

WEARABLE DEVICE TO TRACK COVID-19 SYMPTOMS

Submitted in partial fulfillment of the requirements for the award of

Bachelor of Engineering Degree in

Electrical and Electronics Engineering

by

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**DEPARTMENT OF ELECTRICAL AND ELECTRONICS
ENGINEERING**

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade “A” by NAAC

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MAY 2022



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **GANESAN R** (Reg. No. 38140011) and **PERAMANATHAN S** (Reg. No. 38140038) who carried out the project entitled "**WEARABLE DEVICE TO TRACK COVID-19 SYMPTOMS**" under our supervision from November 2021 to May 2022.

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DECLARATION

We **GANESAN R** (Reg. No. 38140011) and **PERAMANATHAN S** (Reg. No. 38140038) hereby declare that the Project Report entitled “**WEARABLE DEVICE TO TRACK COVID-19 SYMPTOMS**” done by us under the guidance of Dr. **G.T.SUNDAR RAJAN** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electrical and Electronics Engineering.

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ABSTRACT

Covid-19 forms a chain when contact with an infected person in the early months. It's very difficult for us to detect whether the person is having Covid or not. In this article, we are proposing a wearable device that can track Covid 19 symptoms. The proposed framework consists of 4 sensors for heart rate, body temperature, cough rate, and for measuring minimum distance with help Machine learning technique. In the early months of the Covid-19 pandemic with no designated cure or vaccine, the only way to break the infection chain is self-isolation and maintaining the physical distancing. Here a combined application of the Internet of things with the Medical sector to make sure safety of every individual in this pandemic period. Such as real-time diagnosis of medical issues, telemedicine, remote monitoring of patients, and computer-assisted smart transportation in case of emergencies, are anticipated as systems-of-systems (SoS) that can execute multiple applications of varying criticality, necessitating the development of systems-of-systems (SoS) that can be executed.

TABLE OF CONTENTS

Chapter No.	Title		Page No.
	ABSTRACT		V
	LIST OF FIGURES		X
	LIST OF TABLES		XII
	LIST OF SYMBOLS AND ABBREVIATIONS		XIII
1	INTRODUCTION		
	1.1	GENERAL INTRODUCTION	1
	1.2	EMBEDDED SYSTEM	1
		1.2.1 BASIC STRUCTURE OF AN EMBEDDED SYSTEM	3
	1.3	INTERNET OF THINGS	4
	1.4	MACHINE LEARNING	6
		1.4.1 MACHINE LEARNING WORKS BASED ON	6
		1.4.2 MACHINE LEARNING METHODS	7
	1.5	LITERATURE SURVEY	8
2	PRINCIPLE OF OPERATION		
	2.1	AIM	11
	2.2	SCOPE	11

	2.3	EXISTING SYSTEM	11
		2.3.1 DISADVANTAGES	12
	2.4	PROPOSED SYSTEM	13
		2.4.1 ADVANTAGES	13
	2.5	BLOCK DIAGRAM	13
	2.6	HARDWARE REQUIRTEMENTS	13
	2.7	SOFTWARE REQUIREMENTS	14
3	SOFTWARE DESCRIPTIONS AND RESULT		
	3.1	ARDUINO IDE	15
	3.2	EMBEDDED C	18
		3.2.1 SALIENT FEATURES OF THE LANGUAGE	19
	3.3	PHP	22
		3.3.1 CHARACTERISTICS OF PHP	22
	3.4	GPS	23
		3.4.1 WORKING	24
		3.4.2 GPS WORKING ON MOBILE	25
		3.4.3 ACCURACY	25
	3.5	RESULT AND DISCUSSION	26
4	HARDWARE MODULE		
	4.1	CIRCUIT DIAGRAM	30
	4.2	ARDUINO UNO	30
		4.2.1 POWER	31
		4.2.2 MEMORY	32
		4.2.3 PIN CONFIGURATION	34
		4.2.4 USB OVERCURRENT PROTECTION	34

		4.2.5	PHYSICAL CHARACTERISTICS	34
	4.3		POWER SUPPLY	35
		4.3.1	CIRCUIT DESCRIPTION	36
		4.3.2	COMPONENT LIST	37
	4.4		IR SENSOR	39
		4.4.1	CIRCUIT DIAGRAM	40
		4.4.2	DIFFERENT TYPES OF IR SENSOR	41
		4.4.3	IR SENSOR APPLICATIONS	41
		4.4.4	IR IMAGNG DEVICE	43
	4.5		HEART BEAT SENSOR	44
		4.5.1	PRINCIPLE OF HEARTBEAT SENSOR	45
		4.5.2	CIRCUIT DIAGRAM OF HEARTBEAT SENSOR	45
		4.5.3	WORKING OF HEARTBEAT SENSOR	46
	4.6		TEMPERATURE SENSOR	49
	4.7		SOUND SENSOR	53
		4.7.1	SOUND SENSOR PIN CONFIGURATION	54
		4.7.2	WORKING PRINCIPLE	54
		4.7.3	FEATURES	54
		4.7.4	SPECIFICATION	55
		4.7.5	APPLICATION	56
	4.8		ESP8266 MODULE	57
		4.8.1	FEATURE	57
		4.8.2	ESP8266-01 WIFI MODULE	58

		4.8.3 ESP8266-01 MODULE PIN DESCRIPTION	59
	4.9	GSM	60
		4.9.1 GSM ARCHITECTURE	61
		4.9.2 FEATURES OF GSM MODULE	62
		4.9.3 GSM MODEM	62
		4.9.3.1 WORKING OF GSM MODULE BUZZER	63
	4.10	BUZZER	64
		4.10.1 TYPES OF BUZZERS	65
		4.10.2 APPLICATIONS	66
		4.10.3 PIEZO BUZZER	66
		4.10.3.1 CIRCUIT DIAGRAM AND CONSTRUCTION	67
		4.10.3.2 PIEZO BUZZER CHARACTERISTICS	69
		4.10.3.3 STRUCTURE OF PIEZO BUZZER	69
6	CONCLUSION		70
	Reference		71

LIST OF FIGURES

FIGURE	TITLE	PAGE No.
1.1	Embedded System	3
1.2	Structure of an Embedded system	3
1.3	Internet of Things	5
2.1	Block diagram	13
3.1	Arduino IDE	15
3.2	Button Bar	16
3.3	Source Code	17
3.4	GPS working	24
3.5	Simulation circuit for Temperature sensing Normal Condition	26
3.6	Simulation circuit for Temperature sensing Abnormal Condition	26
3.7	Photocopy of Hardware Prototype	27
3.8	serial monitor screen with sound sensor readings	27
3.9	Serial monitor screen with GPS readings	28
3.10	Think Speak Channel	28
3.11	Location tracking of people with covid-19 Symptoms	29
4.1	Hardware Circuit diagram	30

4.2	Arduino UNO	31
4.3	Arduino Pin configuration	34
4.4	Block diagram of a power supply	35
4.5	Circuit Diagram of power supply	37
4.6	Output current	38
4.7	IR Sensor	39
4.8	Circuit diagram of IR Sensor	40
4.9	Gas Analyzer	42
4.10	IR Imaging device	43
4.11	Heartbeat Sensor	45
4.12	Circuit diagram of Heartbeat Sensor	46
4.13	Working of Heartbeat Sensor	47
4.14	Practical Heartbeat Sensor	47
4.15	TCRT 1000 Heartbeat Sensor	48
4.16	Temperature Sensor	51
4.17	Bimetallic Thermostatic	52
4.18	Sound Sensor Module	54
4.19	ESP8266-01 Module Pin Description	59
4.20	GSM modem	61
4.21	GSM modem circuit	63
4.22	Buzzer	65
4.23	Piezo Buzzer	66
4.24	Piezo Buzzer Circuit diagram	67
4.25	Working of Piezo Buzzer	68
4.26	Structure of Piezo Buzzer	69

LIST OF TABLES

TABLE No.	TITLE	PAGE No
3.1	Keywords	20
4.1	Specification of Temperature sensor	50
4.2	Sound Detection Sensor Module Pin Configuration	55

LIST OF SYMBOLS AND ABBREVIATIONS

Ω	-	Ohm
V in	-	Input Voltage
V out	-	Output Voltage
Z	-	Impedance
mA	-	Milli Ampere
μ s	-	Micro Seconds
mm	-	Milli Meter
KWH	-	Kilo Watt Hour
MHz	-	Mega Hertz
DC	-	Direct Current
AC	-	Alternating Current
PV	-	Photo Voltaic
PWM	-	Pulse Width Modulation
RPM	-	Revolution per Minute
MPPT	-	Maximum Power Point Tracking

DCR - DC Resistance

CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION

This project is an IOT-based project where the Internet of Things (IoT) development brings new opportunities in many applications, including smart cities and smart healthcare. The paper proposes a COVID-19 detection and monitoring system that would collect real-time symptom data from wearable sensor technologies. Since COVID is increasing day by day, the death rate is also increasing. COVID-19 also causes respiratory problems such as high fever, cough, throat pain, etc. Recent studies have demonstrated the evolution of disease to hide its symptoms. As it is highly transmittable, this disease might spread at an exponential rate, costing the lives of thousands of people. This chain of transmission has to be detected with the utmost priority through early detection and isolation of infected people. One method of preventing the spread of viruses until a vaccine is developed by implementing better systems for surveillance, healthcare, and transportation, contagious diseases will have fewer chances of spreading [3]. An IoT framework is presented to monitor participants' health conditions and notify them to maintain physical distancing. Applying ML algorithms to body parameters makes it possible to monitor participants' health conditions and to notify them in real-time. In addition, locally processing the data makes it possible to use the IoT node in environments without internet connectivity or fog-based networks. The system can assist participants in monitoring their daily activities and minimise the risk of exposure to the corona virus.

1.2 EMBEDDED SYSTEM

As its name suggests, Embedded means something that is attached to another thing. The embedded system is shown in below figure 1.1. An embedded system can be thought of as a computer hardware system having software embedded in it. An embedded system can be an independent system or it can be a part of a large system. An embedded system is a microcontroller or microprocessor-based system which is designed to perform a specific task.

For example, a fire alarm is an embedded system; it will sense only smoke. An embedded system has three components:

- It has hardware.
- It has application software.

It has Real Time Operating system (RTOS) that supervises the application software and provide mechanism to let the processor run a process as per scheduling by following a plan to control the latencies. RTOS defines the way the system works. It sets the rules during the execution of application program. A small-scale embedded system may not have RTOS. So, we can define an embedded system as a Microcontroller based, software driven, and reliable, real-time control system. Characteristics of an Embedded System

Single-functioned – An embedded system usually performs a specialized operation and does the same repeatedly. For example: A pager always functions as a pager.

Tightly constrained – All computing systems have constraints on design metrics, but those on an embedded system can be especially tight. Design metrics is a measure of an implementation's features such as its cost, size, power, and performance. It must be of a size to fit on a single chip, must perform fast enough to process data in real time and consume minimum power to extend battery life.

Reactive and real time – Many embedded systems must continually react to changes in the system's environment and must compute certain results in real time without any delay.

Consider an example of a car cruise controller; it continually monitors and reacts to speed and brake sensors. It must compute acceleration or deceleration repeatedly within a limited time; a delayed computation can result in failure of the car.

Microprocessors based – It must be microprocessor or microcontroller based.

Memory – It must have a memory, as its software usually embeds in ROM. It does not need any secondary memories in the computer.

Connected – It must have connected peripherals to connect input and output devices.

HW-SW systems – Software is used for more features and flexibility. Hardware is used for performance and security.

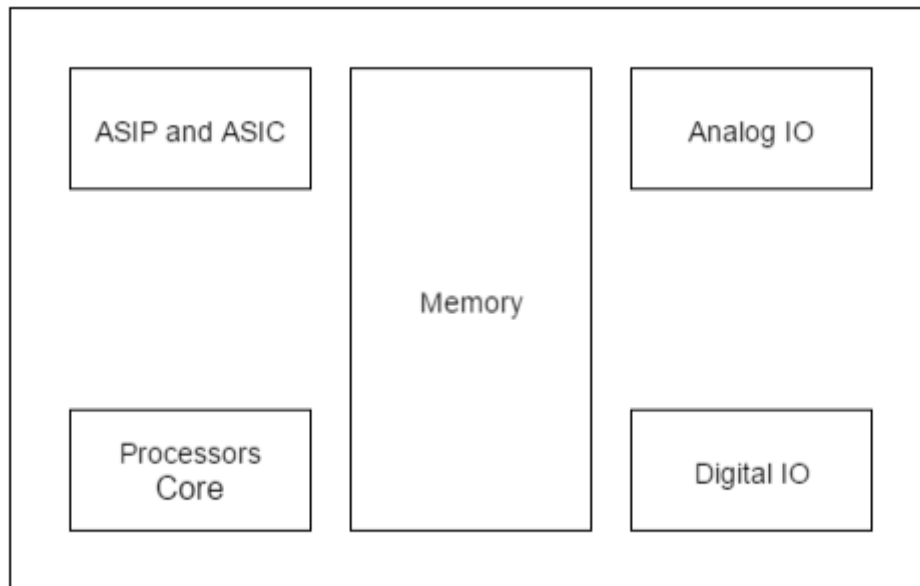


Fig. 1.1 Embedded system

1.2.1 BASIC STRUCTURE OF AN EMBEDDED SYSTEM

The basic structure of an embedded system is consist of Sensors, Analog to Digital converter, Processor &ASIC, Digital to Analog converter, memory and Actuator. This is shown in below figure 1.2.

