A

Project Report

On

IOT BASED EMERENGY HEALTH MONITORING SYSTEM

Submitted in partial fulfillment of the requirement for the award of

BACHELOR OF TECHNOLOGY

In

ELECTRONICS AND COMMUNICATION ENGINEERING

D.DASTAGIRI (20AM1A0416)

M.BADRINATH REDDY (20AM1A0410)

C.GURU NAGA KIRAN (20AM1A0425)

Under the esteemed guidance of

Dr. D.RAGHUNATHA RAO, M. Tech., Ph.D

Associate Professor

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SVR ENGINEERING COLLEGE

AYYALURU METTA NANDYAL– 518 503 (A.P)

(Affiliated to JNTU Anantapur, Approved by AICTE, New Delhi, Accredited by NAAC of UGC & NBA of AICTE)

2020-2024

SVR ENGINEERING COLLEGE

Ayyaluru Metta, Nandyal-518503, NANDYAL (Dist.), A.P.

(Affiliated to JNTU Anantapur, Approved by AICTE, New Delhi, Accredited by NAAC of UGC & NBA of AICTE)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that the dissertation entitled **"IOT BASED EMERGENCY HEALTH MONITORING SYSTEM"** is the bonafide work done and submitted by

D.DASTAGIRI	(20AM1A0416)
M.BADRINATH REDDY	(20AM1A0410)
C.GURU NAGA KIRAN	(20AM1A0425)

In partial fulfillment of the requirement for the award of the degree of **Bachelor of Technology** in **Electronics and Communication Engineering** in the **SVR ENGINEERING COLLEGE (Affiliated to Jawaharlal Nehru Technological University Anantapur)** is a record of bonafide work carried out by them under our guidance and supervision.

The results embodied in this thesis have not been submitted to any other university or institute for the award of any degree.

Project Guide:

Dr. D. RAGHUNATHA RAO M.Tech, Ph.D

Associate Professor

Dept. of ECE, SVREC

Head of the Department:

Dr .G. LAKSHMI NARAYANA M.Tech, Ph.D

Professor & HOD

Dept. of ECE, SVREC

EXTERNAL EXAMINER

DECLARATION

We hereby declare that the project report entitled "IOT BASED EMERGENCY HEALTH MONITORING SYSTEM" is carried out by us during the academic year 2023–2024 in partial fulfillment of the award of Bachelor of Technology in Electronics and communication Engineering from SVR Engineering College affiliated to Jawaharlal Nehru Technological University Anantapur. We have not submitted the same to any other university or organization for the award of any other degree.

D.DASTAGIRI (20AM1A0416)
M.BADRINATH REDDY (20AM1A0410)
C.GURU NAGA KIRAN (20AM1A0425)

ACKNOWLEDGEMENT

We earnestly take the responsibility to acknowledge the following distinguished personalities who graciously allowed us to carry out project work successfully.

We express deep gratitude to our guide **Dr. D.RAGHUNATHA RAO, M. Tech, Ph.D** Associate Professor, Department of ECE, **S.V.R Engineering College** for the guidance and for his incessant help and encouragement throughout the course of the project work. His friendly and informal talks helped us to work under excellent working conditions.

We would like to express our gratitude to project coordinators **Dr. D. RAGHUNATHA RAO, M.Tech, Ph.D, Associate** Professor, in the Department of ECE, **S.V.R Engineering College** for his encouragement throughout the course.

We are extremely thankful to the Head of the Department of ECE, **Dr. G LAKSHMI NARAYANA, M.Tech, Ph.D S.V.R Engineering College** for the encouragement and assistance provided to us, which contributed to the successful completion of this project.

We are thankful to our Principal **Dr. P.MALLIKARJUNA REDDY, M.Tech, Ph.D** who has encouraged and motivated us to complete the project by providing all necessary facilities to carry out the work in the college.

We are thankful to our Honorable chairman **Sri S.V.RAMI REDDY** & Honorable Managing Director **Sri S.DINESH REDDY** for providing good faculty and for their moral support throughout the course.

We would like to thank all teaching and non-teaching members of the ECE Department for their generous help in various ways for the completion of this thesis.

They have been great sources of inspiration to us and we thank them from the bottom of our heart.

D.DASTAGIRI (20AM1A0416)

M.BADRINATH REDDY (20AM1A0410)

C.GURU NAGA KIRAN (20AM1A0425)

Vision and Mission of the institute

Vision

To produce Competent Engineering Graduates & Managers with a strong base of Technical & Managerial Knowledge and the Complementary Skills needed to be Successful Professional Engineers & Managers.

Mission

To fulfill the vision by imparting Quality Technical & Management Education to the Aspiring students by creating Effective Teaching/Learning Environment and providing the State of the Art infrastructure and Resources.

Vision and Mission of the Department

Vision

To produce highly skilled, creative and competitive Electronics and Communication Engineers to meet the emerging needs of the society.

Mission

- Impart core knowledge and necessary skills in Electronics and Communication Engineering through innovative teaching and learning.
- Inculcate critical thinking, ethics, lifelong learning and creativity needed for industry and society.
- Cultivate the students with all-round competencies, for career, higher education and self- employability.

Program Educational Objectives (PEOs)

PEO1: Graduates apply their knowledge of mathematics and science to identify, analyze and solve problems in the field of Electronics and develop sophisticated communication systems.

PEO2: Graduates embody a commitment to professional ethics, diversity and social awareness in their professional career.

PEO3: Graduates exhibit a desire for life-long learning through technical training and professional activities.

Program Specific Outcomes (PSOs)

- PSO1: Apply the fundamental concepts of electronics and communication engineering to design a variety of components and systems for applications including signal processing, image processing, communication, networking, embedded systems, VLSI and control system.
- PSO2: Select and apply cutting-edge engineering hardware and software tools to solve complex Electronics and Communication Engineering problems.

SVR ENGINEERING COLLEGE	
DEPARTMENT	**ELECTRONICS AND COMMUNICATION ENGINEERING**
PROGRAM OUTCOME ATTAINMENT	
PO 1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex Engineering problems.
PO 2	Identify, formulate, review research literature, and analyze Complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	Ability to review research literature, use research methods to execute project and synthesize the problem to provide valid conclusions.
PO 5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	Apply reasoning informed by the contextual Knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	Understand the impact of the professional engineering solutions in societal and environmental contexts, and Demonstrate the knowledge of, and need for sustainable development.
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO 1	Apply the fundamental concepts of electronics and communication engineering to design a variety of components and systems for applications including signal processing, image processing, communication, networking, embedded systems, VLSI and control system.
PSO 2	Identify indigenous processes and components for producing high quality, compact, energy efficient and eco-friendly solutions at affordable prices.

TITLE	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
IOT BASED EMERGENCY HEALTH MONITIORING SYSTEM	3	3	2	2	2	2	1	1	2	2	2	3	3	3

ABSTRACT

As technology has developed and sensors have been miniaturized, there have been attempts to employ contemporary technology in a variety of fields to improve the quality of human life. One of the important areas of research that has been identified is the inclusion of technology in the healthcare business. People who require healthcare services find them unreasonably expensive, especially in developing countries. As a result, this effort aims to solve a current healthcare concern in society. The primary purpose of the project was to develop a remote healthcare system. It's broken into three parts. The first component entails using sensors to detect a patient's vitals, the second sending data to cloud storage, and the third delivering the observed data for remote viewing. The data may be seen remotely, allowing a doctor or guardian to monitor a patient's health state even while they are not in the hospital. The Internet of Things (IoT) has been widely used to connect readily available medical resources and give patients with intelligent, dependable, and effective healthcare services. Health monitoring for active and supported living is one of the paradigms that may use IoT benefits to improve the patient's lifestyle.

TABLE OF CONTENTS

LIST OF TOPICS	PAGE No
ACKNOWLEDGEMENT	
ABSTRACT	i
LIST OF TOPICS	ii-iv
LIST OF FIGURES	v-vi
CHAPTER 1	
INTRODUCTION TO PROJECT	**1-4**
CHAPTER 2	
LITERATURE REVIEW	**5-8**
CHAPTER 3	
EMBEDDED SYSTEM	**9**
3.1 Introduction to embedded system	9-10
3.2 Overview of embedded system	10-12

CHAPTER 4

HARDWARE **13-41**

4.1 Design of hardware 12-17

4.2 Temperature sensor LM35 17-19

4.3 Wi-Fi 20-22

4.4 Buzzer 23-24

4.5 Power supply 24-25

4.6 Transformers 26-27

4.6.1 Rectifier 26

4.6.2 Filter 26

4.6.3 Voltage Regulator 26-27

4.7 Heartbeat sensor 27-29

4.8 Alphanumeric LCD 30-34

4.9 LED 35-37

4.10 MEMS sensor 37-41

CHAPTER 5

SOFTWARE ENGINEERING 42-46

5.1 Introduction to ARDUNIO IDE software 42

5.2 Software steps 42-46

CHAPTER 6

PROJECT DESCRIPTION 47-50

6.1 Block diagram of iot based emergency health monitoring system 47

6.2 Software requirements 48

6.3 Hardware requirements 48

6.4 Working 48

6.5 Flow chart 49

6.6 Experimental results 50

CHAPTER 7

7.1 Conclusion 51

7.2 Future scope 51

CHAPTER 8

REFERENCE 52-53

LIST OF FIGURES

LIST OF FIGURES	PageNo
Fig 3.1: Building blocks of hardware of an embedded system	10
Fig 4.1: Arduino uno R3 board	14
Fig 4.2: Pin diagram of LM35	18
Fig 4.3: LM35 Interfacing circuit	19
Fig 4.4: ZG2100M/ZG2101M module: functional block diagram	21
Fig 4.5: Buzzer driver circuit	23
Fig 4.6: Buzzer interfacing block diagram with microcontroller	24
Fig 4.7: Block diagram of power supply	25
Fig 4.8: Schematic diagram of power supply	25
Fig 4.9: Bridge rectifier	26
Fig 6.1: Block diagram of health monitoring system	47

Fig 6.2: System Architecture 48

Fig 6.3: Flow chart 49

IOT BASED EMERGENCY HEALTH MONITORING SYSTEM

CHAPTER 1

1. INTRODUCTION TO PROJECT

1.1 INTRODUCTION

Capturing and sharing of vital data of the network connected devices through secure service layer is what defines IOT. In simple terms, Internet of Things (IOT) can be defined as the wireless network of devices which are connected to each other to share information and data in order to communicate and produce new information so as to record and analyze it for future use. Internet of Things gains its full potential by utilizing the key role playing objects i.e. “Smart” objects which use various sensors and actuators that are able to perceive their context, and via built in networking capabilities they could communicate to each other, access the open source Internet services and interact with the human world. This not only makes the world connected but also robust and comfortable. The Internet of things in the field of healthcare also plays a major role in providing ease to patients and doctors. It consists of a system that communicates between network connected systems, apps and devices that can help patients and doctors to monitor, track and record patients’ vital data and medical information. Some of the devices include smart meters, wearable health bands, fitness shoes, RFID based smart watches and smart video cameras. Also, apps for smartphones also help in keeping a medical record with real time alert and emergency services. These interconnected IoT devices produce large amounts of information and data that should be dealt efficiently by the providers and so is a big challenge. To overcome this challenge of storing and analyzing large data, the technique of Internet of Things Analytics (IOTA) is implemented. The raw data is converted into a useful and medically relevant data using the techniques like data extraction and data analytics. In fact, it has been predicted that by 2020, more than 50-55 percent of techniques used to analyze raw data will make a better use of this influx of data which is generated from instrumented machines and applications. In order to make our health care services robust and vast, the IOT relies on several enabling technologies. Collection of real-time data from various sources, in this case, unlimited number of patients for a large period of time has become very easy and fast using the potential of IOT. The power of IOT for health and medical services are harnessed by smart sensors (sensor and a microcontroller) which accurately measures, monitors and analyze a variety of health status indicators. These can include basic vital health signs such as pulse rate and blood pressure, oxygen and glucose level in blood and heart rate. Smart sensors can be incorporated into medicines and pill bottles that are connected to a network and can generate alerts about whether the patient has taken a scheduled dose of medication. A lot of advancement and significant changes are occurring in the field of IOT healthcare. The way of interacting and communicating with humans and other devices is changing and getting better day by day. Management of healthcare results and reduction of healthcare costs is enabled by the ever growing information and communication solutions. The healthcare services are getting better and less costly by collecting, recording, analyzing and sharing new data packets in real time and efficiently. Also, as the world is adopting this ever growing technology of IOT, many of the inefficiencies in healthcare will be reduced. For example, various medical devices like fitness bands, health monitoring systems, medication boxes has smart sensors embedded into them that allows to collect the raw data, store it, analyze it, and conduct tests which are further used by medical experts to take proper decisions. To take the full advantage of revolutionizing IOT in healthcare, the consumers, patients and other health experts need to think of some innovative and more reliable methods. And with the help of IoT's potential they are now able to collect realtime raw data from unlimited number of patients for a continuous period of time through smart devices connected on an interconnected network. It will take time to fully realize the technology's capabilities. We will be able to see medical experts carrying out diagnosis and critical tasks in a more better and reliable way. This will ensure them not only with reliable results but also time saving which will be of maximum benefit. The possibilities of IOT are truly unlimited and ever growing. This paper proposes an IoT based health monitoring system which would collect all the medical data of a patient including his heart rate, blood pressure and ECG and would send alerts to the patient's doctor regarding his/her full medical information, providing a fast and reliable healthcare service. Moreover, in today's world everyone is busy neglecting their small healthcare problems like high blood pressure, low pulse rate etc. The paper helps to find a better and robust solution to this challenge.

In today's era, health problems are increasing day-by-day at a high pace. The death rate of 55.3 million people dying each year or 151,600 people dying each day or 6316 people dying each hour is a big issue for all over the world. Hence it is the need of hour to overcome such problems. We, therefore, proposing a change in wireless sensors technology by designing a system which included different wireless sensors to receive information with respective human body temperature, blood pressure, saline level, heart rate etc. that will be undoubtedly further transmitted on an IoT platform which is accessible by the user via internet.

An accessible database is created about patient's health history which can be further monitored & analyzed by the doctor if necessary. The data storage can be saved on the server permanently or can be reset via the software. This project proposes a health monitoring system which is capable of detecting multiple parameters of our body such as blood pressure, temperature, heart rate, ECG & further transmitting this information on an IoT server through 2G/3G/4G GSM technologies. Also in case of emergency, automatically generating alerts will be sent to doctors and family members if any unusual activity is detected by or near the patient. A continuous record of body health parameters can be used to detect the disease in a more efficient manner. Now-a-days, people pay more attention towards prevention & early recognition of disease.

