provide PWM output)
- PWM Digital I/O Pins 6
- Analog Input Pins 6
- DC Current per I/O Pin 20 mA
- DC Current for 3. 3V Pin 50 mA

5.7 PIN MAPPING OF ATMEGA 328P

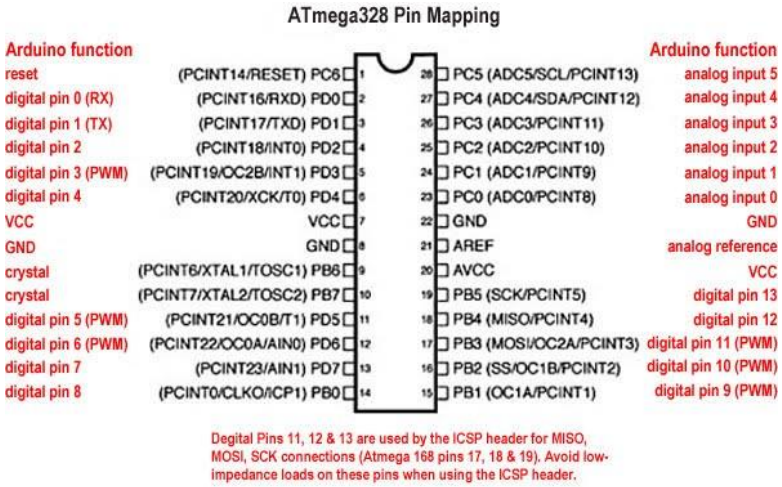


Figure-14: ATMega 328 pin mapping schematic diagram

5.8 ARDUINO SOFTWARE PLATFORM

Arduino software is an integrated development environment make easy to write code and compiling that code uploading that file into Arduino flash. We used Arduino 1. 6. 5 latest version of Arduino IDE. All set of instruction programmed using this software [9].

5.8.1 Quick Setup Procedure

- For quick setup of Arduino software platform we followed steps.
- Download Arduino 1. 6. 5 setup form *https://www. Arduino. cc/en/Main/Software.*
- Pay attention on choosing which kind of OS you have on your PC.
- We used windows 7 OS here so downloaded zip file is extracted in an easy way as you can and then double clicking the Arduino application icon, if not goes well try another time to run it as administrator.
- IDE loading here in Figure-15.
- IDE window will looks like in Figure-16.

Figure-15: Arduino IDE initializing on windows

5.8.2 Getting familiar with Arduino IDE 1. 6. 5

Following steps given in number of ordered Figures used to program Arduino.

- Load Arduino 1.6.5 looks like below in Figure-16.

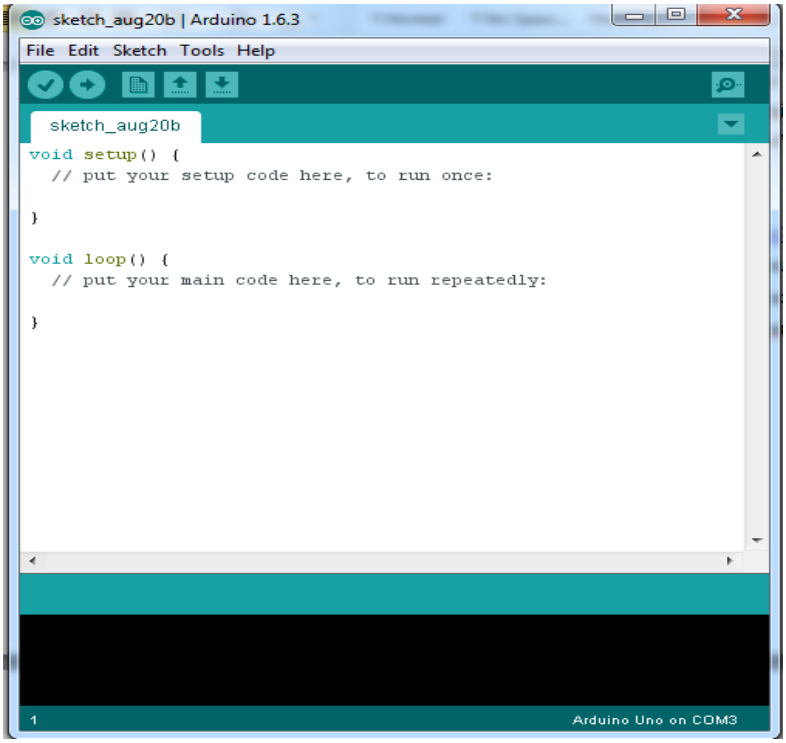


Figure-16: Start up view of Arduino IDE

- Opening Sketch shown in Figure-17.

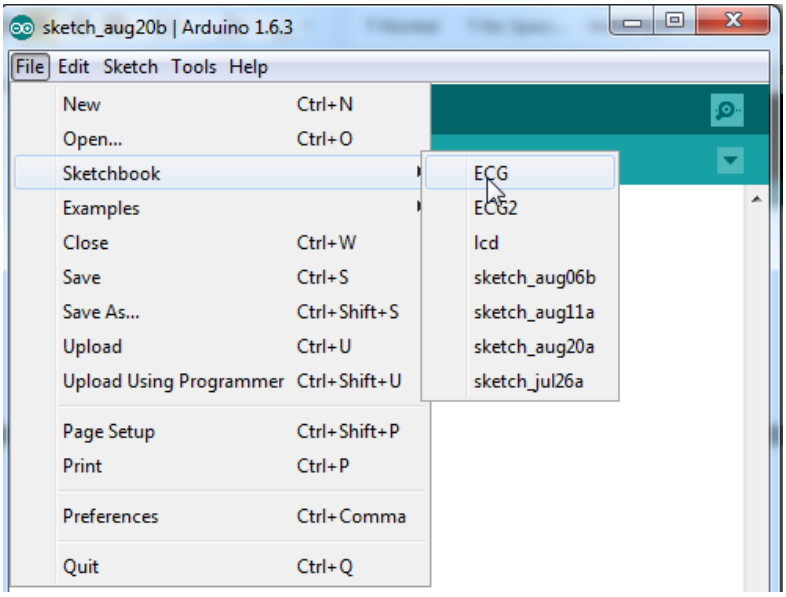


Figure-17: Opening sketches

- Opened Sketch shown in Figure-18

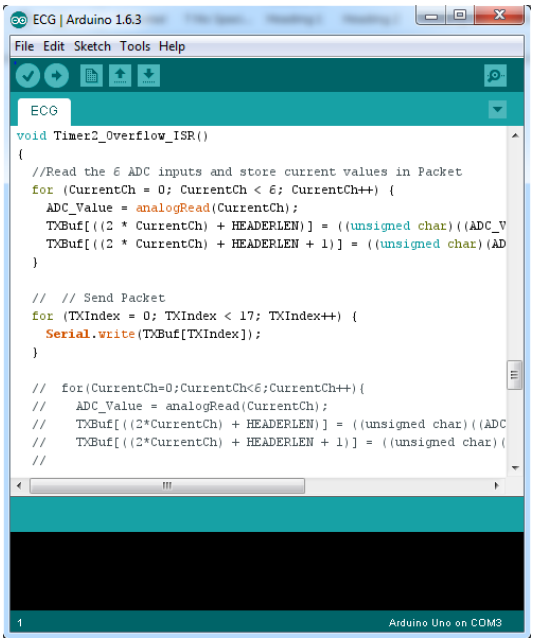


Figure-18: Opened sketch view in Arduino 1.6.5 IDE

- Verifying sketch shown in Figure-19

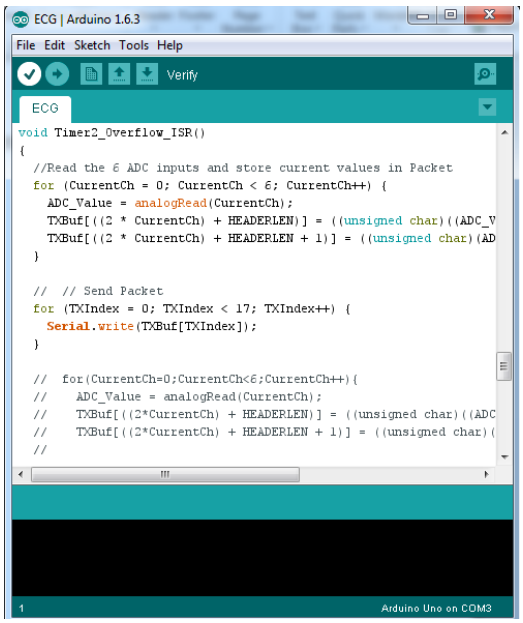


Figure-19: Compiling sketch in Arduino 1.6.5

- Compiled shown in Figure-20

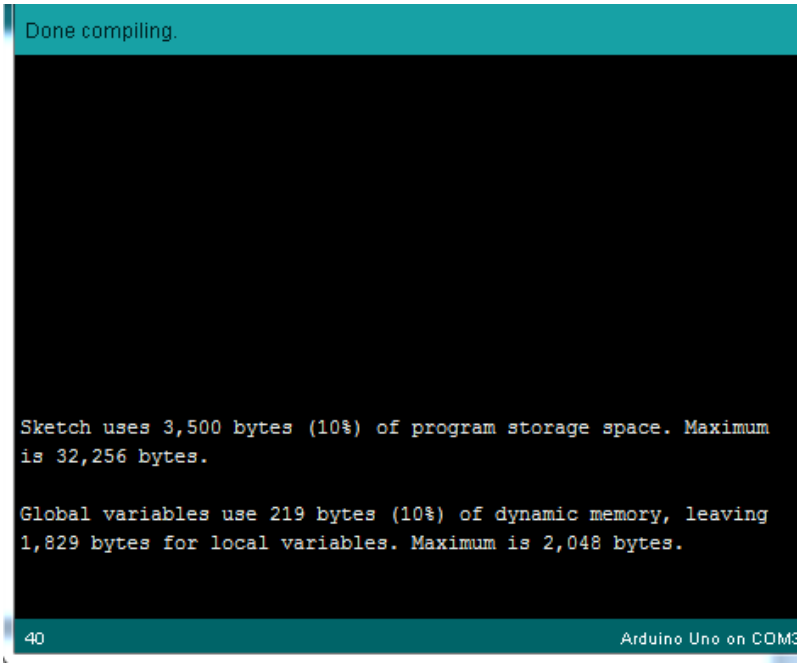


Figure-20: Compiling successful messages

- Selecting board shown in Figure-21

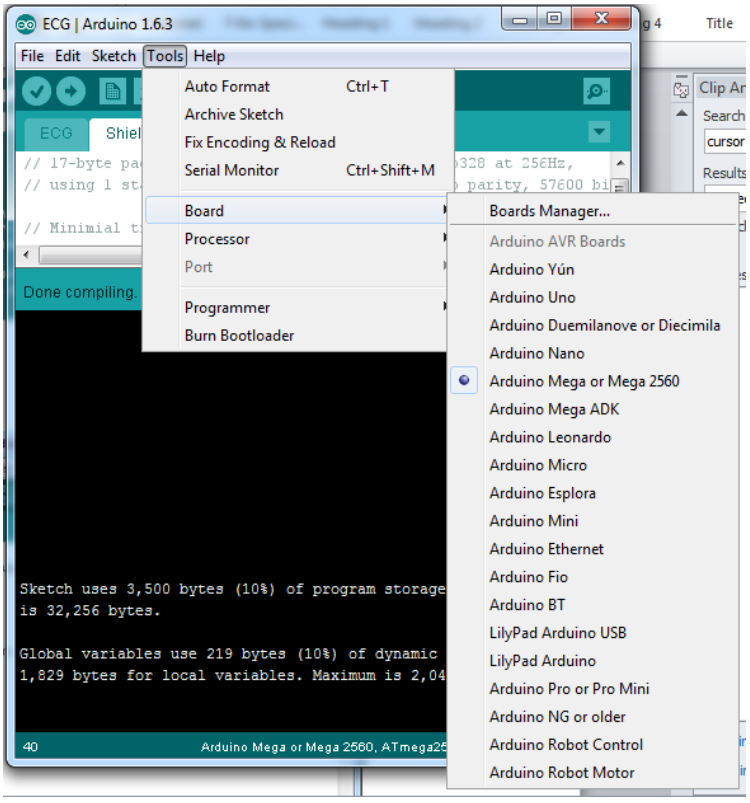


Figure-21: Selecting board

5.8.3 Loading Program into Arduino Mega 2560

For loading program into Arduino Mega 2560 we need a sketch provided in appendix-A and cable shown in Figure-49 which we into Arduino it automatically update the driver of connected board and create a session on COM n port in this case it is COM 2 most of the times shown in Figure-22 to select COM port. If drivers no automatically installed then give reference to driver's directory in Arduino 1. 6. 5. It is a subdirectory in Arduino 1.6.5 directory.