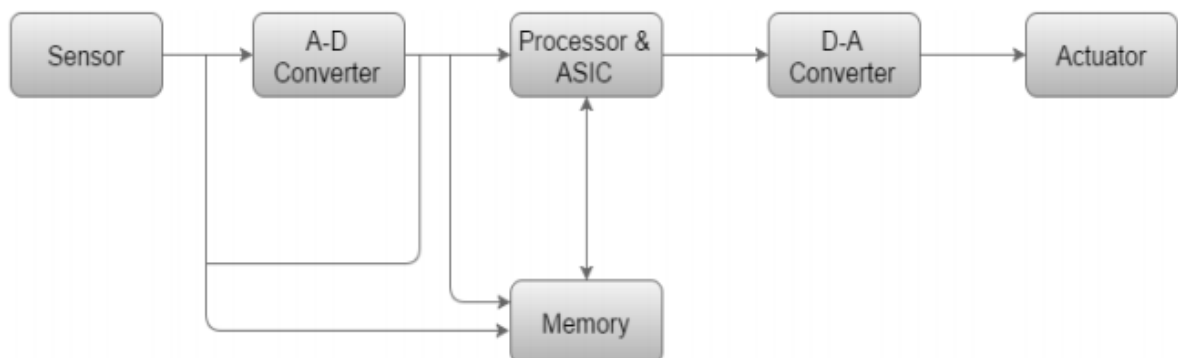


Fig. 1.2 Structure of an embedded system

Sensor – It measures the physical quantity and converts it to an electrical signal which can be read by an observer or by any electronic instrument like an A2D converter. A sensor stores the measured quantity to the memory.

A-D Converter – An analog-to-digital converter converts the analog signal sent by the sensor into a digital signal.

Processor & ASICs – Processors process the data to measure the output and store it to the memory.

D-A Converter – A digital-to-analog converter converts the digital data fed by the processor to analog data. • Actuator – An actuator compares the output given by the D-A Converter to the actual (expected) output stored in it and stores the approved output.

1.3 INTERNET OF THINGS

The term Internet of Things generally refers to scenarios where network connectivity and computing capability extends to objects, sensors and everyday items not normally considered computers, allowing these devices to generate, exchange and consume data with minimal human intervention. There is, however, no single, universal definition. This is shown in figure 1.3.

Enabling Technologies: The concept of combining computers, sensors, and networks to monitor and control devices has existed for decades. The recent confluence of several technology market trends, however, is bringing the Internet of Things closer to widespread reality. These include Ubiquitous Connectivity, Widespread Adoption of IP-based Networking, Computing Economics, Miniaturization, Advances in Data.

Connectivity Models: IoT implementations use different technical communications models, each with its own characteristics. Four common communications models described by the Internet Architecture Board include: Device-to-Device, Device-to-Cloud, Device-to-Gateway, and Back-

End Data-Sharing. These models highlight the flexibility in the ways that IoT devices can connect and provide value to the user.

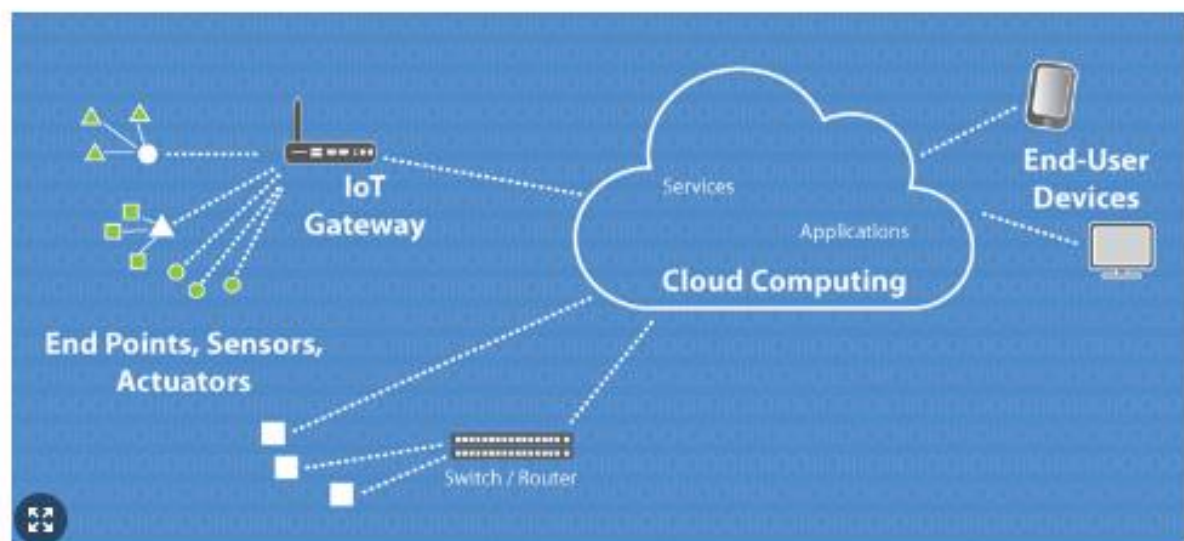
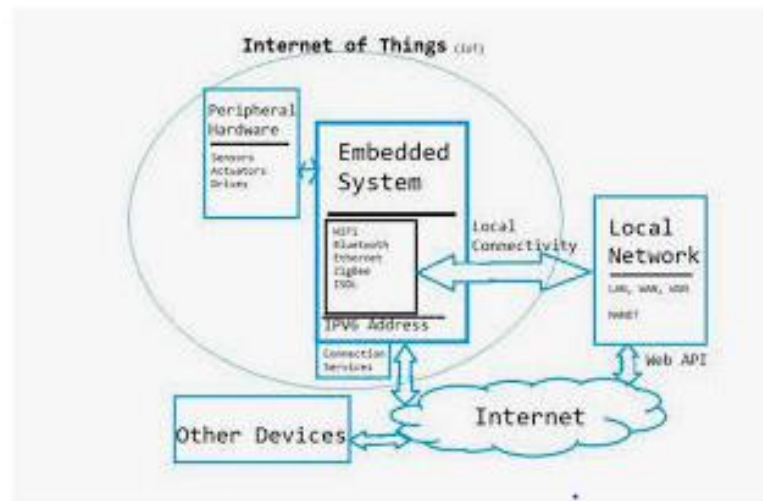


Fig. 1.3 Internet of Things

IoT devices are implemented using both hardware and software components. Dedicated hardware components are used to implement the interface with the physical world, and to perform tasks which are more computationally complex. Microcontrollers are used to execute software that interprets inputs and controls the system. This module discusses the roles of both the hardware and software components in the system. The functions of common hardware components are described and the interface between the software and

hardware through the microcontroller is explained. IoT devices often use an operating system to support the interaction between the software and the microcontroller. We will define the role of an operating system in an IoT device and how an IoT operating system differs from a standard one.

1.4 MACHINE LEARNING

Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy. Machine learning is an important component of the growing field of data science. Through the use of statistical methods, algorithms are trained to make classifications or predictions, uncovering key insights within data mining projects. These insights subsequently drive decision making within applications and businesses, ideally impacting key growth metrics. As big data continues to expand and grow, the market demand for data scientists will increase, requiring them to assist in the identification of the most relevant business questions and subsequently the data to answer them.

1.4.1 MACHINE LEARNING WORKS BASED ON

UC Berkeley (link resides outside IBM) breaks out the learning system of a machine learning algorithm into three main parts.

A Decision Process: In general, machine learning algorithms are used to make a prediction or classification. Based on some input data, which can be labelled or unlabeled, your algorithm will produce an estimate about a pattern in the data.

An Error Function: An error function serves to evaluate the prediction of the model. If there are known examples, an error function can make a comparison to assess the accuracy of the model.

A Model Optimization Process: If the model can fit better to the data points in the training set, then weights are adjusted to reduce the discrepancy between the known example and the model estimate. The algorithm will repeat this evaluate and optimize process, updating weights autonomously until a threshold of accuracy has been met.

1.4.2 MACHINE LEARNING METHODS

Machine learning classifiers fall into three primary categories.

SUPERVISED MACHINE LEARNING : Supervised learning, also known as supervised machine learning, is defined by its use of labelled datasets to train algorithms that to classify data or predict outcomes accurately. As input data is fed into the model, it adjusts its weights until the model has been fitted appropriately. This occurs as part of the cross validation process to ensure that the model avoids overfitting or under fitting. Supervised learning helps organizations solve for a variety of real-world problems at scale, such as classifying spam in a separate folder from your inbox. Some methods used in supervised learning include neural networks, naïve Bayes, linear regression, logistic regression, random forest, support vector machine (SVM), and more.

UNSUPERVISED MACHINE LEARNING: Unsupervised learning, also known as unsupervised machine learning, uses machine learning algorithms to analyze and cluster unlabeled datasets. These algorithms discover hidden patterns or data groupings without the need for human intervention. Its ability to discover similarities and differences in information make it the ideal solution for exploratory data analysis, cross-selling strategies, customer segmentation, image and pattern recognition. It's also used to reduce the number of features in a model through the process of dimensionality reduction; principal component analysis (PCA) and singular value decomposition (SVD) are two common approaches for this. Other algorithms used in unsupervised learning include neural networks, k-means clustering, probabilistic clustering methods, and more.

SEMI-SUPERVISED LEARNING: Semi-supervised learning offers a happy medium between supervised and unsupervised learning. During training, it uses a smaller labelled data set to guide classification and feature extraction from a larger, unlabeled data set. Semi-supervised learning can solve the problem of having not enough labelled data (or not being able to afford to label enough data) to train a supervised learning algorithm.

1.5 LITERATURE SURVEY

Valentyn stadnytski et. al., (2020) proposes speech droplets generated by asymptomatic carriers of severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) are increasingly considered to be a likely mode of disease transmission highly sensitive laser light scattering observations have revealed that loud speech can emit thousands of oral fluid droplets per second. In a closed, stagnant air environment, they disappear from the window of view with time constants in the range of 8 to 14 min, which corresponds to droplet nuclei of ca. 4 μm diameter or 12- to 21- μm droplets prior to dehydration. These observations confirm that there is a substantial probability that normal speaking causes airborne virus transmission in confined environments

K.Gnana Sheela et. al., (2020) proposes the research work aim to develop a Smart Health Monitoring System with machine learning system. It allows physicians to monitor patients at a distance and take periodic actions in case of necessity. A set of five parameters has been identified i.e. Electrocardiogram (ECG), Pulse rate, Pressure, Temperature and Position detection by using wearable sensors. For this the system uses two circuits. The transmitting circuit which is with the patient and the receiver circuit which is being supervised by the doctor or nurse. The system helps to identify doctors for consulting and to identify and predict diseases based on machine learning algorithms. The result shows a webpage for live monitoring and sent message to the concerned doctor.

K.Kalyan et. al, (2016) Proposes A Non-Invasive Heart Rate Monitoring System Using Giant Magneto Resistance Sensor. A simple heart rate (HR) monitoring system designed and developed using the Giant Magneto-Resistance (GMR) sensor is presented in this paper. The GMR sensor is placed on the wrist of the human and it provides the magneto-plethysmographic signal. This signal is processed by the simple analog and digital instrumentation stages to render the heart rate indication. A prototype of the system has been built and test results on 26 volunteers have been reported.

A Skraba et. al., (2017) Proposes the Prototype Of Group Heart Rate Monitoring With Node MCU ESP8266. This Paper describes the development of

prototype that enables monitoring of heart rate and inter beat interval for several subjects. The prototype was realized using ESP8266 hardware modules, WebSocket library, nodejs and JavaScript. System architecture is described where nodejs server acts as the signal processing and GUI code provider for clients. Signal processing algorithm was implemented in JavaScript. Application GUI is presented which can be used on mobile devices. Several important parts of the code are described which illustrate the communication between ESP8266 modules, server and clients. Developed prototype shows one of the possible realizations of group monitoring of biomedical data.

A Skraba et. al., (2016) proposes the Streaming Pulse Data to the Cloud with Bluetooth LE Or Node MCU ESP8266. This paper describes the development of the three prototypes which enable monitoring of heart pulse sensor data on the cloud. The prototypes are based on a) Bluetooth module, b) Low Energy Bluetooth module and c) ESP8266 Wi-Fi module. The client side implementation is developed by the application of JavaScript. Node.js was used on the server side with application of node-serialport library with Bluetooth modules. In the case where ESP8266 Wi-Fi module was used, the data was transmitted directly to the cloud. The three different prototypes were compared according to the power consumption and complexity of design. The code example is provided illustrating the approach to develop cloud based graphing interface for biomedical mobile monitoring.