In addition to it, new generation mobile phones technologies & their services provides an important impact on the development of network varieties (3G, Bluetooth, wireless LAN, GSM) etc. Various sensors have been used like AD8232 ECG sensor for remote ECG monitoring, blood pressure sensor (4811) is used to measure systolic pressure and diastolic pressure & pulse rate for few seconds. LM35 temperature sensor is used to measure surface temperature of skin. Satisfactory work is done in health monitoring by using raspberry pi as well as IoT, but this project gives embedded concept of both the platform. By using combination of these, the proposed structure will be more effective. In this project, we investigated recent projects related to health monitoring systems & IoT. IoT is nothing but an advanced concept of ICT (Information Communication Technology).

IoT is the interconnecting of devices and services that reduces human intervention to live a better life. This project as showing the advancements in health care management technology, it would save patients from the future health problems that would arise and would also help doctors to take an appropriate measure or action at a proper time regarding patient's health.

CHAPTER 2

2. LITERATURE REVIEW

2.1. LITERATURE REVIEW

Many researchers did their work on health monitoring system using IOT.M. Wcislik et al [2] monitors patient's body temperature, pulse rate, ECG wave and patient's body position using AR cortex M4F micro controller. Android app is created for monitor these values. Bluetooth connection is used for connecting microcontroller and Android phone. In my project monitor patient's body temperature, Respiration rate, heart rate and body movements using Raspberry Pi board and sensors. Android app is support only android phones.

Bluetooth is very short distance for communication. It supports only within 100 meters. In my project webpage is created. Using IP address anybody can monitor patient's health status anywhere in the world.

Amir-Mohammad Rahmani et al [3] monitor ECG wave using panda board. Ethernet connection is used for connecting internet to the panda board. In my project monitor body temperature, Respiration rate, heart rate and body movements using Raspberry Pi board. Panda board is very difficult to operate compare to Raspberry Pi board. Ethernet connection is also very short distance. So i use USB modem for connecting internet to the Raspberry Pi board. Hoi Yan Tung [3] et al monitors body temperature, ECG, heart rate using DRZHG micro controller. A Dual Radio ZigBee Homecare Gateway (DRZHG) has been proposed and implemented to support remote patient monitoring. The idea of remote patient monitoring is to simultaneously track the status of long-term patients at home by using mobile medical sensors. The sensors collect medical data from patients and feedback the data to the doctors. Zigbee module is used for connected to the micro controller. Zigbee module is used for transfer the values to the receiver side. It is send data to only nearest place. But my project internet is connected to the Raspberry Pi board. So using IP address anybody can monitor patients health status anywhere in the world. Joao Martinhoa [4] et al describes the design and successful implementation of a remotely operated physiological monitoring device.

The prototype performs acquisition of three types of physiological measurements electrocardiography, finger photoplethysmography, and blood pressure plethysmography. At mega 328 microcontroller is used for connecting these sensors. Wi-Fi connection is used for connecting internet to the at mega 328 microcontroller. After connecting Wi-Fi connection it will transfer the values. If Wi-Fi hotspot is no means it is not transfer the values.

Wi-Fi is also works on short distance. In my project USB modem is used for connecting internet to the Raspberry Pi board.

So it is easily connect to the internet in any place.

Research is going on in the field of IOT-healthcare which gives a clinical evidence that the raw data received from wireless network connected devices has contributed in managing and preventing chronic diseases and monitoring patients. Therefore, various health monitoring systems are getting wearable todays, including glucose monitors, ECG monitors, pulse audiometers, and blood pressure monitors. Similarly, research is going on for the advancement of IOT and various products and services based on them, pertaining to one or more domains among those of Automation, Artificial Intelligence and Intelligent systems for energy conservation, Green Technology, and the likes.

Cooly Smart Health

Cooly Smart health lets you automatically log your medical data through Bluetooth entitled devices. It takes note of your health by storing, analyzing and sharing your medical records. It also advices you on the smart tips and services based upon your health analysis. It also give you alerts and messages about your health risks. It enables you to remotely monitor the health reports as well as also has the option of connecting yourself to various health service providers like pharma, labs, homecare and teleconsulting. It consists of three different health monitoring systems: Smart Blood Pressure Monitor, Smart Body Analyzer, Smart Glucometer. Cooey is lengthwise health monitoring IOT platforms which help the providers in collecting, storing and analyzing of raw medical data so as to provide alerts of vital signs for patients beforehand. It lets you choose and customize your personalized services based upon your health condition. For customers, it is a health management application with personalized services. It is personalized solution for chronic health management. No other product and app is able to provide a last mile connection of a patient with his health experts. But, through the help of #rd platform services, Cooey is able to interconnect and provide focused services to its customers. Some of the 3rd Platform services that Cooey provides: • Measure and Monitor : Smart devices like Bluetooth entitled BP monitor and Weighing Scale lets you automatically record the medical data and lets your medical health experts to remotely access this data.

• Engage: Different data including the profile of patient, his health vitals, his medication and medication history are collected and on that basis health tips are provided in order to improve health management

• Fulfilment: The data collected so is also used to create dynamic profile of the patient according to his current health condition so that on further analysis this profile can be used by other medical experts Cooey smart services target mainly on Chronic patients and Antenatal care offerings.

• Devices which are used to record share your medical data and let it go through analysis.

• Smart assist: Provide personalized advices and recommendations based on the smart recommendation engine using smart algorithms.

• M-Assist: Provides with mobile API for personal health management.

Health Vault by Microsoft

Microsoft Health Vault[2] assists you to gather, store, use, and share health information for you and your loved ones. You can sustain all your health records at one place that's organized and available to you online (E-Book Keeping)in case of medical emergencies, it is able to keep track of all the details so that you are always alerted about your wellness. It records the data once, and use it with new data to get frequent updates about your health. Health Vault-connected apps include websites, computer software, and mobile apps that can help you analyze more out of your captured health information. It also features multi-app connectivity so that the information can be shared with anyone you want.

It features:

• Up-to-date medication and allergy lists

• Latest home health readings (such as blood pressure, blood glucose, and weight)

• Your health history HealthVault not only helps you store, organize, but also give this information to your doctor. It can keep your details at your fingertips and access it from anywhere using Internet connection on a PC, smartphone/tablet. It can record and store your diagnostic results, prescription history, and visit records from an increasing list of connected labs, medical institutes, hospitals and clinics which can send details to your HealthVault and record it. You can transfer your medical logs and can easily keep these track records in HealthVault, for future reference. Medical images can be easily saved and shared to your medical consultants and keep them handy for future reference. Statistical graphs, patterns and trends are drawn from the so collected data in the health vault which help your medical experts to make efficient and better health decisions. It can easily share information with people your healthcare consultants so that they can guide and advice you on proper health management. Weight management dashboard helps you succeed in your fitness goals by keeping a track of your weight, your daily diet, daily activity and tracing the progress. Since the data in health care industry is very huge, So Sharma S [3, 9-10] has proposed a cloud service model to handle such a huge data. Author has also discoursed various type of cloud service model and classification of the services provided by cloud service providers.

HealthVault features:

• Authentication by connecting it with with Windows Live ID, Facebook, and OpenID credentials.

• Authorization by providing user authorization before enabling any data sharing between an application and a user's HealthVault account data.

• User control by giving them the control to authorize data shares and providing them a feature to stop application access at any time, and can change or delete information in their history.

• Data provenance: by intelligently taking decisions on how to treat data from different sources. Optional digital signatures allow for independent verification of data integrity and source.

CHAPTER 3

3. EMBEDDED SYSTEM

3.1 INTRODUCTION OF EMBEDDED SYSTEM

An embedded system is a combination of software and hardware to perform a dedicated task. Some of the main devices used in embedded products are Microprocessors and Microcontrollers.

Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result.

An Embedded System is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a specific function. A good example is the microwave oven. Almost every household has one, and tens of millions of them are used every day, but very few people realize that a processor and software are involved in the preparation of their lunch or dinner.

This is in direct contrast to the personal computer in the family room. It too is comprised of computer hardware and software and mechanical components (disk drives, for example). However, a personal computer is not designed to perform a specific function rather; it is able to do many different things. Many people use the term general-purpose computer to make this distinction clear. As shipped, a general-purpose computer is a blank slate; the manufacturer does not know what the customer will do wish it. One customer may use it for a network file server another may use it exclusively for playing games, and a third may use it to write the next great American novel.

Frequently, an embedded system is a component within some larger system. For example, modern cars and trucks contain many embedded systems. One embedded system controls the anti-lock brakes, other monitors and controls the vehicle's emissions, and a third displays information on the dashboard. In some cases, these embedded systems are connected by some sort of a communication network, but that is certainly not a requirement.

At the possible risk of confusing you, it is important to point out that a general-purpose computer is itself made up of numerous embedded systems. For example, my computer consists of a keyboard, mouse, video card, modem, hard drive, floppy drive, and sound card-each of which is an embedded system. Each of these devices contains a processor and software and is designed to perform a specific function. For example, the modem is designed to send and receive digital data over analog telephone line. That's it and all of the other devices can be summarized in a single sentence as well.

3.2. OVERVIEW OF EMBEDDED SYSTEM

Every embedded system consists of custom-built hardware built around a Central Processing Unit (CPU). This hardware also contains memory chips onto which the software is loaded. The software residing on the memory chip is also called the ‘firmware’.

The same architecture is applicable to any computer including a desktop computer. However, there are significant differences. It is not compulsory to have an operating system in every embedded system. For small appliances such as remote control units, air conditioners, toys etc., there is no need for an operating system and you can write only the software specific to that application.

For applications involving complex processing, it is advisable to have an operating system. In such a case, you need to integrate the application software with the operating system and then transfer the entire software on to the memory chip. Once the software is transferred to the memory chip, the software will continue to run *for* a long time you don’t need to reload new software. Now, let us see the details of the various building blocks of the hardware of an embedded system. As shown in Fig:3.1 the building blocks are:

a. Central Processing Unit (CPU)
b. Memory (Read-only Memory and Random Access Memory)
c. Input Devices
d. Output devices
e. Communication interfaces
f. Application-specific circuitry

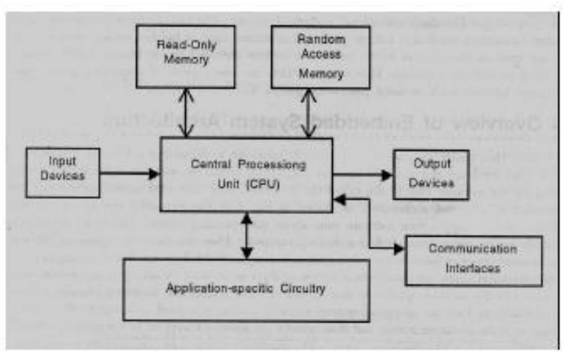


Fig: 3.1 Building blocks of the hardware of an embedded system

- **CENTRAL PROCESSING UNIT (CPU)**

The Central Processing Unit (processor, in short) can be any of the following: microcontroller, microprocessor or Digital Signal Processor (DSP). A micro-controller is a low-cost processor. Its main attraction is that on the chip itself, there will be many other components such as memory, serial communication interface, analog-to digital converter etc.

So, for small applications, a micro-controller is the best choice as the number of external components required will be very less. On the other hand, microprocessors are more powerful, but you need to use many external components with them. DSP is used mainly for applications in which signal processing is involved such as audio and video processing.

- **MEMORY:**

The memory is categorized as Random Access 11emory (RAM) and Read Only Memory (ROM). The contents of the RAM will be erased if power is switched off to the chip, whereas ROM retains the contents even if the power is switched off. So, the firmware is stored in the ROM. When power is switched on, the processor reads the ROM; the program is program is executed.

- **INPUT DEVICES**

Unlike the desktops, the input devices to an embedded system have very limited capability. There will be no keyboard or a mouse, and hence interacting with the embedded system is no easy task. Many embedded systems will have a small keypad-you press one key to give a specific command. A keypad may be used to input only the digits. Many embedded systems used in process control do not have any input device for user interaction; they take inputs from sensors or transducers 1’fnd produce electrical signals that are in turn fed to other systems.

- **OUTPUT DEVICES**

The output devices of the embedded systems also have very limited capability. Some embedded systems will have a few Light Emitting Diodes (LEDs) to indicate the health status of the system modules, or for visual indication of alarms. A small Liquid Crystal Display (LCD) may also be used to display some important parameters.

- **COMMUNICATION INTERFACES**

The embedded systems may need to, interact with other embedded systems at they may have to transmit data to a desktop. To facilitate this, the embedded systems are provided with one or a few communication interfaces such as RS232, RS422, RS485, Universal Serial Bus (USB), IEEE 1394, Ethernet etc.

- **APPLICATION-SPECIFIC CIRCUITRY**

  Sensors, transducers, special processing and control circuitry may be required fat an embedded system, depending on its application. This circuitry interacts with the processor to carry out the necessary work. The entire hardware has to be given power supply either through the 230 volts main supply or through a battery. The hardware has to design in such a way that the power consumption is minimized.

CHAPTER 4

4. HARDWARE

4.1. DESIGN OF HARDWARE

This chapter briefly explains about the hardware implementation of health monitoring systems using iot and raspberry pi. It discusses the circuit diagram of each module in detail. For implementing the health diagnosis system, there is a need of essential components that are suitable and manipulate health problems. The components use generally includes temperature sensor LM-35, OXIGEN LEVEL SENSOR, heartbeat sensor.