When drivers are installed launch Arduino application software write the code for EKG shield. In this case I've wrote that code in notepad and i just paste it into Arduino application and verify it with icon. It will show you compilation done it there is no syntax error and acknowledge you with white line of statements and if there is an error program can't compile and red line messages display according to nature of error you have done. It is successful here Figure-24 box message shows "Done Compiling". Now it's time to burn Arduino board. To burn successfully we have to choose correct port and correct board to be programmed by user [9]. Following steps are followed for uploading programs into Arduino.

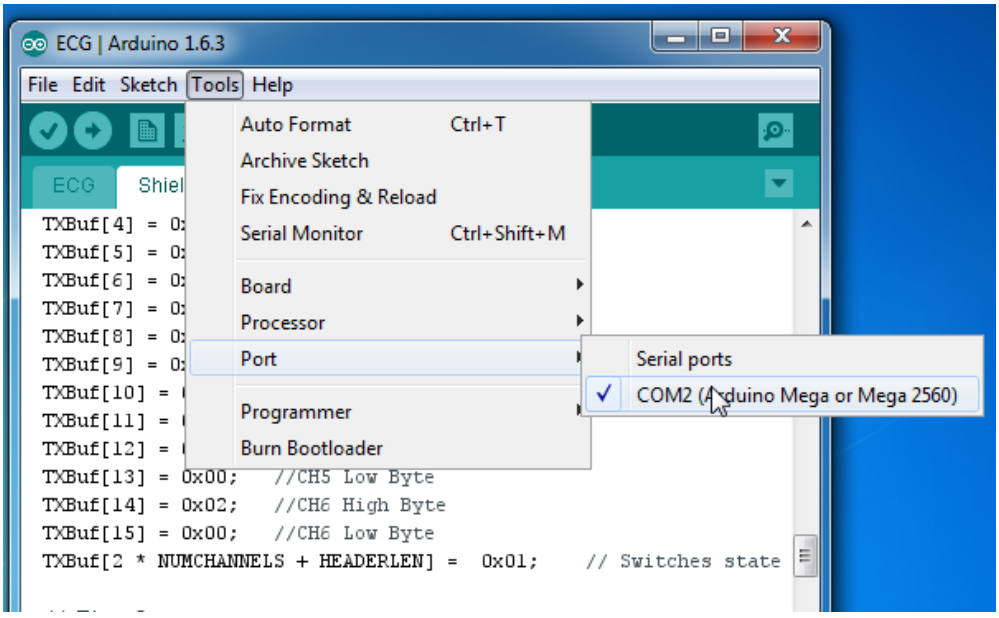


Figure-22: Selecting COM port

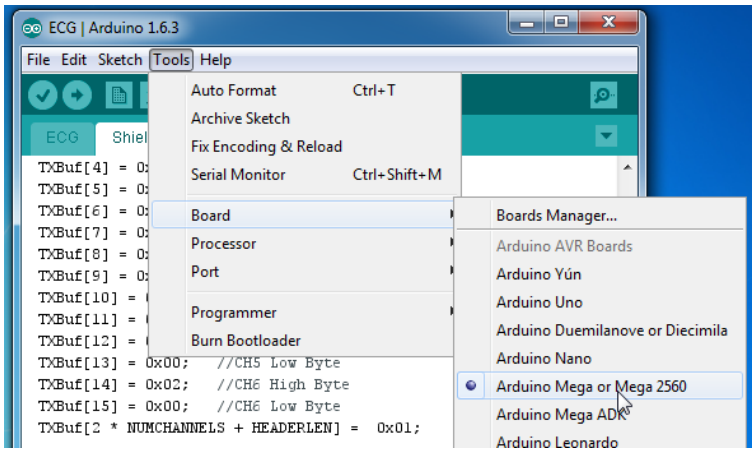


Figure-23: Selecting board Arduino mega 2560

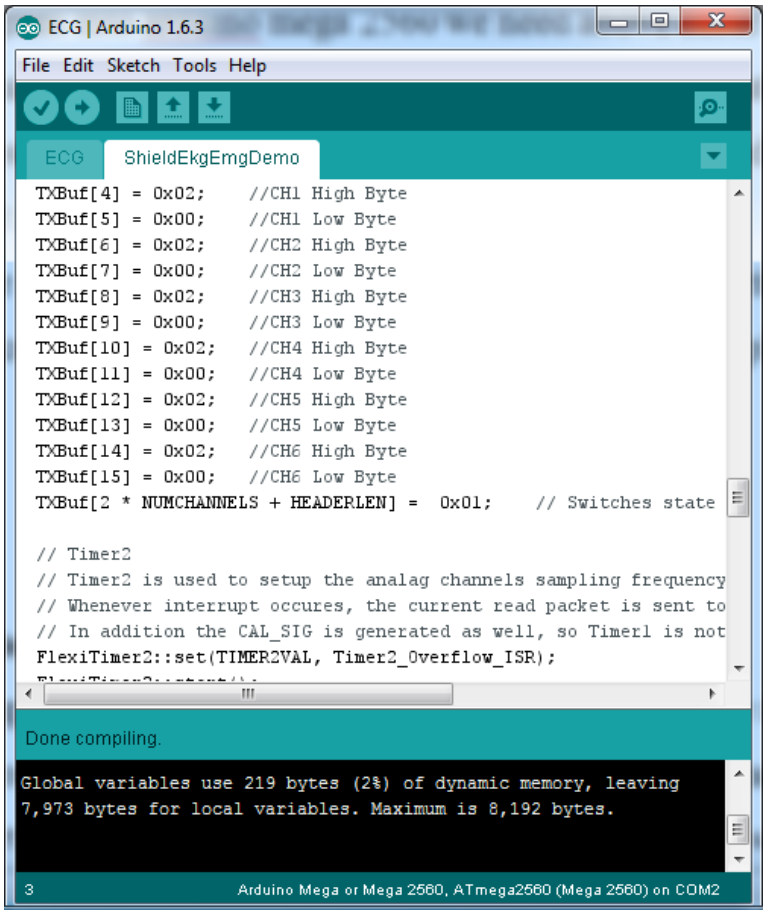


Figure-24: Done compiling

Now we have selected proper board it is time to burn our verified file into Arduino. To do this just click  icon,the program will be uploaded and meassage

will display "*Done Uploading"* Now program is saved in flash memory of Arduino and every time when Arduino powered up it will be executed automatically from memory address 0.

5.9 TEMPERATURE MONITORING

As we know temperature matters for this device to give us precise results so we have to monitor temperature of our environment. Temperature sensor can be easily implemented using Arduino but we had done our semester project on 8051 which is actually a temperature sensor so we used that small module into our project for time saving. Figure-25 shows temperature sensor module.

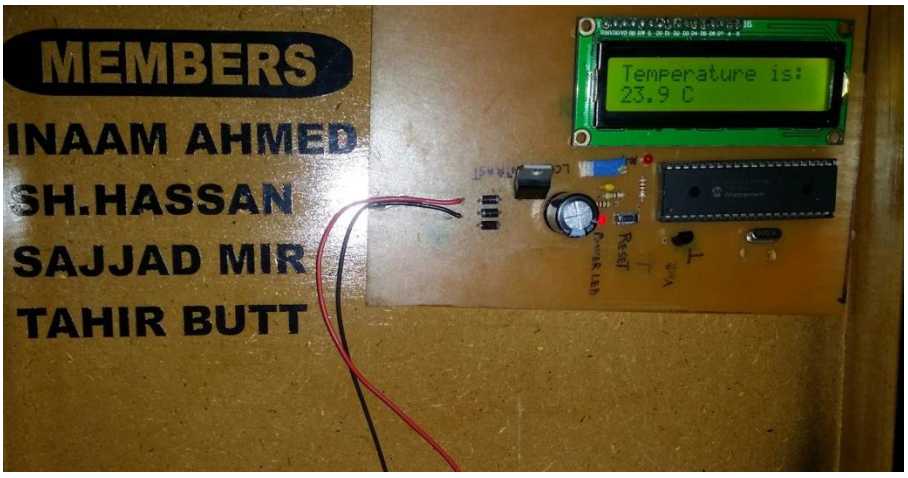


Figure-25: Temperature sensor module physical prototype

Chapter 6

ELECTROCARDIOGRAM ACQUISITION

6.1 ECG/EKG SHIELD

For acquiring ECG of a patient we used EKG Olimex Shield Figure-26 which will mount on Arduino Mega 2560 shown Figure-27 and record electrical activity of heart from patient chest, arms and legs. Sending that recorded information timely from patient to Arduino which will send that information according to program written into flash memory of Arduino to computer using serial port session either COM1,2,3,…20.

We have programmed data acquisition module by software means through C++/Arduino language code and put that code into Arduino memory so that it will use that sequence of instructions to get and throw information toward PC buffer using serial port. Furthermore part of this explanation will be given into seventh chapter hardware assembly and programming part using Arduino IDE [10].

Figure-26: EKG shield top view going to be used for electrocardiogram transducing

Figure-27: Arduino mega 2560 host board of EKG shield

6.1.1 ECG/EKG Shield Electrostatic warning

Starting up EKG shield is a short process but one thing must be kept in mind that there is an electrostatic warning during use of EKG shield as to avoid touching metallic elements of board it may results the electric shock [10].

6.1.2 ECG/EKG Shield Requirements

Three elements are needed given below,

- EKG shield itself
- Arduino compatible board
- Transducer (PA,PRO)

6.1.3 ECG/EKG Shield Powering Up

EKG shield must be powered up using host board on which it is mounted. When it is powered up red led is ON.

6.1.4 EKG shield top layout

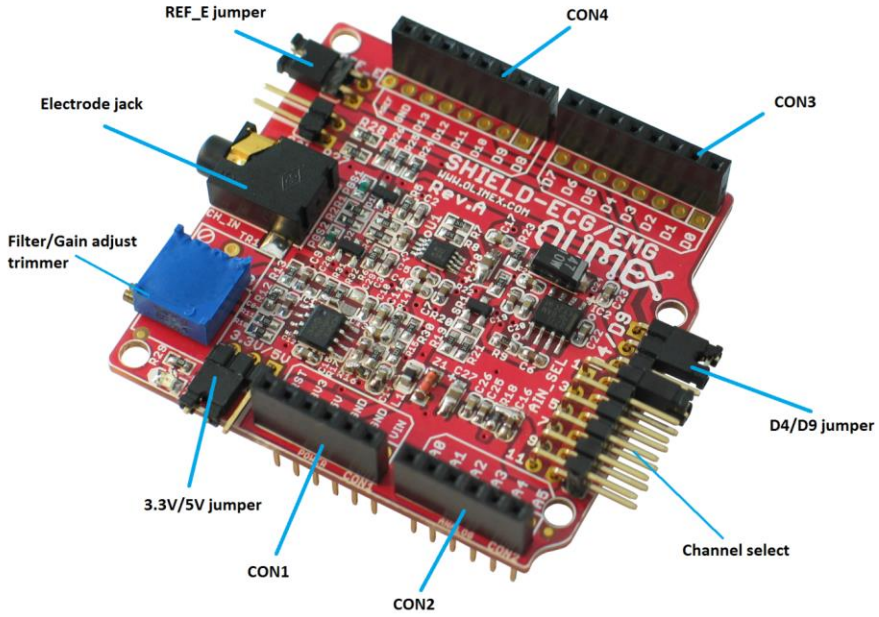


Figure-28: EKG shield pins grouping

6.1.5 EKG shield bottom layout

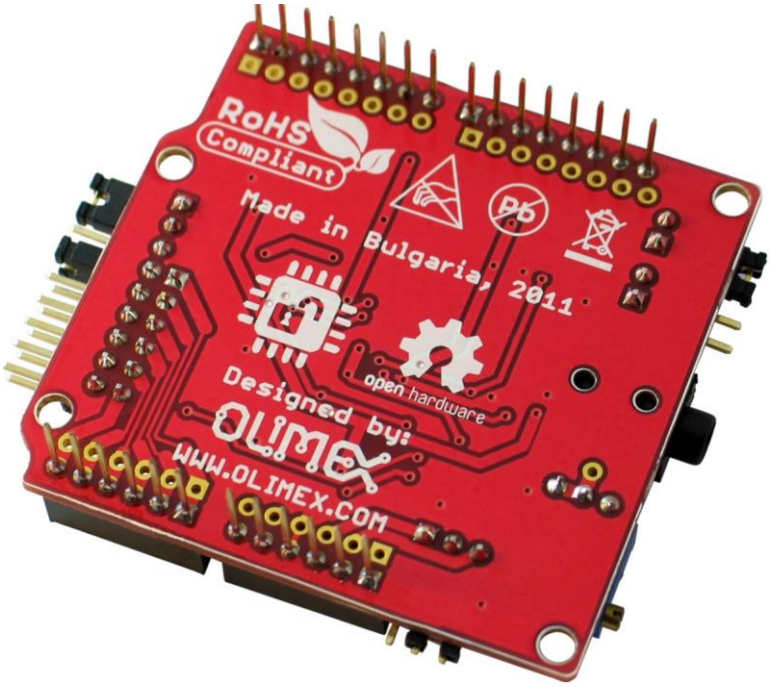


Figure-29: EKG shield bottom layout showing 6-8 male connectors

6.2 EKG SHIELD PIN MAPPING TO ARDUINO

These connectors follows the pattern of off the shelf programmable Arduino boards to be mounted as simple as pins allow to fix them. [10]. Figure-30 shows connectors left one is 6 pin and right one is 8 pins connector.