MS Jassas et. al., (2015) Proposes a Smart System Connecting E-Health Sensors And The Cloud . This paper presents the design and implementation of an e-health smart networked system. The system is aimed to prevent delays in the arrival of patients' medical information to the healthcare providers, particularly in accident and emergency situations, to stop manual data entering, and to increase beds capacity in hospitals, especially during public events where a large number of people are meeting in one place.

A Al-Fuqaha et. al., (2015) proposes an Internet Of Things: A Survey On Enabling Technologies, Protocols, And Applications . This paper starts by providing a horizontal overview of the IoT. Then, we give an overview of some technical details that pertain to the IoT enabling technologies, protocols, and applications. We also provide an overview of some of the key IoT challenges presented in the recent

literature and provide a summary of related research work. Moreover, we explore the relation between the IoT and other emerging technologies including big data analytics and cloud and fog computing. We also present the need for better horizontal integration among IoT services. Finally, we present detailed service use-cases to illustrate how the different protocols presented in the paper fit together to deliver desired IoT service

CHAPTER-2

PRINCIPLE OF OPERATION

2.1 AIM

The aim of this project resuscitation in emergency situations. The proposed framework includes four sensors: heart rate, body temperature, cough rate, and minimum distance measurement. With no cure or vaccine available in the early stages of the COVID-19 pandemic, self-isolation and physical separation are the only ways to break the infection cycle. Here's an example of combining the Internet of Things with the medical sector to ensure everyone's safety throughout this pandemic. Internet-based solutions, such as the Internet of Things (IoT) and cloud computing and storage technologies, have been driving revolutionary approaches in the sensitive domain of healthcare.

2.2 SCOPE

The scope of the project is to monitor the post-COVID patients who are under isolation.

The pandemic of COVID-19 has brought attention to the possibilities of wearing electronic devices in healthcare. The next generation of wearable sensors, with its capacity to continually monitor both physical characteristics and biochemical indicators, might play a crucial role in battling the next pandemic with continuing research and development. In our work, it was quite larger in size. In the future, we can minimize the system as a small and compact wearable device and also include many applications in it.

2.3 EXISTING SYSTEM:

Robust healthcare is a requirement for both developed countries, where the cost of healthcare is high and security and privacy are critical issues and developing countries like India, where there is a mass population to handle in hospitals and robust healthcare procedures are required.

Doctors should visit the patient regularly and check the status. Situation may occur like nurse make mistake while noting the report.

2.3.1 DISADVANTAGES:

- Collected data cannot be received immediately, efficiency is low
- Doctors should visit the patient regularly and check the status.
- Situation may occur like nurse make mistake while noting the report

2.4 PROPOSED SYSTEM:

The proposed COVID-SAFE framework includes a low-cost and lightweight IoT node that continuously monitors a person's body temperature, heart rate, and periodically monitored cough rate.

A smartphone app that displays the parameters and individual risk factors. a physical distance tracking mechanism that alerts the user in the event of a violation of safe physical distance. A fog server that collects data from the IoT nodes and sends the data. Three modules make up the majority of the system. Our system is made up of these modules.

The LM35 User Module Temperature Sensor is an integrated circuit sensor that may be used to measure temperature more accurately than a thermistor. A heartbeat sensor by producing an electrical output proportional to the temperature.

Simply connect the sensor's Vcc and ground connections to power it. The sensor is powered via the Vcc and ground pins. The sensor can work with both 5 and 3.3 volt systems once powered.

The signal pin is then linked to the microcontroller's ADC pin to monitor the change in output voltage. Mobile communication system on a global scale.

The GSM module is capable of sending all data to the cloud server. Using the GSM module, we may connect to the internet on the microcontroller. The server module may send all of the data to an Android app via the internet and updates the data to the IOT module.

From there, the data is uploaded to the Think speak platform. Through that, we can get the data of the crop, and then the mapping the location of the patient in Google map.

2.4.1 ADVANTAGES:

In the proposed system, we use mapping of covid patient location in map, which helps us to find them easily.

2.5 BLOCK DIAGRAM:

The block diagram of this project is shown in figure 2.1. It consists of four sensors at input side and Buzzer on the output side. Data collected from the sensor is sent to think speak channel through IoT.

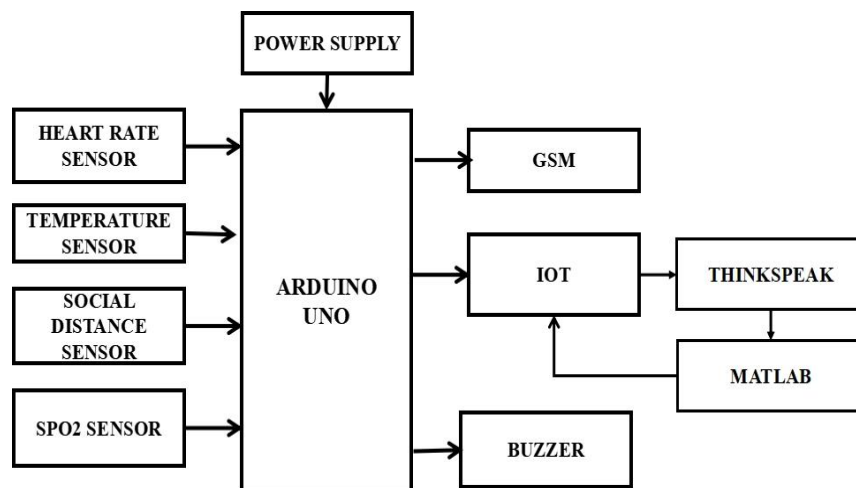


Fig. 2.1 Block diagram

2.6 HARDWARE REQUIREMENTS

- Arduino UNO
- Heart rate Sensor
- Temperature sensor
- Distance sensor
- SPO2
- GSM
- IoT

2.7 SOFTWARE REQUIREMENTS

- Arduino IDE
- Embedded
- PHP
- MATLAB

CHAPTER-3

SOFTWARE DESCRIPTIONS AND RESULT

3.1 ARDUINO IDE

The Arduino IDE is incredibly minimalistic, yet it provides a near-complete environment for most Arduino-based projects. The top menu bar has the standard options, including “File” (new, load save, etc.), “Edit” (font, copy, paste, etc.), “Sketch” (for compiling and programming), “Tools” (useful options for testing projects), and “Help”. The middle section of the IDE is a simple text editor that where you can enter the program code. The bottom section of the IDE is dedicated to an output window that is used to see the status of the compilation, how much memory has been used, any errors that were found in the program, and various other useful messages. The window screen of Arduino IDE is shown in below figure 5.1.



Fig. 3.1 Arduino IDE

Projects made using the Arduino are called sketches, and such sketches are usually written in a cut-down version of C++ (a number of C++ features are not included). Because programming a microcontroller is somewhat different from programming a computer, there are a number of device-specific libraries (e.g., changing pin modes, output data on pins, reading analog values, and timers). This sometimes confuses users who think Arduino is programmed in an “Arduino language.” However, the Arduino is, in fact, programmed in C++. It just uses unique libraries for the device.

The 6 Buttons

While more advanced projects will take advantage of the built-in tools in the IDE, most projects will rely on the six buttons found below the menu bar. And it is shown in below figure 5.2.



Fig. 3.2 Button Bar

The button bar

1. The **check mark** is used to verify your code. Click this once you have written your code.
2. The **arrow** uploads your code to the Arduino to run.
3. The **dotted paper** will create a new file.
4. The **upward arrow** is used to open an existing Arduino project.
5. The **downward arrow** is used to save the current file.
6. The far-right button is a **serial monitor**, which is useful for sending data from the Arduino to the PC for debugging purposes.



Fig. 3.3 Source code

The source code for the IDE is released under the GNU General Public License, version 2 and the basic source code is shown in figure 5.3. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiringproject, which provides many common input and output procedures.

User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub `main()` into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program `avrdude` to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware

Projects made using the Arduino are called sketches, and such sketches are usually written in a cut-down version of C++ (a number of C++ features are not included). Because programming a microcontroller is somewhat different from programming a computer, there are a number of device-specific libraries

(e.g., changing pin modes, output data on pins, reading analog values, and timers). This sometimes confuses users who think Arduino is programmed in an “Arduino language.” However, the Arduino is, in fact, programmed in C++. It just uses unique libraries for the device.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub `main()` into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution.

The Arduino IDE employs the program `avrdude` to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

3.2 EMBEDDED C:

Embedded C Programming is the soul of the processor functioning inside each and every embedded system we come across in our daily life, such as mobile phone, washing machine, and digital camera.

Each processor is associated with an embedded software. The first and foremost thing is the embedded software that decides functioning of the embedded system. Embedded C language is most frequently used to program the microcontroller.

Earlier, many embedded applications were developed using assembly level programming. However, they did not provide portability. This disadvantage was overcome by the advent of various high-level languages like C, Pascal, and COBOL. However, it was the C language that got extensive acceptance for embedded systems, and it continues to do so. The C code written is more reliable, scalable, and portable; and in fact, much easier to understand.

C language was developed by Dennis Ritchie in 1969. It is a collection of one or more functions, and every function is a collection of statements performing a specific task.

C language is a middle-level language as it supports high-level applications and low-level applications. Before going into the details of embedded C programming, we should know about RAM memory organization.

3.2.1 Salient features of the language

C language is software designed with different keywords, data types, variables, constants, etc.

Embedded C is a generic term given to a programming language written in C, which is associated with particular hardware architecture.

Embedded C is an extension to the C language with some additional header files. These header files may change from controller to controller.

The microcontroller 8051 `#include<reg51.h>` is used.

The embedded system designers must know about the hardware architecture to write programs. These programs play prominent role in monitoring and controlling external devices. They also directly operate and use the internal architecture of the microcontroller, such as interrupt handling, timers, serial communication and other available features.

The basic additional features of the embedded software

Data types : The data type refers to an extensive system for declaring variables of different types like integer, character, float, etc. The embedded C software uses four data types that are used to store data in the memory. The 'char' is used to store any single character; 'int' is used to store integer value, and 'float' is used to store any precision floating point value. The size and range of different data types on a 32-bit machine is given in the following table. The size and range may vary on machines with different word sizes.

Keywords : There are certain words that are reserved for doing specific tasks. These words are known as keywords. They are standard and predefined in the

Embedded C Keywords are always written in lowercase. These keywords must be defined before writing the main program. The basic keywords of an embedded software are given below:

Table no. 3.1 Keywords

Name	Funtion
sbit	Accessing of single bit
bit	Accessing of bit addressable memory of RAM
sfr	Accessing of sfr register by another name

sbit: This data type is used in case of accessing a single bit of SFR register.

- Syntax: sbit variable name = SFR bit;
- Ex: sbit a=P2^1;
- Explanation: If we assign p2.1 as 'a' variable, then we can use 'a' instead of p2.1 anywhere in the program, which reduces the complexity of the program.

Bit: This data type is used for accessing the bit addressable memory of RAM (20h-2fh).

- Syntax: bit variable name;
- Ex: bit c;
- Explanation: It is a bit sequence setting in a small data area that is used by a program to remember something.

SFR: This data type is used for accessing a SFR register by another name. All the SFR registers must be declared with capital letters.

- Syntax: SFR variable name = SFR address of SFR register;
- Ex: SFR port0=0x80;

- Explanation: If we assign 0x80 as 'port0', then we can use 0x80 instead of port0 anywhere in the program, which reduces the complexity of the program.

SFR Register: The SFR stands for 'Special Function Register'. Microcontroller 8051 has 256 bytes of RAM memory. This RAM is divided into two parts: the first part of 128 bytes is used for data storage, and the other of 128 bytes is used for SFR registers. All peripheral devices like I/O ports, timers and counters are stored in the SFR register, and each element has a unique address.

The Structure of an Embedded C Program

```

comments
preprocessor directives
global variables
main() function
{

    local variables
    statements
    .....
    .....
}

fun(1)
{

    local variables
    statements
    .....
    .....
}

```

3.3 PHP

PHP started out as a small open source project that evolved as more and more people found out how useful it was. Rasmus Lerdorf unleashed the first version of PHP way back in 1994. PHP is a recursive acronym for "PHP: Hypertext Pre-processor".

PHP is a server side scripting language that is embedded in HTML. It is used to manage dynamic content, databases, session tracking, even build entire e-commerce sites. It is integrated with a number of popular databases, including MySQL, PostgreSQL, Oracle, Sybase, Informix, and Microsoft SQL Server.

PHP is pleasingly zippy in its execution, especially when compiled as an Apache module on the Unix side. The MySQL server, once started, executes even very complex queries with huge result sets in record-setting time.

PHP supports a large number of major protocols such as POP3, IMAP, and LDAP. PHP4 added support for Java and distributed object architectures (COM and CORBA), making n-tier development a possibility for the first time. PHP is forgiving: PHP language tries to be as forgiving as possible. PHP Syntax is C-Like.

