ECG DATA ACQUISITION AND WIRELESS TRANSMISSION

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

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

By

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UNDER THE GUIDANCE OF

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DECLARATION

We hereby declare that the work reported in the B.Tech Project Report entitled **"ECG Data Acquisition And Wireless Transmission"** submitted at **Jaypee University of Information Technology, Waknaghat, India** is an authentic record of our work carried out under the supervision of Dr. Harsh Sohal**.** We have not submitted this work elsewhere for any other degree or diploma.

ANUSHKA SHUKLA HIMANSHI SINGH

161014 161021

This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Dr. Harsh Sohal

Date:

Head of the Department/Project Coordinator

ACKNOWLEDGEMENT

Fruitfulness of a project is the culmination of sustained and continuous hard work. Our project is no exception to this. However it would have not been possible without the kind support of many individuals and the department itself, hence it is our privilege to extend our thanks to all those people who have contributed directly or indirectly in the successful execution of our project.

We are heartily indebted to our guide **Dr. Harsh Sohal, Assistant Professor, Electronics and Communication Department**, for his constant support, encouragement, valuable guidance and timely help for the progress of this project.

We express our sincere gratitude towards **Dr. M J Nigam, Head of the Department, Electronics and Communication Engineering**, for his support and enduring encouragement for the successful completion of the dissertation.

It is our privilege to express our heartful thanks to our project coordinator **Dr. Naveen Jaglan, Assistant Professor, Electronics and Communication Department** for his wholehearted support, valuable guidance in all our endeavors in connection with this project.

We also thank all the teaching and non-teaching staff of the department for the direct or indirect help they rendered.

We would like to express our thanks to our parents without whom co-operation and unflinching support we would have not been in the position to complete our project in such a successful manner and we also express our thanks and appreciation to all our colleagues who willingly helped us with best of their abilities.

Lastly, it is our privilege to remember here the grace of God Almighty, for pouring his blessings over us and also for giving us a life to make all of our dreams true.

LIST OF ACRONYMS AND ABBREVIATIONS

S.NO	ABBREVIATION	FULL FORM
1.	ECG	ELECTRO CARDIOGRAPY
2.	HRV	HEART RATE VARIABILITY
3.	SA	SINO ATRIA
4.	AV	ATRIO VENTRICULAR
5.	HR	HEART RATE
6.	SNR	SIGNAL TO NOISE RATIO
7.	LMS	LEAST MEAN SQUARE
8.	FFT	FAST FOURIER TRANSFORM
9.	DFT	DISCRETE FOURIER TRANSFORM
10.	STFT	SHORT TERM FOURIER TRANSFORM
11.	CLB	CONFIGURABLE LOGIC BLOCKS
12.	CWT	CONTINUOUS WAVLET TRANSFORM
13.	DWT	DISCRETE WAVELET TRANSFORM
14.	FPGA	FIELD PROGRAMMABLE GATE ARRAY
15.	ASIC	APPLICATION SPECIFIC INTEGRATED CIRCUIT
16.	IC	INEGRATED CIRCUIT
17.	DSP	DIGITAL SIGNAL PROCESSING
18.	EMG	ELECTROMYOGRAPHY

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ABSTRACT

Second most noteworthy explanation behind death in world is because of coronary illness. Group of clinical people invite the improvement in treatment and urge to find such device that will help in reducing deaths due to heart diseases. One of the most valuable indicative devices for heart tolerant is the electrocardiogram, which work by estimating the little electrical sign produced by the heart. The objective of this project is to build up a gadget, “ECG DATA ACQUISITION AND WIRELESS TRANSMISSION” which outflank presently accessible gadget. It is expected this very device will experience clinical endorsement. This ECG gadget is intended to record single channel of full-range ECG. It stores this gigantic measure of data in the memory for additional correspondence. Remote procedure is utilized to expel weight of mobile electrocardiography gadget. It can screen ECG of a patient, who is starting far. The gadget will show Heart Rate and interval of some basic part and break down ECG for ongoing.

CHAPTER 1

ECG DATA ACQUISITION AND WIRELESS TRASMISSION: AN INTRODUCTION

1.1 INTRODUCTION

The Electrocardiogram (ECG) [1] is an estimation of the electrical action of the heart after some time, caught and remotely recorded as estimated by skin terminals. The signs demonstrate the general cadence of the heart and shortcomings in various pieces of the heart muscle. This strategy is the most ideal approach to gauge and analyze strange rhythms of the heart [1], and is usually utilized in medical clinics everywhere throughout the world. It is additionally utilized in sports and military conditions for cutting edge diagnostics of healthy people.

FIGURE 1.1: ECG Machine

As of late, the exploration network has been dynamic in quest for advancements for a "Remote ECG" where patients are not, at this point required to be connected to a huge fixed gadget while their ECG signals are observed. A significant help behind this pattern is the decreased human services expenses of remote observing, where patients can live in their homes as opposed to involve a medical clinic bed. Numerous frameworks have been proposed to achieve this accomplishment, with changing objectives and approaches [2]. Remote ECG checking should be possible utilizing 3, 4, 5 or 10 sensors, giving progressively itemized data to cardiologists.

The circuitry which is used for capturing and monitoring the data is wearable in nature, which further is transmitted to a close by receiving device. Receiving device can be of both type simple or complex, basic logging or analysis device in case of simple receiving device whereas large hospitals where ECG data is collected actively wirelessly from multiple patients at a time in case of complex receivers. There are two categories in which a wireless ECG system is grouped i.e. first group being the systems [2] with wired sensors which allows patients to be free from being tied to the bulky equipments and for connecting all the sensors to central PDA-sized device it uses physical wires in order for transmission of data to the monitoring systems wirelessly, and another group being systems with wireless sensors.

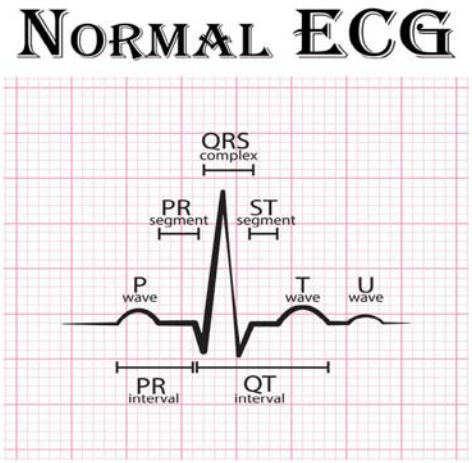


FIGURE 1.2: ECG WAVEFORM

The fundamental target of this venture is to give most extreme accommodation to the client or patient with most extreme comfort during ECG method, particularly for since quite a while ago run. Use of the advanced innovation and media transmission so as to produce the intelligent social insurance supplies is the capacity of remote innovation. For the proficient remote observing framework, utilizing for constant, consistent and precisely data of patient heart condition, the remote frameworks are utilized. In this venture we will structure remote ECG sensor and show its yield on LCD screen remotely.

Willem Einthoven in 1900's, developed ECG method. The Electrical activity of the heart is measured with help of ECG method. There are four chambers inside a human heart which are named as follows. Inferior and superior vena cava is the two large veins through which blood enters inside the heart. How is oxygen added to the blood- blood when it enters the heart is poor blood or blood with carbon dioxide in it, when it enters right atrium through veins it is hen directed to the right ventricle from where it is pushed to lungs, where gas exchange process takes place and oxygen is added to the blood and after addition of oxygen it is again pushed back from the lungs to the left atrium, from here it is forwarded to left ventricle and from here finally oxygenated blood is supplied to each and every part of body through arteries.

There are two main phases in which ECG works:

- Depolarization – Mechanical contraction of either atrium or ventricle is depolarization.
- Repolarization. – Mechanical relaxation of either atrium or ventricle is repolarization.

1.2 PROBLEM STATEMENT

The ECG signals are plotted in the Mill volt extend, in this way are inclined to a great deal of impedance from different sources. The meddling sources are isolated into 3 separate gatherings:

- Noise starting from sources outer to the patient.
- Interference starting from the patient undesirable possibilities.
- Interference starting from understanding anode contact

1.3 SOLUTION

The solution of this project is to develop a method that aims to wireless ECG monitoring of heart activity for patients with heart diseases, faulty pacemakers, and other special heart conditions in order to enable a patient to lead an active life without being confined to various restrictions or specific region. Being able to monitor sick patients remotely, Peace of mind can be obtained by the family after being able to monitor sick patients remotely, as they know that emergency services will be dispatched if any emergency like cardiac arrest or irregular heart patterns occurs.

1.4 OBJECTIVE OF THE PROJECT

The primary goal of this undertaking is to give most extreme comfort to the client or patient with most extreme accommodation during ECG technique, particularly for since quite a while ago run. Use of the advanced innovation and media transmission so as to produce the intelligent medicinal services supplies is the capacity of remote innovation. For the effective remote checking framework, utilizing for constant, consistent and precisely data of patient heart condition, the remote frameworks are utilized. In this undertaking we will structure remote ECG sensor and show its yield on LCD screen remotely.

1.5 ORGANISATION OF DISSERTATION

Further the following topics are discussed in the report:

1) **CHAPTER ONE: Introduction:** A brief introduction to project.
2) **CHAPTER TWO: System Requirements:** The hardware and software requirements of the project are described by this chapter.
3) **CHAPTER THREE: System Design:** The Project description is given by this chapter which includes the block diagram, flowchart of the project.
4) **CHAPTER FOUR: Hardware Description:** This chapter provides the detail information about the hardware components required for the project like microcontroller, GSM module etc.

5) **CHAPTER FIVE: Software Description:** This chapter gives the detailed information about software used in the project.

6) **CHAPTER SEVEN:** Advantages and Disadvantages.

7) **CHAPTER EIGHT:** Conclusion and future scope.