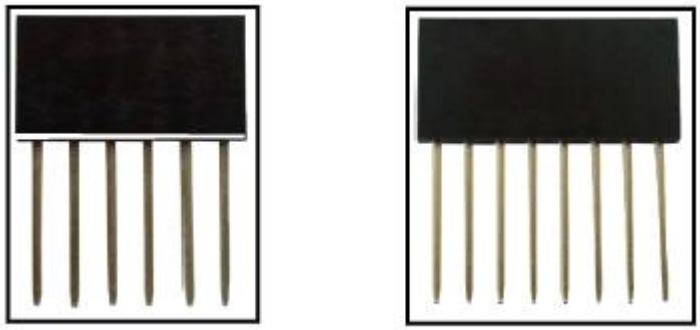


Figure-30: 6/8 pin connector

6.3 EKG SHIELD JUMPER CONFIGURATION

Jumper configuration is given below in Table-6.

Table-6: EKG shield jumper configuration

Name	Use	Default state
3. 3V/5V	Controls power circuit	**3. 3V**
REF_E	Depends upon host board If voltage provided by host board REF_E must be open If no voltage provided to REF_E voltage board REF_E must be closed	Closed
AIN_SEL	Which channel to utilize responsible for which channel the current SHIELD-EKG-EMG would utilize. If you have more than one shield one of them should have AIN_SEL in position 1, the second in position 3	Position 1
D4/D9	Utilized by processor	D9
CAL	Used for feedback of calibration	Open

6.4 BENEFITS TO USE ECG/EKG SHIELD

- Lower price

- Can be operated easily
- Small Size
- Lower power consumption
- Portability
- Digital record management etc.

6.5 DRAWBACKS TO USE ECG/EKG SHIELD

- Low temperature requirement approximately 25-30 c
- Electrostatics warnings
- Proper placement of electrodes
- Small mismanagement of PA or PRO may led to noisy results

6.6 OTHER USES OF ECG/EKG SHIELD

This shield can be used to record electromyogram which is actually electrical activity of muscles in human body Also is can be used to capture electroencephalography which is electrical activity of brain.

6.7 ECG/EKG SHIELD COMPATIBILITY TO ARDUINO BOARD

EKG shield is completely compatible to Arduino Mega 2560 and Arduino Uno. It is also compatible to Olimex boards but we used Arduino here as it is available in Pakistan easily with reasonable price the only problem is to conFigure Arduino with source code is on your own in this case Olimex does not provide any kind of favor to you because they are limited to Olimex boards only. Figure-31 shows the EKG shield mounted on Arduino Mega 2560 board [11].

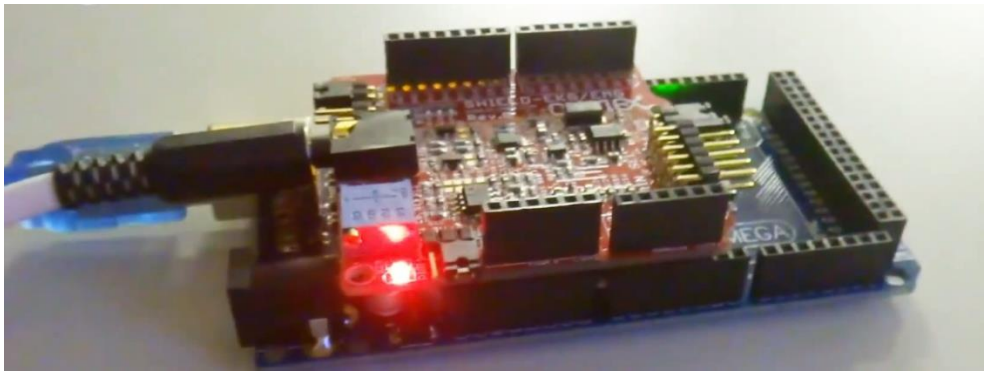


Figure-31: EKG shield mounted on Arduino mega 2560

6.8 ECG/EKG TRANSDUCER

Electrocardiogram is monitored by a doctor as a multichannel signal here we have used 3 lead ECG electrodes one called EKG Electrode PRO Figure-32 these electrodes tightened in way given below[8]. EKG Electrodes PA mounted on chest as given below in Figure-33. And Figure-34 shows EKG Electrode PRO that is how fastened on wrists.

Table-7: Electrodes placement

Lead	Position
R	Right Wrist
L	Left Wrist
D	Right Ankle

Figure-32: EKG electrode PRO interfaced with hands/ankle

Figure-33: EKG electrode PA interfaced with chest

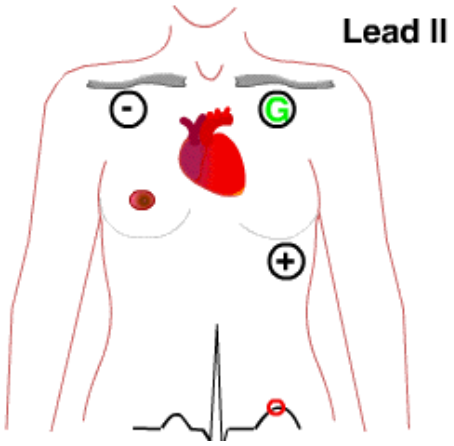


Figure-34: Three lead interfacing with human chest

6.9 ECG SIGNAL REAL TIME PLOTTING

Data acquired from ECG device it sends data in character form with 10 bit mode 1 start bit 1 stop bit and 8 bit character data sandwiched between start bit and stop bit. Software platform recommended by Olimex is used to decode that character data and use fast fourier transform and analyze the frequency spectrum of original heart statistical signal and noise, frequency of noise and original signal determined and use BP filter to remove that noise from original signal and plot it by repeating to process of accessing COM port data on real time. Simple example of that plot in Electric Guru is given below in Figure-35.

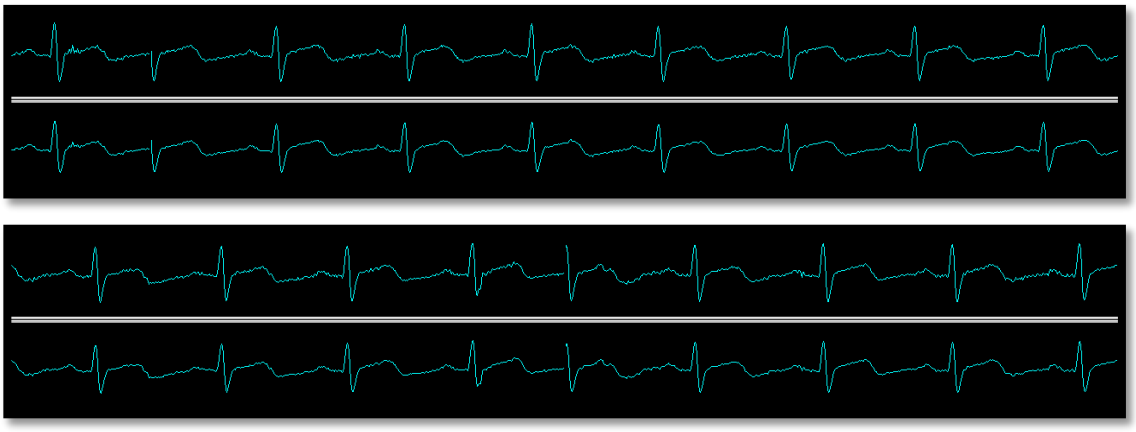


Figure-35: ECG signal plot on electric guru channel 1

Chapter 7

WEBSITE DESIGN AND INTERFACE

7.1 WEBSITE UML DESIGN

Website UML design is given below in Figure-36. Given UML design shows a parent child relationship

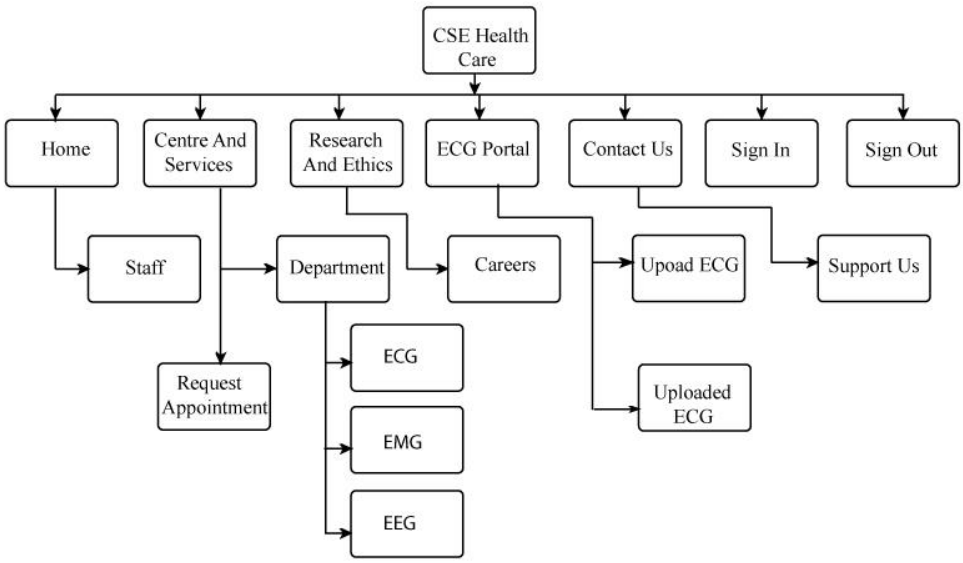


Figure 36: Unified modeling language design of website menus

7.2 WEB DEVELOPMENT PLATFORM

We are going to design website for our ECG based system but a thinking point is to check what kind of platform is best for our website. After lot of struggle our team decided to choose cPanel for our web hosting and WordPress as our content management system [4].

7.2.1 CMS

Content management system is used as an intermediary manager to database access and front/back ends of website. Figure-37 shows WordPress as CMS.

Figure-37: WordPress as content management system

7.2.2 cPanel

cPanel is linux based hosting server used with web host manager in comparison to cPanel many other panels are available but we chooses c panel as it has strong integrity with WordPress and most commonly use panel.

7.2.3 WordPress

WordPress is an open source free website development tool used massively all around the world for web development. User can easily manage themes, plugins, pages, custom menus etc.

We have used twenty thirteen theme of WordPress which is recommended theme used mostly for custom blogging and websites creation. Here is list of plugins we used in website given in Table-8.

Table- 8: WordPress plugins

Plugin	Use
Custom Contact Form	Create custom forms, Appointment, Contact Us, Sign Up etc
Add This Sharing	Share Website link on social media Facebook, twitter and Gmail etc
Staff List	Create List of staff members
User Post Submission	Submit posts from frontend
We Google Maps	Use Maps

7.2.4 Domain Name Servers

Domain name system servers match domain name with its associated IP address shown in Figure-38.