- PHP is an acronym for "PHP: Hypertext Preprocessor"
- PHP is a widely-used, open source scripting language
- PHP scripts are executed on the server
- PHP is free to download and use
- PHP files can contain text, HTML, CSS, JavaScript, and PHP code
- PHP code is executed on the server, and the result is returned to the browser as plain HTML
- PHP files have extension ".php"

3.3.1 CHARACTERISTICS OF PHP

Five important characteristics make PHP's practical nature possible –

- Simplicity
- Efficiency

- Security
- Flexibility
- Familiarity

STRUCTURE

```
<!DOCTYPE html>

<html>

<body>

<?php

echo "My first PHP script!";

?>

</body>

</html>
```

3.4 GPS

GPS Stands for "Global Positioning System." GPS is a satellite navigation system used to determine the ground position of an object. GPS technology was first used by the United States military in the 1960s and expanded into civilian use over the next few decades. Today, GPS receivers are included in many commercial products, such as automobiles, smartphones, exercise watches, and GIS devices.

The GPS system includes 24 satellites deployed in space about 12,000 miles (19,300 kilometers) above the earth's surface. They orbit the earth once every 12 hours at an extremely fast pace of roughly 7,000 miles per hour (11,200 kilometers per hour). The satellites are evenly spread out so that four satellites are accessible via direct line-of-sight from anywhere on the globe.

Each GPS satellite broadcasts a message that includes the satellite's current position, orbit, and exact time. A GPS receiver combines the broadcasts from multiple satellites to calculate its exact position using a process called triangulation.

Three satellites are required in order to determine a receiver's location, though a connection to four satellites is ideal since it provides greater accuracy.

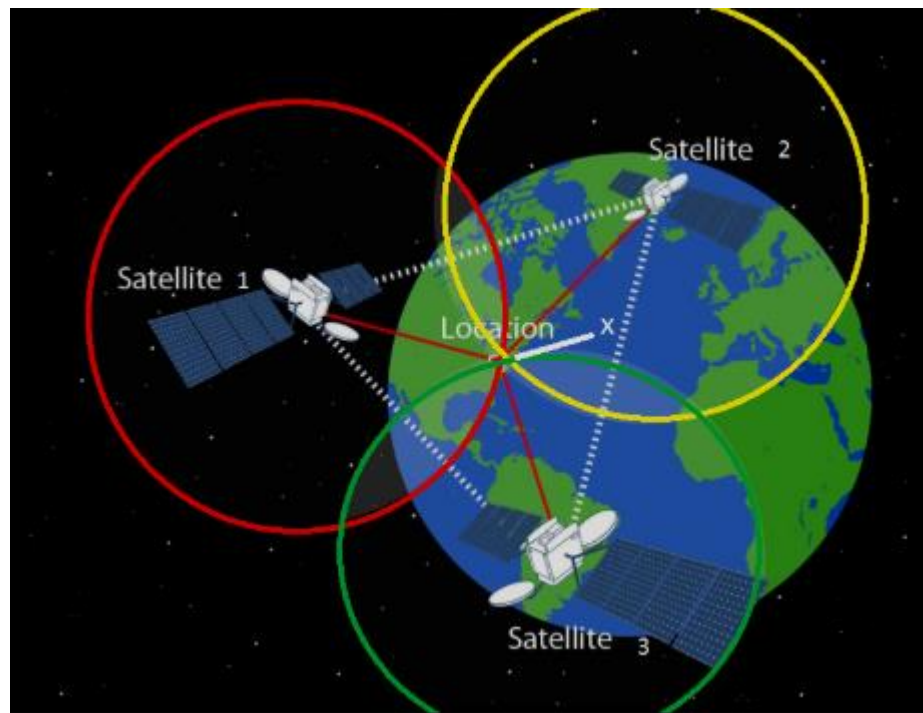


Fig. 3.4 GPS Working

The GPS working is shown in figure 3.4. In order for a GPS device to work correctly, it must first establish a connection to the required number of satellites. This process can take anywhere from a few seconds to a few minutes, depending on the strength of the receiver. For example, a car's GPS unit will typically establish a GPS connection faster than the receiver in a watch or smartphone. Most GPS devices also use some type of location caching to speed up GPS detection. By memorizing its previous location, a GPS device can quickly determine what satellites will be available the next time it scans for a GPS signal.

3.4.1 WORKING

GPS satellites circle the Earth twice a day in a precise orbit. Each satellite transmits a unique signal and orbital parameters that allow GPS devices to decode and compute the precise location of the satellite. GPS receivers use this information and trilateration to calculate a user's exact location. Essentially, the GPS receiver measures the distance to each satellite by the amount of time it takes to receive a

transmitted signal. With distance measurements from a few more satellites, the receiver can determine a user's position and display it electronically to measure your running route, map a golf course, find a way home or adventure anywhere.

3.4.2 GPS WORKING ON MOBILE:

To calculate your 2-D position (latitude and longitude) and track movement, a GPS receiver must be locked on to the signal of at least 3 satellites. With 4 or more satellites in view, the receiver can determine your 3-D position (latitude, longitude and altitude). Generally, a GPS receiver will track 8 or more satellites, but that depends on the time of day and where you are on the earth. Some devices can do all of that from your wrist.

Once your position has been determined, the GPS unit can calculate other information, such as:

3.4.3 ACCURACY

Today's GPS receivers are extremely accurate, thanks to their parallel multi-channel design. Our receivers are quick to lock onto satellites when first turned on. They maintain a tracking lock in dense tree-cover or in urban settings with tall buildings. Certain atmospheric factors and other error sources can affect the accuracy of GPS receivers. Garmin GPS receivers are typically accurate to within 10 meters. Accuracy is even better on the water.

Some Garmin GPS receiver accuracy is improved with WAAS (Wide Area Augmentation System). This capability can improve accuracy to better than 3 meters, by providing corrections to the atmosphere. No additional equipment or fees are required to take advantage of WAAS satellites. Users can also get better accuracy with Differential GPS (DGPS), which corrects GPS distances to within an average of 1 to 3 meters. The U.S. Coast Guard operates the most common DGPS correction service, consisting of a network of towers that receive GPS signals and transmit a corrected signal by beacon transmitters. In order to get the corrected signal, users must have a differential beacon receiver and beacon antenna in addition to their GPS.

3.5 RESULT AND DISCUSSION

The Simulation and its results attached below figure.3.5.1 - a and figure.3.5.1 - b for temperature sensor .In that we can see that whenever the temperature becomes high the buzzer was changed its mode from OFF to ON. The Hard ware picture after the execution is shown in below figure 3.5.2.

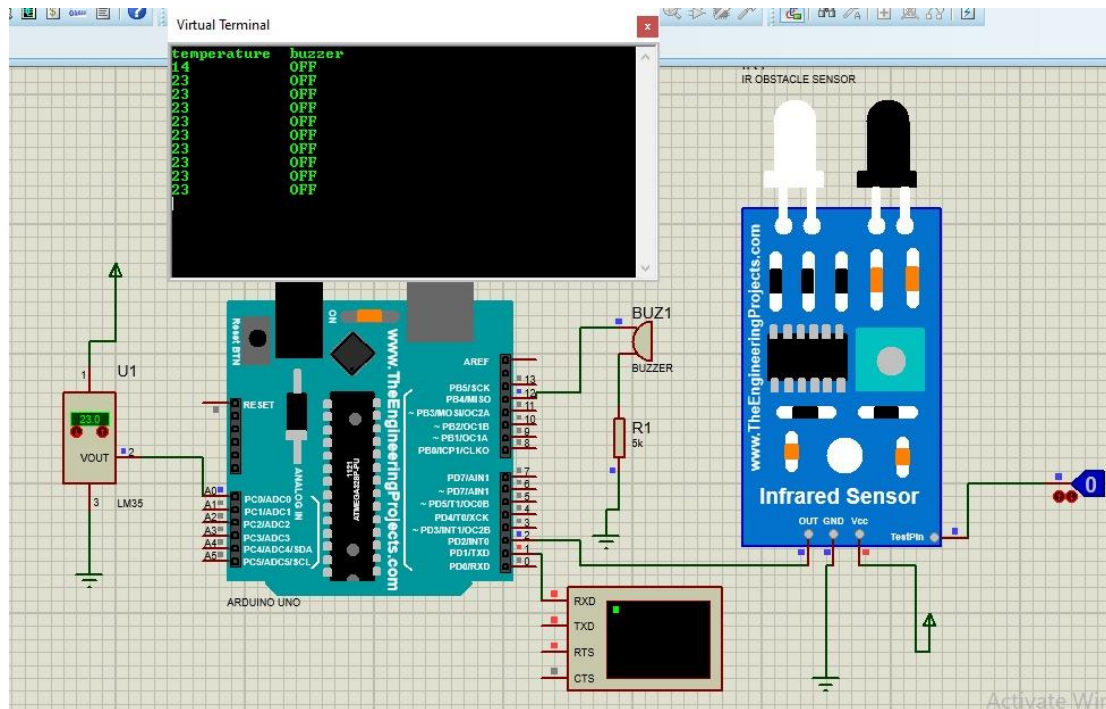


Figure 3.5 Simulation circuit for Temperature sensing – Normal Condition

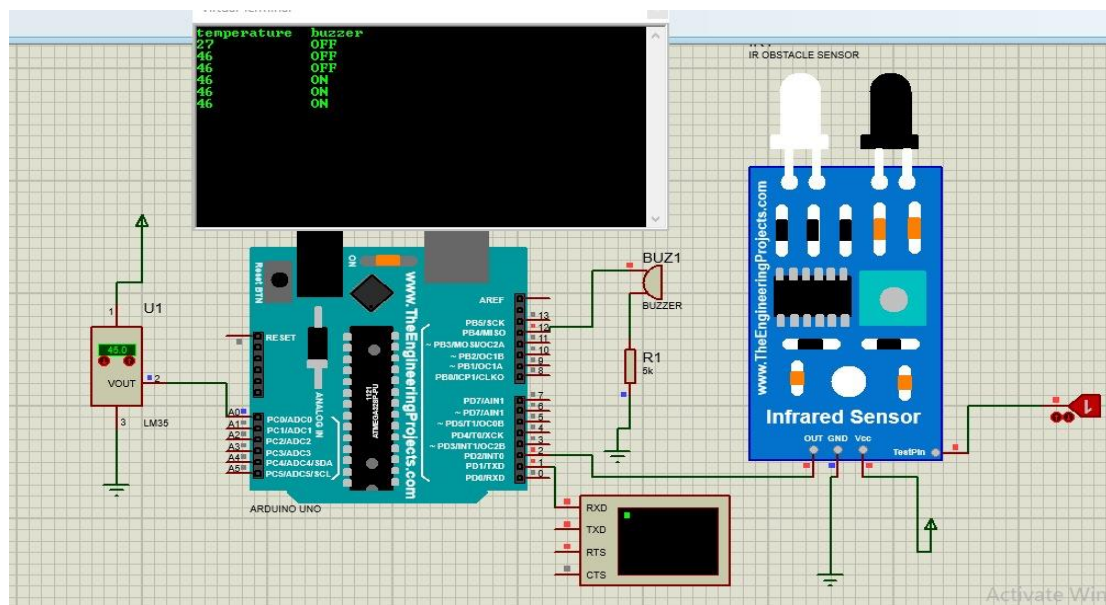


Figure 3.6 Simulation circuit for Temperature sensing – Abnormal Condition

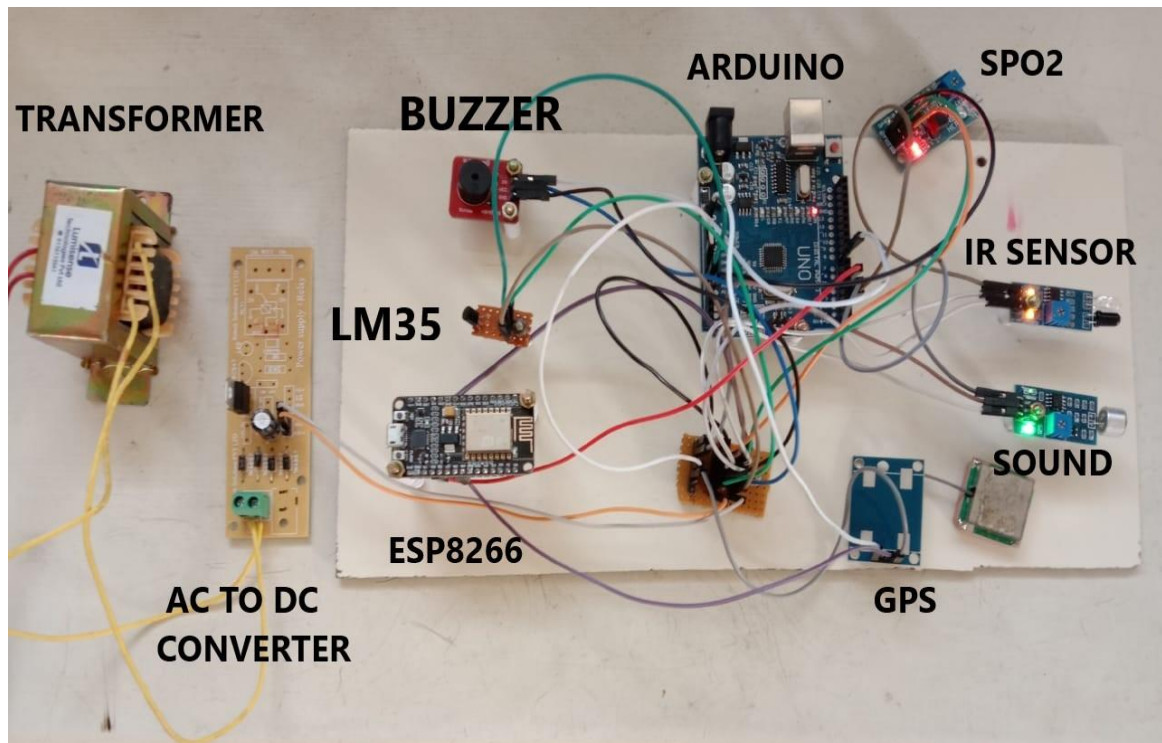


Figure 3.7 Photo copy of Hardware Prototype

The below Figure 3.5.3 is the serial monitor screen in that we can see LM35, Sound sensor reading are printed