Arduino Uno

The most common version of Arduino is the Arduino Uno. This board is what most people are talking about when they refer to an Arduino. The Uno is one of the more popular boards in the Arduino family and a great choice for beginners. There are different revisions of Arduino Uno, below detail is the most recent revision (Rev3 or R3). The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Microcontroller	:	ATmega328
Operating Voltage	:	5V
Input Voltage (recommended)	:	7-12V
Input Voltage (limits)	:	6-20V
Digital I/O Pins	:	14 (of which 6 provide PWM output)
Analog Input Pins	:	6
DC Current per I/O Pin	:	40 mA
DC Current for 3.3V Pin	:	50 mA
Flash Memory	:	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	:	2 KB (ATmega328)
EEPROM	:	1 KB (ATmega328)
Clock Speed	:	16 MHz
Length	:	68.6 mm
Width	:	53.4 mm

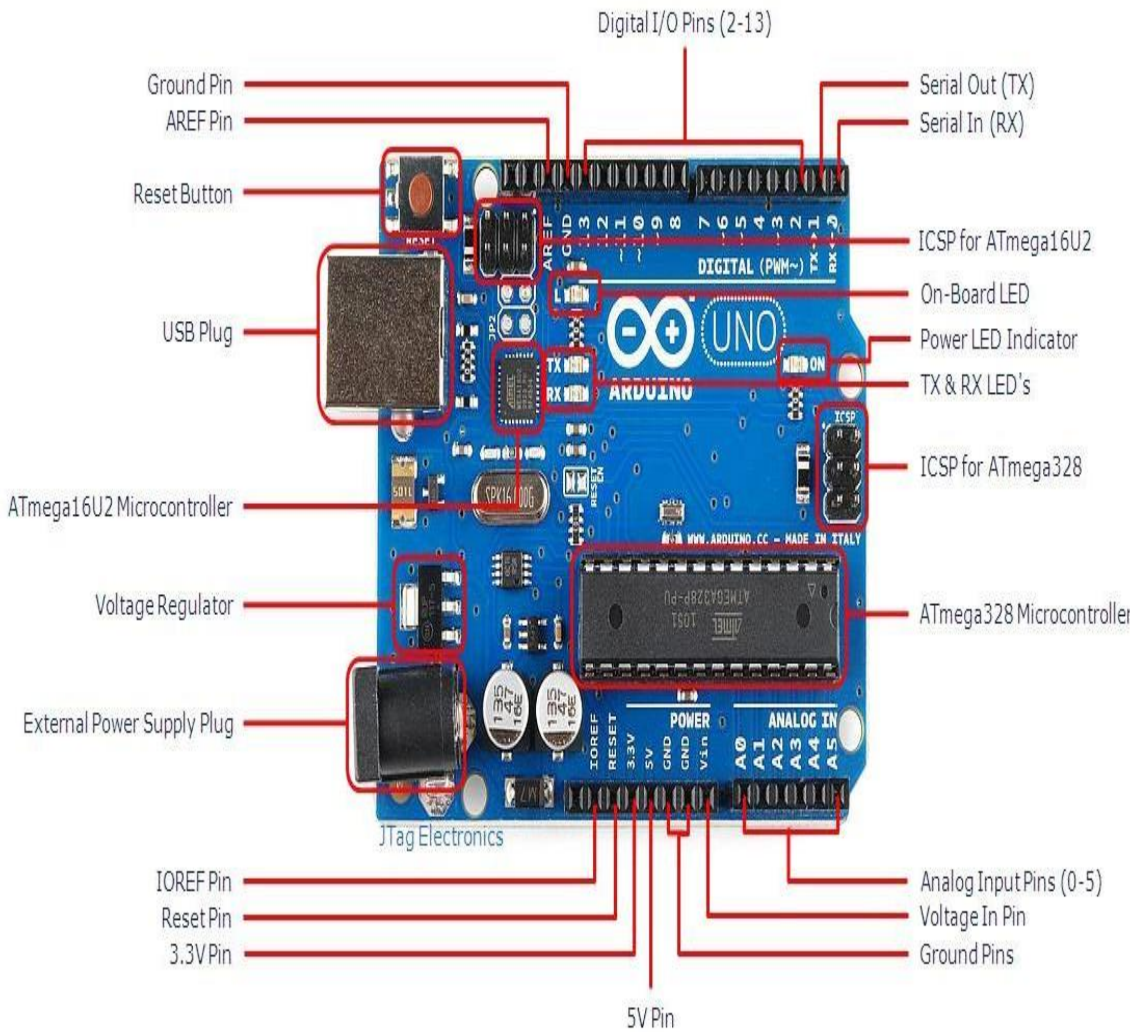


fig 4.1 ArduinoUno R3 Board

- **USB Plug & External Power Supply Plug**

Every Arduino board needs a way to be connected to a power source. The Arduino Uno can be powered from a USB cable coming from your computer or a wall power supply that is terminated in a barrel jack. The power source is selected automatically. The USB connection is also how you will load code onto your Arduino board. Please on my other post on how to program with Arduino can be found in Installing and Programming Arduino.

NOTE: The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable.If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts

- **Voltage Regulator**

The voltage regulator is not actually something you can (or should) interact with on the Arduino. But it is potentially useful to know that it is there and what it's for. The voltage regulator does exactly what it says – it controls the amount of voltage that is let into the Arduino board. Think of it as a kind of gatekeeper; it will turn away an extra voltage that might harm the circuit. Of course, it has its limits, so don't hook up your Arduino to anything greater than 20 volts.

- **Power Pins**

Voltage In Pin – The input voltage to the Arduino board when it's using an external power source(as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V Pin – This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 – 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. It's not recommended.3.3V Pin – A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

- **Ground Pins**

There are several GND pins on the Arduino, any of which can be used to ground your circuit.

- **IOREF Pin**

This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

- **Input and Output Pins**

Each of the 14 digital pins on the Uno can be used as an input or output. They operate at 5 volts. These pins can be used for both digital input (like telling if a button is pushed) and digital output (like powering an LED). Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-5k Ohms. In addition, some pins have specialized functions.

- **Serial Out (TX) & Serial In (RX)**

Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

- **External Interrupts**

Pins 2 and 3 can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.

PWM – You may have noticed the tilde (~) next to some of the digital pins (3, 5, 6, 9, 10, and 11). These pins act as normal digital pins, but can also be used for something called Pulse-Width Modulation (PWM). Think of these pins as being able to simulate analog output (like fading an LED in and out).

SPI – Pins 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). SPI stands for Serial Peripheral Interface. These pins support SPI communication using the SPI library.

Analog Input Pins – Labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). These pins can read the signal from an analog sensor (like a temperature sensor) and convert it into a digital value that we can read. By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF Pin (Stands for Analog Reference. Most of the time you can leave this pin alone). Additionally, some pins have specialized functionality:

TWI – Pins A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

- **Reset Pin**

Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

- **LED Indicators**

Power LED Indicator – Just beneath and to the right of the word “UNO” on your circuit board, there’s a tiny LED next to the word ‘ON’. This LED should light up whenever you plug your Arduino into a power source. If this light doesn’t turn on, there’s a good chance something is wrong. Time to re-check your circuit!

On-Board LED – There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it’s off. This useful to quickly check if the board has no problem as some boards has a pre-loaded simple blinking LED program in it.

TX & RX LEDs – These LEDs will give us some nice visual indications whenever our Arduino is receiving or transmitting data (like when we’re loading a new program onto the board).

Reset Button: Pushing the reset button temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino. This can be very useful if your code doesn't repeat, but you want to test it multiple times.

4.2. Temperature Sensor-LM35

It is an IC sensor that is used to measure temperature with an output voltage linearly proportional to the Centigrade temperature. The LM35 sensor has an advantage over linear temperature sensor, as the user has not to make the conversion of Kelvin to Centigrade. This is major significance of LM-35 that it calibrates directly in Celsius and it is also suitable for remote applications. It has better efficiency than thermistor.

Temperature is one of the most commonly measured parameter in the world. They are used in your daily household devices from Microwave, fridges, AC to all fields of engineering. Temperature sensor basically measures the heat/cold generated by an object to which it is connected. It then provides a proportional resistance, current or voltage output which is then measured or processed as per our application. Temperature sensor are basically classified into two types

- Non Contact Temperature Sensors: These temperature sensors use convection & radiation to monitor temperature
- Contact Temperature Sensors: Contact temperature sensors are then further sub divided into three type

1. Electro-Mechanical (Thermocouples).
2. Resistive resistance Temperature Detectors (RTD).
3. Semiconductor based. (LM35, DS1820 etc).

In this project, we will be discussing about LM35 Temperature Sensor which is a semiconductor based sensor. LM35 is an integrated analog temperature sensor whose electrical output is proportional to Degree Centigrade. LM35 Sensor does not require any external calibration or trimming to provide typical accuracies. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy.

Features of LM35 Temperature Sensor

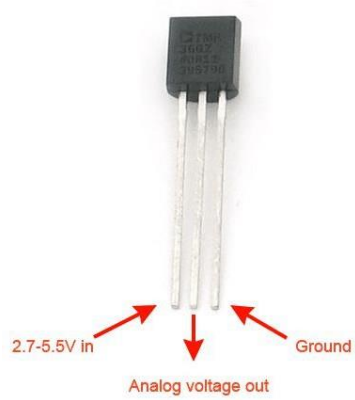


Fig 4.2: Pin diagram of LM35

- Calibrated directly in Degree Celsius (Centigrade)
- Linear at 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee-able (at a25°C)
- Rated for full -55°C to a 150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 mA current drain
- Low self-heating, 0.08°C instill air
- Non-linearity only 0.25°C typical
- Low impedance output, 0.1Ωfor 1 mA load

LM35 Interfacing Circuit

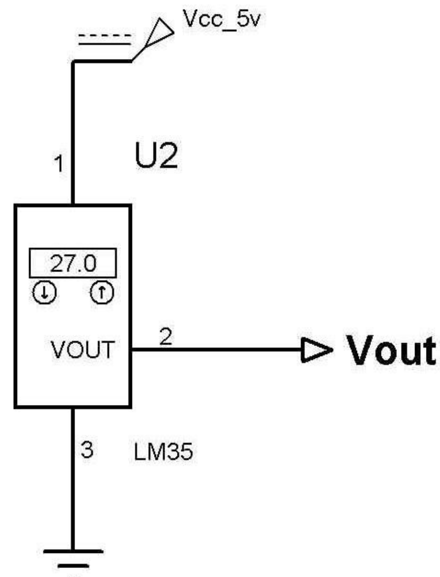


Fig 4.3 LM35 Interfacing Circuit

As such no extra components required to interface LM35 to ADC as the output of LM35 is linear with 10mv/degree scale. It can be directly interfaced to any 10 or 12 bit ADC. But if you are using an 8-bit ADC like ADC0808 or ADC0804 an amplifier section will be needed if you require to measure 1°C change.

LM35 can also be directly connected to Arduino. The output of LM35 temperature can also be given to comparator circuit and can be used for over temperature indication or by using a simple relay can be used as a temperature controller.

4.3. Wi-Fi

Description

The ZG2100M & ZG2101M modules are low-power 802.11b implementations. All RF components, the baseband and the entirety of the 802.11 MAC reside on-module, creating a simple and cost-effective means to add Wi-Fi connectivity for embedded devices. The module(s) implement a high-level API, simplifying design implementation and allowing the ZG2100M or ZG2101M to be integrated with 8- and 16-bit host microcontrollers.

Features

• Single-chip 802.11b including MAC, baseband, RF and power amplifier

• Data Rate: 1 & 2 Mbps

• 802.11b/g/n compatible

• Low power operation

• API for embedded markets, no OS required

• PCB or external antenna options

• Hardware support for AES and RC4 based ciphers (WEP, WPA, WPA2 security)

• SPI slave interface with interrupt

• Single 3.3V supply, operates from 2.7V to 3.6V (see section 5)

• 21mm x 31mm 36-pin Dual Flat pack PCB SM Package

• Wi-Fi Certified, RoHS and CE compliant

• FCC Certified (USA, FCC ID: W7O-ZG2100-ZG2101)

• IC Certified (IC: 8248A-G21ZEROG)

• Fully compliant with EU & meets the R&TTE Directive for Radio Spectrum

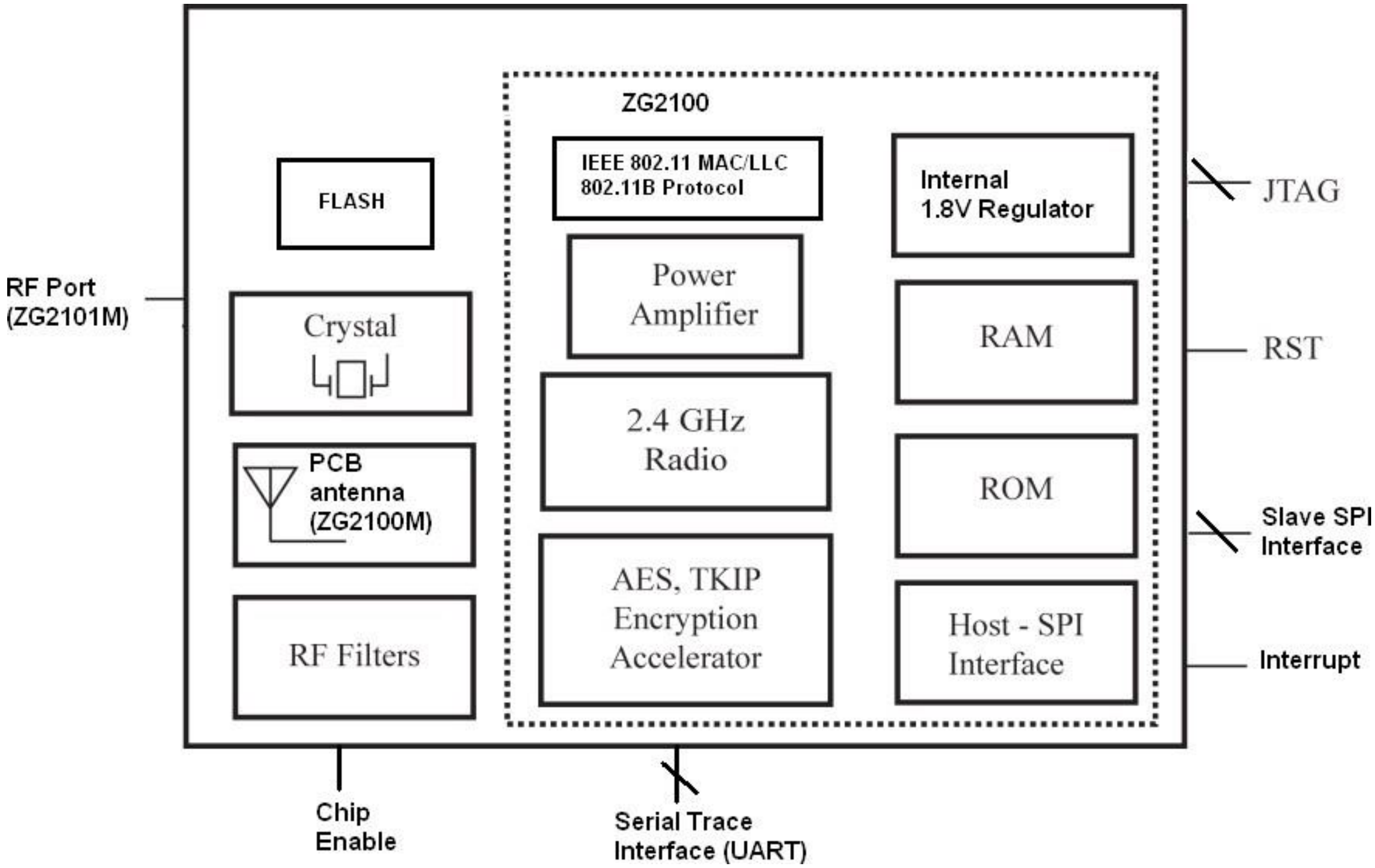


Fig 4.4:ZG2100M/ZG2101M Module: Functional Block Diagram

The ZG2100 single-chip 802.11b transceiver includes MAC, baseband, RF and power amplifier, and built in hardware support for AES, and TKIP (WEP, WPA, WPA2 security). The device has an API targeted for embedded markets so an operating system is not required for operation. There is a fully integrated radio ideal for 1 & 2Mbps operation with optional support for external PA and antenna switch operation.

The ZG2100M modules incorporate the Zero G ZG2100 single chip 802.11b transceiver with all associated RF components, crystal oscillator, and bypass and bias passives along with a printed antenna to provide a fully integrated Wi-Fi I/O solution controllable from an 8 or 16-bit processor. The ZG2101M module is similar but bypasses the on-board PCB antenna and uses a U.FL connector for connection to an external antenna.