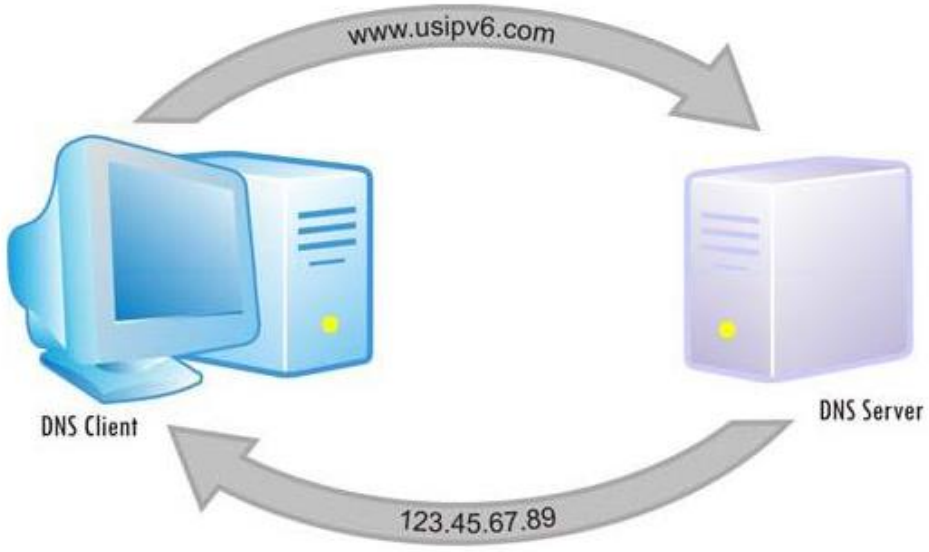


Figure-38: DNS role as an intermediary server

7.3 WEBSITE FRONTEND

Front End of our website is an attractive deign of a health care center named here CSE Health Care. Website Front End and backend layout is defined separately for PC and smart phon.

7.3.1 PC Frontend Layout

Figures given below in order are frontend view of our website complete website images are given in CD with directory names *"website"*.