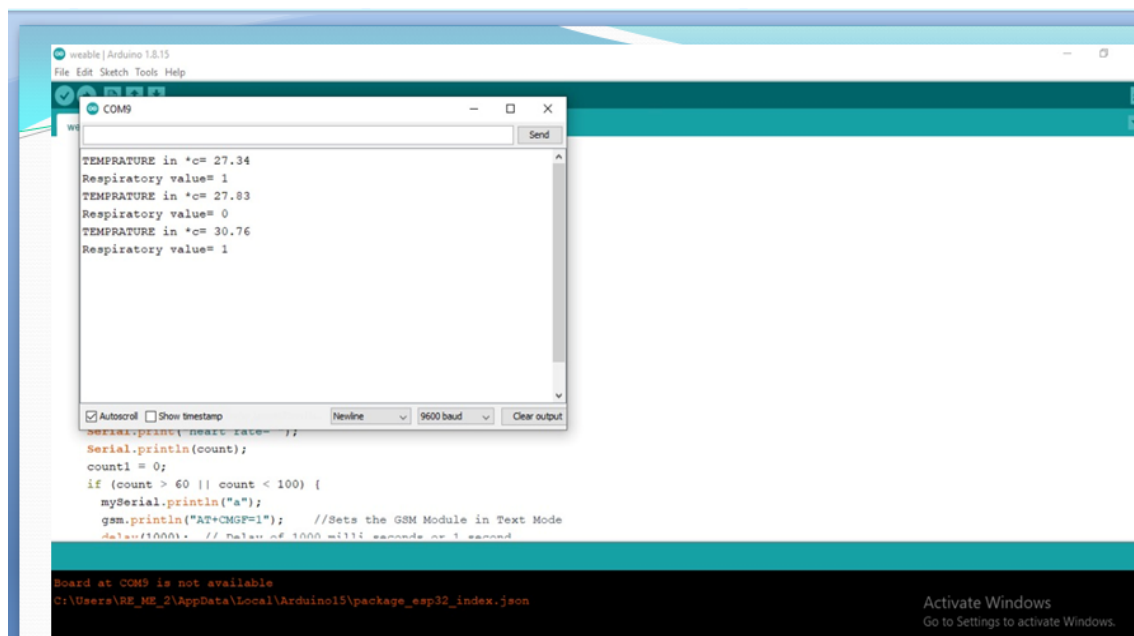


Figure 3.8 serial monitor screen with sound sensor readings

In below figure 3.5.4 we can see that whenever the covid symptoms are detected, the person locations data was sent to our THINKSPEAK channel.

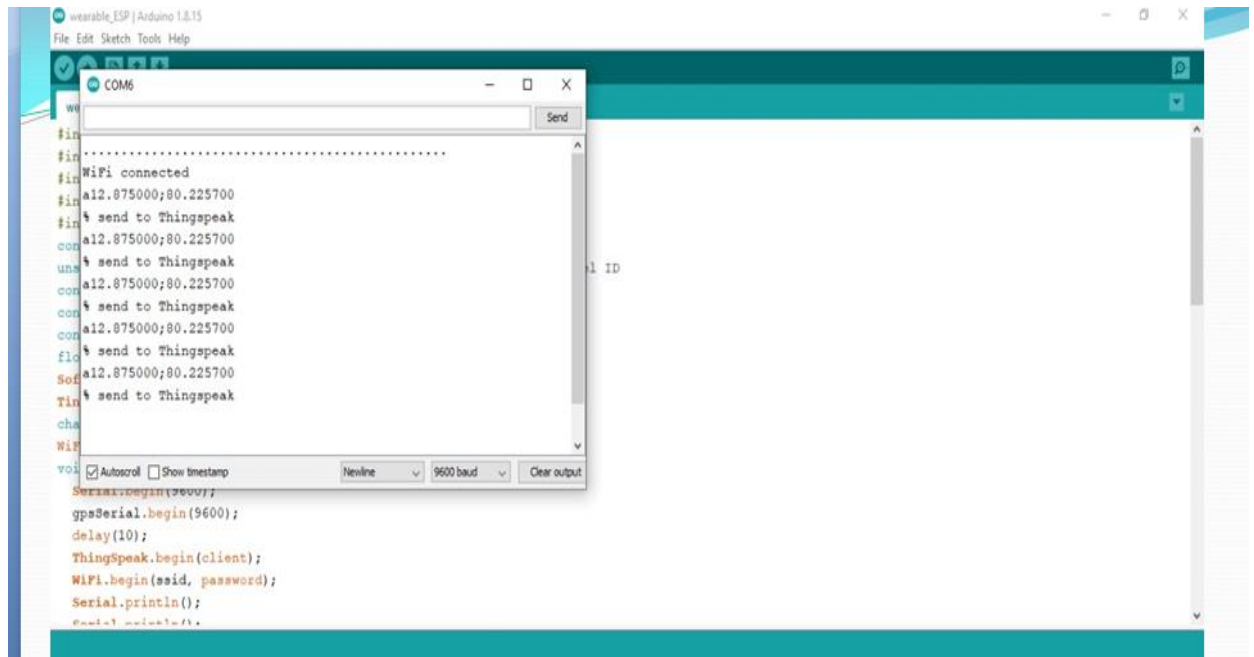


Figure 3.9 Serial monitor screen with GPS readings

In below figure3.5.5 we can see the thinkspeak and its field.

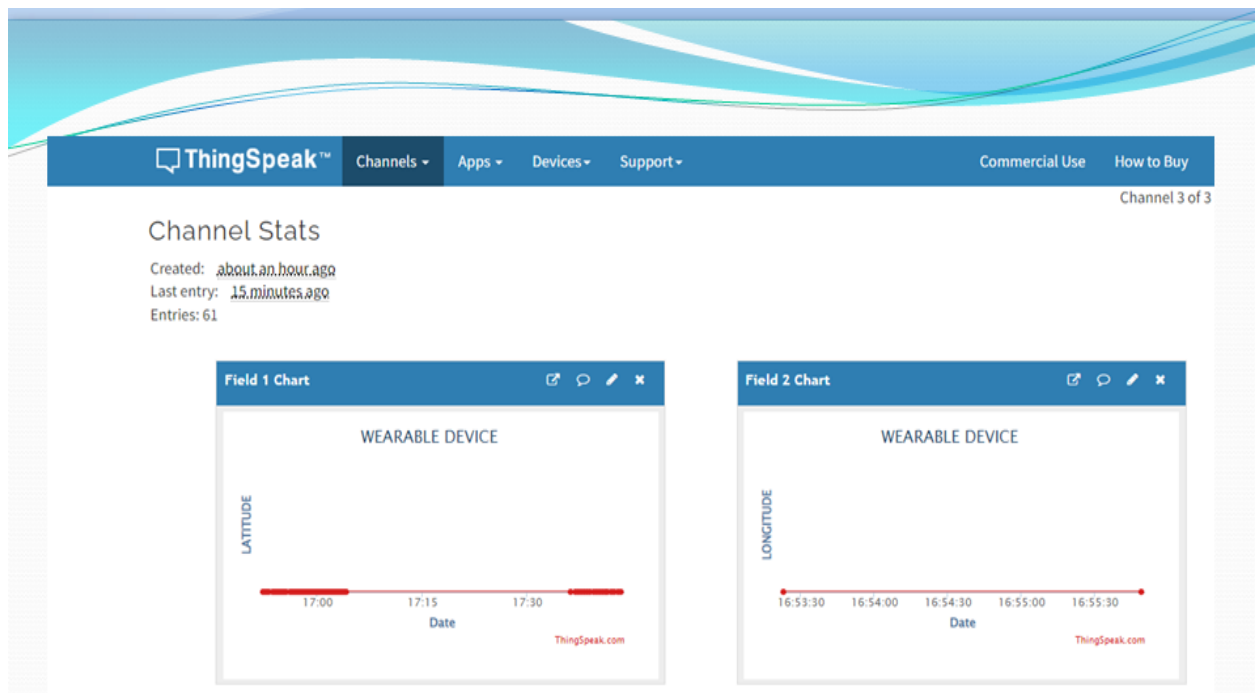


Figure 3.10 Think speak channel

In thinkspeak we track the location of person who has the covid-19 symptoms, by latitude and longitude value. The figure 3.5.6 shows the location of the person who has the symptoms.

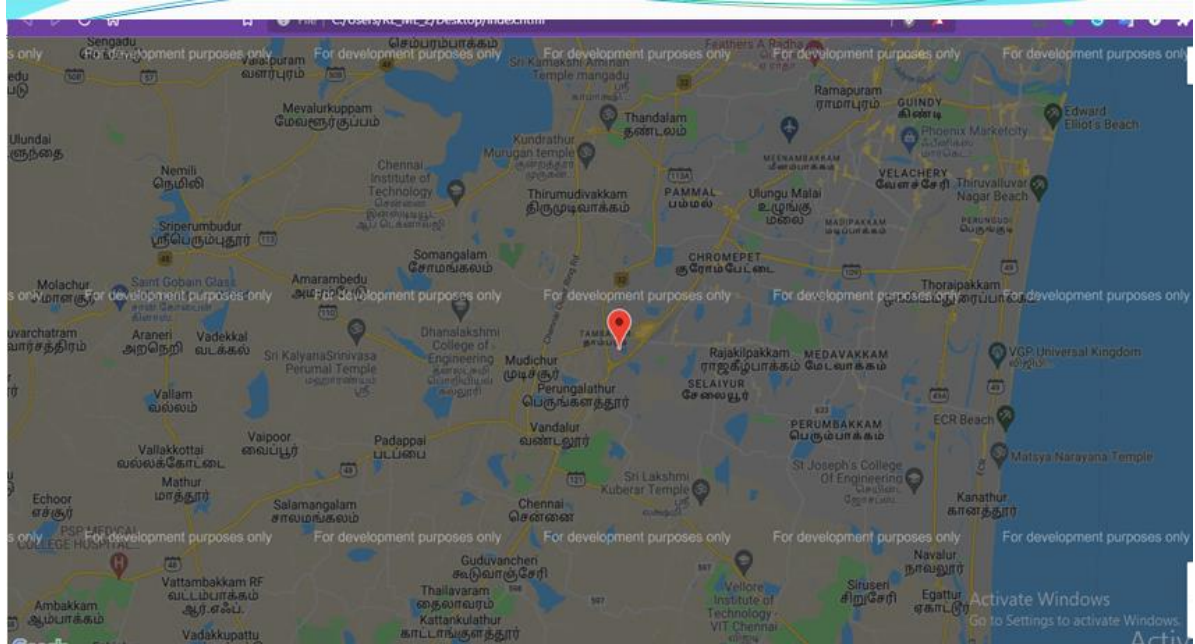


Figure 3.11 Location tracking of people with covid-19 symptoms

HARDWARE MODULE

4.1 CIRCUIT DIAGRAM

The circuit diagram is shown in below figure 4.1.