Interface is via SPI slave interface with interrupt for HOST operation. The modules support RS232 serial interfaces (requires level shifter) for debug and JTAG boundary scan. Operation is via a single 3.3V supply, supporting various power states, such as hibernate and SLEEP, for end applications long battery life. ZG2100M contains a built in PCB antenna for ease of system integration and significant BOM reduction.

The module is manufactured on an FR4 PCB substrate, with components on the top surface only. Connection is made as a surface mount component via flat pack (no pin) connections on two sides.

The internal regulators for the digital and analog core power supplies are enabled by keeping the chip enable pin (CE_N) low. The waveforms for the core supplies, illustrated on the following page, as shown when powering up the ZG2100M/ZG2101M with a nominal 3.3V applied to VDD_3.3. There is an internal power-on-reset detect which starts the boot sequence from the internal ROM when the core supply (VDD_1.8) is up. After approximately 50 ms from when VDD_3.3 supply is within specification, the ZG2100M/ZG2101M is ready for operation.

4.3.1. JTAG Interface

Joint Test Action Group (JTAG) is the common name used for the IEEE 1149.1 standard entitled Standard Test Access Port and Boundary-Scan Architecture for test access ports used for testing printed circuit boards using boundary scan. ZG2100M/ZG2101M supports JTAG boundary scan. JTAG_EN and JTAG_RST_N need to be driven HIGH to enable JTAG mode.

4.3.2. Serial Interface for Trace

ZG2100M/ZG2101M incorporates Transmitted Data pin (UART0_TX) and Received Data pin (UART0_RX) for serial testing purposes. These pins can be connected to commercially available RS-232 line drivers/ receivers with appropriate external level shifters. The ZG2100 serial interface is fully tested at 115200 bits/seconds baud rate with RS232/UART interface applications.

4.3.3. Host-Control SPI Interface

The slave SPI interface implements the [CPOL=0; CPHA=0] and [CPOL=0; CPHA=1] modes (0 and 3) of operation. That is, data is clocked in on the first rising edge of the clock after Chip Select goes valid.

Data on the bus is required to be big endian, with most significant bit on the bus first and least significant bit going last. There are two decode regions. One for register access and one for a FIFO interface. Operation for both regions is shown below. The INT_NX signal allows interrupts to be signaled to the host device.

4.4. BUZZER

BUZZER DRIVER CIRCUIT

Digital systems and microcontroller pins lack sufficient current to drive the circuits like relays, buzzer circuits etc. While these circuits require around 10milli amps to be operated, the microcontroller's pin can provide a maximum of 1-2milli amps current. For this reason, a driver such as a power transistor is placed in between the microcontroller and the buzzer circuit.

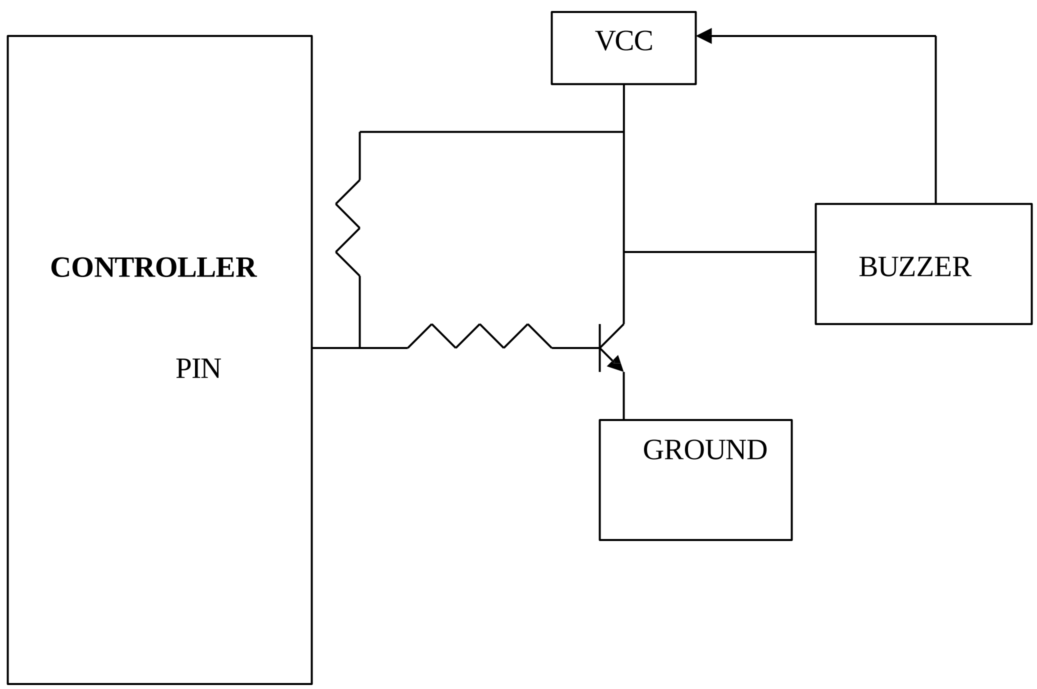


Fig 4.5:Buzzer driver circuit

The operation of this circuit is as follows

The input to the base of the transistor is applied from the microcontroller port pin P1.0. The transistor will be switched on when the base to emitter voltage is greater than 0.7V (cut-in voltage). Thus when the voltage applied to the pin P1.0 is high i.e., P1.0=1 (>0.7V), the transistor will be switched on and thus the buzzer will be ON.

When the voltage at the pin P1.0 is low i.e., P1.0=0 (<0.7V) the transistor will be in off state and the buzzer will be OFF. Thus the transistor acts like a current driver to operate the buzzer accordingly.

BUZZER INTERFACING WITH THE MICROCONTROLLER

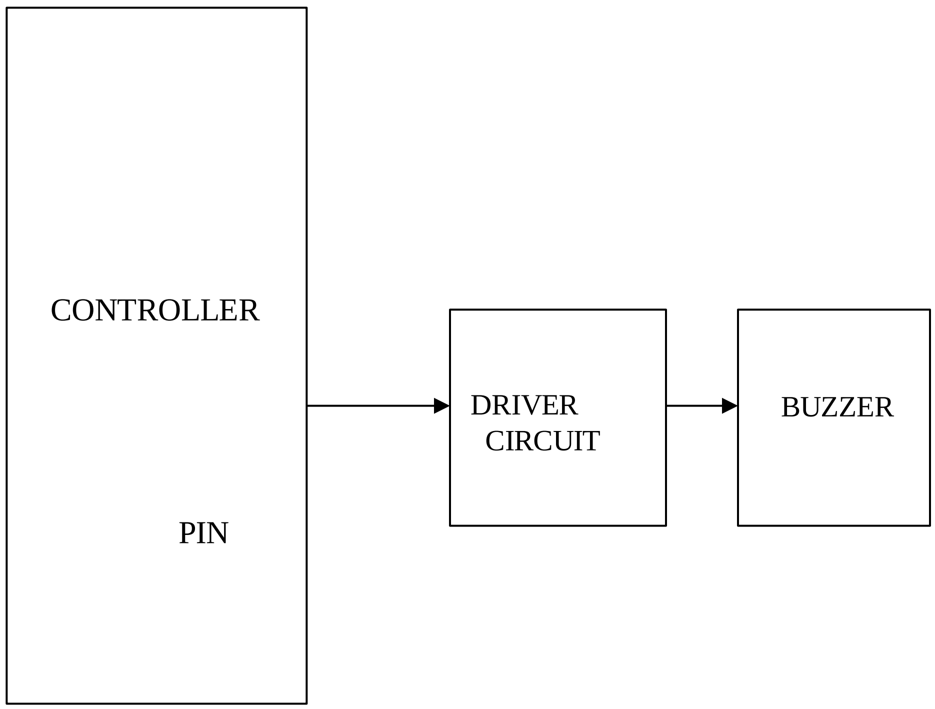


Fig 4.6: Buzzer interfacing with microcontroller

4.5. POWER SUPPLY

The power supplies are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can by broken down into a series of blocks, each of which performs a particular function. A d.c power supply which maintains the output voltage constant irrespective of a.c mains fluctuations or load variations is known as “Regulated D.C Power Supply”.

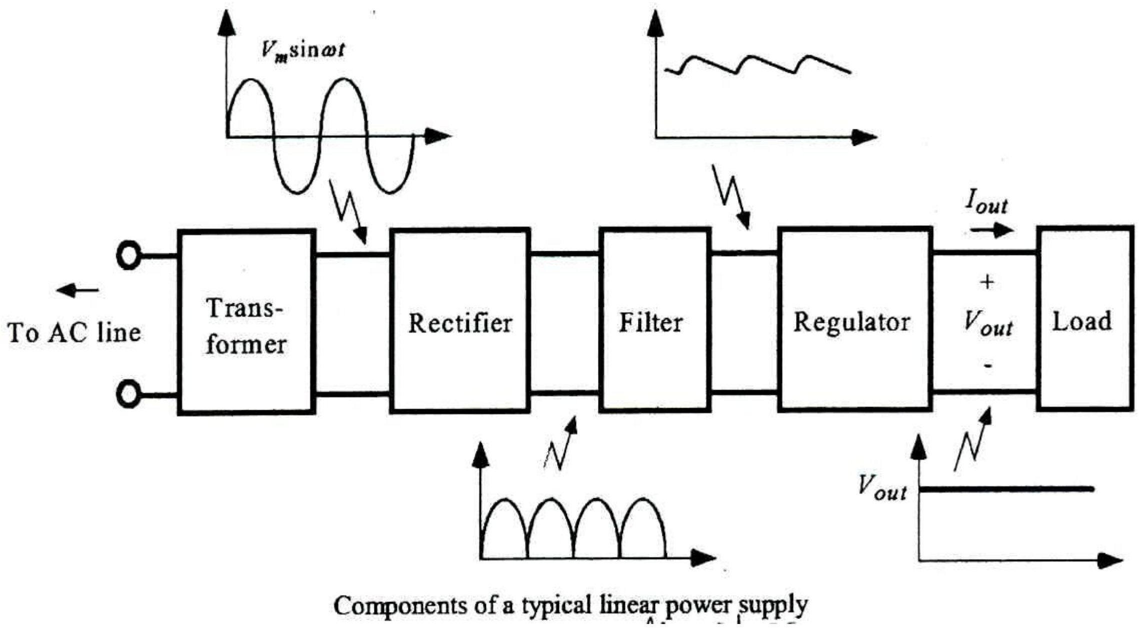


Fig:4.7. Block Diagram of Power Supply

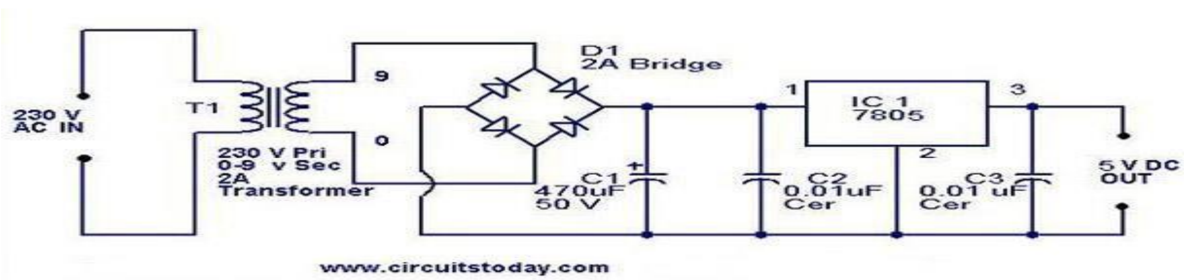


Fig: 4.8. Schematic Diagram of Power Supply

4.6. TRANSFORMER

A transformer is an electrical device which is used to convert electrical power from one Electrical circuit to another without change in frequency.

When AC is applied to the primary winding of the power transformer it can either be stepped down or up depending on the value of DC needed. In our circuit the transformer of 230v/12-0-12v is used to perform the step down operation where a 230V AC appears as 12V AC across the secondary winding.

4.6.1. RECTIFIER

A circuit which is used to convert a.c to dc is known as RECTIFIER. The process of conversion a.c to d.c is called “rectification.

Bridge Rectifier

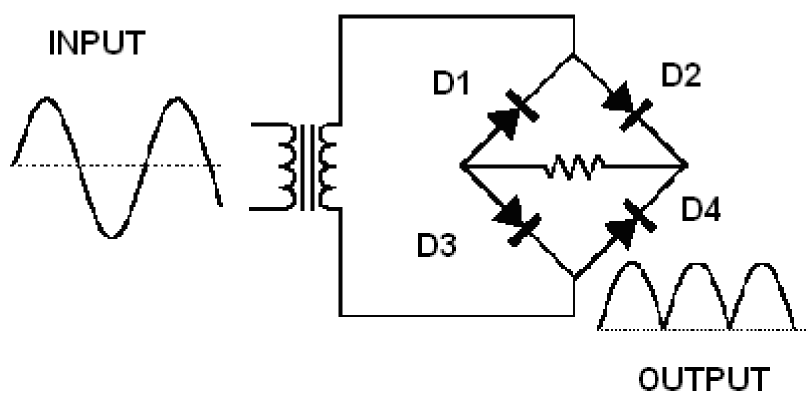


Fig: 4.9 Bridge Rectifier

OPERATION

During positive half cycle of secondary, the diodes D2 and D3 are in forward biased while D1 and D4 are in reverse biased. During negative half cycle of secondary voltage, the diodes D1 and D4 are in forward biased while D2 and D3 are in reverse biased.