Figure-39: Home page Of *"CSE Health Care"*

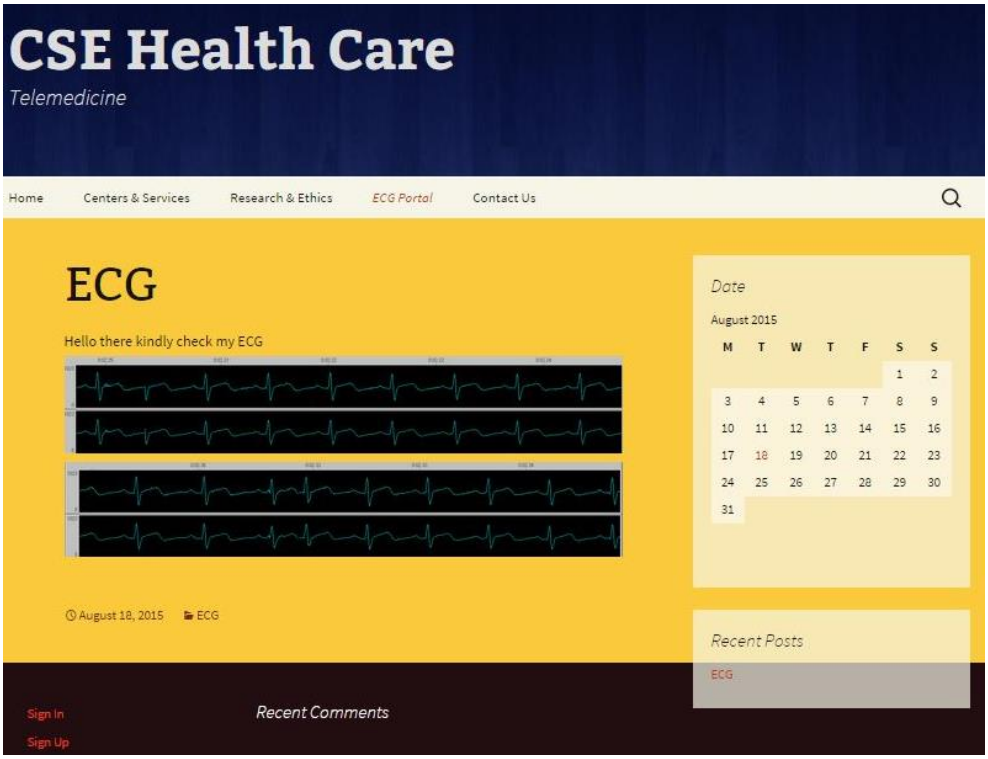


Figure-40: ECG uploading portal

7.3.2 Mobile Frontend Layout

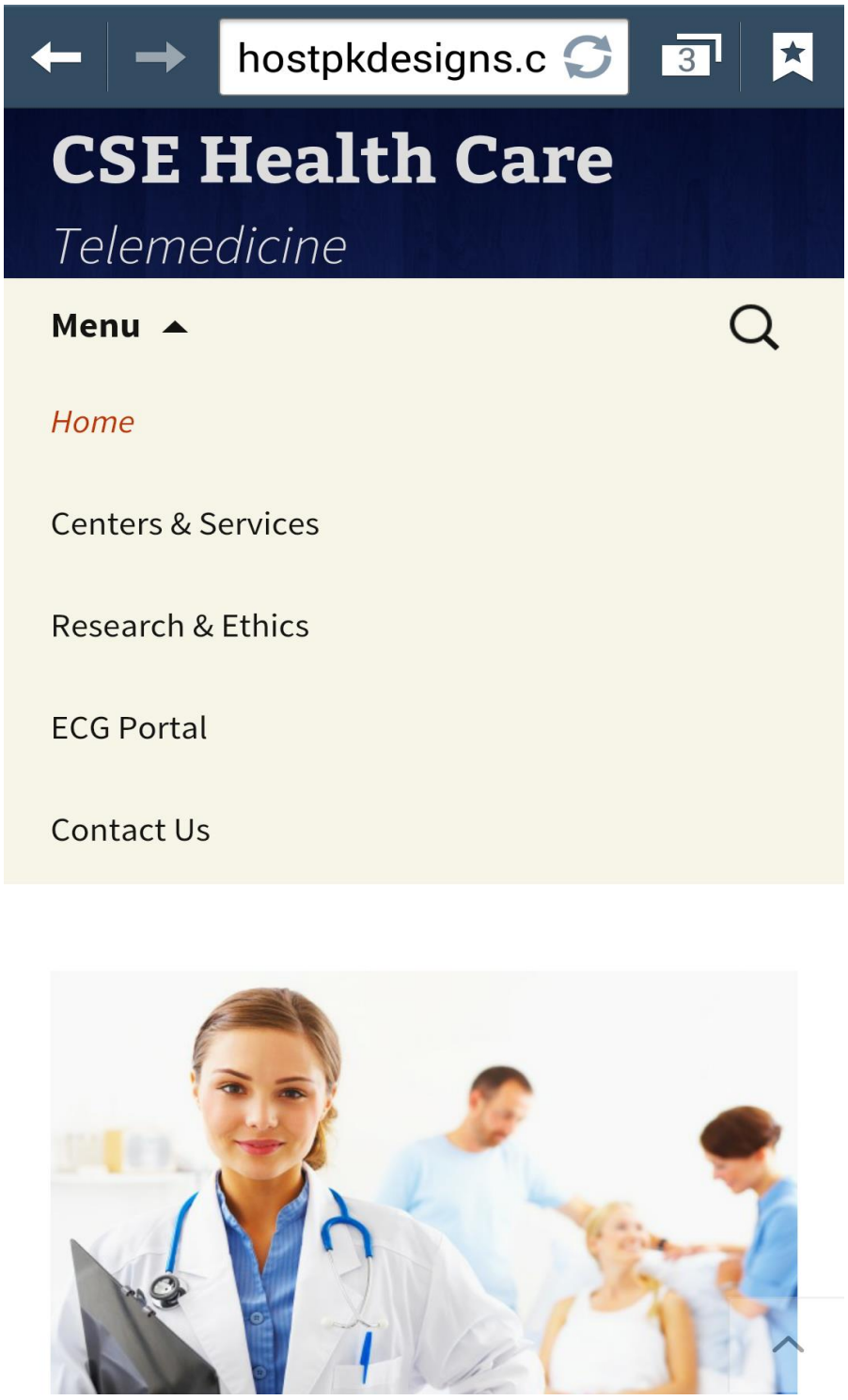


Figure-41: Home page of mobile layout

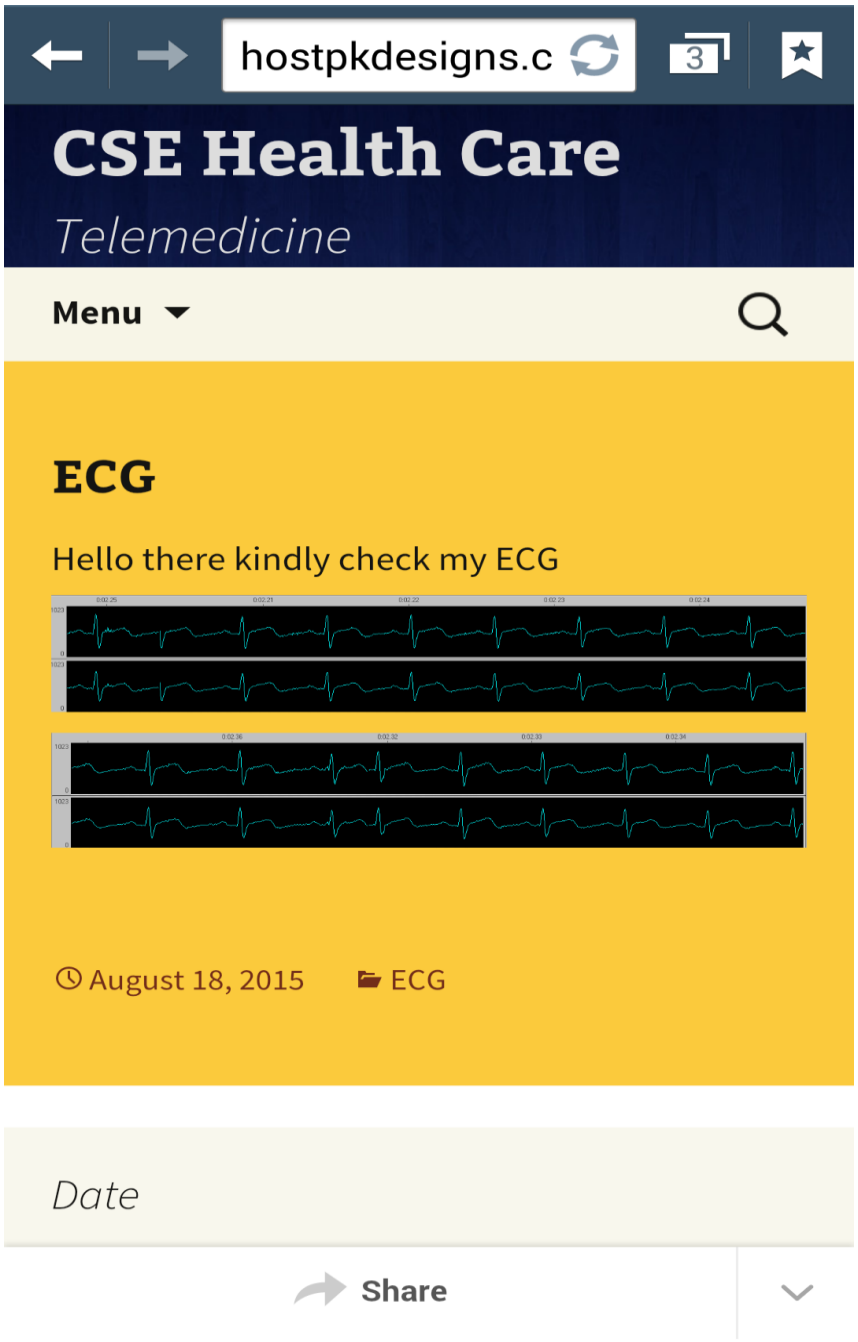


Figure-42: ECG post page of mobile layout

7.4 WEBSITE BACKEND

7.4.1 PC Backend Layout

Website has user friendly backend interface

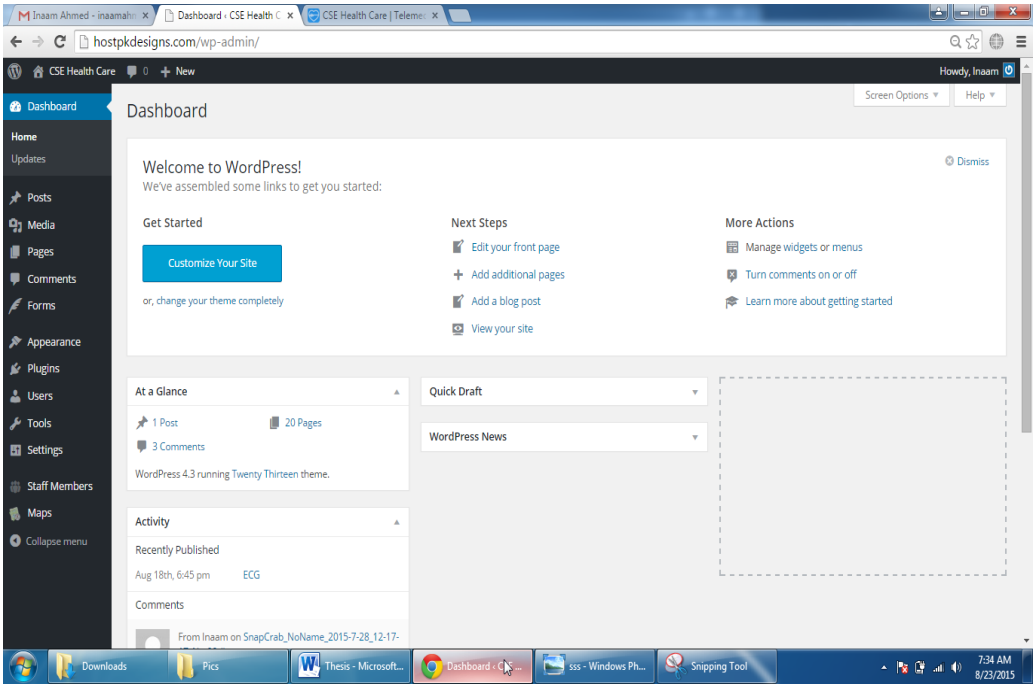


Figure-43: Backend of website "WordPress Dashboard"

7.4.2 Mobile Backend Layout

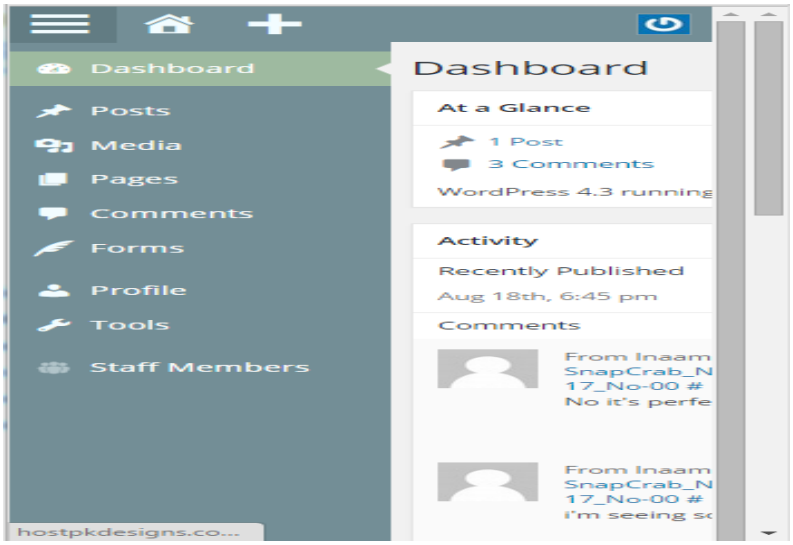


Figure-44: Backend of Website "WordPress Dashboard" Mobile Layout

7.5 USERS AND THEIR ROLE

Website of our ECG based system has membership service under defined roles of users but these users are not to create from front end of website due to security purpose every person who wants to be a member (patient, doctor etc) submit is signup sheet which will be processed by administrator manually any account is then created for use. Some of user types are given below with their roles. Images of their user interfaces are given in appendix A.

7.5.1 Administrator

Highest access level is administrator. He can create edit delete any kind of post pages and manage other users change theme, install plugins. He can change front end of website and any kind of settings required.

7.5.2 Author

He can post own content and change other user's contents. It is password protected

7.5.3 Editor

Publish own and other people contents. It is password protected

7.5.4 Contributor

Access own profile and submit posts

7.5.5 Subscriber

Lowest access level only can view own profile and website front end.

Chapter 8

HARDWARE ASSEMBLY AND ARDUINO PROGRAMMING

8.1 ARDUINO AND EKG SHIELD

Now time comes to assemble all hardware module together to build a final prototype for our web based ECG monitoring system. Following components are going to be assembled

- EKG shield
- Arduino Mega 2560
- Arduino Uno
- 16x2 LCD Display
- Temperature Sensor and Display
- Wooden Box

8.2 MOUNTING EKG ON ARDUINO MEGA 2560

EKG shield is mounted on Arduino Mega 2560 using 6 and 8 pin jack shown in Figure-45.

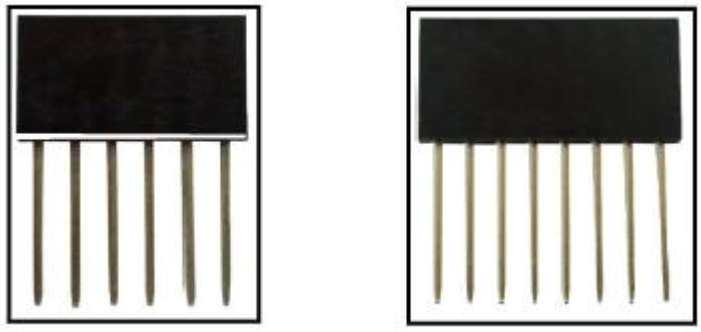


Figure-45: 6/8 connectors

8.3 POWERING UP ARDUINO

To power up Arduino **Mega 2560** we used USB cable also we require permanent connection between Arduino and PC so it's giving two outputs using one input. By giving power to Arduino using USB cable it gives power voltage to EKG

shield and ultimately it's red led becomes on showing EKG is powered up now [9]-[10]. Table- 8. 1 shows pin mapping of Arduino Mega 2560 and EKG Shield

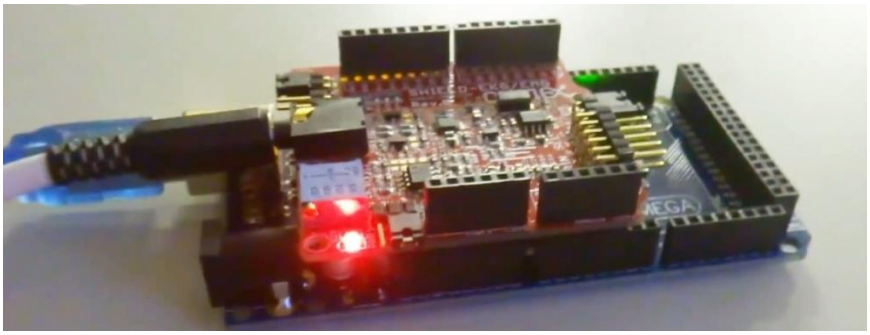


Figure-46: EKG shield mounted on Arduino mega 2560

Table-9: Pin mapping of Arduino mega 2560 and EKG shield

Arduino Mega 2560	**EKG Shield**
A0	A0
A1	A1
A2	A2
A3	A3
A4	A4
A5	A5
Vin	Vin
GND	GND
GND	GND
5V	5V

3V	3V
RESET	RESET
0	D0
1	D1
2	D2
3	D3
4	D4
5	D5
6	D6
7	D7
8	D8
9	D9
10	D10
11	D11
12	D12
13	D13
GND	GND
AREF	AREF

8.4 ELECTRODES PLACEMENT

Electrodes placement is essential part of ECG capturing. Electrode R fastened on Right wrist Electrode L fastened on Left one and Electrode D fastened on right ankle as shown in Figure-47 and audio jack for input analog vibrations into EKG shield as input is given in Figure-48.

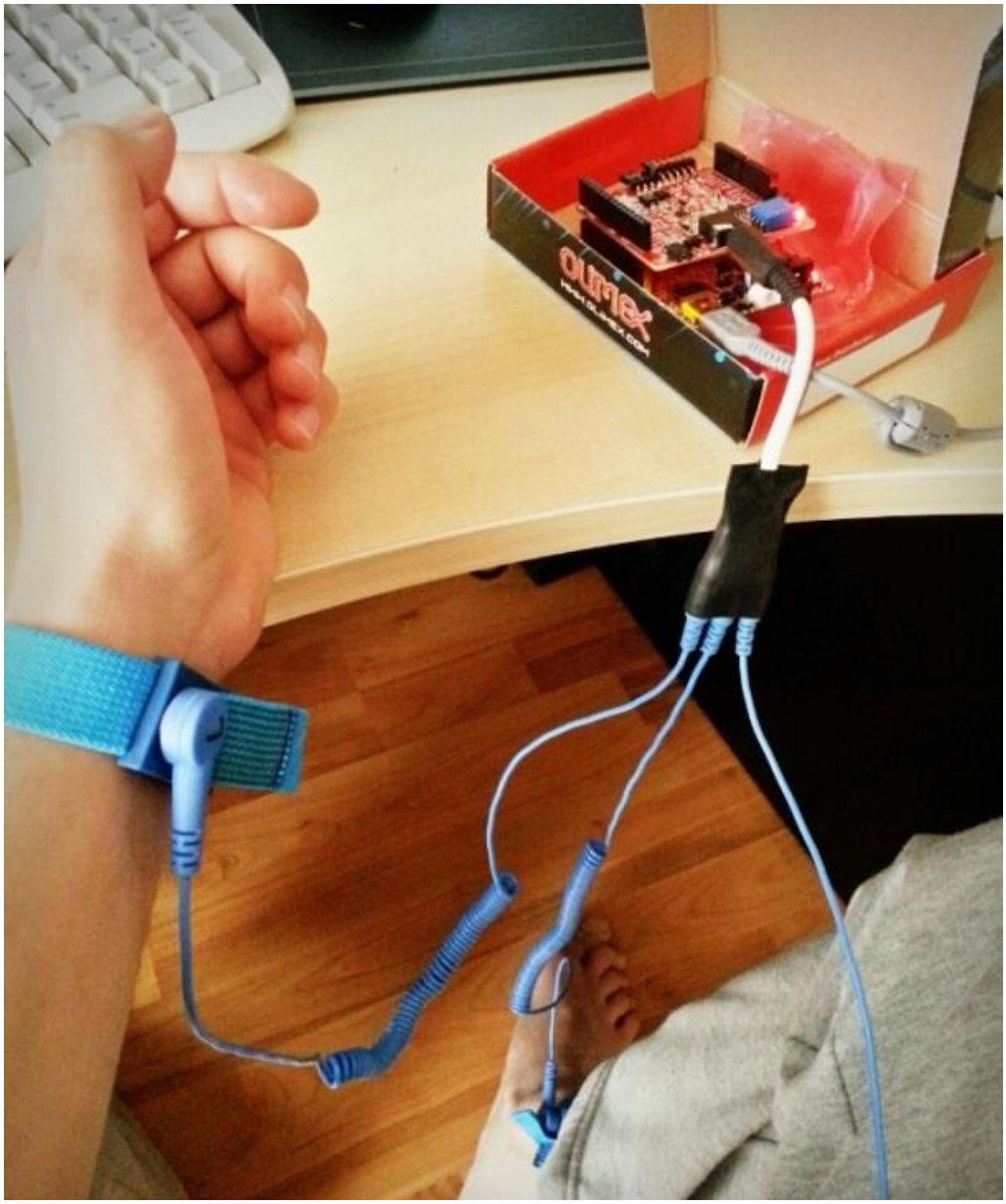


Figure-47: Electrodes placement on hands

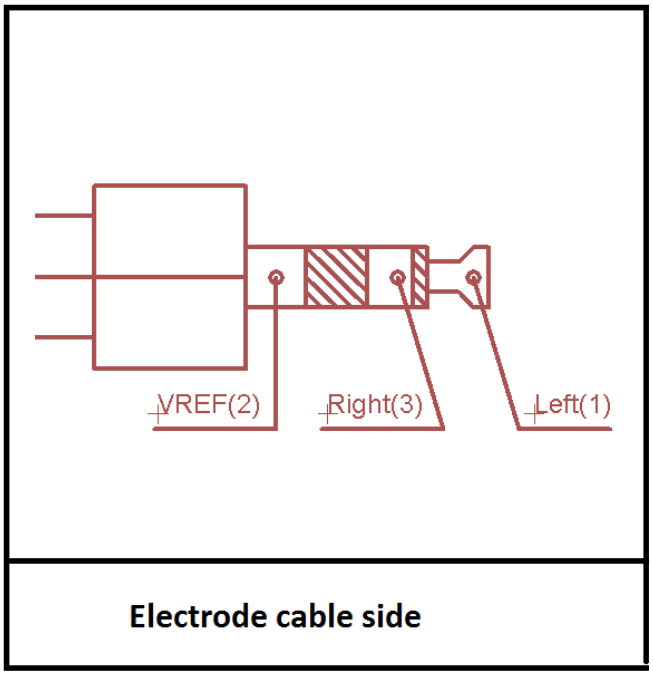


Figure-48: Audio jack 3 pin configuration

8.5 CONNECTING TO PC

To connect Arduino with laptop/PC we need USB A-B cable given in Figure 59 below. Pin description of cable is below in Figure-50.