1.6 LITERATURE SURVEY

Low Cost ECG Monitoring System for the Patient using Smart Device: Design and Implementation Miss. Komal Kharde, Miss. Vaishali Shinde, Prof. P. R. Ugale, Student, BE Computer, SPCOE, Department Of Computer Engineering, Dumbarwadi, AssistantProfessor, SPCOE, Department Of Computer Engineering, Dumbarwadi: CardiovascularDisease (CVD) is one of the major reasons of death in the world. Heart arrest rate is rising very fast pace day by day, with current rate of 25%. The main reason behind this is the unhealthy lifestyle followed by the people. Improper medical care given to the patient at the time of cardiac arrest is one of the main reasons for the same. Regular health check up is required to avoid various heart diseases. For some cases, frequent monitoring of ECG is required, but due to expensive equipment and time taking process it is not possible for every person to afford it, and this is the limitation of the ECG system that is most commonly used in the hospitals. In order to overcome this and to monitor ECG of an individual anytime and anywhere followed by sending the report to the doctor for further communication, there is a need of a device which is portable, cost effective, less power consuming and also time efficient. This paper illustrates a portable, cost effective, less power consuming and also time efficient ECG monitoring device development. The platform used for transmission is Android because of its common availability on mobile phones and also due to its future growth.

ECG Monitoring System using Arduino and ESP8266 Dr. N.Shanmugasundaram, R.Bharathkumar, T.Gowthamraj, V.Kaliyugathuayyan, A.Manojkumar Sri Eshwar College of Engineering, Coimbatore, Tamil Nadu, India: Designing of ECG monitoring system with the help of ESP8266 and arduino microcontroller is illustrated by this paper. Input to the system is given in the form of pulse taken with the help of Ag/CI 3-lead electrodes attached on the right leg andarms of the patient. Pulse from patient is taken under proper inspection. For signal conditioning of the input pulse and to view it on the serial monitor window as an ECG

waveform, an ECG module (ESP8266) is comprehended by this model. In order to control and transmit the functionality of the ECG wave to monitor and also for displaying the normality or abnormality of the ECG wave along with the ECG wave on LCD, microcontroller Arduino UNO is used to process conditioned signal.

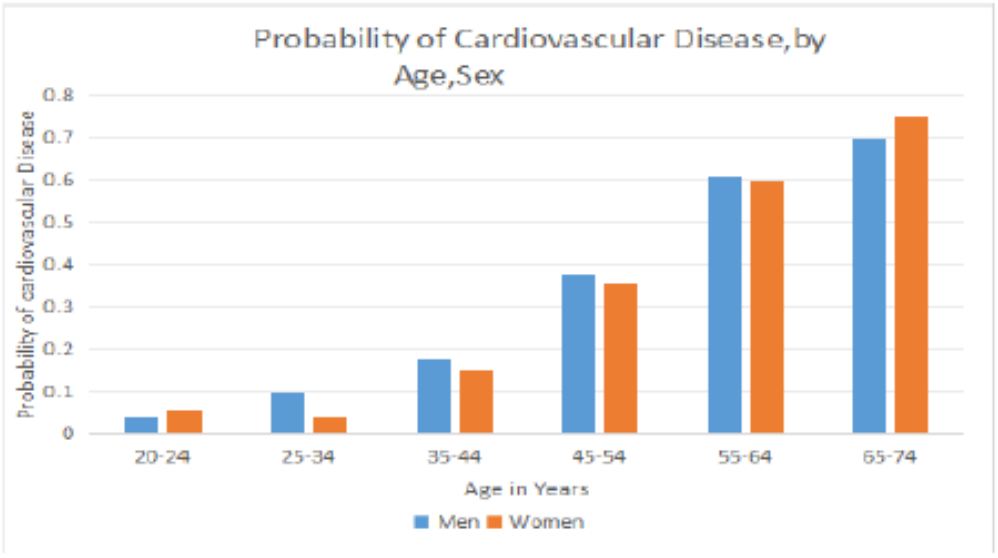


FIGURE 1.3: PROBABILITY OF CARDIOVASCULAR DISEASE BY AGE, SEX

Real Time ECG and Saline Level Monitoring System Using Arduino UNO ProcessorP.Kalaivani, T.Thamaraiselvi, P.Sindhuja and G.Vegha Assistant Professor, Department ofElectronics and Communication Engineering, SNS College of Engineering, Coimbatore,India. UG Student, Department of Electronics and Communication Engineering, SNSCollege of Engineering, Coimbatore, India. UG Student, Department of Electronics andCommunication Engineering, SNS College of Engineering, Coimbatore, India. UG Student,Department of Electronics and Communication Engineering, SNS College of Engineering,Coimbatore, India: In this era the lifestyle of an individual is highly affected by the growth of wireless technology and mobile services. Many early attempts have been made by the medical industry to introduce these technologies in medical science. In order to contribute in the same line development of wireless ECG monitoring system is new and innovative idea. The aim of this system is to provide health care to a patient at the time of

emergency anywhere irrespective of the situation and place. In this system ECG of a patient is sensed through electrode system via ESP8266 whose ultimate goal is to provide arduino with amplified minor and small bio signals for processing along with the saline levels. IR sensors are used to detect saline levels. For indicating saline levels and for showing electrical pulse output LCD and serial monitor are used respectively. Serial plotter is used for displaying analog signal. Rest all outputs are displayed through mobile applications.

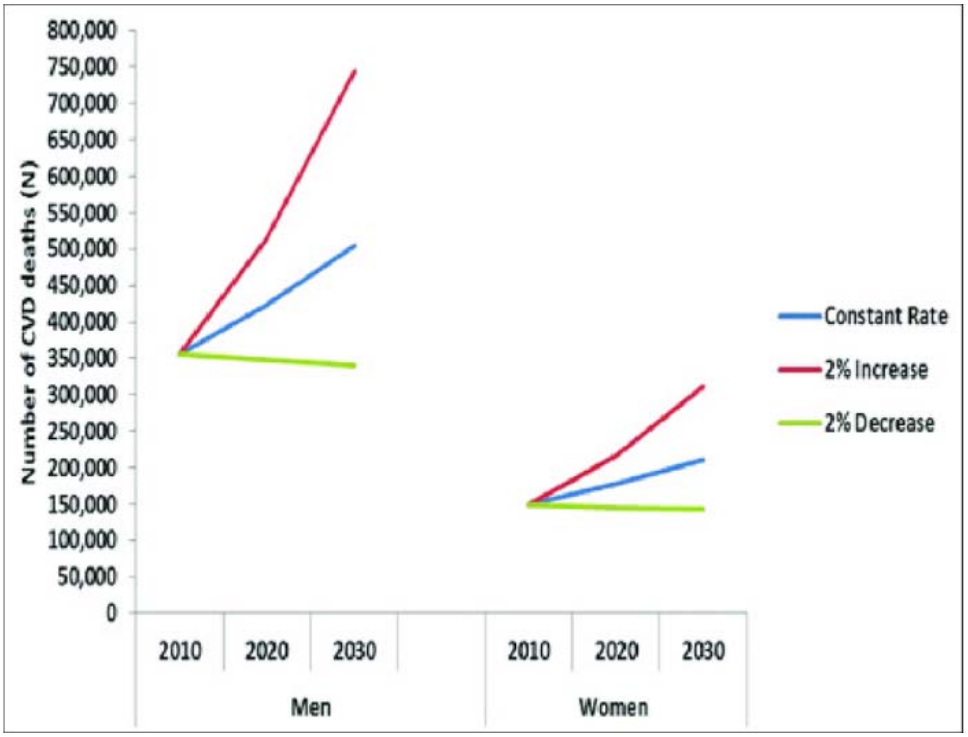


FIGURE 1.4: RATE OF CARDIOVASCULAR DISEASE DEATHS

Real Time ECG Signal Transmission for Remote Monitoring Allada Tirupathi Rao, M.Gopi, M.V.S.S.Prasad: This paper illustrates the development of a wireless monitoring system that monitors patient's heart rate as its major objective. It further illustrates easy-to-use and non invasive monitoring of the ECG using wireless steering wheel. A prototype model in terms of steering wheel is used. A continuous wavelet transform based algorithm for detecting the heart rate is used because of its special design to avoid noise and interference while acquiring ECG.

Heart pulses are monitored from the recorded nerve voltages. The recorded voltages are then send to amplifier for amplification and then to a filter for removing noise. Then, an analog to digital convertor (ACD) is used which converts analog voltages to digital voltages which are then stored in EEPROM of arduino. These values are then sent to PC wirelessly.

CHAPTER 2

SYSTEM REQUIREMENT SPECIFICATIONS

The framework equipment and programming prerequisites for the usage of the proposed project are referenced beneath:

2.1 SOFTWARE REQUIREMENTS

1. MATLAB
2. ARDUINO UNO.

2.2 HARDWARE REQUIREMENTS

1. Arduino Uno.
2. 16*2 LCD Module
3. Jumper Wire
4. Potentiometer
5. Microcontroller (ESP8266)

CHAPTER 3

SYSTEM DESIGN

3.1 PROJECT DESCRIPTION

In order to maintain the wellness of the patient thorough assessment is utmost importance. The ECG seems to have a lot many benefits.

Heart diseases cause about 7.3 million of deaths every year. Electrical activity of the heart in recorded form is known as Electrocardiography. ECG can comfortably monitor a number of coronary heart malfunctions or disorders.

Advantages of ECG are listed below:

- Chest and abdominal pain etc. information is given by ECG.
- Cost effective and safe method.
- Silent heart condition can be detected.
- Low mobility.
- It is a diagnostic method.