4.6.2. FILTER

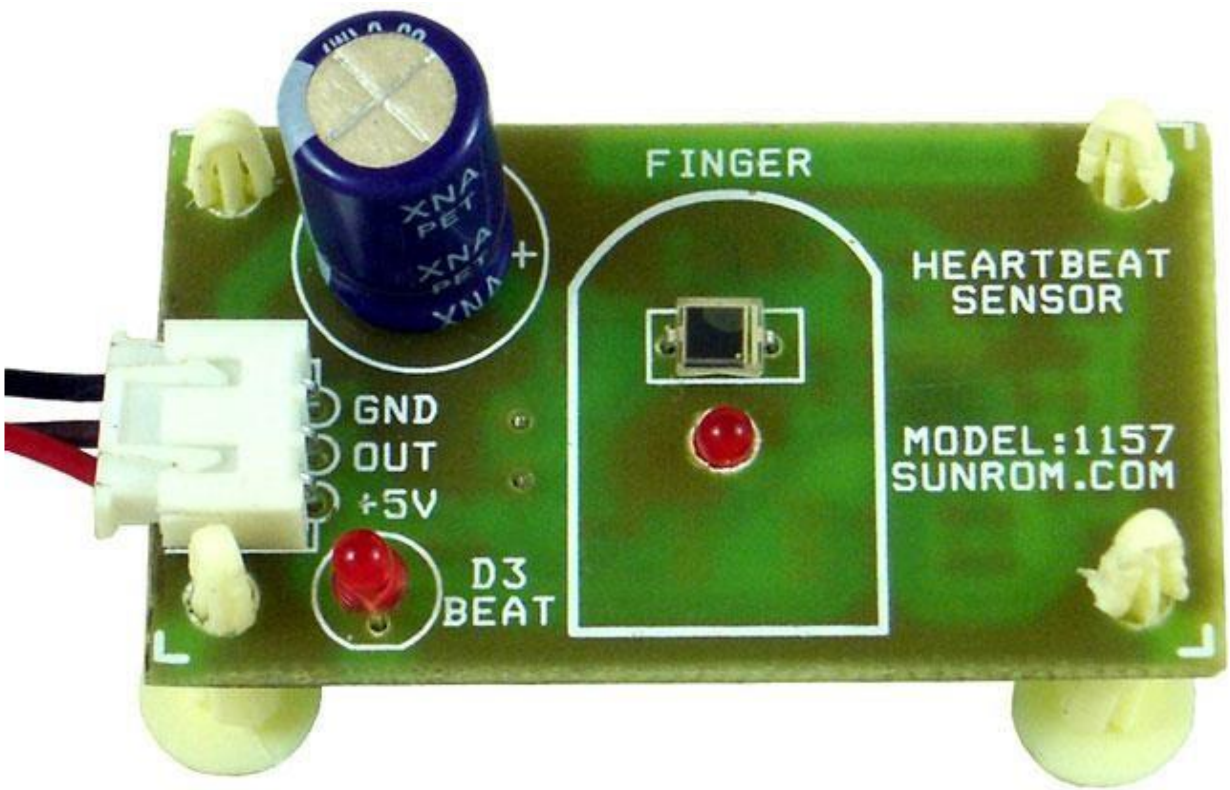
A Filter is a device which removes the a AC component of rectifier output but allows the DC component to reach the load .We have seen that the ripple content in the rectified output of half wave rectifier is **121%** or that of full-wave or bridge rectifier or bridge rectifier is **48%** such high percentages of ripples is not acceptable for most of the applications. Ripples can be removed by one of the following methods of filtering. A capacitor, in parallel to the load, provides an easier by –pass for the ripples voltage though it due to low impedance. At ripple frequency and leave the d.c.to appears the load.

4.6.3. VOLTAGE REGULATOR

As the name itself implies, it regulates the input applied to it. A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. In this project, power supply of 5V and 12V are required. In order to obtain these voltage levels, 7805 and 7812 voltage regulators are to be used. The first number 78 represents positive supply and the numbers 05, 12 represent the required output voltage.

4.7. Heart Beat Sensor

Heart beat sensor is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heart beat. This digital output can be connected to microcontroller directly to measure the Beats per minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.



Features

· Heat beat indication by LED

· Instant output digital signal for directly connecting to microcontroller

· Compact Size

· Working Voltage +5V DC

Applications:

· Digital Heart Rate monitor

· Patient Monitoring System

· Bio-Feedback control of robotics and applications

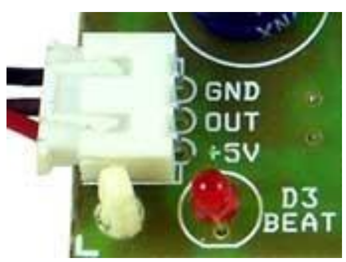
Specification:

Parameter	Value
Operating Voltage	+5V DC regulated
Operating Current	100 mA
Output Data Level	5V TTL level
Heart Beat detection	Indicated by LED and Output High Pulse
Light source	660nm Super Red LED

Pin Details:

Board has 3-pin connector for using the sensor. Details are marked on PCB as below.

Pin	**Name**	**Details**
1	+5V	Power supply Positive input
2	OUT	Active High output
3	GND	Power supply Ground



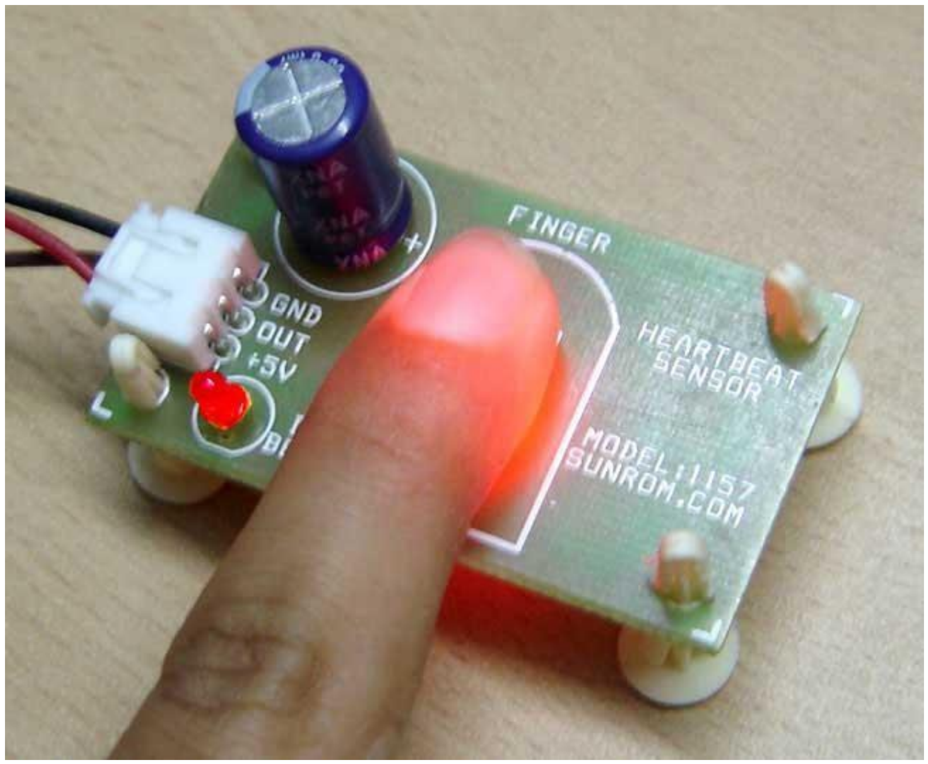
Using the Sensor

· Connect regulated DC power supply of 5 Volts. Black wire is Ground, Next middle wire is Brown which is output and Red wire is positive supply. These wires are also marked on PCB.

· To test sensor you only need power the sensor by connect two wires +5V and GND. You can leave the output wire as it is. When Beat LED is off the output is at 0V.

· Put finger on the marked position, and you can view the beat LED blinking on each heart beat.

· The output is active high for each beat and can be given directly to microcontroller for interfacing applications.s



Working

The sensor consists of a super bright red LED and light detector. The LED needs to be super bright as the maximum light must pass spread in finger and detected by detector. Now, when the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and so less light reached the detector. With each heart pulse the detector signal varies. This variation is converted to electrical pulse. This signal is amplified and triggered through an amplifier which outputs +5V logic level signal. The output signal is also indicated by a LED which blinks on each heart beat.

4.8. Alphanumeric LCD

Liquid Crystal Display also called as LCD is very helpful in providing user interface as well as for debugging purpose. The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. The most commonly used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only 1 controller and support at most of 80 characters, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers.

Pin Description

Pin No.	Name	Description
1	**VSS**	Power supply (GND)
2	**VCC**	Power supply (+5V)
3	**VEE**	Contrast adjust
4	**RS**	0 = Instruction input 1 = Data input
5	**R/W**	0 = Write to LCD module 1 = Read from LCD module
6	**EN**	Enable signal
7	**D0**	Data bus line 0 (LSB)
8	**D1**	Data bus line 1

9	**D2**	Data bus line 2
10	**D3**	Data bus line 3
11	**D4**	Data bus line 4
12	**D5**	Data bus line 5
13	**D6**	Data bus line 6
14	**D7**	Data bus line 7 (MSB)
15	**LED+**	Back Light VCC
16	**LED-**	Back Light GND

DDRAM - Display Data RAM

Display data RAM (DDRAM) stores display data represented in 8-bit character codes. Its extended capacity is 80 X 8 bits, or 80 characters. The area in display data RAM (DDRAM) that is not used for display can be used as general data RAM. So whatever you send on the DDRAM is actually displayed on the LCD. For LCDs like 1x16, only 16 characters are visible, so whatever you write after 16 chars is written in DDRAM but is not visible to the user.

CGROM - Character Generator ROM

Now you might be thinking that when you send an ASCII value to DDRAM, how the character is displayed on LCD? So the answer is CGROM. The character generator ROM generates 5 x 8 dot or 5 x 10 dot character patterns from 8-bit character codes. It can generate 208 5 x 8 dot character patterns and 32 5 x 10 dot character patterns.

CGRAM - Character Generator RAM

As clear from the name, CGRAM area is used to create custom characters in LCD. In the character generator RAM, the user can rewrite character patterns by program. For 5 x 8 dots, eight character patterns can be written, and for 5 x 10 dots, four character patterns can be written.

BF - Busy Flag

Busy Flag is a status indicator flag for LCD. When we send a command or data to the LCD for processing, this flag is set (i.e. BF =1) and as soon as the instruction is executed successfully this flag is cleared (BF = 0). This is helpful in producing and exact amount of delay for the LCD processing.

To read Busy Flag, the condition RS = 0 and R/W = 1 must be met and The MSB of the LCD data bus (D7) act as busy flag. When BF = 1 means LCD is busy and will not accept next command or data and BF = 0 means LCD is ready for the next command or data to process.

Instruction Register (IR) and Data Register (DR)

There are two 8-bit registers in HD44780 controller Instruction and Data register. Instruction register corresponds to the register where you send commands to LCD e.g. LCD shift command, LCD clear, LCD address etc. and Data register is used for storing data which is to be displayed on LCD. When send the enable signal of the LCD is asserted, the data on the pins is latched in to the data register and data is then moved automatically to the DDRAM and hence is displayed on the LCD. Data Register is not only used for sending data to DDRAM but also for CGRAM, the address where you want to send the data, is decided by the instruction you send to LCD.

Commands and Instruction set

Only the instruction register (IR) and the data register (DR) of the LCD can be controlled by the MCU. Before

Command	Code										Description	Execution Time
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Clears the display and returns the cursor to the home position (address 0).	82μs~1.64ms
Return Home	0	0	0	0	0	0	0	0	1	*	Returns the cursor to the home position (address 0). Also returns a shifted display to the home position. DD RAM contents remain unchanged.	40μs~1.64ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets the cursor move direction and enables/disables the display.	40μs
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Turns the display ON/OFF (D), or the cursor ON/OFF (C), and blink of the character at the cursor position (B).	40μs
Cursor & Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Moves the cursor and shifts the display without changing the DD RAM contents.	40μs
Function Set	0	0	0	0	1	DL	N$	F	*	#	Sets the data width (DL), the number of lines in the display (L), and the character font (F).	40μs
Set CG RAM Address	0	0	0	1	A_{CG}						Sets the CG RAM address. CG RAM data can be read or altered after making this setting.	40μs
Set DD RAM Address	0	0	1	A_{DD}							Sets the DD RAM address. Data may be written or read after making this setting.	40μs
Read Busy Flag & Address	0	1	BF	AC							Reads the BUSY flag (BF) indicating that an internal operation is being performed and reads the address counter contents.	1μs
Write Data to CG or DD RAM	1	0	Write Data								Writes data into DD RAM or CG RAM.	46μs
Read Data from CG or DD RAM	1	1	Read Data								Reads data from DD RAM or CG RAM.	46μs
	I/D = 1: Increment; I/D = 0: Decrement S = 1: Accompanies display shift. S/C= 1: Display shift; S/C = 0: cursor move R/L= 1: Shift to the right. R/L= 0: Shift to the left. DL = 1: 8 bits; DL = 0: 4 bits N = 1: 2 lines; N = 0: 1 line F = 1: 5x10 dots; F = 0: 5 x 7 dots BF = 1: Busy; BF = 0: Can accept data *# Set to 1 on 24x4 modules* *$ With KS0072 is Address Mode.*										DD RAM: Display data RAM CG RAM: Character generator RAM A_{CG}: CG RAM Address A_{DD}: DD RAM Address Corresponds to cursor address. AC: Address counter Used for both DD and CG RAM address.	Execution times are typical. If transfers are timed by software and the busy flag is not used, add 10% to the above times.

starting the internal operation of the LCD, control information is temporarily stored into these registers to allow interfacing with various MCUs, which operate at different speeds, or various peripheral control devices. The internal operation of the LCD is determined by signals sent from the MCU. These signals, which include register selection signal (RS), read/write signal (R/W), and the data bus (DB0 to DB7), make up the LCD instructions (Table 3). There are four categories of instructions that:

- Designate LCD functions, such as display format, data length, etc.
- Set internal RAM addresses
- Perform data transfer with internal RAM
- Perform meticulous function

Although looking at the table you can make your own commands and test them. Below is a brief list of useful commands which are used frequently while working on the LCD.

No.	Instruction	Hex	Decimal
1	Function Set: 8-bit, 1 Line, 5x7 Dots	0x30	48
2	Function Set: 8-bit, 2 Line, 5x7 Dots	0x38	56
3	Function Set: 4-bit, 1 Line, 5x7 Dots	0x20	32
4	Function Set: 4-bit, 2 Line, 5x7 Dots	0x28	40
5	Entry Mode	0x06	6
6	Display off Cursor off (clearing display without clearing DDRAM content)	0x08	8
7	Display on Cursor on	0x0E	14
8	Display on Cursor off	0x0C	12
9	Display on Cursor blinking	0x0F	15
10	Shift entire display left	0x18	24
12	Shift entire display right	0x1C	30
13	Move cursor left by one character	0x10	16
14	Move cursor right by one character	0x14	20
15	Clear Display (also clear DDRAM content)	0x01	1

16	Set DDRAM address or cursor position on display	0x80+add	128+add
17	Set CGRAM address or set pointer to CGRAM location	0x40+add	64+add

Sending Commands to LCD

To send commands we simply need to select the command register. Everything is same as we have done in the initialization routine. But we will summarize the common steps and put them in a single subroutine. Following are the steps:

- move data to LCD port
- select command register
- select write operation
- send enable signal
- wait for LCD to process the command

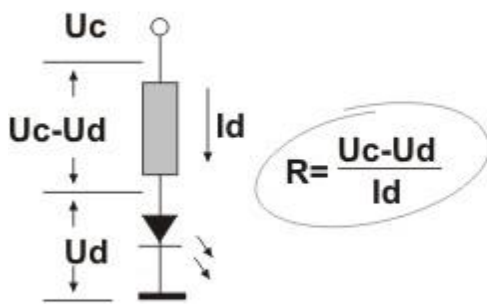
Sending Data to LCD

To send data we simply need to select the data register. Everything is same as the command routine. Following are the steps:

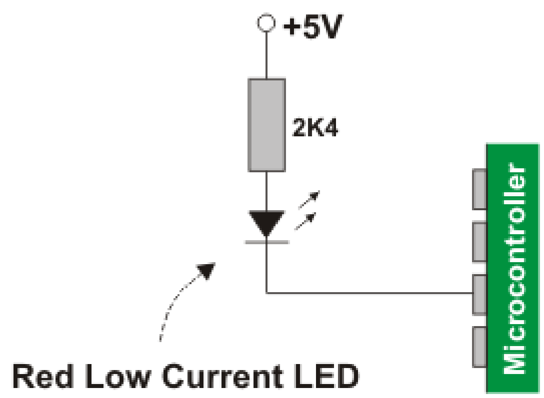
- move data to LCD port
- select data register
- select write operation
- send enable signal
- wait for LCD to process the data

4.9. Light-emitting diode (LED)

Light-emitting diodes are elements for light signalization in electronics. They are manufactured in different shapes, colors and sizes. For their low price, low consumption and simple use, they have almost completely pushed aside other light sources- bulbs at first place. They perform similar to common diodes with the difference that they emit light when current flows through them.