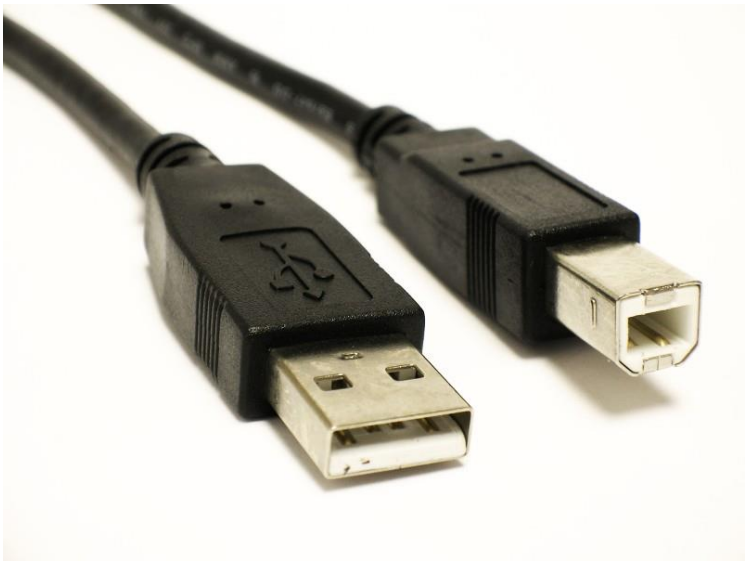
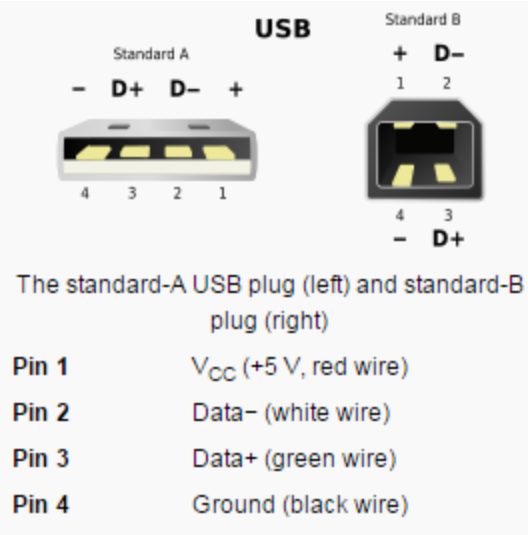


Figure-49: USB A-B cable used for programming Arduino & getting serial data



The standard-A USB plug (left) and standard-B plug (right)

Pin 1	V_{CC} (+5 V, red wire)
Pin 2	Data− (white wire)
Pin 3	Data+ (green wire)
Pin 4	Ground (black wire)

Figure-50: Pin description A-B USB interface

Standard A is connected to PC while standard B connected to Arduino.

8.6 ARDUINO UNO WITH LCD DISPLAY

Arduino Uno is used here to operate LCD for displaying our project title and names of our team members it is just for look of our prototype nothing functional is here. Sketch of Arduino LCD operation given in appendix B sounds good☺. Connection of LCD with Arduino shown in Figure-51 [12] .

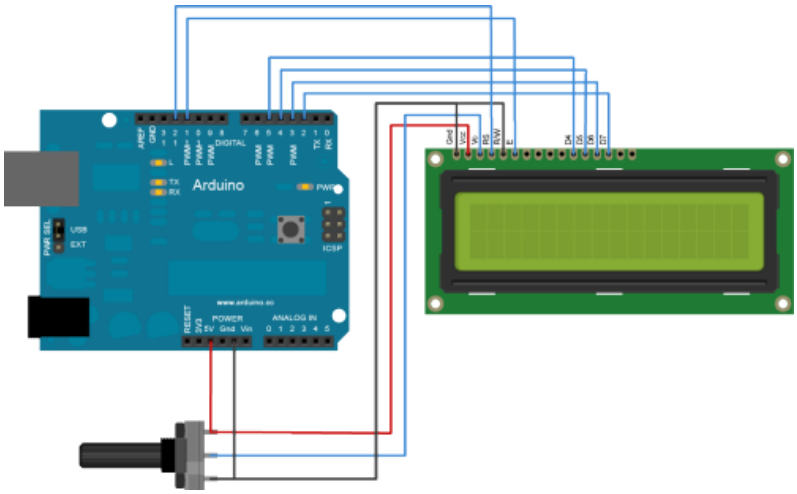


Figure-51: LCD and Arduino Uno connection

Arduino code for LCD display program is given with in compact disk provided with thesis book with file name ladino.

Pin configuration for LCD operation is given below.

- Pin 15 goes to VCC of Arduino and Pin 16 goes to GND of Arduino via Breadboard
- Pin 5 RW of LCD so put it into GND
- Connect Pin 4 RS of LCD to Digital Pin 8 of Arduino
- Connect Pin 6 EN of LCD to Digital Pin 9 of Arduino
- Pin 14 DB7 of LCD to Digital Pin 13
- Pin 13 DB6 of LCD to Digital Pin 12
- Pin 12 DB5 of LCD to Digital Pin 11
- Pin 11 DB4 of LCD to Digital Pin 10

8.7 COOLING FAN

Due to low temperature requirement we have installed cooling fans into wooden cage for sustaining temperature as low as device allows its operation under certain temperature Figure-52 shows cooling fan.

Figure-52: Cooling fan reducing temperature of circuit

8.8 WOODEN BOX FIXING

Complete set of hardware modules is fixed into a wooden box for protection of circuit, physical security is also recommended. Wooden cage shown below in Figure-53.

Figure-53: Wooden box for complete DAM's safety

8.9 FINAL PROTOTYPE OF DAM

Final prototype is shown in Figure-54 [13].

Figure-54: Final prototype of DAM

8.10 ECG DATA PLOTTING

For plotting ECG signal we need a connection to Arduino and software called *"Electric Guru"* Is must be installed, it's a third party and available free on Olimex

you can download and run just by unzipping the file and double clicking the file names *"ElecGuru"* it looks like Figure-55. Some basic settings are required as below

- Set COM port to Connected Arduino COM port under *"Preferences"*
- Set Machine to RS232 under *"Preferences"*

  Figures to do so are given in CD inside "*Electric Guru"* Directory

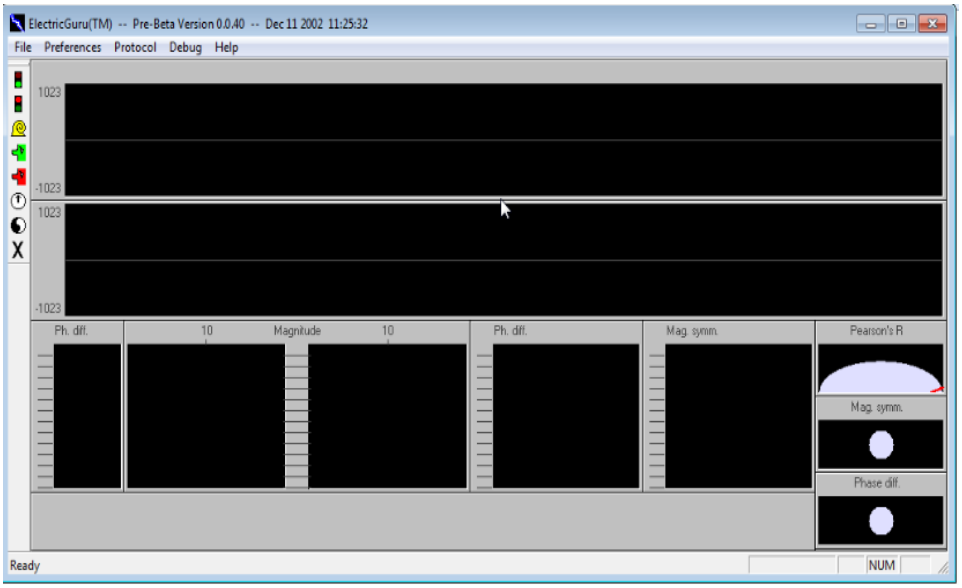


Figure-55: Electric guru interface

8.10.1 Serial Data Transfer and Plot using Electic_Guru

Data acquired from ECG device it sends data in character form with 10 bit mode 1 start bit 1 stop bit and 8 bit character data sandwiched between start bit and stop bit. Software platform recommended by Olimex is used to decode that character data and use fast fourier transform and analyze the frequency spectrum of original heart statistical signal and noise, frequency of noise and original signal determined and use BP filter to remove that noise from original signal and plot it by repeating to process of accessing COM port data on real time. Simple example of that plot in Electric Guru is given below in Figure 56.

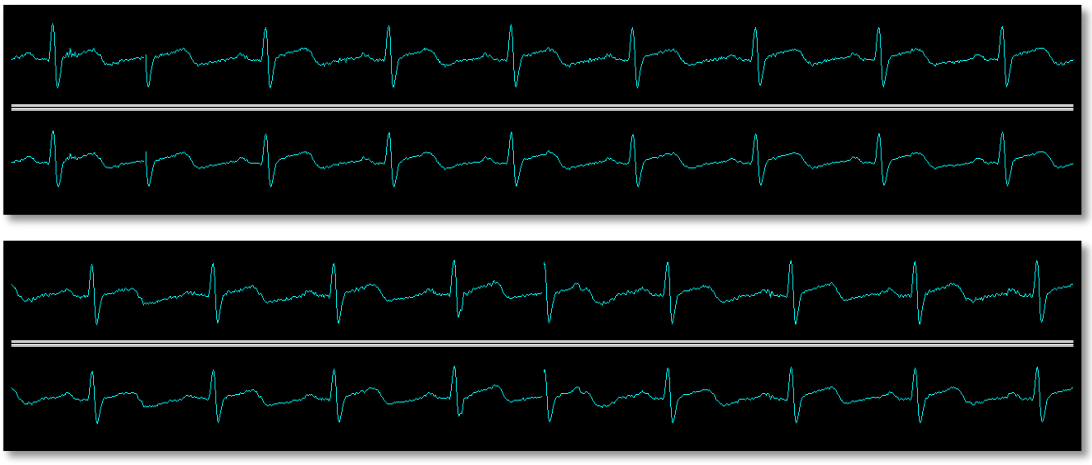


Figure-56: ECG snaps

For Plotting data coming from serial port just click on icon and ECG will start like Figure above and one thing to remember don't move during ECG operation and breathe slowly.

8.10.2 Real Time plot using FreeHC

Another software platform called FreeHC available on web can be used to capture ECG you just have to download from web and double click its . exe file under bin directory. It will start plotting ECG after selecting current COM port as given in below Figure-57.