Main challenges faced by ECG devices are listed below:

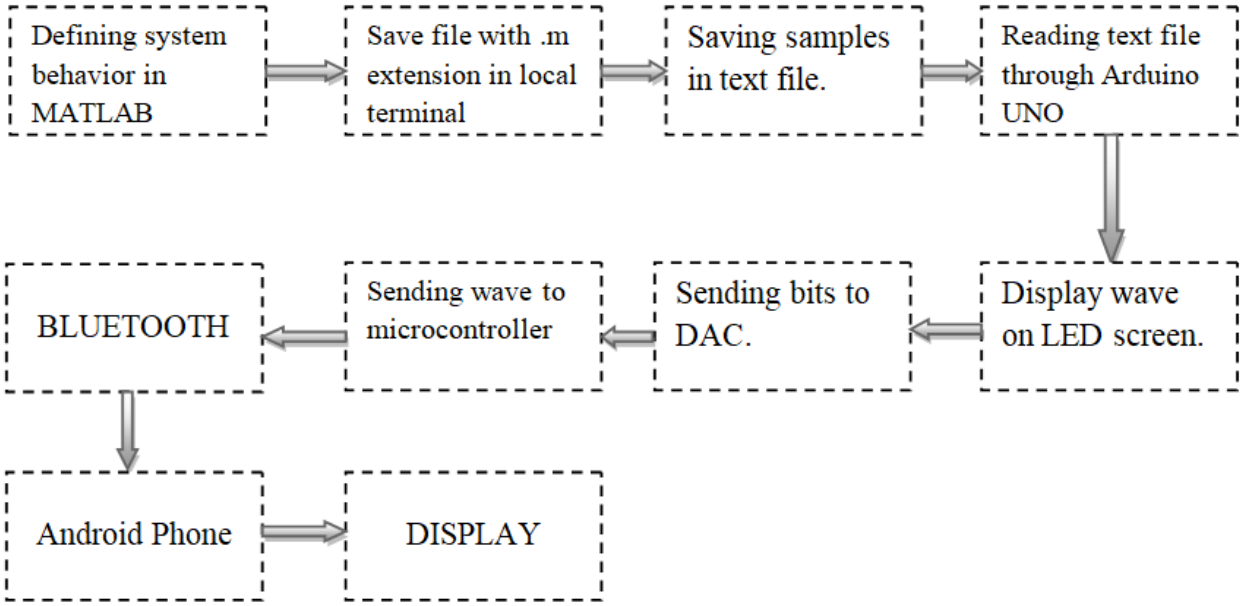
- A convenient ECG observing framework with at standard exactness and which is incorporated with different capacities which make it fit in the homecare administrations and adequate execution is required.
- A FPGA board ought to be utilized to make a convenient inserted framework for most appropriate home consideration and wellbeing observing.
- FPGA strategy to be utilized so as to perform ECG pre-preparing and pulse changeability (HRV) highlight extraction based on disconnected information sheet
- Parallel processing of large scale ECG data analysis.

Under stringent time constraint real rime computation should be done.

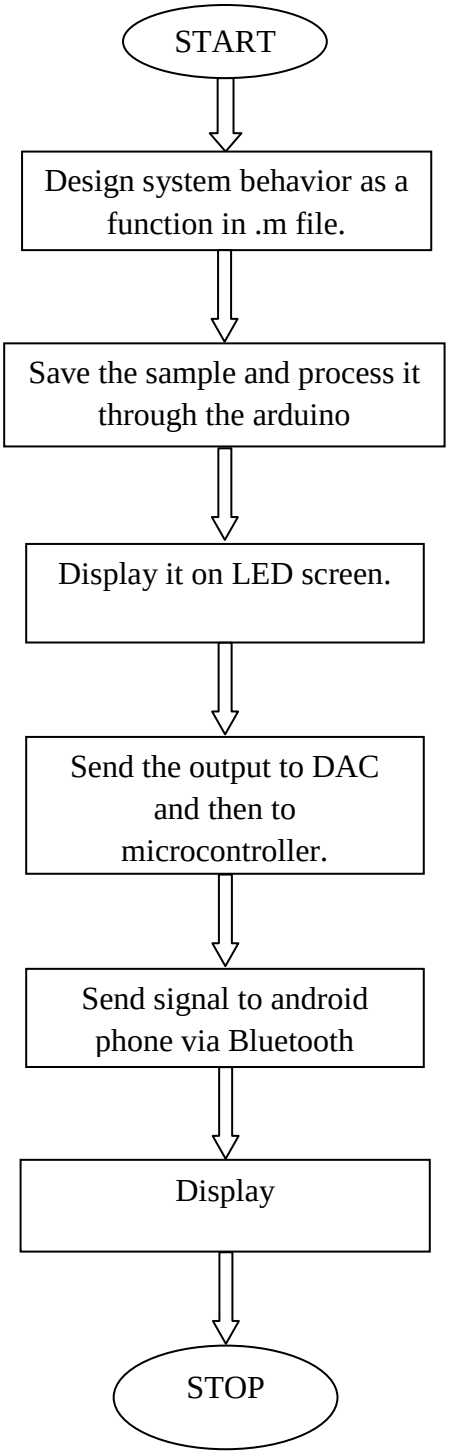
3.2 SOLUTION

The solution of this project is to develop a method that aims to wireless ECG monitoring of heart activity for patients with heart diseases, faulty pacemakers, and other special heart conditions in order to enable a patient to lead an active life without being confined to various restrictions or specific region. Being able to monitor sick patients remotely, Peace of mind can be obtained by the family after being able to monitor sick patients remotely, as they know that emergency services will be dispatched if any emergency like cardiac arrest, or irregular heart patterns occurs.

3.3 BLOCK DIAGRAM



3.4 SYSTEM FLOWCHART:



3.5 METHODOLOGY

3.5.1 GENERATING CODE THROUGH MATLAB

For specialized figuring MATLAB is considered as a superior language. It incorporates computation, perception, and writing computer programs is coordinated in a situation which is effectively utilized by people, and where fundamental scientific documentation is utilized for communicating issues and arrangements.

Together P, Q, R, S, T and U waves as appeared underneath is utilized to speak to a fundamental ECG wave structure. Q, QRS, S waves and P, T, U waves can be spoken to by triangular and a sinusoidal waveform individually. By the expansion of these waves an ECG sign can be created. Fourier arrangement is utilized to speak to an ECG wave as it is intermittent in nature.

- **Modeling of basic ECG signal using Fourier Series**:
  It is shown below:

$$F(x) = a_0/2 + \sum_{N=1}^{\infty}[a_n \cos(nwx) + b_n \sin(nwx)]$$

Where,

F(x)—› represents instantaneous amplitude of an ECG signal.

a_0 —› constant, representing average amplitude value.

x —› variable representing angular frequency of ECG signal.

$x = 2p/T$

T—› period of ECG signal.

a_n, b_n —›Fourier coefficient.

a_0, a_n and b_n are calculated by given formulas:

$$a_o = 2/T \int_0^T f(x)\, dx$$

$$a_n = 2/T \int_0^T f(x)\cos(nwx)dx$$

$$b_n = (2/T)\int_0^T f(x)\sin(nwx)\, dx$$

- **Modeling of Q, QRS and S waves with Fourier Series:**

  Q, QRS and S waves can be assumed in triangular waveform as below. Let the period of signal be equal to T = 2l and it is assumed that the amplitude of signal, f(x) can be calculated as,

((-bax/l) +a) if (0<x<(1/b)

f(x)=0 if x=0

((bax/l) +a) if ((-1/b)<x<0)

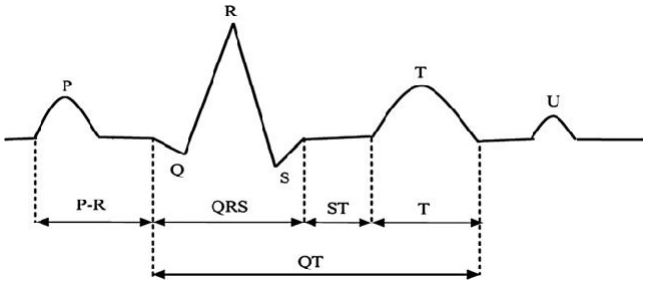


FIGURE 3.1: A basic ECG Signal

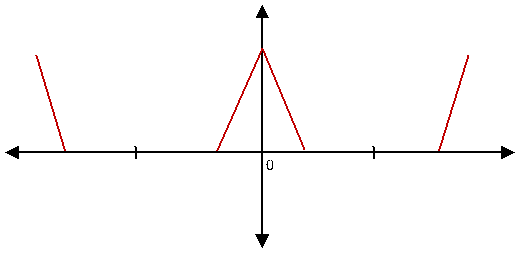


FIGURE 3.2: QRS WAVEFORM

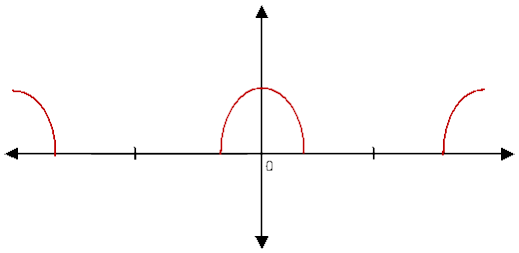


FIGURE 3.3: P, T AND U WAVES

$F_{Q,QRS,S}(x)$ can be calculated as shown below. It can be seen below no sinusoidal harmonic since $f_{Q,QRS,S}(x)$ is symmetric and bn = 0

$$f_{Q,QRS,S}(x) = (a_o/2)+\sum_{n=1} a_n \cos(n\pi x/l)$$

From the above equation we get,

$$a_o = (a/b),\ a_n = ((2ba/n^2\pi^2)(1-\cos(n\pi/b)))$$

- **Modeling of P, T and U waves with fourier series:**

P, T and U waves can be assumed in sinusoidal waveform, thus, f(x) can be calculated by

$$f(x) = \cos(\pi bx/2l)\ ,\ if((-1/b)<x<(1/b))$$

$F_{P,T,U}(x)$ may be written as, it can be seen below no sinusoidal harmonic wave since $f_{P,T,U}(x)$ is symmetric and $b_n = 0$

$$f_{P,T,U}(x)=(a_0/2) +)+\sum_{n=1} a_n \cox(n\pi x/l)$$

Let a_o and a_n are solved by the help of above equation, we get,

$$a_o = 4/\pi b$$

$$a_n = (4b\cos(\pi n/b))/(\pi(b-2n)(b+2n))$$

Finally, we get a clear ECG signal consists of the combination of P, Q, R, S, T and U waves. Thus, it can be calculated as

$$f_{ECG} = f_Q(x) + f_{QRS}(x) + f_S(x) + f_P(x) + f_T(x) + f_U(x)$$

- **Modeling of arrhythmias with Fourier series:**

Arrhythmias can be differentiated with the normal ECG on the basis of heartbeat forms as it has irregular heartbeat forms unlike normal ECG signals. For example, Absence of some essential components of ECG like P, U wave and may be any other wave, extreme amplitudes value that is either very high or very low which results in either very high or very low heartbeat can be classified as arrhythmia. Fourier series is used here in order to model nine (9) arrhythmia types, by making various small changes in the final equation of normal ECG wave.