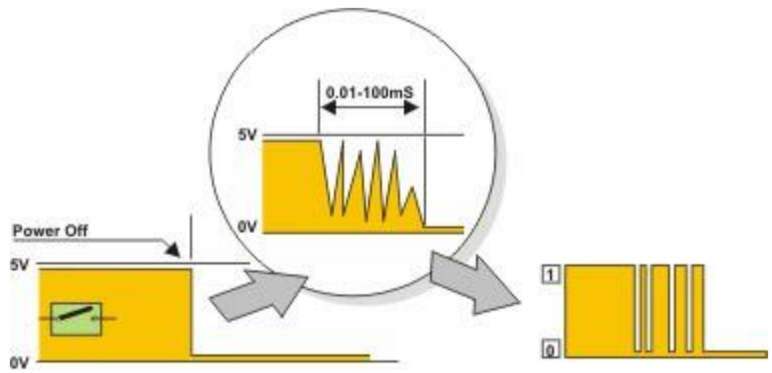
It is important to know that each diode will be immediately destroyed unless its current is limited. This means that a conductor must be connected in parallel to a diode. In order to correctly determine value of this conductor, it is necessary to know diode's voltage drop in forward direction, which depends on what material a diode is made of and what colour it is. Values typical for the most frequently used diodes are shown in table below: As seen, there are three main types of LEDs. *Standard* ones get full brightness at current of 20mA. *Low Current* diodes get full brightness at ten times lower current while *Super Bright* diodes produce more intensive light than Standard ones.



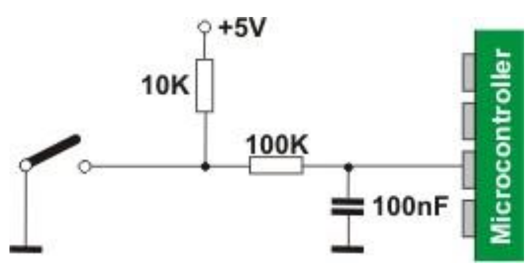
Since the 8051 microcontrollers can provide only low input current and since their pins are configured as outputs when voltage level on them is equal to 0, direct connecting to LEDs is carried out as it is shown on figure (*Low current* LED, cathode is connected to output pin).

Switches and Pushbuttons

There is nothing simpler than this! This is the simplest way of controlling appearance of some voltage on microcontroller's input pin. There is also no need for additional explanation of how these components operate.



Nevertheless, it is not so simple in practice... This is about something commonly unnoticeable when using these components in everyday life. It is about contact bounce- a common problem with m e c h a n i c a l switches. If contact switching does not happen so quickly, several consecutive bounces can be noticed prior to maintain stable state. The reasons for this are: vibrations, slight rough spots and dirt. Anyway, whole this process does not last long (a few micro- or milliseconds), but long enough to be registered by the microcontroller. Concerning pulse counter, error occurs in almost 100% of cases!



The simplest solution is to connect simple RC circuit which will "suppress" each quick voltage change. Since the bouncing time is not defined, the values of elements are not strictly determined. In the most cases, the values shown on figure are sufficient.

If complete safety is needed, radical measures should be taken! The circuit, shown on the figure (RS flip-flop), changes logic state on its output with the first pulse triggered by contact bounce. Even though this is more expensive solution (SPDT switch), the problem is definitely resolved! Besides, since the condensator is not used, very short pulses can be also registered in this way. In addition to these hardware solutions, a simple software solution is commonly applied too: when a program tests the state of some input pin and finds changes, the check should be done one more time after certain time delay. If the change is confirmed it means that switch (or pushbutton) has changed its position. The advantages of such solution are obvious: it is free of charge, effects of disturbances are eliminated too and it can be adjusted to the worst-quality contacts.

4.10. MEMS

MEMS are a process technology used to create tiny integrated devices or systems that combine mechanical and electrical components. They are fabricated using integrated circuit (IC) batch processing techniques and can range in size from a few micrometers to milli meters . These
devices (or systems) have the ability to sense, control and actuate on the micro scale, and generate effects on the macro scale.

The interdisciplinary nature of MEMS utilizes design, engineering and manufacturing
expertise from a wide and diverse range of technical areas including integrated circuit fabrication technology, mechanical engineering, materials science, electrical engineering, chemistry and chemical engineering, as well as fluid engineering, optics, instrumentation and packaging. The complexity of MEMS is also shown in the extensive range of markets and applications that incorporate MEMS devices. MEMS can be found in systems ranging across automotive, medical, electronic, communication and defense applications. Current MEMS devices include accelerometers for airbag sensors, inkjet printer heads, computer disk drive read /write heads, projection display chips, blood pressure sensors, optical switches ,microvalves, biosensors and many other products that are all manufactured and shipped in high commercial volumes.

MEMS have been identified as one of the most promising technologies for the 21st Century and has the potential to revolutionize both industrial and consumer products by combining silicon based microelectronics with micromachining technology. Its techniques and microsystem based devices have the potential to dramatically affect of all of our lives and the way we live.

If semiconductor microfabrication was seen to be the first micromanufacturing revolution, MEMS is the second revolution. This report introduces the field of MEMS and is divided into four main sections. In the first section, the reader is introduced to MEMS, its definitions, history, current and potential applications, as well as the state of the MEMS market and issues concerning miniaturization.

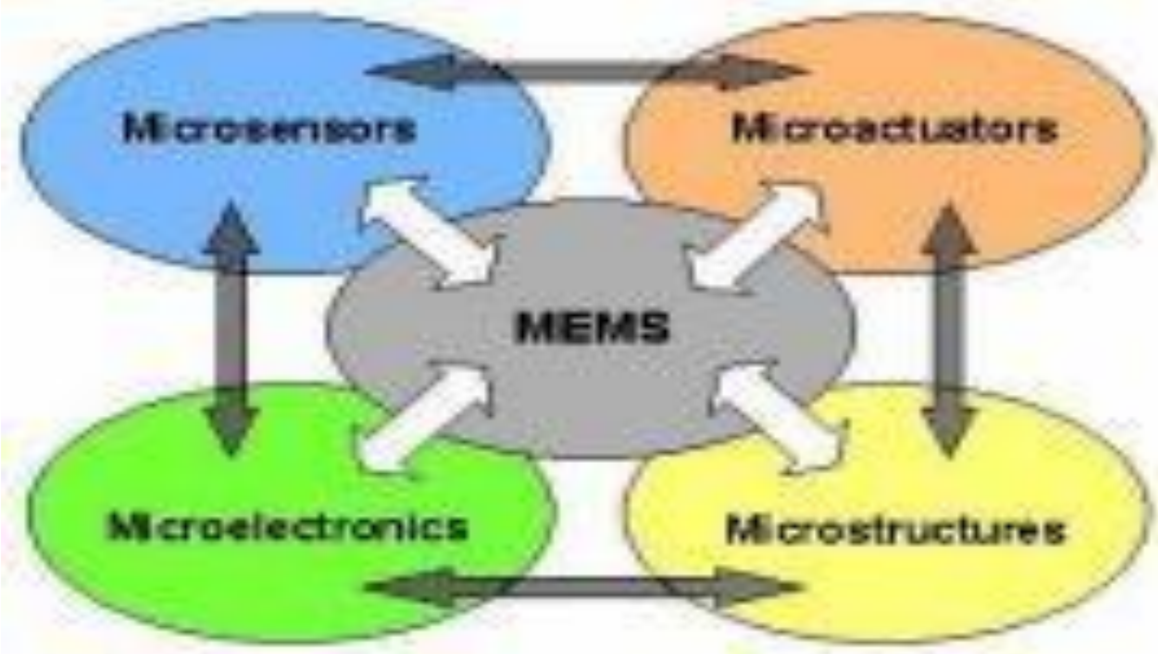
The second section deals with the fundamental fabrication methods of MEMS including photolithography, bulk micromachining, surface micromachining and high-aspect-ratio micromachining; assembly, system integration and packaging of MEMS devices is also described here. The third section reviews the range of MEMS sensors and actuators, the phenomena that can be sensed or acted upon with MEMS devices, and a brief description of the basic sensing and actuation mechanisms. The final section illustrates the challenges facing the MEMS industry for the commercialization and success of MEMS.

Micro-electromechanical Systems (MEMS)

What is MEMS?

Micro-electro mechanical systems (MEMS) is a process technology used to create tiny integrated devices or systems that combine mechanical and electrical components. They are fabricated using integrated circuit (IC) batch processing techniques and can range in size from a few micrometers to millimeters. These devices (or systems) have the ability to sense, control and actuate on the micro scale, and generate effects on the macro scale.

MEMS, an acronym that originated in the United States, is also referred to as Microsystems Technology (MST) in Europe and Micromachines in Japan. Regardless of terminology, the uniting factor of a MEMS device is in the way it is made. While the device electronics are fabricated using 'computer chip' IC technology, the micromechanical components are fabricated by sophisticated manipulations of silicon and other substrates using micromachining processes. Processes such as bulk and surface micromachining, as well as high-aspect-ratio micromachining (HARM) selectively remove parts of the silicon or add additional structural layers to form the mechanical and electromechanical components. While integrated circuits are designed to exploit the electrical properties of silicon, MEMS takes advantage of either silicon's mechanical properties or both its electrical and mechanical properties.



Mechanical microstructures, microsensors, micro actuators and microelectronics, all integrated onto the same silicon chip. This is shown schematically in Figure .Microsensors detect changes in the system's environment by measuring mechanical, thermal, magnetic, chemical or electromagnetic information or phenomena. Microelectronics process this information and signal the micro actuators to react and create some form of changes to the environment.

MEMS devices are very small; their components are usually microscopic. Levers, gears,
pistons, as well as motors and even steam engines have all been fabricated by MEMS . However, MEMS is not just about the miniaturization of mechanical components or making things out of silicon (in fact, the term MEMS is actually misleading as many micromachined devices are not mechanical in any sense). MEMS is a manufacturing technology; a paradigm for designing and creating complex mechanical devices and systems as well as their integrated electronics using batch fabrication techniques.

MEMS Transducers

Microsensors and micro actuators are at the very core of a MEMS device or system. A microsensor detects changes in the system's environment; an 'intelligent' part processes the information detected by the sensor and makes a decision in the form of a signal; and a micro actuator acts on this signal to create some form of changes in the environment.

Microelectronic components make up most of the intelligent part of the device and, as an established technology, will not be discussed here. Sensors and actuators are broadly termed transducers and are essentially devices that convert one form of energy into another. Many of the MEMS sensors and actuators described in this section have been developed within the microelectronics industry and do not all involve any special micromachining techniques; they are based on conventional integrated circuits that, through inherent mechanisms, sense light, temperature etc. However, many of these can be enhanced by the use of MEMS. Basic MEMS mechanisms and structures consist of both in-plane and out-of-plane mechanisms as well as structural members to couple energy between the actuator and sensors as well as with the physical interface of a mechanical system. Mechanisms such as joints, linkages, gears and hinges are very typical.

This section concentrates on the phenomena that can be sensed or acted upon with MEMS devices with a brief description of the basic sensing and actuation mechanisms. It is important to note that although these devices are mechanical and have been categorized in terms of their sensing domain (e.g. thermal, chemical, radiation), there are many overlaps, and forms of mechanical transducer can be commonly found as intermediate mechanisms in other devices.

Mechanical Sensors

There is a tremendous variety of direct mechanical sensors that have been or could be micromachined depending on their sensing mechanism (usually piezoresistive, piezoelectric or capacitive) and the parameters sensed (typically strain, force and displacement).

i) Piezoresistive sensors

As a result of the piezoresistive effect (defined as the change in resistivity of the material with applied strain), changes in gauge dimension result in proportional changes in resistance in the sensor. The piezoresistive effect in semiconductors is considerably higher than in traditional metals, making silicon an excellent strain sensor. MEMS piezoresistors are readily manufactured using bulk silicon doped with p-type or n-type impurities.

ii) Piezoelectric sensors

Piezoelectric sensors utilize the piezoelectric effect in which an applied strain (or force) on a piezoelectric crystal results in a potential difference across the crystal. Similarly, if the crystal is subjected to a potential difference, a displacement, or strain, is produced. The effect can be used to sense mechanical stress (i.e. displacement) and as an actuation mechanism, although displacements are small even for large voltages. Common piezoelectric materials used for MEMS applications include quartz, lead zirconate titanate (PZT), polyvinylidene fluoride (PVDF) and ZnO, PVDF and ZnO being the most common. Silicon is not piezoelectric; hence a thin film of a suitable material must be deposited on the devices.

iii) Capacitive sensors

Capacitive (or electrostatic) sensing is one of the most important (and widely used) precision sensing mechanisms and includes one or more fixed conducting plates with one or more moving conducting plates. Capacitive sensing relies on the basic parallel-plate capacitor equation shown below. As capacitance is inversely proportional to the distance between the plates, sensing of very small displacements is extremely accurate.