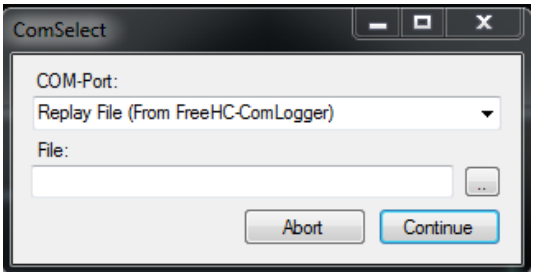


Figure-57: Selecting COM port for FreeHC

It will plot your ECG signal given below in Figure-58.

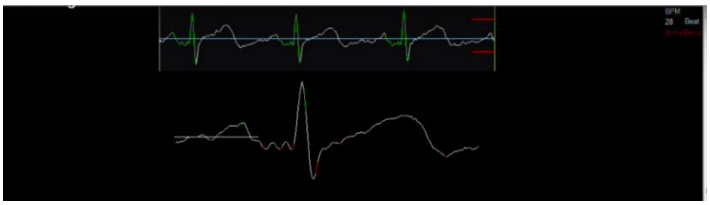


Figure-58: FreeHC Used to Plot ECG

8.11 FINAL DESIGN OF PROJECT HARDWARE

Final prototype of system is given below in Figure-59.

Figure 59: Finalized design of DAM/hardware module

Chapter 9

PROJECT RUNNING PRINCIPLE

9.1 RECORDING ECG

DAM is our data execution module given below is Figure-54.For starting up DAM we power on laptop/PC and plug USB cable into it's one of USB port which is from other interface has B layout inserted in Arduino Mega 2560 B female port. Ultimately connecting with port Arduino Mega 2560 powered up from voltage referenced to laptop/PC USB port. Since EKG shield is mounted on Arduino Mega 2560 get voltage from 5V pin of Arduino and also grounded using GND to GND connecting pin between Arduino and EKG shield shown in Figure-46.

When both boards are powered up Arduino green led is ON and EKG red led is ON. Now EKG is ready to get data from female Audio Jack in which electrodes wire is plugged in using male Audio Jack shown in Figure-61.

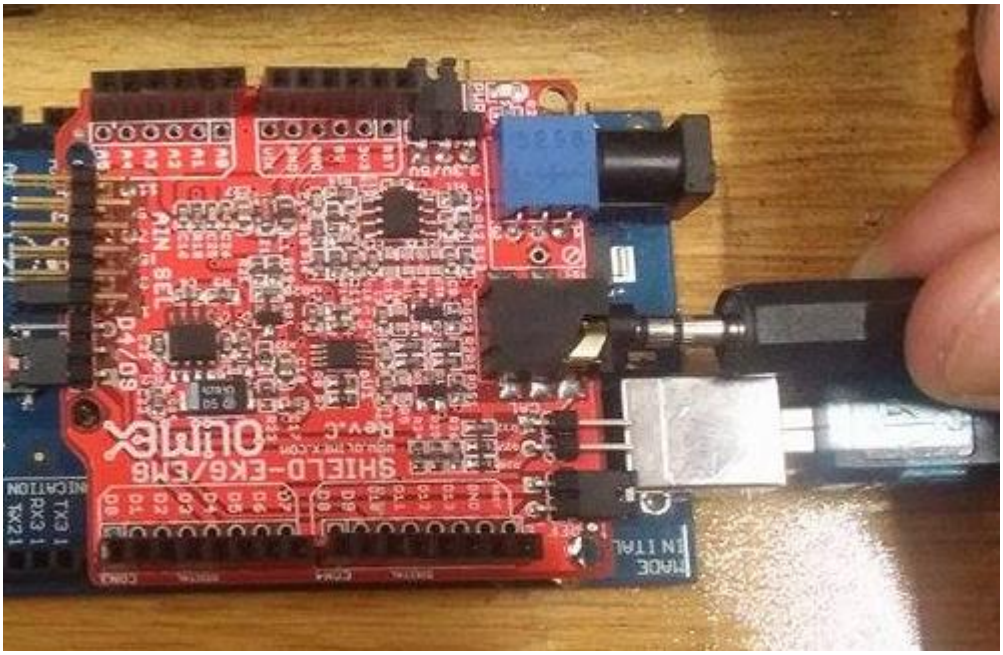


Figure 60: Audio jack inserted into EKG

Note: Avoid touching metallic areas of circuit and also does not

Now place electrodes on your body according to Figure 32, 33 and 57.Now it is time to see your ECG start *ElectricGuru* provided in CD with thesis book or download freely from http://*www.olimex.com*. It will show up interface like Figure-55.

9.2 TAKING SNAPSHOT

Use third party software called *"Snap Crab"* provided in your CD. Double click the icon  and press "*PrntScr"* on your keyboard as many times as you wish to take images and save them one by one on desktop.

9.3 ACCESSING WEBSITE

To access website just the use any popular web browser and type *"http://www.hostpkdesigns.com"* and hit enter. Website home page will display, on menu list choose "*Upload ECG"* from *"ECG Portal"* and now upload your image using form that form. If you wish to add more ECG images you must have login of website which will be provided by Administrator.

Uploaded post will automatically goes to page uploaded ECG's and that is the only way doctor can see that ECG. In response to patient, doctor will comment on that post. and further patient can see that. To see how backend users can post and comment go through the presentation provided in CD so you can approach to posting and viewing constraints. Here we are just giving idea that complete system is operational.

Chapter 10

DISCUSSIONS

10.1 OUR GOAL

We proposed in previous chapters that our need is to design a system which allows doctors to monitor ECG of a patient from remote areas. To implement this scheme we need to design a website and a DAM. Website is source of reliable session creation between doctor and patient whereas DAM is ECG acquisition hardware module. In this way we serve non clinical areas, military camps, homes where clinical services are not available and also for saving time and money for travelling and going through a number of protocols in conventional ECG systems and we are going to get rid of old thermal paper based conventional ECG system where patients have to be present at hospitals and going through a long queue waiting for his/her time to come and report (thermal paper) delivered to doctor manually where chance of error is expected.

10.2 ACHIEVEMENTS

For that we have designed own website that can be accessible from all over the world through domain *www.hostpkdesigns.com*. On the other hand we have designed our low cost electrocardiogram machine called DAM which is used to acquire ECG of a patient and send ECG data to PC through serial port. Patient and doctor have not only to communicate through web but patient can take appointment and it may become a regular customer to our health care center called "CSE Health Care". Finally we have done it as we proposed by implementing some simple strategies.

10.3 PROBLEMS & DRAWBACKS

Although we have succeeded in implementing this web based ECG system but there are some limitations.

- Electrostatic Warnings
- Low Temperature requirement for DAM
- Dedicated person is required to manage DAM is patient is illiterate
- Dedicated website administrator is required to manage website
- lead ECG

- Internet Access is essential
- More hair on arms may results wrong capturing

10.4 CONCLUSION

We conclude the following things while testing implementation and working of our project *"Web Based ECG Monitoring System"* At first we describe the advantages of our project the main thing that energize us to make this project is to reduce the losses of properties and lives of the people due to cardiac diseases. So we decided to design a system that capture ECG of a patient and avail him web login to upload his/her ECG for doctors suggestions.

For this purpose we have used Arduino, EKG shield, LCDs and temperature sensor. Arduino is the brain of our project that controls all components and receive ECG data and further send that data through serial port to PC.

Now we discuss the future enhancements that can be made in this project. We can use just ECG DAM here but EEG and EMG DAMs can also be implemented using the same strategy using same web portal.

10.5FUTURE WORK

Currently we have only implemented electrocardiogram using web but game does not end here we are determined to design electromyogram and electroencephalogram DAM for same system and put them online on out "CSE Health Care". Here is some introduction to EEG and EMG.

10.5.1 EEG

EEG is basically electrical activity of our brain, here electrodes attached to brain and record brain's activity. Electroencephalogram testing shown in Figure-61. It is normally done to diagnose epilepsy. Loss of consciousness, coma, brain dead, sleeping disorder, spinal cord, nervous system problems etc.

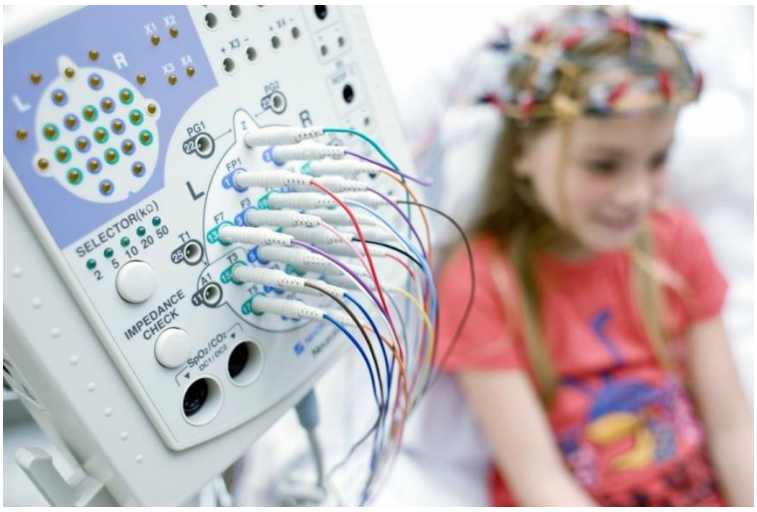


Figure-61: Electroencephalogram setup

10.5.2 EMG

Electromyogram is to assess the health of muscles as it is activity of muscles of human body. Data acquisition module used in EMG module record electrical activities in muscles. EMG used to diagnose nerve malfunctioning, muscles dysfunction and problem in nerve to muscle signal transmission. Figure-62 below is electromyogram example.

Figure-62: Electromyogram setup

Appendix A

```
#include <FlexiTimer2.h>
struct Olimexino328_packet
{
uint8_t   sync0;         // = 0xa5
uint8_t   sync1;         // = 0x5a
uint8_t   version;  // = 2 (packet version)
uint8_t   count;         // packet counter. Increases by 1
//each packet.
  uint16_t     data[6];  // 10-bit sample (= 0 - 1023) in
big endian (Motorola) format.
  uint8_t switches;// State of PD5 to PD2, in bits 3 to 0.
};
#include <compat/deprecated.h>
#define NUMCHANNELS 6
#define HEADERLEN 4
#define PACKETLEN (NUMCHANNELS * 2 + HEADERLEN + 1)
#define SAMPFREQ 256                        // ADC sampling
rate 256
#define TIMER2VAL (1024/(SAMPFREQ))       // Set 256Hz
sampling frequency
#define LED1  13
#define CAL_SIG 9
// Global constants and variables
volatile unsigned char TXBuf[PACKETLEN];  //The
transmission packet
volatile unsigned char TXIndex;           //Next byte to
write in the transmission packet.
volatile unsigned char CurrentCh;         //Current
channel being sampled.
volatile unsigned char counter = 0;       //Additional
divider used to generate CAL_SIG
volatile unsigned int ADC_Value = 0;      //ADC current
value
void Toggle_LED1(void) {
  if ((digitalRead(LED1)) == HIGH) {
    digitalWrite(LED1, LOW);
  }
  else {
    digitalWrite(LED1, HIGH);
  }
}
void toggle_GAL_SIG(void) {
  if (digitalRead(CAL_SIG) == HIGH) {
```

```
    digitalWrite(CAL_SIG, LOW);
  }
  else {
    digitalWrite(CAL_SIG, HIGH);
  }
}
void setup() {
  noInterrupts();  // Disable all interrupts before
initialization
  // LED1
  pinMode(LED1, OUTPUT);  //Setup LED1 direction
  digitalWrite(LED1, LOW); //Setup LED1 state
  pinMode(CAL_SIG, OUTPUT);
  //Write packet header and footer
  TXBuf[0] = 0xa5;    //Sync 0
  TXBuf[1] = 0x5a;    //Sync 1
  TXBuf[2] = 2;       //Protocol version
  TXBuf[3] = 0;       //Packet counter
  TXBuf[4] = 0x02;    //CH1 High Byte
  TXBuf[5] = 0x00;    //CH1 Low Byte
  TXBuf[6] = 0x02;    //CH2 High Byte
  TXBuf[7] = 0x00;    //CH2 Low Byte
  TXBuf[8] = 0x02;    //CH3 High Byte
  TXBuf[9] = 0x00;    //CH3 Low Byte
  TXBuf[10] = 0x02;   //CH4 High Byte
  TXBuf[11] = 0x00;   //CH4 Low Byte
  TXBuf[12] = 0x02;   //CH5 High Byte
  TXBuf[13] = 0x00;   //CH5 Low Byte
  TXBuf[14] = 0x02;   //CH6 High Byte
  TXBuf[15] = 0x00;   //CH6 Low Byte
  TXBuf[2 * NUMCHANNELS + HEADERLEN] =  0x01;     //
Switches state

  // Timer2
  // Timer2 is used to setup the analag channels sampling
frequency and packet update.
  // Whenever interrupt occures, the current read packet
is sent to the PC
  // In addition the CAL_SIG is generated as well, so
Timer1 is not required in this case!
  FlexiTimer2::set(TIMER2VAL, Timer2_Overflow_ISR);
  FlexiTimer2::start();

  // Serial Port
  Serial.begin(57600);
```

```
  //Set speed to 57600 bps
  // MCU sleep mode = idle.
  //outb(MCUCR,(inp(MCUCR) | (1<<SE)) & (~(1<<SM0) |
~(1<<SM1) | ~(1<<SM2)));

  interrupts();  // Enable all interrupts after
initialization has been completed
}
void Timer2_Overflow_ISR()
{
  // Toggle LED1 with ADC sampling frequency /2
  Toggle_LED1();
  //Read the 6 ADC inputs and store current values in
Packet
  for (CurrentCh = 0; CurrentCh < 6; CurrentCh++) {
    ADC_Value = analogRead(CurrentCh);
    TXBuf[((2 * CurrentCh) + HEADERLEN)] = ((unsigned
char)((ADC_Value & 0xFF00) >> 8)); // Write High Byte
    TXBuf[((2 * CurrentCh) + HEADERLEN + 1)] = ((unsigned
char)(ADC_Value & 0x00FF));   // Write Low Byte
  }
  //  // Send Packet
  for (TXIndex = 0; TXIndex < 17; TXIndex++) {
    Serial.write(TXBuf[TXIndex]);
  }
  TXBuf[3]++;

  // Generate the CAL_SIGnal
  counter++;        // increment the devider counter
  if (counter == 12) {   // 250/12/2 = 10.4Hz ->Toggle
frequency
    counter = 0;
    toggle_GAL_SIG();    // Generate CAL signal with frequ
~10Hz
  }
}
void loop() {
  __asm__ __volatile__ ("sleep");

} [14]
```