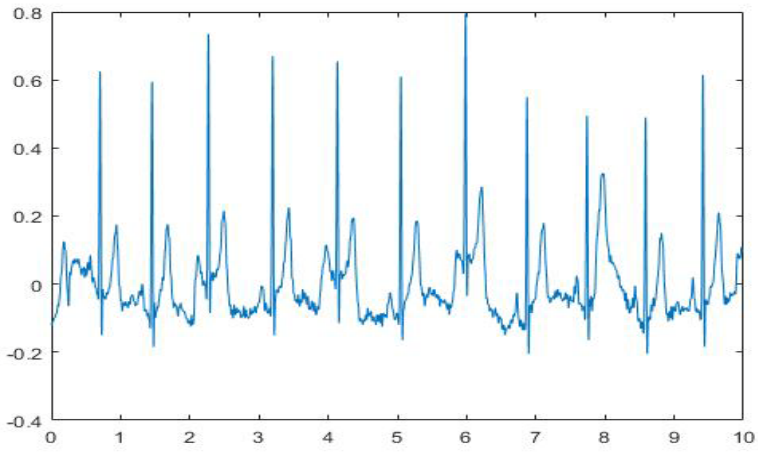


FIGURE 3.4: NORMAL ECG WAVE

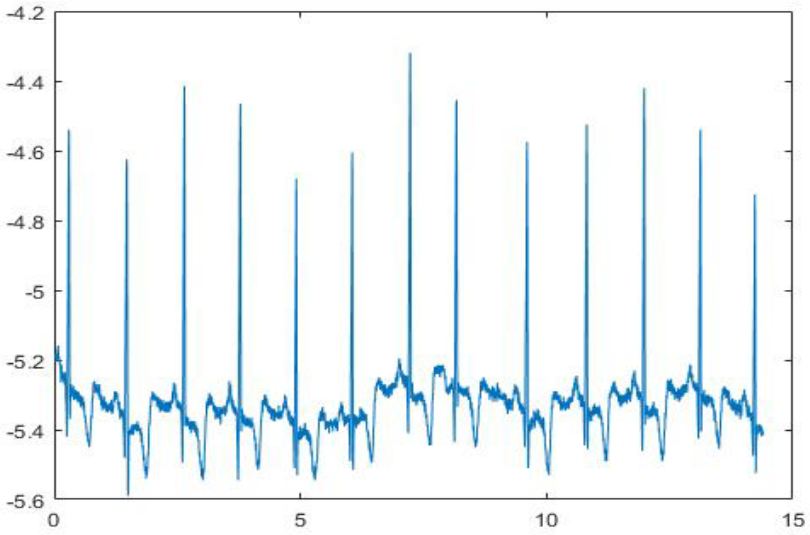


FIGURE 3.5: ARRHYTHMIA WAVE

3.5.2 READING TXT FILE THROUGH ARDUINO AND DISPLAY ON SCREEN:

The Arduino Uno board, pre-modified with the Arduino boot loader is utilized in this venture. Arduino IDE form 1.0.3 on windows working framework is utilized as the programming IDE for this undertaking.

The arduino expert smaller than expected board has worked in ADC which peruses as well as changes into their computerized equal. The info arrives at the ADC with the assistance of information channels that are most extreme eight in number and are set apart in board as A0, A1, A2, etc till A7 and can be designed as simple information pins.

In this specific undertaking pin A0 is associated with the variable pin of the potentiometer. VCC and GND are associated with the other two pins of the potentiometer so as to isolate the voltage as the variable moves consequently furnishing the Arduino board with flexibly voltage as simple information.

There is a worked in function in the arduino IDE which helps in perusing the simple incentive from input, called analogRead(). Impression of the waveform shown on a LCD is dictated by the deferral() function. This capacity is utilized in request to create a postponement between

the code steps delay() function is utilized and in this specific undertaking for setting delay between the progressive showcases of the custom characters this capacity has been utilized.

The information given to the postponement () function is the simple sensor esteem which is perused with the assistance of analogRead() function by the utilization of some alignment procedures. At that point the simple voltage read from the sensor will be identical to the produced delay. In this task waveform was created through custom characters that equivalent.

3.5.3 PROCESSING SIGNAL:

Data is converted from its digital form to the analog form with the help of device known as Digital to Analog Convertor or DAC. With the help of two features that is Bandwidth and Nyquist criterion any data which is in sampled form can be perfectly reconstructed - “Nyquist-Shannon sampling theorem”.

Precisely an analog signal can be reconstructed from its sampled data with the help of a DAC. Ultimately the conversion of digital data to an analog signal is required though it may be produced from different sources like microprocessor, Application Specific Integrated Circuit (ASIC), or Field Programmable Gate Array (FPGA), for its interaction with the real world.

DACs find its applications in various digital signal processing applications and many more other applications such as:

Data Acquisition Systems:

Processor receives the digitalized data by analog to digital convertor which needs to be measured. In data acquisition a process known as control end is also included, in which the feedback data is send to a DAC from processor in order to convert it to analog signals.

Because of the reasons that DACs are a largely specification driven, one can always pick the required one by identifying it by just looking at the packaging. If a cheap or cost effective amplifier is required to go along with the DAC then FIIO is the right place to purchase it. Too much money sinking is not required and also not worth it for this work.

3.5.4 DISPLAYING VIA BLUETOOTH ON PHONE

AFE Module is used for filtering, amplifying and digitalizing the raw ECG which is acquired by the Data Acquisition System (DAQ). The digital ECG is stored after a command to acquire the ECG data wirelessly from DAQ is received from an android application via smart phone. MATLAB is used for plotting the acquired data.

The bioelectric signal achieved from the data is shown by the ECG. There are five segments of an ECG wave known as P wave, Q wave, R wave, S wave and T wave which is additionally carried on by U wave that is contingent. For full lead ECG records, inference of 10 terminal positions is required for acquiring 12 lead ECG signals. For exact ECG signal securing spillage current under 1 A with low information and high regular mode dismissal proportion is basic [7]. In the wake of dealing with all the previously mentioned prerequisites ECG terminals which are comprised of silver chloride (Ag Cl) material are appended to the patient's body. For securing 12 lead ECG information ADS129x ECG signal procurement chip, a Texas instrument is utilized as the Analog front end. Little size fine execution is accomplished by it. Application arranged usefulness is conveyed by ADS129x than straightforward sign molding. The previously mentioned chip discovers its dominant part of utilizations in Electromyography (EMG), Electrocardiography (ECG) and Electroencephalography (EEG). For synchronous inspecting process low clamor Programmable Gain Amplifiers (PGAs) eight in number and high goals 24-piece Analog to Digital Converters which are additionally eight in number alongside an on-board oscillator and a reference voltage are fused in the chip. The enhancers are additionally enveloped for Right Leg Drive (RLD), Wilson Central Terminal (WCTs) and Goldberger Terminals (GCT). Pacing beats created by a cardiovascular pacemaker can be recognized inside an ECG signal. The ADS129x likewise incorporates barely any highlights like low force utilization for example 0.75 mWatt, for inside producing signals for test an adaptable information multiplexer for every channel is appended, temperature and lead off recognition. Voltage scope of 1.65-5.25V on advanced side and 2.7-5.25V on simple side is utilized for chip working. In ESP8266 chip Tensilica Xtensa, a microcontroller is utilized. What makes a DAQ practical is its little size and minimal effort. Here we have utilized 12E form out of the different adaptations present. For correspondence with ADS129x and 17 GPIO's universally useful information yield (GPIO) pins are utilized which are effectively accessible. The ESP8266 Arduino IDE is utilized for programming which bolsters all the Arduino libraries.

Android telephone remotely gets the ECG information that is gotten at the microcontroller. For lossless remote transmission of information Bluetooth is utilized. For Bluetooth transmission, a Bluetooth module, for transmitting information by means of Bluetooth is utilized [8]. RS-232 interfacing is utilized for associating the ESP8266 microcontroller and the Bluetooth module. Cell phone progressively shows 8 leads after the information is gotten from the obtaining framework by means of advanced mobile phone. Utilizing 3G/4G portable web joins (3G/4G) on the telephone information is spilled on web stage by means of advanced cell. The procured information is plotted utilizing MATLAB.

CHAPTER 4

HARDWARE DESCRIPTION

4.1 ARDUINO

Arduino comprises of a physical circuit board that can be programmed, commonly known as microcontroller, it is used to upload and write the computer code on the physical board and it runs on computer. The popularity of the Arduino platform seem to have increased among people who have just started trying their hand on electronics, which is in turn a good practice to do. Unlike other programmable circuit boards, an extra programmer in the form of hardware is not required by the arduino for loading a new code, instead a USB cable is used. Using simplified version of C++ make it easy for learners to learn how to program on it. Functions of the microcontroller are broken into packages that are more easily accessible by the form factor that is provided by the Arduino.

There are various kinds of arduino boards few of them are shown below:

FIGURE 4.1: ARDUINO NANO

FIGURE 4.2: ARDUINO MEGA2560

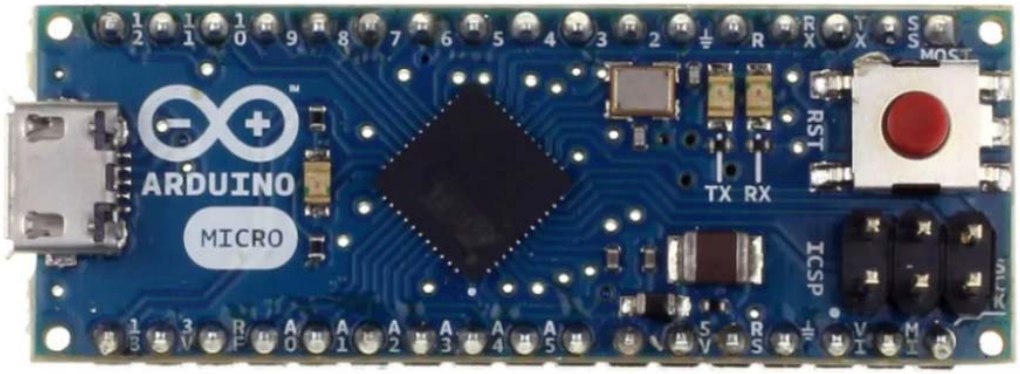


FIGURE 4.3: ARDUINO MICRO

FIGURE 4.4: ARDUINO PRO

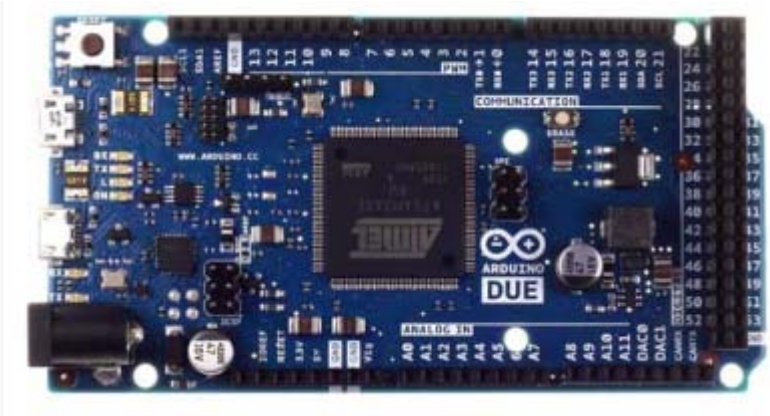


FIGURE 4.5: ARDUINO DUE

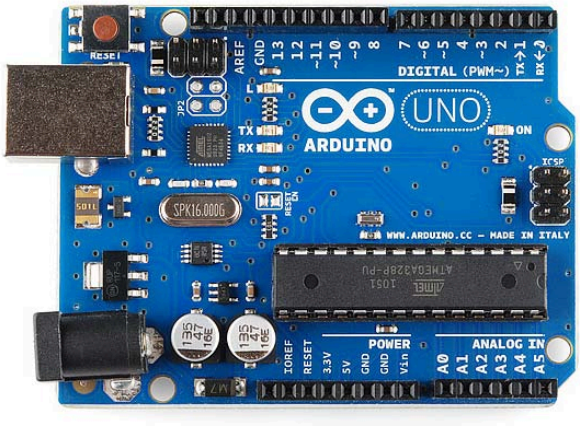


FIGURE 4.6: ARDUINO UNO

Out of all, we have used Arduino Uno in our project

4.2 ARDUINO UNO

On the basis of removable, dual-in line package (DIP) ATMega328 AVR microcontroller, the Arduino Uno R3 is a microcontroller board. The information/yield pins present in it are 20 in number, out of which 6 can be utilized as PWM yields and 6 can be utilized as simple data sources. Arduino computer program which is considered to be easy to use are used to load programs. What makes it very easy to start working with the embedded electronics is the extensive support community which Arduino has. The third and latest version of Arduino Uno present is R3.

In view of ATmega328 the Arduino Uno is a microcontroller board which has computerized input/yield sticks out of which 6 can be utilized as PWM yields and 6 can be utilized as simple data sources separated from this. It likewise has a resonator which is of 16 MHz, a USB association, an in-circuit framework programming (ICSP) header, a force jack, and a reset button. Everything which is or can be required to help the microcontroller is available in it, just there is requirement for a force flexibly which can be satisfied by basically associating it to a PC with a USB link or with an AC-to-DC connector or a battery to begin.

FTDI USB-to-serial driver chip is not used in Arduino Uno which differentiates it from all the other boards. Instead, a USB-to-serial converter which is formed by programming an

ATmega16U2 is used. An USB bootloader of its own is present in the microcontroller which gives provision to advance users to reprogram it.

What makes Arduino an incredible starting stage for inserted gadgets is a huge help network and a restrictive arrangement of help libraries and equipment add-on "shields" (for example it very well, may be effectively made remote by utilizing Wixel shield). To make fun early on ventures a SparkFun Inventor's Kit is likewise offered which incorporates an Arduino Uno and furthermore arrangement of segments with it (for example breadboard, sensors, jumper wires, and LEDs).

The 3rd revision of the Uno (R3) has a number of changes which are listed below:

- The USB controller chip ATmega8U2 (8K streak) is changed to ATmega16U2 (16K glimmer) while this change doesn't make the blaze or RAM accessible to portrays in expanded sum.
- Duplicates of previous pins are added which are three in number. The I2C pins (A4, A5) are brought out on the side of the board near AREF. A duplicate of the 5 V pin is also present next to the reset pin and called IOREF.
- The reset button is currently brought close to the USB connector for making it increasingly available when a shield is utilized. The 14 computerized input/yield pins can be utilized as information or yield sticks by utilizing pinMode(), digitalRead() and digitalWrite() works in arduino programming. Each pin work at 5V and can give or get a limit of 40mA current, and has an inner draw up resistor of 20-50 KOhms which are disengaged as a matter of course. Out of these 14 pins, a few pins have explicit capacities as recorded underneath:
- **Serial Pins 0 (Rx) and 1 (Tx):** Rx and Tx pins are utilized to get and transmit TTL sequential information. They are associated with the relating ATmega328P USB to TTL sequential chip.
- **External Interrupt Pins 2 and 3:** These pins can be arranged to trigger a hinder on a low worth, a rising or falling edge, or an adjustment in esteem.

- **PWM Pins 3, 5, 6, 9 and 11:** These pins give a 8-piece PWM yield by utilizing analogWrite() work.
- **SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK):** These pins are utilized for SPI correspondence.
- **In-assembled LED Pin 13:** This pin is associated with an implicit LED, when pin 13 is HIGH – LED is on and when pin 13 is LOW, it's off**.**

Alongside 14 Digital pins, there are 6 simple information sticks, every one of which gives 10 bits of goals, for example 1024 distinct qualities. They measure from 0 to 5 volts however this cutoff can be expanded by utilizing AREF pin with simple Reference() work.

Simple pin 4 (SDA) and pin 5 (SCA) likewise utilized for TWI communication utilizing Wire library.

Arduino Uno has a few different pins as clarified underneath:

- **AREF:** Used to give reference voltage to simple contributions with analogReference() work.
- **Reset Pin:** Making this pin LOW, resets the microcontroller.

PIN DIAGRAM:

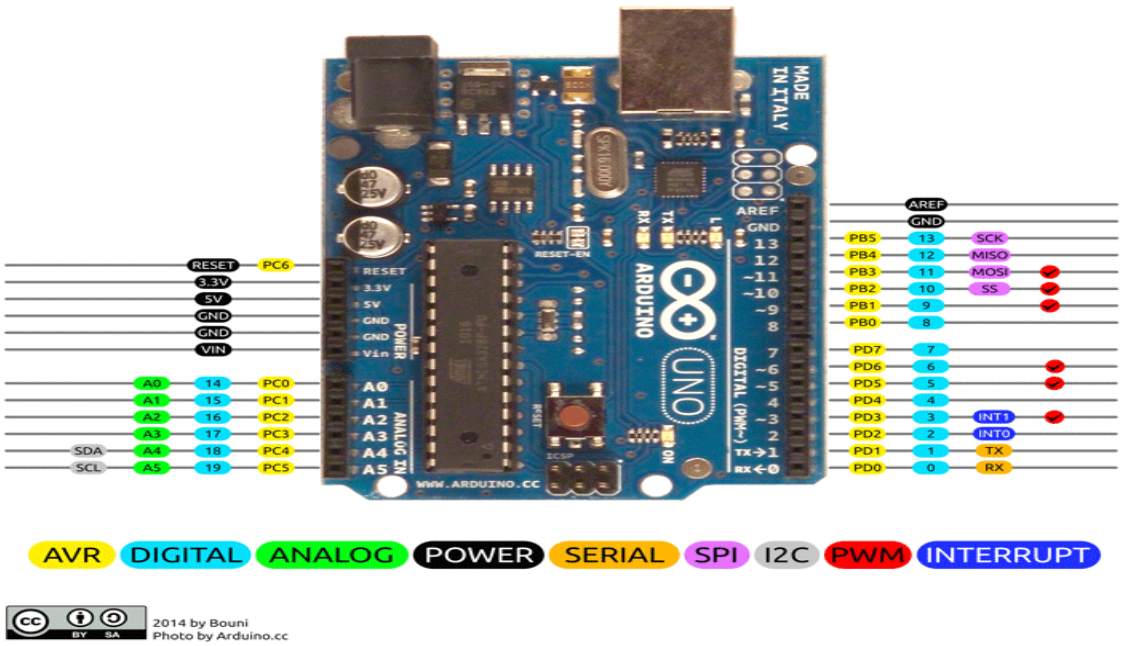


FIGURE 4.7: PIN DIAGRAM OD ARDUINO UNO

TABLE 4.1: PIN DESCRIPTION OF ARDUINO

Pin Category	Pin Name	Details
Power	Vin, 3.3V, 5V, GND	Vin: Input voltage to Arduino when using an external power source. 3.3V: 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA. 5V: Regulated power supply used to power microcontroller and other components on the board. GND: Ground pins
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 - A5	Used to provide analog input in the range of 0-5V
Input/Output pins	Digital Pins 0-13	Can be used as input or output pins.
Serial	0(Rx), 1(Tx)	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)	Used for SPI communication.
Inbuilt LED	13	To turn on the inbuilt LED.
TWI	A4 (SDA), A5(SCA)	Used for TWI communication.
AREF	AREF	To provide reference voltage for input voltage.

TABLE 4.2: TECHNICAL SPECIFICATIONS OF AURDINO

Microcontroller	ATmega328P
Operation Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
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	20mA
DC Current for 3.3V	50mA
Flash Memory	32KB (ATmega328P) of which 0.5KB used by bootloader
SRAM	2KB (ATmega328P)
EEPROM	1KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g

4.3 16 x 2 LCD MODULE

An electronic presentation module which utilizes fluid gem to deliver an obvious picture is called LCD. Simple to make circuits utilizes the extremely fundamental module of the LCD that is 16X2 LCD show. The 16×2 presentation has 2 lines and show. In this LCD each character is shown in a 5×7 pixel grid structure in this LCD.