CHAPTER-5

5. DESIGN OF SOFTWARE

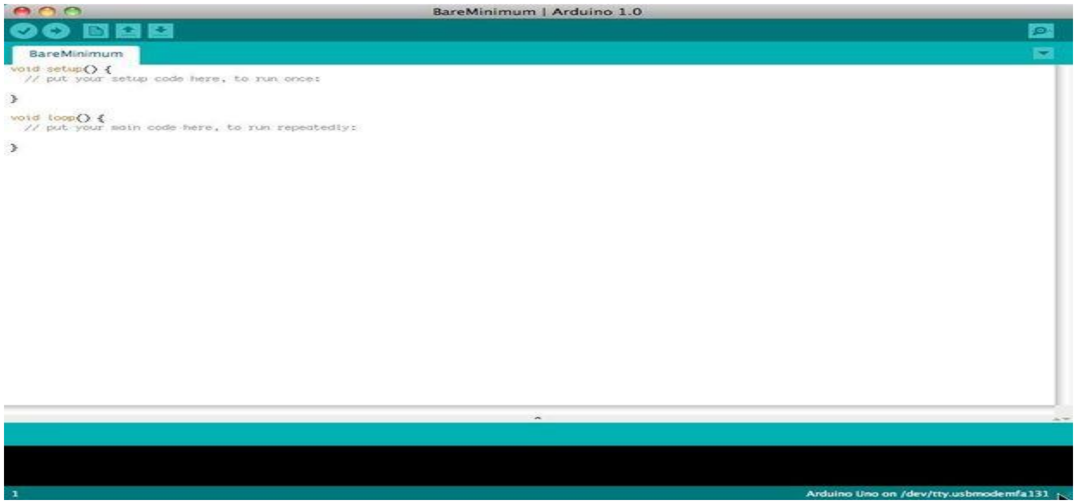
5.1. INTRODUCTION TO ARDUINO IDE SOFTWARE

This is free software (evaluation version) which solves many of the pain points for an embedded system developer. This software is an Integrated Development Environment(IDE), which integrated text editor to write program, a compiler and it will convert your source code into HEX file. Here is simple guide to start working with Arduino IDE Vision which can be used for:

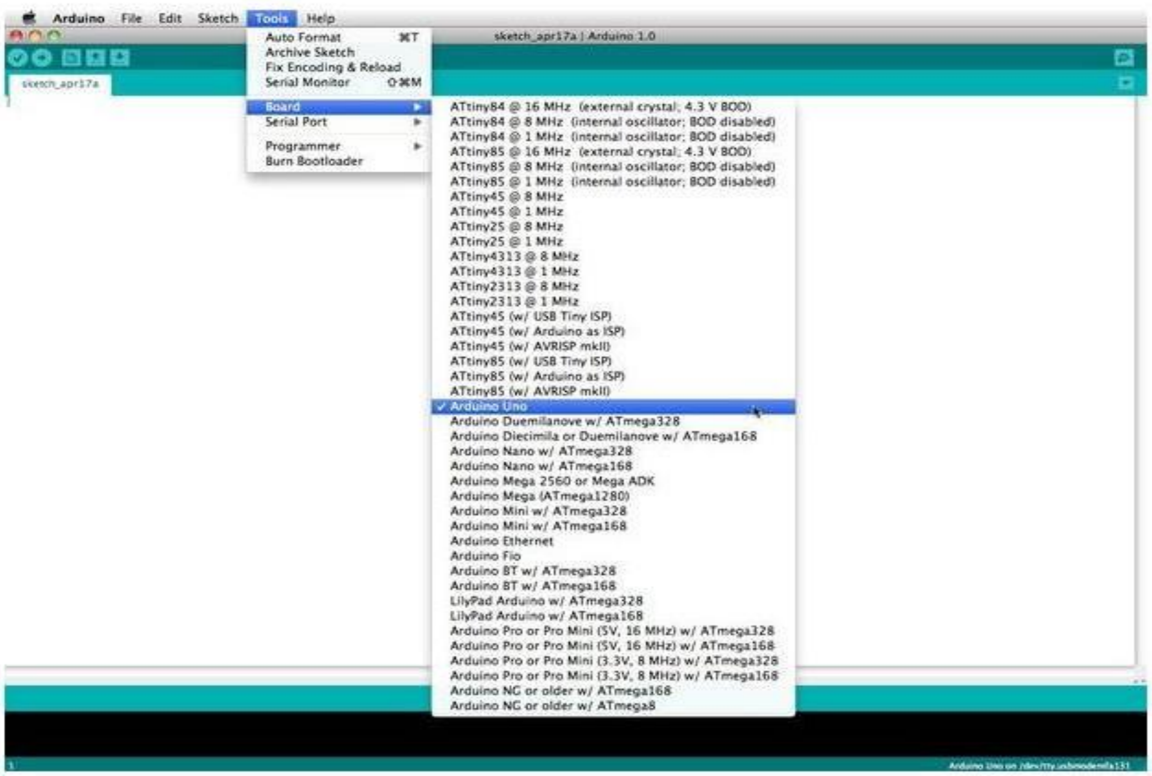
- Writing programs in Arduino IDE
- Compiling and assembling programs
- Debugging programs

5.2. SOFTWARE STEPS

Before you can start doing anything with the Arduino, you need to download and install the Arduino IDE (integrated development environment).



After the opening IDE the settings are changed in order to connect to the Arduino.



Before you can start doing anything in the Arduino programmer, you must set the board-type and serial port.

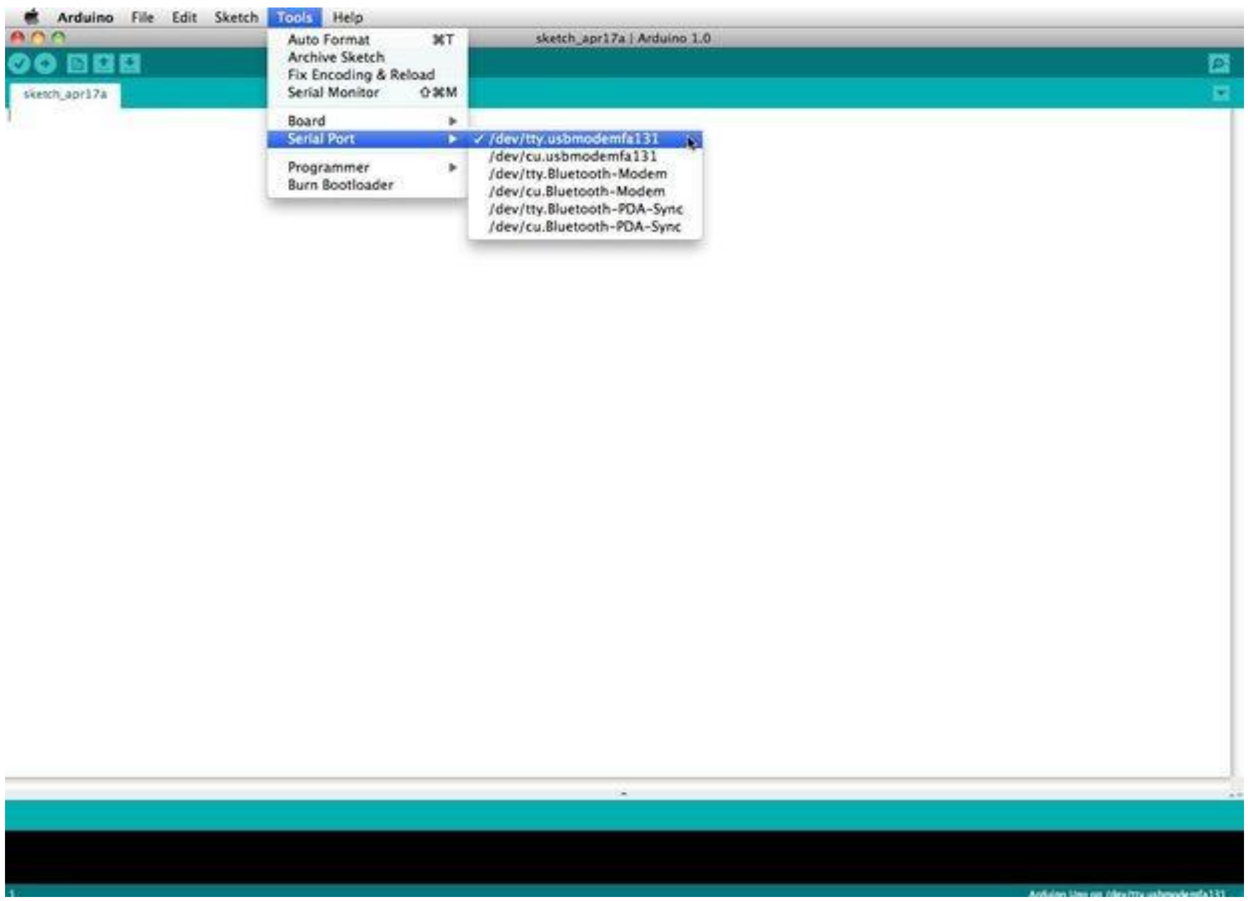
To set the board, go to the following:

Tools --> Boards

Select the version of board that you are using. Since I have an Arduino Uno plugged in, I obviously selected "Arduino Uno."

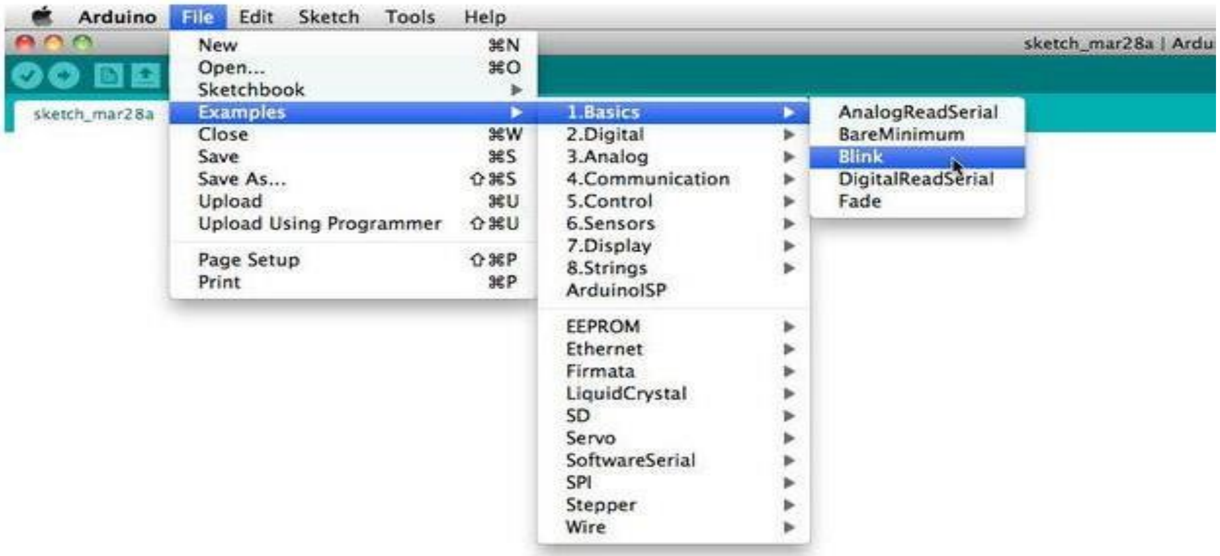
To set the serial port, go to the following:

Tools --> Serial Port



Arduino programs are called sketches. The Arduino programmer comes with a ton of example sketches preloaded.

This is great because even if you have never programmed anything in your life, you can load one of these sketches and get the Arduino to do something.



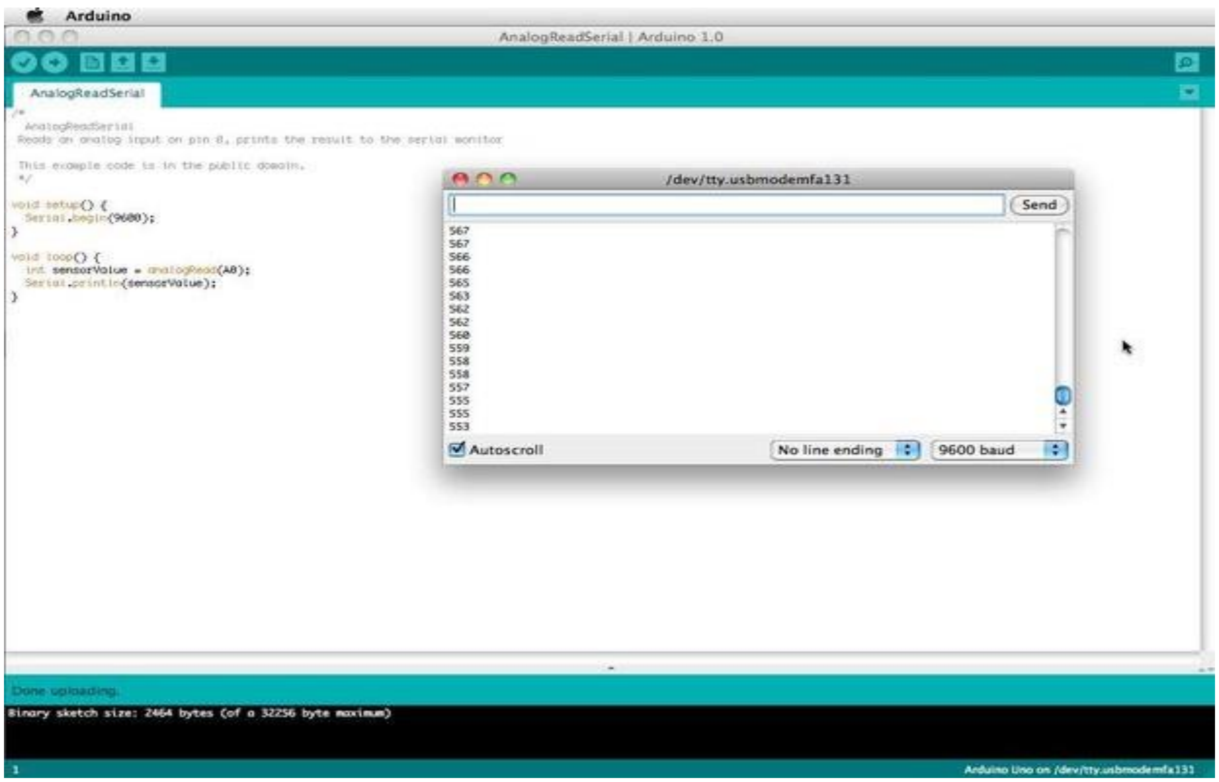
The serial monitor allows your computer to connect serially with the Arduino. This is important because it takes data that your Arduino is receiving from sensors and other devices and displays it in real-time on your computer. Having this ability is invaluable to debug your code and understand what number values the chip is actually receiving.

For instance, connect center sweep (middle pin) of a potentiometer to A0, and the outer pins, respectively, to 5v and ground. Next upload the sketch shown below:

File --> Examples --> 1.Basics --> Analog Read Serial

Click the button to engage the serial monitor which looks like a magnifying glass. You can now see the numbers being read by the analog pin in the serial monitor. When you turn the knob the numbers will increase and decrease.

The numbers will be between the range of 0 and 1023. The reason for this is that the analog pin is converting a voltage between 0 and 5V to a discreet number.



CHAPTER 6

6. PROJECT DESCRIPTION

This chapter deals with working and circuits of "**HEALTH MONITORING SYSTEMS USING IOT BASED ON ARDUINO**". It can be simply understood by its block diagram &circuit diagram.