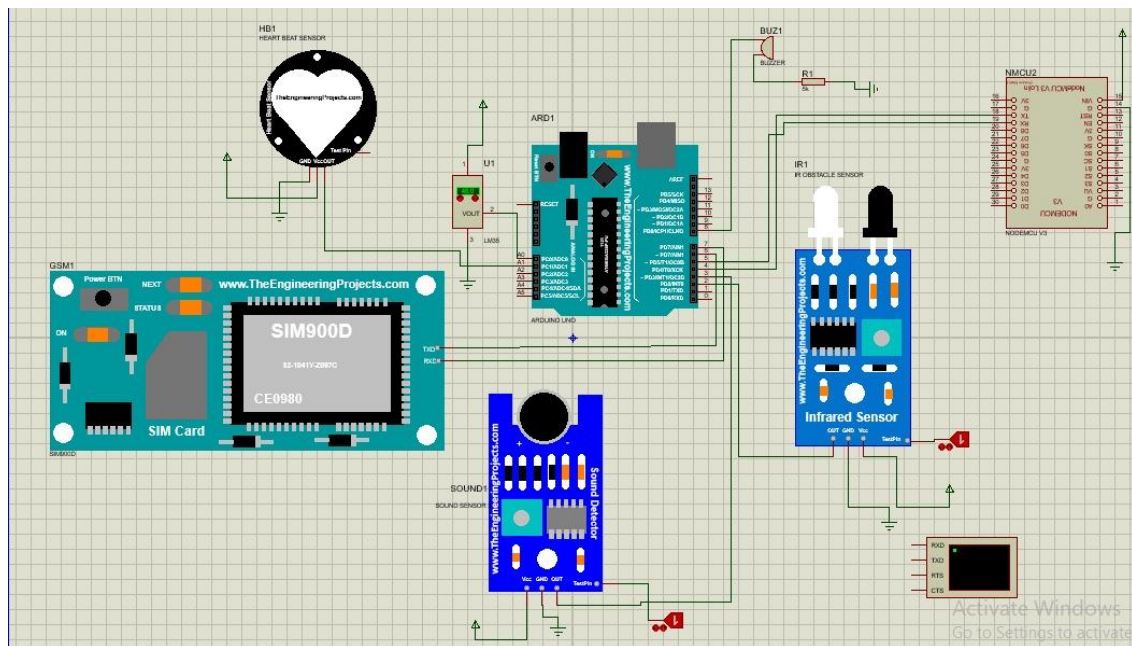


Fig. 4.1 Hardware Circuit diagram

4.2 ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It is shown in fig.4.2. 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. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. Revision 3 of the board has the following new features:

- 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the AVR, which operate with 5V and with the Arduino Due that operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes.
- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

DUINO UNO:

The Arduino Uno and its pin description is shown in below figure 4.2.

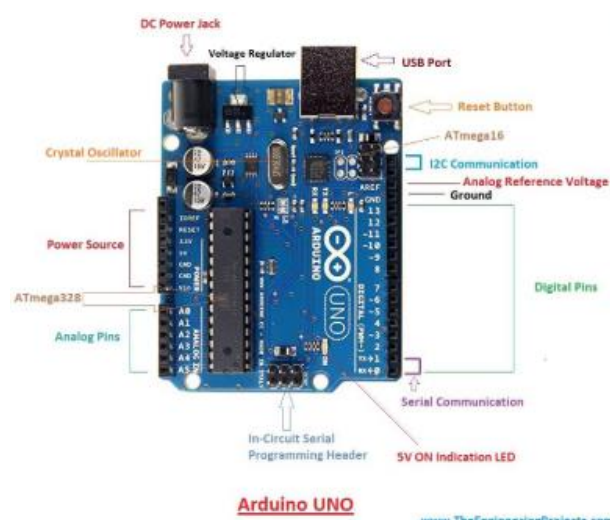


Fig. 4.2 Arduino UNO

4.2.1 POWER

VIN. 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. 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. We don't advise it.

3V 3. A 3.3-volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

GND. Ground pins.

4.2.2 Memory

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library). Input and Output each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode (), digital Write (), and digital Read () functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kilo Ohms.

In addition, some pins have specialized functions: Serial: 0 (RX) and 1 (TX). 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: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt () function for details.

PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analog Write () function.

SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

LED: 13. 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. The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e., 1024 different values). By default, they measure from ground to 5 volts, though it is possible to change the upper end of their range using the AREF pin and the analog Reference () function. Additionally, some pins have specialized functionality:

TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library. There are a couple of other pins on the board:

AREF Reference voltage for the analog inputs used with analog Reference ().

Reset. Bring this line LOW to reset the microcontroller typically used to add a reset button to shields which block the one on the board see also the mapping between Arduino pins and ATmega328 ports. The mapping for the Atmega8, 168, and 328 is identical. Communication the Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers.

The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed.

However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

4.2.3 PIN CONFIGURATION

The Arduino Uno pin configuration is show in below figure 4.3.

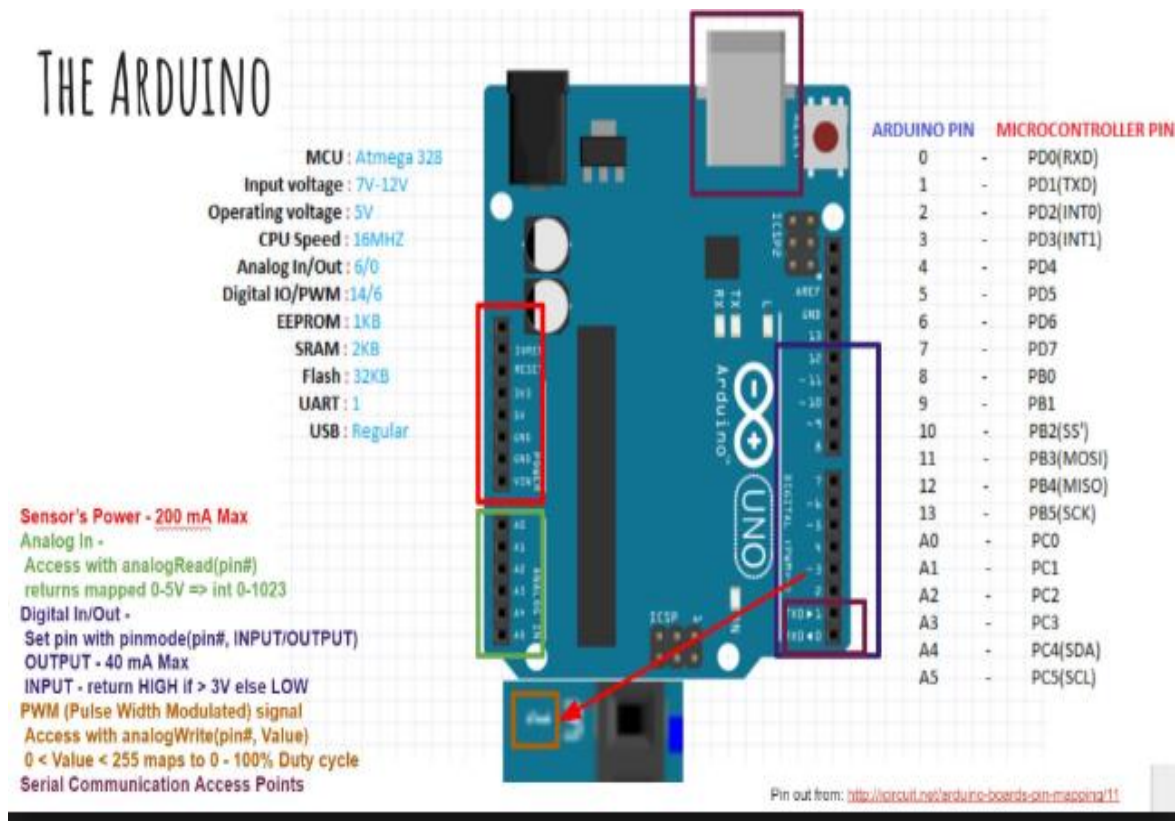


Fig. 4.3 Arduino pin Configuration

4.2.4 USB OVERCURRENT PROTECTION

The Arduino Uno has a resettable poly fuse that protects your computer's USB ports from shorts and overcurrent. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.

4.2.5 PHYSICAL CHARACTERISTICS

The maximum length and width of the Uno PCB are 2.7 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Four screw holes allow the board to be attached to a surface or case.

Note that the distance between digital pins 7 and 8 is 160 mil (0.16"), not an even multiple of the 100-mil spacing of the other pins.

4.3 POWER SUPPLY:

DEFINITION: A **power supply** (sometimes known as a **power supply unit** or **PSU**) is a device or system that supplies electrical or other types of energy to an output load or group of loads. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

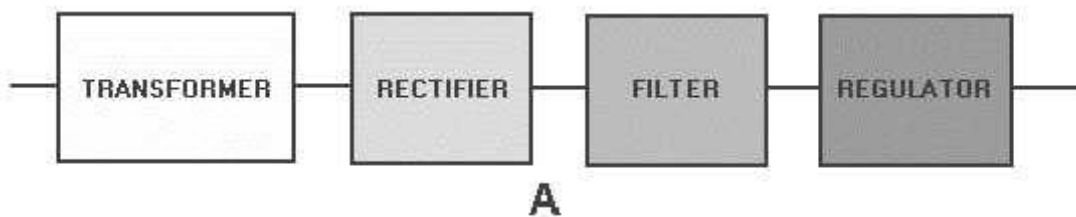


Fig. 4.4 Block diagram of a basic power supply

The transformer steps up or steps down the input line voltage and isolates the power supply from the power line. The rectifier section converts the alternating current input signal to a pulsating direct current. However, as you proceed in this chapter you will learn that pulsating dc is not desirable. For this reason, a filter section is used to convert pulsating dc to a purer, more desirable form of dc voltage.

The final section, the regulator, does just what the name implies. It maintains the output of the power supply at a constant level in spite of large changes in load current or input line voltages. Now that you know what each section does, let's trace an AC signal through the power supply. At this point you need to see how this signal is altered within each section of the power supply. Later on, in the chapter you will see how these changes take place. In view B of figure 4-1, an input signal of 115 volts AC is applied to the primary of the transformer. The transformer is a step-up transformer with a turn's ratio of 1:3. We can calculate the output for this

transformer by multiplying the input voltage by the ratio of turns in the primary to the ratio of turns in the secondary; therefore, 115 volts AC $\times 3 = 345$ volts ac (peak-to-peak) at the output. Because each diode in the rectifier section conducts for 180 degrees of the 360-degree input, the output of the rectifier will be one-half, or approximately 173 volts of pulsating DC. The filter section, a network of resistors, capacitors, or inductors, controls the rise and fall time of the varying signal. Consequently, the signal remains at a more constant DC level. We will see the filter process more clearly in the discussion of the actual filter circuits. The output of the filter is a signal of 110 volts dc, with ac ripple riding on the dc. The reason for the lower voltage (average voltage) will be explained. The regulator maintains its output at a constant 110-volt dc level, which is used by the electronic equipment (more commonly called the load).

Simple 5v supply for digital circuits

- Brief description of operation: Gives out well-regulated +5V output, output current capability of 100 mA.
- Circuit protection: Built-in overheating protection shuts down output when regulator IC gets too hot.
- Circuit complexity: Very simple and easy to build.
- Circuit performance: Very stable +5V output voltage, reliable operation.
- Availability of components: Easy to get, uses only very common basic components.
- Applications: Part of electronics devices, small laboratory power supply.
- Power supply voltage: Unregulated DC 8-18V power supply.
- Power supply current: Needed output current + 5 mA.

4.3.1 Circuit description

This circuit is a small +5V power supply, which is useful when experimenting with digital electronics. Those transformers are easily available, but usually their voltage regulation is very poor, which makes them not very usable for digital circuit experimenter unless a better regulation can be achieved in some way.

This circuit can give +5V output at about 150 mA current, but it can be increased to 1 A when good cooling is added to 7805 regulator chip. The circuit has over overload and terminal protection and it is shown in figure 4.5.

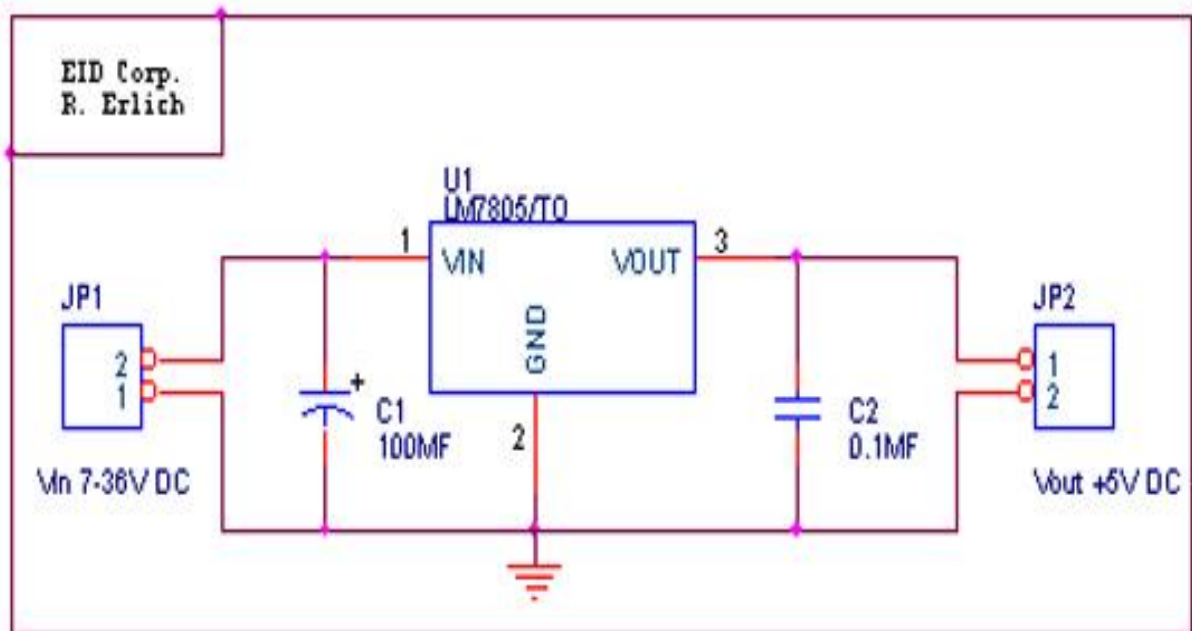


Fig. 4.5 Circuit diagram of power supply

The capacitors must have enough high voltage rating to safely handle the input voltage feed to circuit. The circuit is very easy to build into a piece of Vero board.