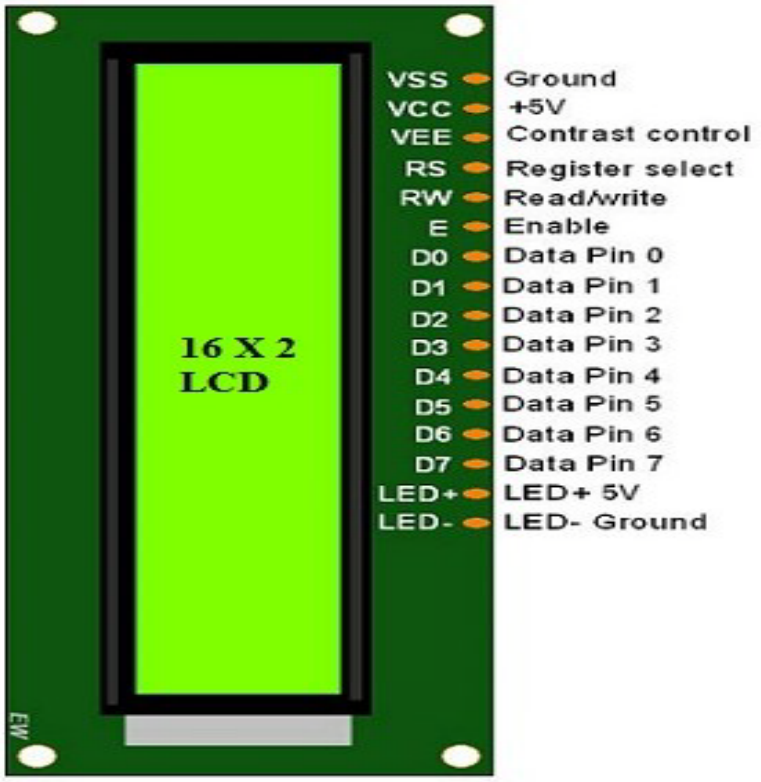


FIGURE 4.8: 16X2 LCD DISPLAY PIN DIAGRAM

1. For sending data through the microcontroller to the display data pins are used.
2. Supply voltage is varied from 0V to 5V in order to control the contrast of the display via VEE port.
3. Between command or data register mode the register select pin toggles.
4. Data mode=0, and command mode=1 is obtained by the microcontroller pin.
5. High voltage is required by the enable pin to enable read/write process.
6. Ground pin of the microcontroller is connected to the ground pin of the LCD.

TABLE 4.3: LCD PIN DESCRIPITION

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply Voltage; 5V (4.7V – 5.3V)	VCC
3	Contrast adjustment; the best way is to use a variable resistor such as a potentiometer. The output of the potentiometer is connected to this pin. Rotate the potentiometer knob forward and backwards to adjust the LCD contrast.	VO / VEE
4	Selects command register when low; and data register when high	RS (Register Select)
5	Low to write to the register; High to read from the register	Read/Write
6	Send data to data pins when a high to low pulse is given; Extra voltage push is required to execute the instruction and EN(enable) signal is used for this purpose. Usually, we make it en=0 and when we want to execute the instruction we make it high en=1 for some milliseconds. After this we again make it ground that is, en=0.	Enable

7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight VCC (5V)	Led+
16	Backlight Ground (0V)	Led-

Features of 16 X 2LCD

Features and properties of this LCD are described as follows:-

- 4.7V to 5.3V is the voltage range required to operate this LCD screen.
- 16-characters can be produced by the rows of display.
- There is no backlight and current utilization is of 1mA and has no backlight.
- Has a pixel box of 5X8.
- It has both alphabets and numbers making it an alphanumeric LCD.
- 2 variants in form of blue and green backlight are available.
- A few custom generated characters can also be displayed on it.

RS (Register select): There are two registers in 16X2 LCD which are named as order and information. For changing starting with one register then onto the next register the register select is utilized. RS=0 is utilized for order register, though RS=1 is utilized for information register.

Command Register: Command instructions that are given to the LCD are stored in the command registers. For carrying out a predefined task the instruction which is given is called command. Examples include initialization, clearing of screen, setting cursor position, display control etc. Processing for commands happens in the command.

Data Register: Information that will be shown on the LCD is put away in information registers. The shown ASCII estimation of the character on LCD is information. Information is handled in information enlists as it is send to the LCD. Information register is chosen when RS=1.

Display Custom Characters on 16X2 LCD.

It's not hard to create custom character on a LCD. Exclusively produced irregular access memory (CG-RAM) and the controller of chip are required as it were. Hitachi HD4478 controller is contained in the majority of LCDs. CG-RAM fills in as a primary segment in producing custom characters.

TABLE 4.4: COMMAND CODES FOR LCD

Sr. No.	Hex Code	Command to LCD instruction Register
1	01	Clear display Screen
2	02	Return home
3	04	Decrement Cursor (shift cursor to left)
4	06	Increment Cursor (shift cursor to right)
5	05	Shift display right
6	07	Shift display left
7	08	Display off, cursor off
8	0A	Display off, cursor on
9	0C	Display on, cursor off
10	0E	Display on, cursor blinking
11	0F	Display on, cursor blinking
12	10	Shift cursor position to left
13	14	Shift cursor position to right
14	18	Shift the entire display to left
15	1C	Shift the entire display to right
16	80	Force cursor to beginning (1st line)

4.4 JUMPER WIRES (Male To Male)

The jumper wires plays a very significant role for making breadboard connections between the components required without requirement of any soldering and hence makes it easy to change the circuitry whenever required. Only male to male jumper wires are required which can be identified as they are pointed at both the ends.

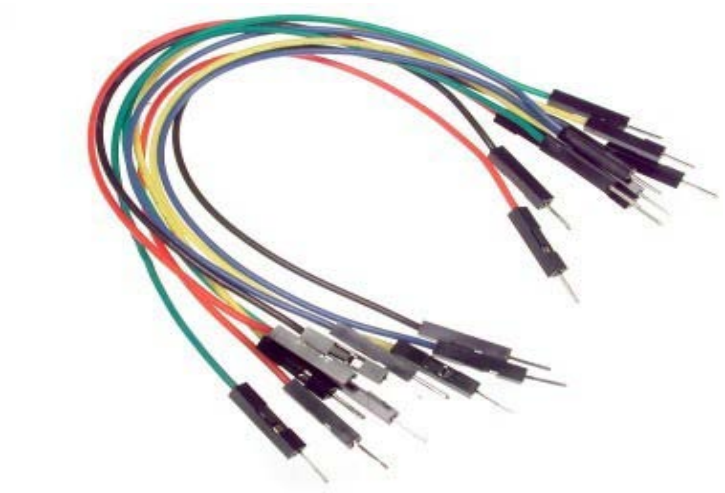


FIGURE 4.9: JUMPER WIRE

4.5 POTENTIOMETER

Variable resisters are known as Potentiometers. Different values of resistance is provided by it by varying the knob which is present on the upper portion of its head as per required. It can be used only for circuits that requires less current and hence have a power rating of 0.3 Watts (W).

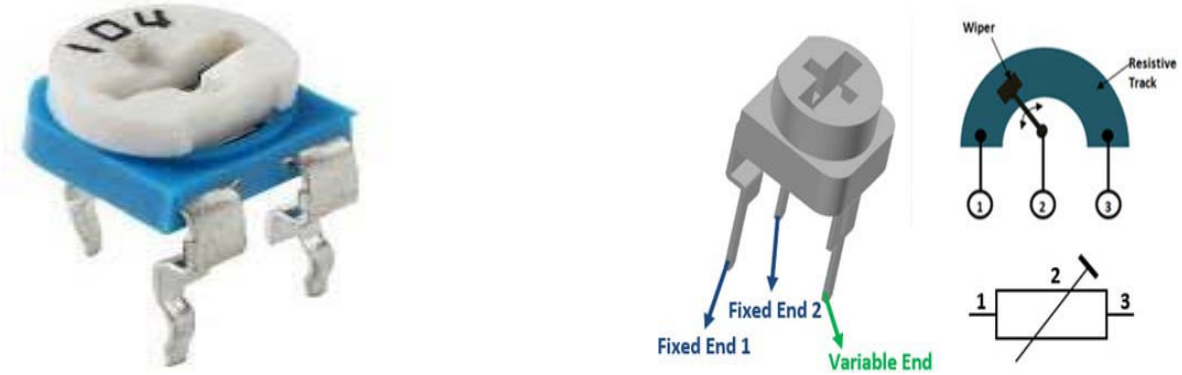


FIGURE 4.10: POTENTIOMETER

4.6 MICROCONTROLLER (ESP8266)

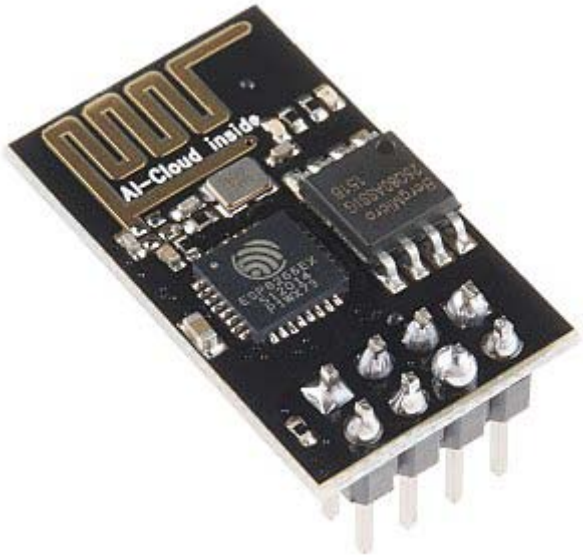


FIGURE 4.11: ESP8266 MICROCONTROLLER

The ESP8266 is a practical Wi-Fi microchip, with abilities of full TCP/IP stack and microcontroller. In ESP8266 chip Tensilica Xtensa, a microcontroller is utilized. What makes it DAQ financially savvy is its little size and minimal effort. Here we have utilized 12E form out of the different adaptations present. For correspondence with ADS129x and 17 GPIO's broadly useful info yield (GPIO) pins are utilized which are effectively accessible. The ESP8266 Arduino IDE is utilized for programming which underpins all the Arduino libraries.

Android telephone remotely gets the ECG information that is gotten at the microcontroller. For lossless remote transmission of information Bluetooth is utilized (Fig 4). For transmission through Bluetooth, A Bluetooth module, for transmitting information by means of Bluetooth is utilized [8]. RS-232 interfacing is utilized for associating the ESP8266 microcontroller and the Bluetooth module. Cell phone progressively shows 8 leads after the information is gotten from the procurement framework by means of PDA. Utilizing 3G/4G versatile web joins (3G/4G) on the telephone information is spilled on web stage by means of advanced cell. The gained information is plotted utilizing MATLAB.

Espressif Systems' Smart Connectivity Platform (ESCP) of elite remote SOCs, for portable stage creators, gives amazing capacity to insert Wi-Fi abilities inside different frameworks, at the most reduced expense with the best usefulness.