Appendix B

```
// include the library code:
#include <LiquidCrystal.h>
// initialize the library with the numbers of the
interface pins
LiquidCrystal lcd(8,9,10,11,12,13);
void setup() {
// set up the LCD’s number of columns and rows:
lcd.begin(16,2);
// Print a message to the LCD.
lcd.print("CSE Health Care : ");
}
void loop()
{
// set the cursor to column 0, line 1
// (note: line 1 is the second row, since counting begins
//with 0):
lcd.setCursor(0, 1);
// print the number of seconds since reset:

lcd.print("11CSE12 11CSE25 11CSE108 11CSE128");
delay(800);
lcd.scrollDisplayLeft();
}[13]
```

Appendix C

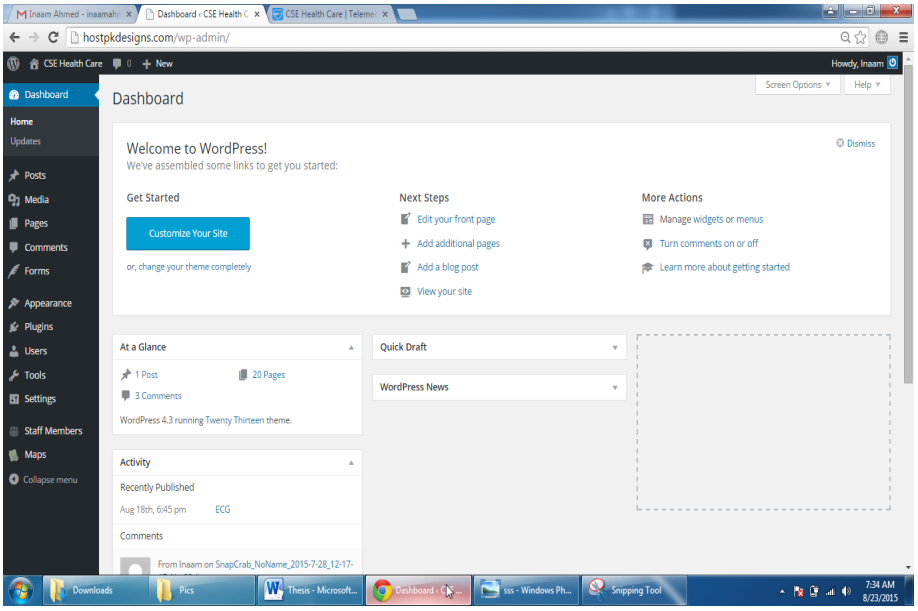


Figure-63: Backend Administrator Panel

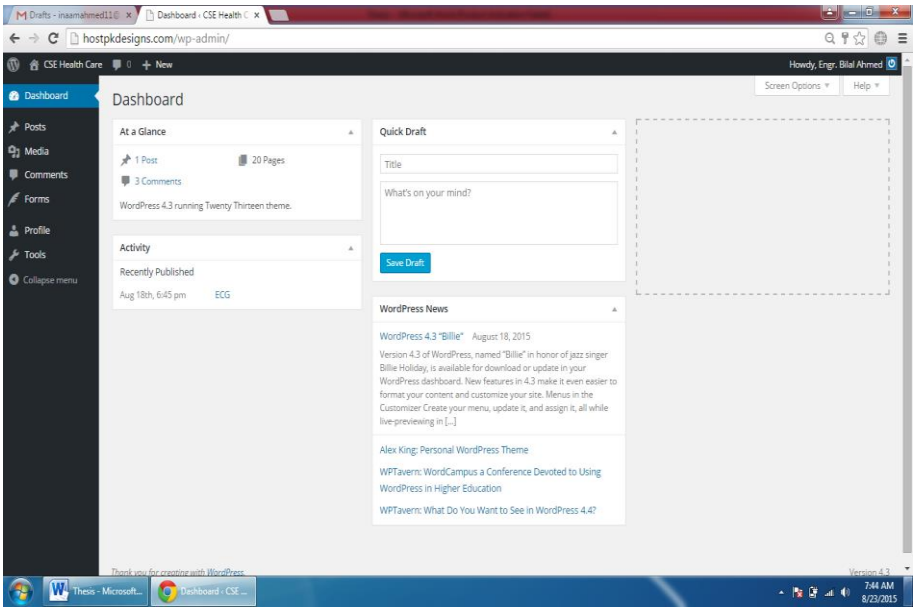


Figure-64: Backend Author Panel

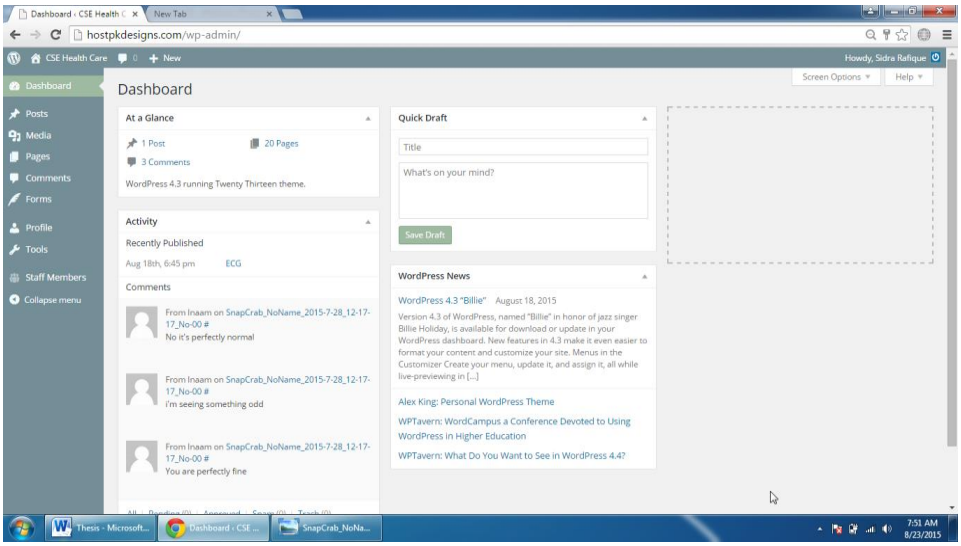


Figure-65: Backend Editor Panel

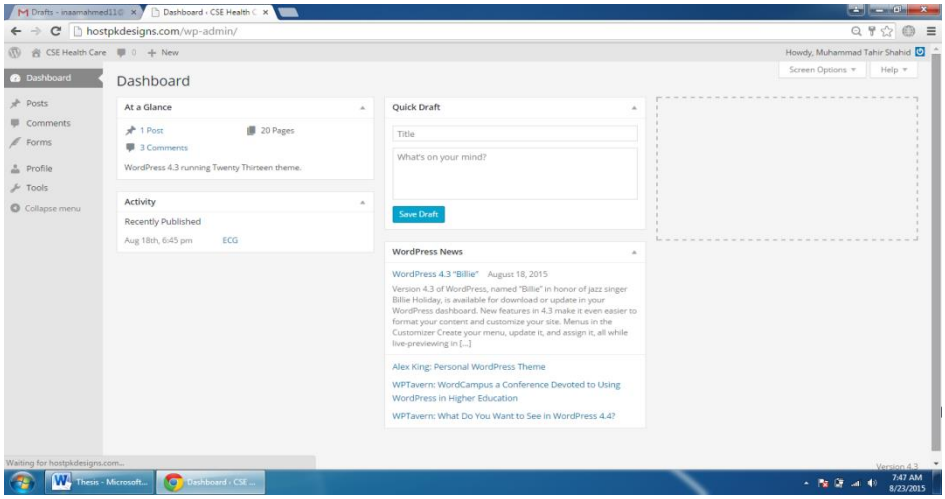


Figure-66: Backend Contributor Panel

REFERENCES

[1] K.M Alajel,K.BYousaf and A.R Ramli "Remote Electrocardiogram Monitoring Based On Internet" KMITL Sci, J. VOL, 5 No.2 Jan-June 2015.

[2] Travis. "2000 Internet Space Application In Lab View". Upper Saddle Space River, NJ: Prentice Hall, pp. 28-52.

[3] Nolina, J. 1994 "Design A 60Hz Notech Filter with the UAF 42". AB-071 Application Bulletin .Burr Brown Carp.

[4] "Heart Disease Health Center", available on-line at http://www. webmd.com/ heart-disease/electrocardiogram accessed on (11:45 PM Mon 09/03/2015).

[5] "About WordPress", available on-line at https://WordPress. Org /about/ accessed on (11:35 AM Tue 10/03/2015).

[6] Behrouz A. Forouzan, Data Communication and Networking, Fourth Edition, Publisher Alan R. Apt.

[7] "DNS-Domain Name System", available on-line at http://www.webopedia.com/ TERM/D/DNS.html accessed on (10:30 AM Mon 16/03/2015).

[8] Price D. "How to read an Electrocardiogram (ECG)". Part One: Basic principles of the ECG. The normal ECG .Southern Sudan Medical Journal 2010; 3(2) 26-28.

[9] "Arduino Genuino", available on-line at https://www. Arduino. cc/ accessed on-accessed on (9:35 AM Wed 06/05/2015).

[10] "SHIELD-EKG-EMG bio-feedback shield USER'S MANUAL" available on line at https://www.Olimex.com accessed on (3:51 PM Mon 01/06/2015).

[11] "Deploying Rail Books", available on-line at http://www.talkingquickly.co.uk /2015/01/diy-ekg-with-Arduino-javascript (1:35 PM Mon 01/06/2015).

[12] "BreadBoard + Arduino Mega 2560 + LCD", available on-line at http:// chetanpatil.info/?s =LCD+ Arduino&submit=Search "Products" available on-line at https://www. Olimex.com (accessed on 10:39 AM Fri 01/05/2015).

[13] Brain w. Evans, Arduino Programming Notebook, Published First Edition August 2007.