Pinout of the 7805 regulator IC.

1. Unregulated voltage in
2. Ground
3. Regulated voltage out

4.3.2 COMPONENT LIST

- 7805 regulator IC.
- 100 μ F electrolytic capacitor, at least 25V voltage rating.

- 10 μF electrolytic capacitor, at least 6V voltage rating.
- 100 nF ceramic or polyester capacitor.

MORE OUTPUT CURRENT

If we need more than 150 mA of output current, we can update the output current up to 1A doing the following modifications:

- Change the transformer from where we take the power to the circuit to a model which can give as much current as we need from output
- Put a heat sink to the 7805 regulators (so big that it does not overheat because of the extra losses in the regulator) and this is shown in figure 4.6.

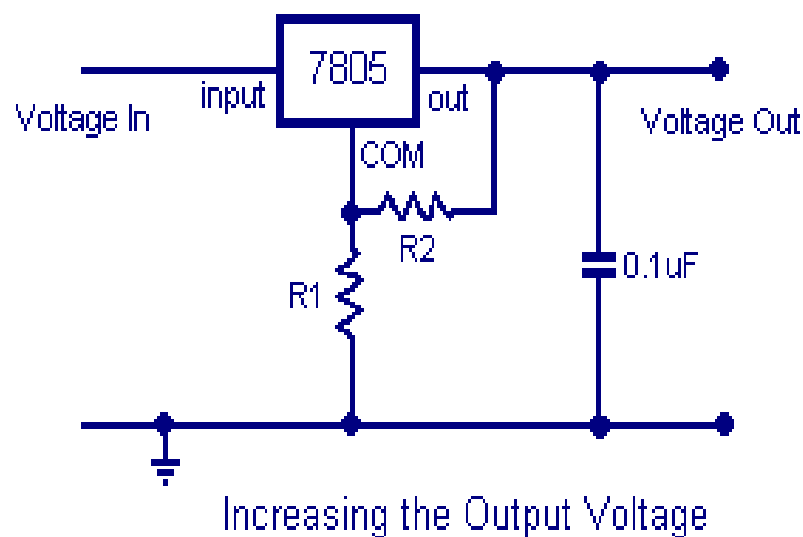


FIG. 4.6 MORE OUTPUT CURRENT

OTHER OUTPUT VOLTAGES If we need other voltages than +5V, we can modify the circuit by replacing the 7805 chips with another regulator with different output voltage from regulator 78xx chip family. The last numbers in the chip code tells the output voltage. The input voltage must be at least 3V greater than regulator output voltage to otherwise the regulator does not work well.

4.4 IR SENSOR:

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. It is shown in fig.4.7. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

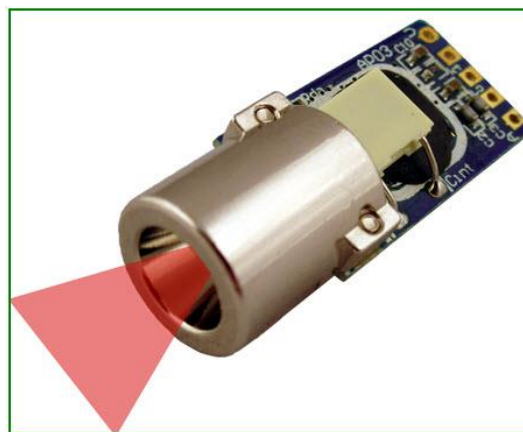


Fig. 4.7 IR SENSOR

IR Sensor Circuit Diagram and Working Principle An infrared sensor circuit is one of the basic and popular sensor module in an electronic device. This sensor is analogous to human's visionary senses, which can be used to detect obstacles and it is one of the common applications in real time. This circuit comprises of the following components

- LM358 IC 2 IR transmitter and receiver pair
- Resistors of the range of kilo ohms.
- Variable resistors.
- LED (Light Emitting Diode).

4.4.1 CIRCUIT DIAGRAM

The circuit diagram of IR sensor is shown in below figure 4.8.

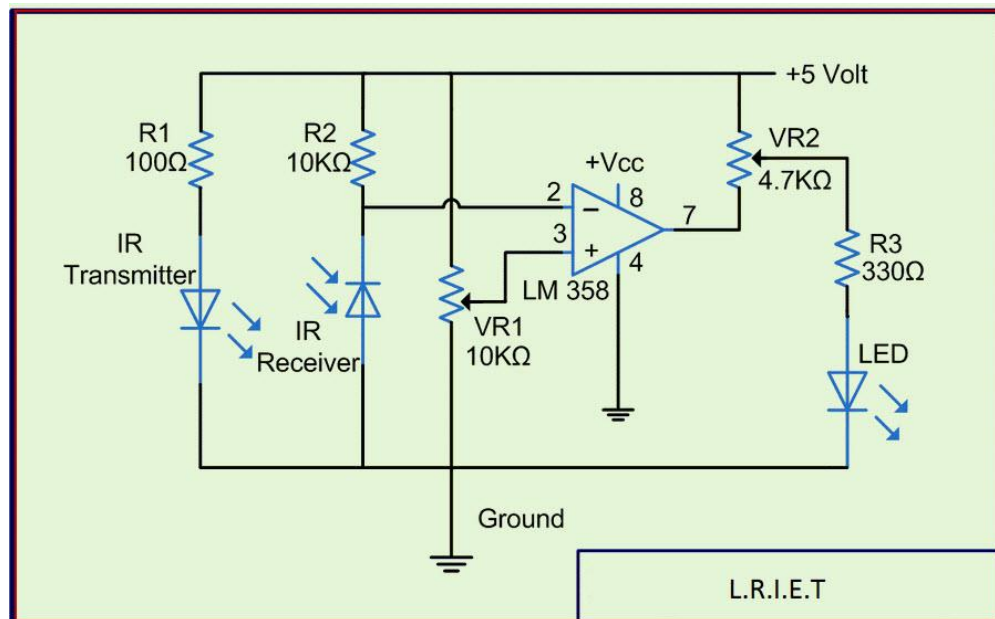


Fig. 4.8 Circuit diagram of IR Sensor

In this project, the transmitter section includes an IR sensor, which transmits continuous IR rays to be received by an IR receiver module. An IR output terminal of the receiver varies depending upon its receiving of IR rays. Since this variation cannot be analyzed as such, therefore this output can be fed to a comparator circuit. Here an operational amplifier (op-amp) of LM 339 is used as comparator circuit.

When the IR receiver does not receive a signal, the potential at the inverting input goes higher than that non-inverting input of the comparator IC (LM339). Thus, the output of the comparator goes low, but the LED does not glow. When the IR receiver module receives signal to the potential at the inverting input goes low. Thus, the output of the comparator (LM 339) goes high and the LED starts glowing. Resistor R1 (100), R2 (10k) and R3 (330) are used to ensure that minimum 10 mA current passes through the IR LED Devices like Photodiode and normal LEDs respectively. Resistor VR2 (preset=5k) is used to adjust the output terminals. Resistor VR1 (preset=10k) is used to set the sensitivity of the circuit Diagram. Read more about IR sensors.

4.4.2 Different Types of IR Sensors and Their Applications

IR sensors are classified into different types depending on the applications. Some of the typical applications of different types of sensors are

The speed sensor is used for synchronizing the speed of multiple motors. The temperature sensor is used for industrial temperature control. PIR sensor is used for automatic door opening system and Ultrasonic sensor are used for distance measurement.

4.4.3 IR Sensor Applications

IR sensors are used in various Sensor based projects and also in various electronic devices which measures the temperature that are discussed in the below.

Radiation Thermometers : IR sensors are used in radiation thermometers to measure the temperature depend upon the temperature and the material of the object and these thermometers have some of the following features

- Measurement without direct contact with the object
- Faster response
- Easy pattern measurements

Flame Monitors These types of devices are used for detecting the light emitted from the flames and to monitor how the flames are burning. The Light emitted from flames extend from UV to IR region types. PbS, PbSe, Two-color detector, pyro electric detector are some of the commonly employed detector used in flame monitors.

Moisture Analyzers Moisture analyzers use wavelengths which are absorbed by the moisture in the IR region. Objects are irradiated with light having these wavelengths (1.1 μm , 1.4 μm , 1.9 μm , and 2.7 μm) and also with reference wavelengths. The Lights reflected from the objects depend upon the moisture content and is detected by analyzer to measure moisture (ratio of reflected light at these wavelengths to the reflected light at reference wavelength). In GaAs PIN photodiodes, Pbs photoconductive detectors are employed in moisture analyzer circuits.

GAS ANALYZERS IR sensors are used in gas analyzers which use absorption characteristics of gases in the IR region and that is show in below figure 4.9. Two types of methods are used to measure the density of gas such as dispersive and non-dispersive.



Fig. 4.9 Gas Analyzer

GAS ANALYZER Dispersive: An Emitted light is spectroscopically divided and their absorption characteristics are used to analyze the gas ingredients and the sample quantity.

Non dispersive: It is most commonly used method and it uses absorption characteristics without dividing the emitted light. Non dispersive types use discrete optical band pass filters, similar to sunglasses that are used for eye protection to filter out unwanted UV radiation.

This type of configuration is commonly referred to as non-dispersive infrared (NDIR) technology. This type of analyzer is used for carbonated drinks, whereas non dispersive analyzer is used in most of the commercial IR instruments, for an automobile exhaust gas fuel leakage.

4.4.4 IR IMAGING DEVICES

IR image device is one of the major applications of IR waves, primarily by virtue of its property that is not visible. It is used for thermal imagers, night vision devices, etc. It is shown below figure 4.10.



Fig. 4.10 IR IMAGING DEVICES

For examples Water, rocks, soil, vegetation, an atmosphere, and human tissue all features emit IR radiation. The Thermal infrared detectors measure these radiations in IR range and map the spatial temperature distributions of the

object/area on an image. Thermal imagers usually composed of a Sb (indium antimonite), Gd Hg (mercury-doped germanium), Hg Cd Te (mercury-cadmium-telluride) sensors.

An electronic detector is cooled to low temperatures using liquid helium or liquid nitrogen. Then the Cooling the detectors ensures that the radiant energy (photons) recorded by the detectors comes from the terrain and not from the ambient temperature of objects within the scanner itself an IR imaging electronic device.

Thus, this is all about IR sensor circuit with working and applications. These sensors are used in many sensors based electronics projects.

4.5 HEART BEAT SENSOR:

A person's heartbeat is the sound of the valves in his/heir's heart contracting or expanding as they force blood from one region to another. The number of times the heart beats per minute (BPM), is the heart beat rate and the beat of the heart that can be felt in any artery that lies close to the skin is the pulse.

Ways to Measure a Heartbeat

Manual Way: Heart beat can be checked manually by checking one's pulses at two locations- wrist (the radial pulse) and the neck (carotid pulse). The procedure is to place the two fingers (index and middle finger) on the wrist (or neck below the windpipe) and count the number of pulses for 30 seconds and then multiplying that number by 2 to get the heart beat rate. However, pressure should be applied minimum and also fingers should be moved up and down till the pulse is felt.

Using a sensor: Heart Beat can be measured based on optical power variation as light is scattered or absorbed during its path through the blood as the heart beat changes

4.5.1 PRINCIPLE OF HEARTBEAT SENSOR

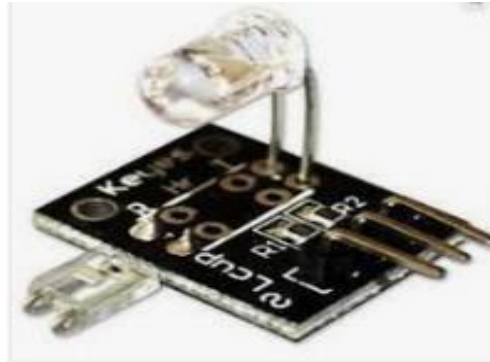


Fig. 4.11 Heartbeat Sensor

Heartbeat sensor is picture was shown above figure 4.11. The heartbeat sensor is based on the principle of photo plethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ (a vascular region). In case of applications where heart pulse rate is to be monitored, the timing of the pulses is more important. The flow of blood volume is decided by the rate of heart pulses and since light is absorbed by blood, the signal pulses are equivalent to the heart beat pulses

Primary Applications of Heartbeat Sensor

- Works as a Digital Heart Rate monitor
- Works as a Patient Health Monitoring System
- Used as a Bio-Feedback control of robotic applications

When the heart pumps blood through the blood vessels, the finger becomes slightly more opaque; due to this, less amount of light reaches from the LED to the detector.