4.6.1 ESP8266 Applications:

- Smart power plugs
- Home automation
- Mesh network
- Industrial wireless control
- Baby monitors
- IP Cameras
- Sensor networks
- Wearable electronics
- Wi-Fi location-aware devices
- Security ID tags
- Wi-Fi position system beacons
- 802.11 b/g/n protocol
- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack
- Integrated TR switch, balun, LNA, power amplifier and matching network
- Integrated PLL, regulators, and power management units
- +19.5dBm output power in 802.11b mode
- Integrated temperature sensor
- Supports antenna diversity
- Power down leakage current of < 10uA
- Integrated low power 32-bit CPU could be used as application processor
- SDIO 2.0, SPI, UART
- STBC, 1×1 MIMO, 2×1 MIMO
- A-MPDU & A-MSDU aggregation & 0.4μs guard interval
- Wake up and transmit packets in < 2ms
- Standby power consumption of < 1.0mW (DTIM3

4.6.2 DATASHEET ESP8266

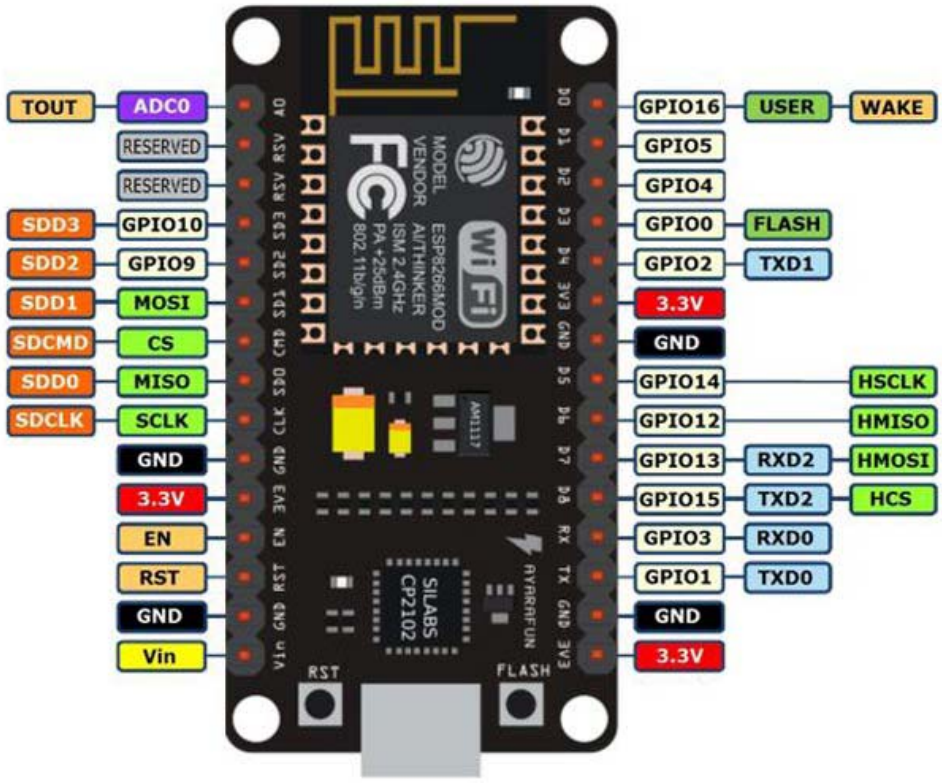


FIGURE 4.12: ESP8288 DATASHEET

4.6.3 BLOCK DIAGRAM (ESP8266):

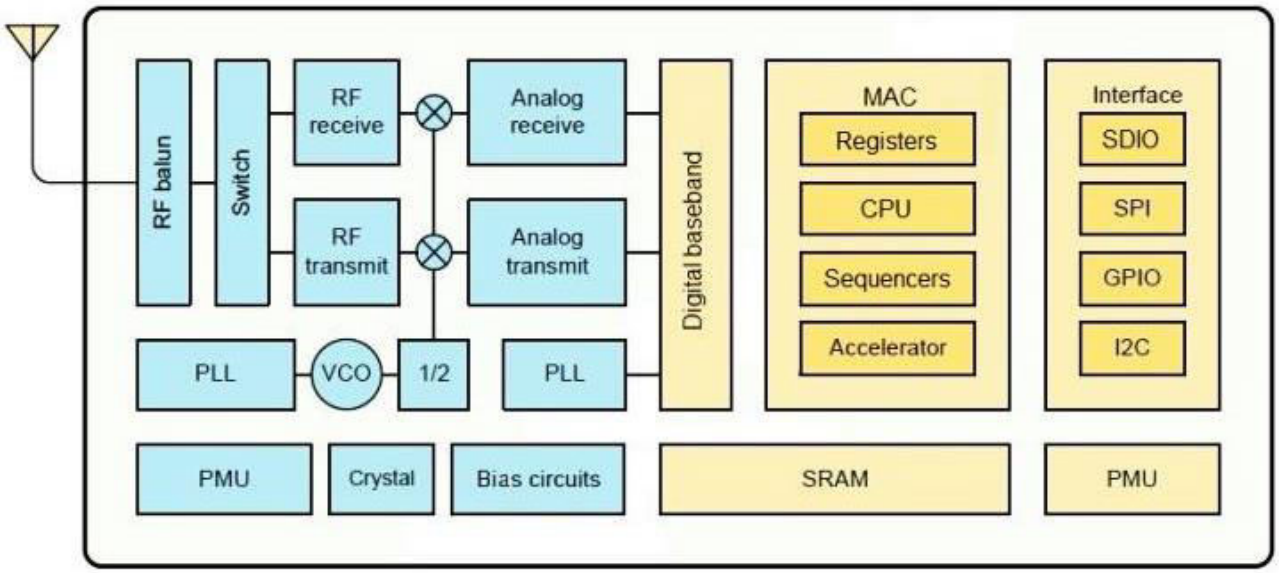


FIGURE 4.13: BLOCK DIAGRAM OF ESP8266

CHAPTER 5
SOFTWARE DESCRIPTION

5.1 INTRODUCTION

The functions from C/C++ are drafted in a platform application which is used by The Arduino Integrated Development Environment. These languages are used by boards that are Arduino compatible to run as well as write the programs.

In order to support the languages C/C++, codes with special rules are used by the Arduino. A software library from the wiring project in order to provide same input and output procedure is supplied by the Arduino IDE. Two basic functions are required by the user written codes that are it should always be implemented in a form of recapitulate language. C/C++ compilers are available on many platforms as it is provided by many merchants, including the Free Software Foundation, Microsoft, Intel, Oracle, and IBM.

5.1.1 JAVA:

Java is another object oriented programming language based on class and objects and seems to have less dependency on implementations. It allows all the Java codes which are written and once compiled by the application developers can be run or executed anywhere without further need of compiling the code, on any Java supported platform. Irrespective of the architecture of the computer byte codes that are generated by compiling the Java application can be run on any JAVA virtual machine. C/C++ has more offices when contrasted with Java, sentence structure of C and C++ being like it however. The most well known programming language as per GitHub and for customer server web applications is Java.

C/C++ vs. JAVA

In our project we have used Arduino as the executing platform, since for our project Arduino is the best suited platform. Since Arduino uses C/C++ as it is the most flexible known language. Its homogenous nature with the Arduino ecosystem enables the smooth usage of the code and documentation that already exist. Using C/C++ program directly

and compiler without the Arduino IDE and libraries is more suited usage of files directly from the command line, as well as optionally programming of some parts in assembler should be the need. Arduino bootloader running on the board required may or may not be used to work with this, with the help of ICSP in order to program the chip directly. As a result of this extra memory space and less complexity is given to the application, otherwise bootloader consumes the maximum part.

WHY C/C++

C/C++ has Arduino language as it' subset and for ultra-low level code assembly can also be used. When someone intent to program the arduino that means programming in C/C++. It doesn't make any difference if Arduino is programmed in C/C++ itself or not because C/C++is used in the microcontroller within the board. For example, AtMega328p microcontroller is present in the Arduino Uno and Performance is of utmost importance in writing codes for microcontroller. Due to this reason programming languages C/C++ are used, since they are strong and fast which makes them one of the most powerful programming languages one can search for easily. Due to their quick and stable nature, they are best suited for coding microcontrollers. A compiler known as avr-g++ is used to change codes into object file. Then, a program known as avrdude is used by the Arduino microcontroller function to upload the program into it, in order to state the main program loop, which a further compiled into a program that is executable with the help of a program called main(). The program is then employed by the Arduino IDE with intension to produce a text fine in hexadecimal encoding from the conversion of executable code, and then a loader program is used to load the hexadecimal encoded text file into the Arduino-board.

5.1.2 C/C++:

C++ or C with classes is a programming language that is an augmentation of the programming language called C. C++ has essentially extended after some time, and furthermore incorporates some item arranged capacities and highlights which encourages for control of low-level memory. It is executed as a summarize language, and its compilers are made accessible by numerous dealer including the Free Software Foundation, Microsoft, Intel, Oracle, and IBM, making it accessible on different stages.

5.2 ARDUINO UNO

Arduino, software based on prototype platform and hardware that is extremely easy to use. Computer code is written and uploaded on the physical board which further includes a circuit board commonly known as microcontroller which can be programmed on the basis of requirement and the software called Arduino IDE.

Micro controller functions are broken into the packages that are more easily accessible, by the standard form factor provided by the arduino.

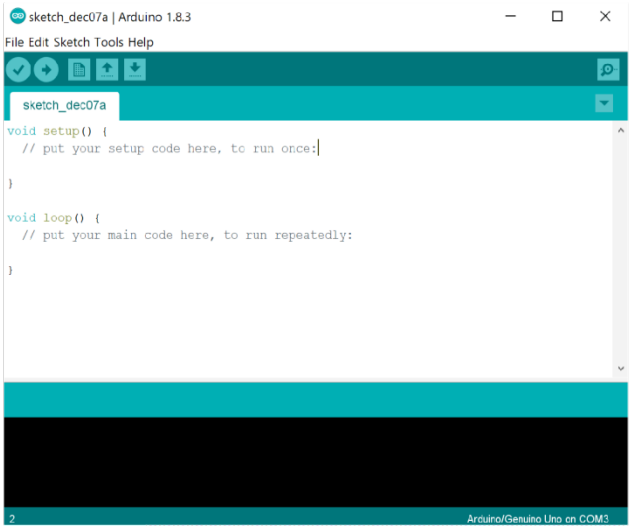


FIGURE 5.1: ARDUINO INTERFACE

Features of Arduino:-

1. Analogue or digital input signals can be read and output can be produced by the Arduino boards with the help of different sensors. For example, connecting to the cloud and motor activation, on/off actions on an LED, and various others.
2. Functions of board can be controlled through Arduino IDE with the help of set of instructions send to the microcontroller.
3. Unlike other programmable circuit boards, an extra programmer in the form of hardware is not required by the arduino for loading a new code, instead a USB cable is used.