6.1. BLOCK DIAGRAM

Block Diagram:

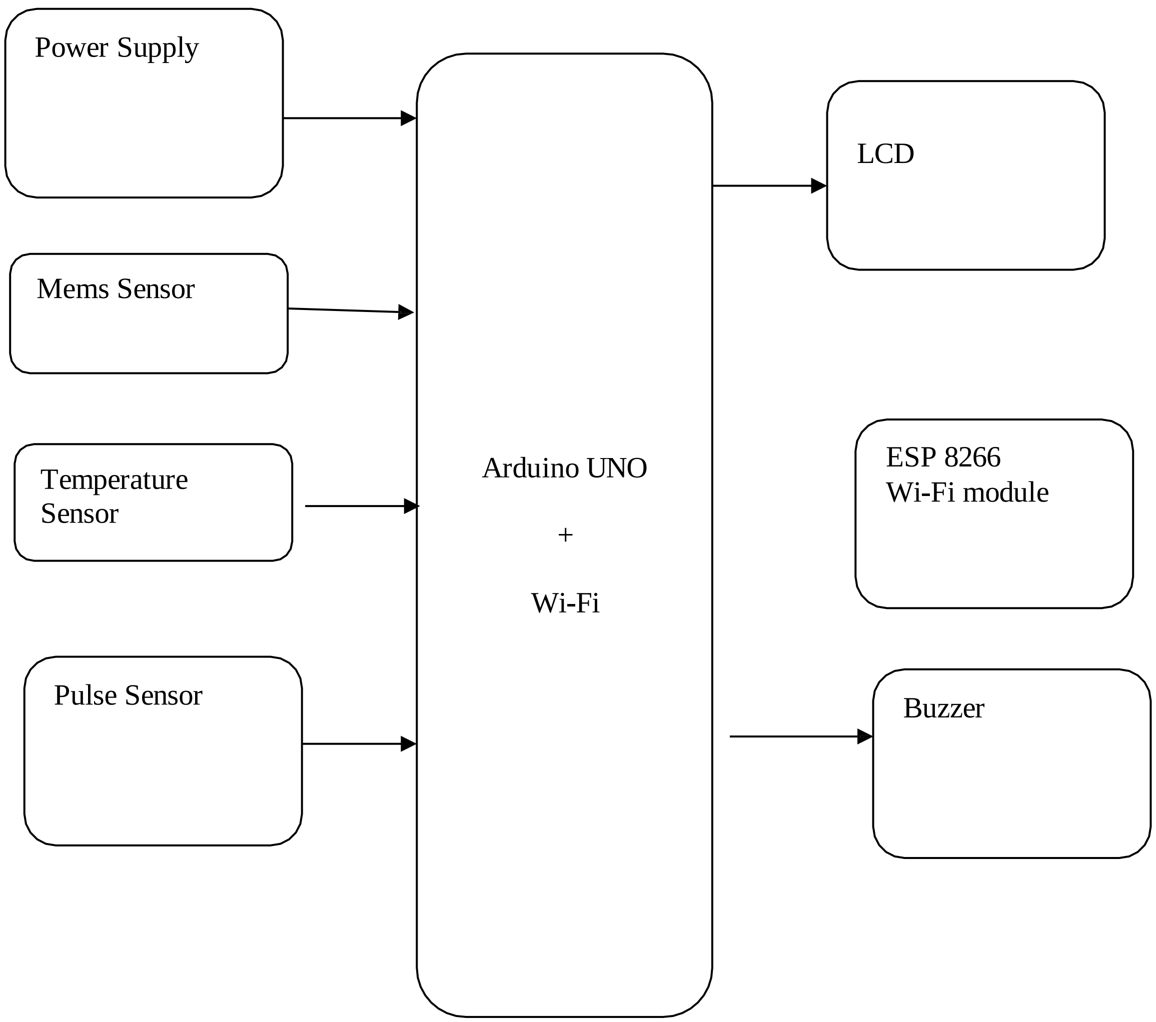


Fig 6.1 block diagram of iot based emergency health monitoring system

6.2. SOFTWARE REQUIREMENTS

- AURDUINO UNO

6.3. HARDWARE REQUIREMENTS

- Power supply
- ARDUINO
- LM35
- HEART BEAT SENSOR
- LCD

6.4. WORKING

We have proposed a robust health monitoring system that is intelligent enough to monitor the patient automatically using IOT that collects the status information through these systems which would include patient's heart rate, temp, Vibration sends an emergency alert to patient's doctor with his current status and full medical information. This would help the doctor to monitor his patient from anywhere and also to the patient to send his health status directly without visiting to the hospital. Our model can be deployed at various hospitals and medical institutes. The system uses smart sensors that generates raw data information collected from each sensor and send it to a database server where the data can be further analyzed and statistically maintained to be used by the medical experts. Maintaining a database server is a must so that there is even track of previous medical record of the patient providing a better and improved examining.

Fig: System Architecture

6.5. FLOW CHART

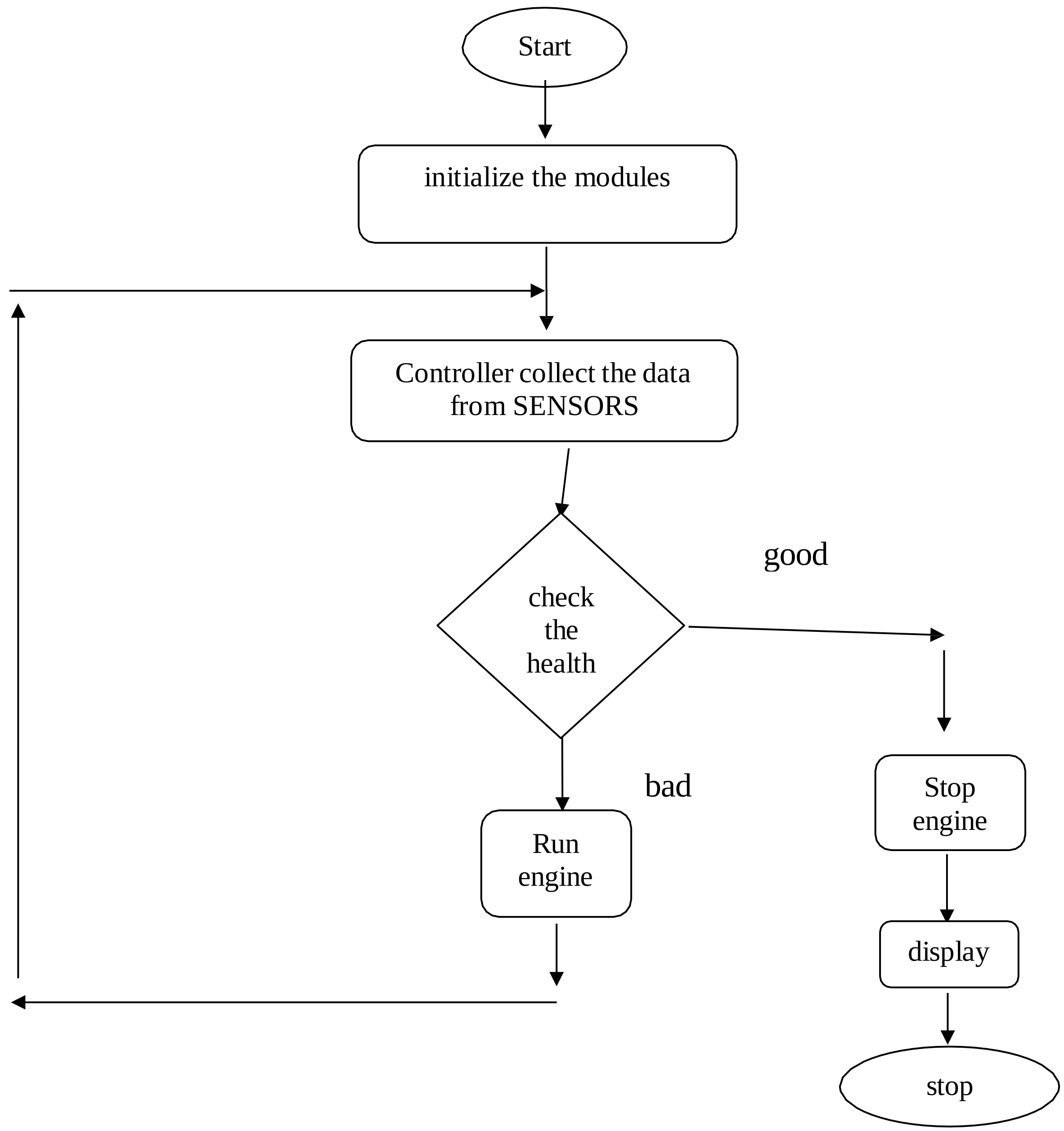
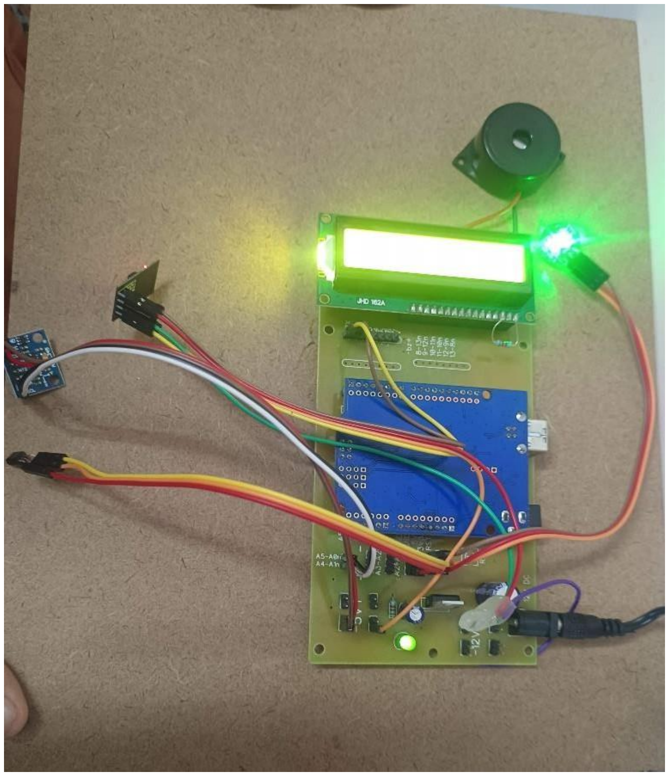


Fig 6.3. Flow chart

6.6. EXPERIMENTAL RESULTS



S.No	TEMPERATURE	HEART RATE	Location	Date
1	72	0	Location	2024-04-05 16:32:51
2	72	0	Location	2024-04-05 16:32:32
3	72	0	Location	2024-04-05 16:32:22
4	72	65	Location	2024-04-05 16:32:02
5	72	65	Location	2024-04-05 16:31:52
6	72	0	Location	2024-04-05 16:31:37
7	72	0	Location	2024-04-05 16:31:27
8	72	0	Location	2024-04-05 16:31:07
9	72	0	Location	2024-04-05 16:30:57
10	72	0	Location	2024-04-05 16:30:39
11	72	0	Location	2024-04-05 16:30:28
12	72	78	Location	2024-04-05 16:30:09
13	72	78	Location	2024-04-05 16:29:59
14	72	78	Location	2024-04-05 16:29:50
15	72	73	Location	2024-04-05 16:29:33
16	72	73	Location	2024-04-05 16:29:23
17	72	0	Location	2024-04-05 16:29:08
18	72	0	Location	2024-04-05 16:28:58
19	72	0	Location	2024-04-05 16:28:39
20	72	71	Location	2024-04-05 16:28:09

CHAPTER 7

7.1. CONCLUSIONS

In this project, The main idea of the proposed system is to provide better and efficient health services to the patients by implementing a networked information cloud so that the experts and doctors could make use of this data and provide a fast and an efficient solution. The final model will be well equipped with the features where doctor can examine his patient from anywhere and anytime. Emergency scenario to send an emergency mail or message to the doctor with patient’s current status and full medical information can also be worked on.

7.2. FUTURESCOPE

In the future, more sensors can be attached to the Prototype of the health monitoring system device to enhance the capability of monitoring the patients with different prospective from different locations with ease, efficiency, and economical.

CHAPTER 8

REFERENCES:

[1]. K. Navya, Dr. M. B. R. Murthy, “A Zigbee Based Patient Health Monitoring System”, Int. Journal of Engineering Research and Applications Vol. 3, Issue 5, Sep-Oct 2013, pp.483-486

[2]. Matthew D'Souza, Montserrat Ros, Adam Postula, “Wireless Medical Information System Network for Patient ECG Monitoring” Digital System Design:Architectures, Methods and Tools, 2006, DSD 2006, 9th EUROMICRO Conference, 2006, pp.617-624.

[3]. C.C.Gavimath, Krishnamurthy Bhat, C.L. Chayalakshmi , R. S. Hooli and B.E.Ravishankera, “Design and Development of versatile saline flow rate measuring system and GSM based remote monitoring device”, International Journal of Pharmaceutical Applications ISSN 0976-2639. Vol 3, Issue 1,2012, pp 277-281.

[4]. NakulPadhye and Preet Jain, “Implementation of ARM Embedded Web Server for DAS using Raspberry pi”, VSRD IJEECE April 2013.

[5]. Ch. Sandeep Kumar Subudhi and S. Sivanandam, “Intelligent Wireless Patient Monitoring and Tracking System(Using Sensor Network and Wireless Communication)”, International Journal of Interdisciplinary and Multidisciplinary Studies,2014,Vol 1,No.3,97-104.

[6]. Hossein Fotouhi, Aida Causevic, Kristina lundqvist, Mats bjorkman,” Communication and Security in Health monitoring System – A Review”, 2016 IEEE 40th Annual computer software and application conference, DOI 10.1109/COMPSAC.2016.8.

[7]. M. U. Ahmed, M. Bj orkman, and A. Cauˇsevic, et al. An overview on the internet of things for health monitoring systems. In IoT Technologies for HealthCare, 2015.

[8]. [9] F. Samie and L. Bauer and C.-M. Hsieh et al. Online binding of applications to multiple clock domains in shared fpgabased systems. InDATE, pp. 25–30, 2015.

[9]. C. Perera and A. Zaslavsky and P. Christen et al. Context aware computing for the Internet of Things: A survey. IEEE Communications Surveys & Tutorials, 16(1):414–454, 2014.

[10]. Farzad Samie, Lars Bauer, Jörg Henkel, "IoT Technologies for Embedded Computing: A Survey", ESWEEK'16, October 2-7 2016, Pittsburgh, PA, USA.

[11]. V. K. Chippa and S. T. Chakradhar and K. Roy, "Analysis and characterization of inherent application resilience for approximate computing", in DAC, 2013.

[12]. S. Qaisar, R. M. Bilal, and W. Iqbal, "Compressive sensing: From theory to applications, a survey", Journal of Communications and Networks, pp. 443–456, 2013.

[13]. K. Ma, Y. Zheng, S. Li, "Architecture exploration for ambient energy harvesting nonvolatile processors", in HPCA, pp. 526–537, 2015. https://www.raspberrypi.org/blog/libraries-codecs-oss/

[14]. D. Kelf. IoT: A Return to Our Favorite EDA Requirements. Online:www.eetimes.com/author.asp?doc id= 1322009, 2014.

[15]. J. Kwong and A. P. Chandrakasan, "An energy-efficient biomedical signal processing platform", IEEE Journal of SolidState Circuits, 46(7):1742–1753, 2011.

[16]. V. Shnayder, B.-r. Chen, and K. Lorincz, "Sensor networks for medical care", in SenSys, pp. 314–314, 2005.

[17]. Pankaj S. Hage, Sanjay B. Pokle, Venkateshwarlu Gudur, "Discrete Wavelet Transform Based Video Signal Processing", IEEE ICAC