4. Using simplified version of C++ make it easy for learners to learn how to program on it.
5. Functions of the microcontroller are broken into packages that are more easily accessible by the form factor that is provided by the Arduino.

Structure:

There are three basic parts of the Arduino program that is **Structure, Values** which in turn consist of variables and constants, and **Functions**

There are two main functions of software structure −

- Setup( )function
- Loop( )function

Syntax of structure of software:

Void setup () {}

PURPOSE - At the point when a program begins the arrangement() work is called. Its capacities incorporates introduction of factors, pin modes, libraries utilization, and so forth program arrangement capacity will pursue once each reset or catalyst.

INPUT − -

OUTPUT -

RETURN

Void Loop ( ) { }

PURPOSE - After the formation of arrangement() work which instates and sets the underlying qualities, the circle() work circles continuously, which permits program to additionally react and change. It is utilized to control Arduino board effectively.

INPUT –

OUTPUT − -

RETURN − -

DATATYPES

In C data types is referred as a big system used for variable declaration or for declaring the functions of different types. Function of calculating how much space is or will be occupied in the storage is governed by the variable data type, because as per the data type used compiler will know about the space.

Arduino programming uses the following data types:-

- **Void**
  Void is a keyword or data type that is used for declaring functions. It is called void as it does not return any value to the function through which it is called.
- **Boolean**
  It is a data type that uses only one byte of memory and stores either true or false one at a time.
- **Char**
  It is a data type that uses one byte of memory. Multiple characters string are written in double quotes, for example: “ANU”, whereas single character string is written in single quotes for example: ‘A’. Character strings can be written both ways.
- **Unsigned char**
  It is a data type with one byte of memory and can take numbers from 0 to 255. It is an unsigned type of data type.
- **Int**
  A two byte data that is 16 bit can be stored in an int variable. It’s a primary data type whose function includes storage of numbers.
- **Word**
  It is used to store a 16 bit number which is unsigned on the other boards which are based on ATMega.
- **Long**

It is a data type that stores 32 bits and its variables have extended size variables for storing numbers.

- **Short**

  It is a 16-bit data-type which stores a 16-bit (2-Byte) values on all AtMega and Arm based Arduinos.

5.3 MATLAB:

MATLAB is a multi-worldview numerical processing condition and exclusive programming language created by MathWorks. MATLAB permits framework controls, plotting of capacities and information, usage of calculations, production of UIs, and interfacing with programs written in different dialects.

In spite of the fact that MATLAB is expected principally for numerical processing, a discretionary tool stash utilizes the MuPAD representative motor permitting access to emblematic figuring capacities. An extra bundle, Simulink, includes graphical multi-space recreation and model-based plan for dynamic and implanted frameworks.

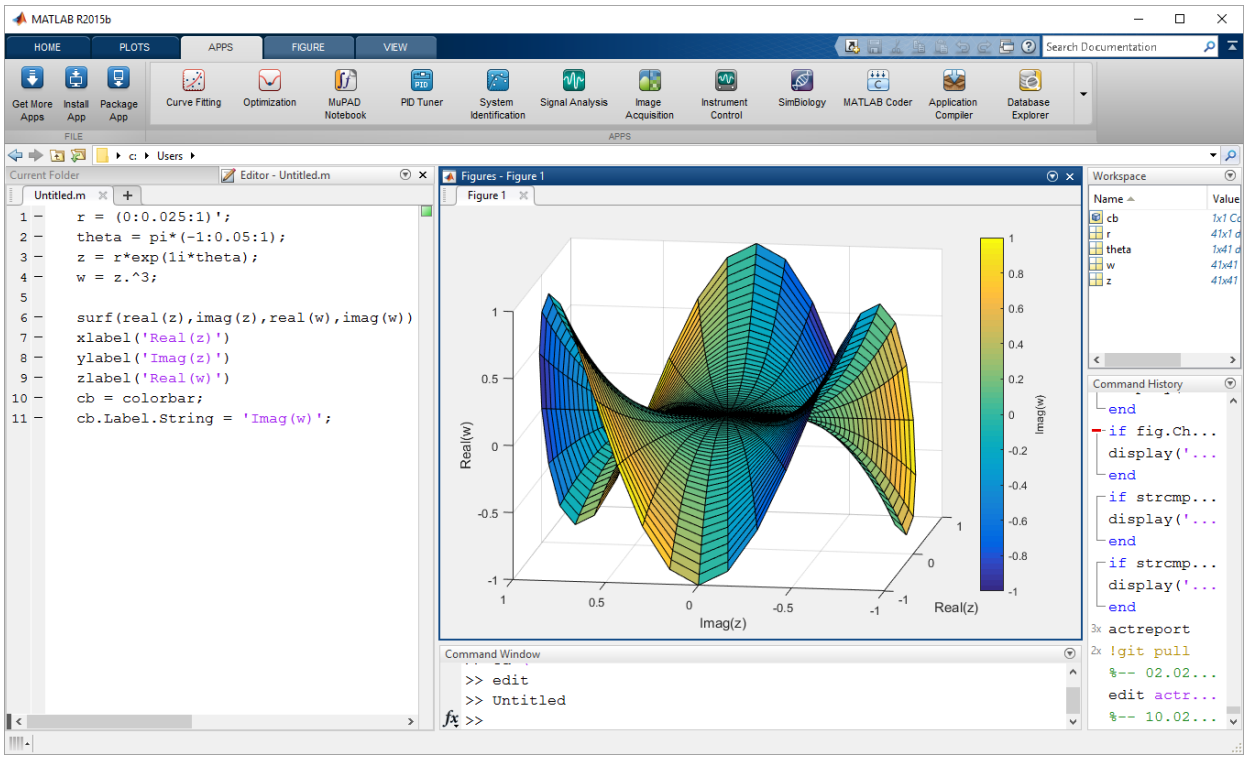


FIGURE 5.2: MATLAB INTERFACE

MATLAB programming language is utilized for building a MATLAB application. The use of "Order Window" in MATLAB is engaged with regular use of MATLAB application as an intuitive scientific shell or executing content documents containing MATLAB code.

5.3.1 SYNTAX

Variables

Task administrator is utilized to characterize factors in MATLAB, =. MATLAB has certainly changed over sorts consequently is a once in a while composed programming language [25]. Aside from the explanation that factors are treated as emblematic items and their sort can be changed, in rest cases factors are allotted without type affirmation and thus considered as derived composed language.

Vectors and matrices

Vectors and matrices are the simple array defined using the colon syntax: initial : increment: terminator.

Structures

Structure data types are supported by MATLAB.[28] Name "structure array" is more accurate since all variables in MATLAB are arrays, and each array element has the same field names. Dynamic field names are supported by MATLAB.

Functions

Name of the first function in MATLAB file should be same as the MATLAB file when created. Function names beginning with an alphabetic character are considered valid functions, and letters, numbers, or underscores can be included while Variables and functions being case sensitive.

Classes and object-oriented programming

Classes, inheritance, virtual dispatch, bundles, cruise by-esteem semantics, and cruise by-reference semantics which are incorporated by Object-arranged writing computer programs are

additionally upheld by MATLAB.[34] The Syntax and calling shows in MATLAB are not quite the same as different dialects. In MATLAB on the off chance that the super-class is available as handle, at that point it is known as reference class and in the event that it doesn't have it, at that point it is known as worth classes.

5.3.2 Interfacing with other languages:

Functions and subroutines written in C or FORTRAN programming dialects can be called by MATLAB. By making a wrapper work MATLAB information types are permitted to be passed and returned, and furthermore by aggregating the wrapper work the MATLAB executables documents otherwise called MEX records which are object documents can be stacked. Two-route interfacing with Python was included since 2014.

MATLAB can directly call the libraries written in various languages like: Perl, Java, ActiveX or .NET and also in form of wrapper around libraries of java or ActiveX, XML or SQL support few MATLAB libraries are implemented. Despite being complicated MATLAB can be called from Java with the help of MATLAB toolbox which is separately provided by MathWorks, one can easily purchase it, or using JMI which is an undocumented mechanism.

CHAPTER 6

ADVANTAGES AND DISADVANTAGES

6.1 ADVANTAGES

1. Portable patient system is not tether to the huge machines.
2. With this system patient is given ease of use and comfort.
3. Doctors can see data remotely and analyze the ECG signals of patients.
4. ECG signals can be stored in computer as files for further analysis.
5. Accuracy, the usage of wires in traditional machines can affect the reading of the patient, hence wireless systems increases the accuracy as no such component is used that could interfere the diagnosis results.
6. Electrodes are simply and efficiently placed on patient's chest.
7. Disposable electrodes are used in wireless system which further reduces the risk of infection and also the possibility of transmission of any ailment from one patient to another are minimized.
8. Along with portable it is much cheaper than the traditional one.

6.2 DISADVANTAGES

1. Short battery life, battery can die soon as it is operated with the help of battery.
2. Privacy and security issues.
3. Wireless transmission can be jammed or can have interference from similar frequency sources.
4. ECG system gives only the required ECG waveform but it does not give information about the underlying problems, cardiac abnormalities, etc.
5. Detailed information is not provided by the portable ECG system.
6. Sometimes ECG for few diseases is similar to the normal one hence making it difficult for diagnosis.
7. False negative is another one of the biggest concern with ECG.

CHAPTER 7
CONCLUSION AND FUTURE SCOPE

7.1 CONCLUSION

Utilizing remote innovation limits work area mess and repeats the solid market for innovation that takes into consideration straightforwardness in medical clinics and inside the house. A remote ECG sensor which shows its yield on PC utilizing Lab see. A gadget which permits effective checking for data of heart condition that is ongoing, persistent, and exact, remotely.

7.2 FUTURE SCOPE

1. Cloth fitted capacitive electrodes can used in place of ECG electrodes that are directly worn on body using gel. For sharing the information for administering the collected data Wi-Fi can be used through which phone can be directly connected to internet via android app dedicated for the same purpose.
2. In order to build Ultra-low power system, low power wireless protocol is used which further saves power and increases battery.
3. In future solar powered ECG electrodes can be used.
4. Very small electrodes can be built in future.

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