With every heart pulse generated, the detector signal gets varied. The varied detector signal is converted into an electrical pulse. This electrical signal gets amplified and triggered through an amplifier.

4.5.2 CIRCUIT DIAGRAM OF HEART BEAT SENSOR:

The circuit diagram of heart beat sensor is shown in below figure 4.12.

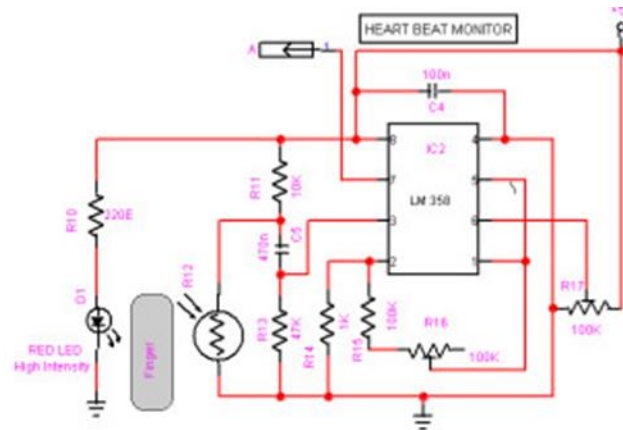


Fig. 4.12 Circuit diagram of Heartbeat sensor

4.5.3 WORKING OF A HEARTBEAT SENSOR

The working of a heartbeat sensor is shown in below figure 4.13. The basic heartbeat sensor consists of a light emitting diode and a detector like a light detecting resistor or a photodiode. The heart beat pulses cause a variation in the flow of blood to different regions of the body. When a tissue is illuminated with the light source, i.e. light emitted by the led, it either reflects (a finger tissue) or transmits the light (earlobe). Some of the light is absorbed by the blood and the transmitted or the reflected light is received by the light detector. The amount of light absorbed depends on the blood volume in that tissue. The detector output is in form of electrical signal and is proportional to the heart beat rate.

This signal is actually a DC signal relating to the tissues and the blood volume and the AC component synchronous with the heart beat and caused by pulsatile changes in arterial blood volume is superimposed on the DC signal. Thus, the major requirement is to isolate that AC component as it is of prime importance.

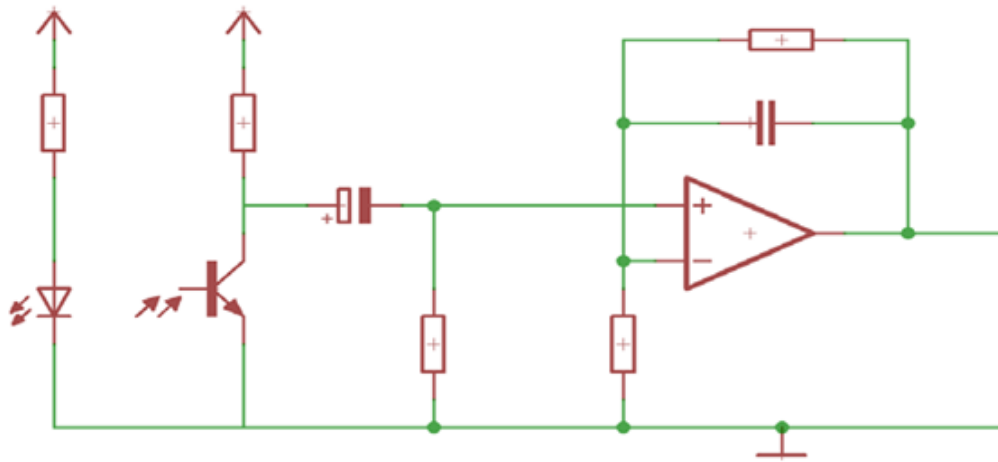


Fig. 4.13 Working of Heartbeat sensor

To achieve the task of getting the AC signal, the output from the detector is first filtered using a 2 stage HP-LP circuit and is then converted to digital pulses using a comparator circuit or using simple ADC. The digital pulses are given to a microcontroller for calculating the heart beat rate, given by the formula-

$$\text{BPM (Beats per minute)} = 60 \cdot f \quad (\text{Where } f \text{ is the pulse frequency})$$

Practical Heartbeat Sensor

Practical heartbeat Sensor examples are **Heart Rate Sensor (Product No PC-3147)** and it is shown in figure 4.14. It consists of an infrared led and an ldr embedded onto a clip like structure. The clip is attached to the organ (earlobe or the finger) with the detector part on the flesh.



Fig. 4.14 Practical Heartbeat Sensor

Another example is **TCRT1000**, and it is shown figure 4.15. It having 4 pins

Pin1: To give supply voltage to the LED

Pin2 and 3 are grounded. Pin 4 is the output. Pin 1 is also the enable pin and pulling it high turns the LED on and the sensor starts working. It is embedded on a wearable device which can be worn on the wrist and the output can be sent wirelessly (through Bluetooth) to the computer for processing.



Fig. 4.15 TCRT1000 Heartbeat sensor

Application developing your own Heartbeat Sensor System

A basic Heartbeat Sensor system can also be built using basic components like a Ldr, comparator IC LM358 and a Microcontroller

As described above regarding the principle of heart beat sensor, when the finger tissue or the earlobe tissue is illuminated using a light source, the light is transmitted after getting modulated i.e., a part getting absorbed by the blood and the rest being transmitted. This modulated light is received by the light detector.

Here a Light Dependent Resistor (LDR) is used as a light detector. It works on the principle that when light falls on the resistor, its resistance changes. As the light intensity increases, the resistance decreases. Thus, the voltage drops across the resistor decreases.

Here a comparator is used which compares the output voltage from the LDR to that of the threshold voltage. The threshold voltage is the voltage drop across the LDR when the light with fixed intensity, from the light source falls directly on it. The inverting terminal of the comparator LM358 is connected to the potential divider arrangement which is set to the threshold voltage and the non-inverting terminal is connected to the LDR. When a human tissue is illuminated using the light source, the intensity of the light reduces. As this reduced light intensity falls on the LDR, the resistance increases and as a result the voltage drop increases. When the voltage drop across the LDR or the non-inverting input exceeds that of the inverting input, a logic high signal is developed at the output of the comparator and in case voltage drop being lesser a logic low output is developed. Thus, the output is a series of pulses. These pulses can be fed to the Microcontroller which accordingly processes the information to get the heart beat rate and this is displayed on the Display interfaced to the Microcontroller.

4.6 TEMPERATURE SENSOR:

The world is getting warmer day by day.' This sentence has started to crop up every now and then in our day to day lives. But seldom do we wonder what it means. What is warmer? How warm is warm? Is it hotter than hot, or just hotter than cold? To our human senses, temperature is only a subjective evaluation. For an objective and reproducible measurement, we need to quantify the temperature values, and to do that, a suitable measurement device is required

SPECIFICATIONS:

Table 4.1 Specification of Temperature sensor

Range	0°...100°C
Accuracy	< 0,1°C + NTC-spread over 0°...70°C
Resolution	2 m°C@30°C and 25 m°C@100°C
Linearity	see table
No. Sensors	1....30
Type	5 kOhm NTC-resistors Max. wireresistance 3,3 Ohm
Conditioner	Wheatstone-bridge with +15 Bits ADC
Calibration	at 0°C and 100°C _ 0,1°C
Drift	1 m°C/°C with periodic calibration and 5 m°C/°C without calibration
Scanfreq.	default max. 10 meas./s
Amb.temp	0°...60°
Control	Micro-WireTM 5 (Di, Do, Clk en CS)
Levels	0 and 5 Volt
Power	+12 Volt 3,5 mAmp (+5,5 +20 Volt) -5 Volt 1 mAmp (-4,5-8 Volt)
Dimensions	224 x 120 x 60 + 40 mm

Temperature and its Measurement Simply speaking, temperature is the degree of hotness of the body which is a measure of the heat content in the body. The problem to quantify the heat content of the body on a scale did not arise until the invention of the Steam Engine. The curiosity of scientists to understand the behavior of water at different levels of heat contents gave rise to a formal and better laid out study. One of the first references for 'temperature' dates back to 1760, when Joseph Black declared that applying the same heat to different materials resulted in different temperatures. Years of rigorous scientific study led to many theories ranging from the simple 'Caloric' concept, which treated heat as a material substance which is exchanged among materials, to Carnot's description of heat as a form of energy (which laid the foundation of the first law of thermodynamics).

However, none of them satisfactorily explained the concept of temperature. It was Maxwell's theory which offered good reasoning into it. He defined temperature of a body as is its thermal property which provides information about the energy content of the system. It is the measure of the average kinetic energy (energy by virtue of motion) of the molecules of the substance and signifies a heat potential due to which heat flows from higher temperature to lower temperature.

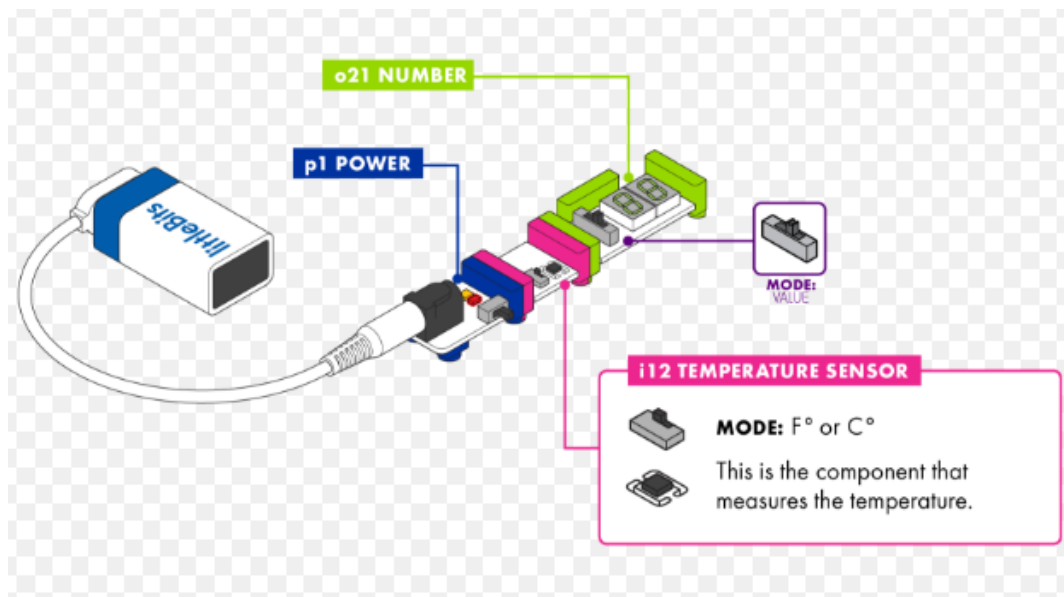


Fig. 4.16 Temperature sensor

There are many different types of **Temperature Sensor** available and all have different characteristics depending upon their actual application. A temperature sensor consists of two basic physical types:

- **Contact Temperature Sensor Types** – These types of temperature sensor are required to be in physical contact with the object being sensed and use conduction to monitor changes in temperature. They can be used to detect solids, liquids or gases over a wide range of temperatures.
- **Non-contact Temperature Sensor Types** – These types of temperature sensor use convection and radiation to monitor changes in temperature. They can be used to detect liquids and gases that emit radiant energy as heat rises and cold settles to the bottom in convection

currents or detect the radiant energy being transmitted from an object in the form of infra-red radiation (the sun).

The two basic types of contact or even non-contact temperature sensors can also be sub-divided into the following three groups of

- **Sensors,**
- **Electro-mechanical,**
- **Resistive and Electronic.**

The Thermostat The **Thermostat** is a contact type electro-mechanical temperature sensor or switch, that basically consists of two different metals such as nickel, copper, tungsten or aluminum etc., that are bonded together to form a **Bi-metallic strip**. The different linear expansion rates of the two dissimilar metals produces a mechanical bending movement when the strip is subjected to heat.

The bi-metallic strip can be used itself as an electrical switch or as a mechanical way of operating an electrical switch in thermostatic controls and are used extensively to control hot water heating elements in boilers, furnaces, hot water storage tanks as well as in vehicle radiator cooling systems.

The Bi-metallic Thermostat The Bi-metallic Thermostat is shown in below figure 4.17.

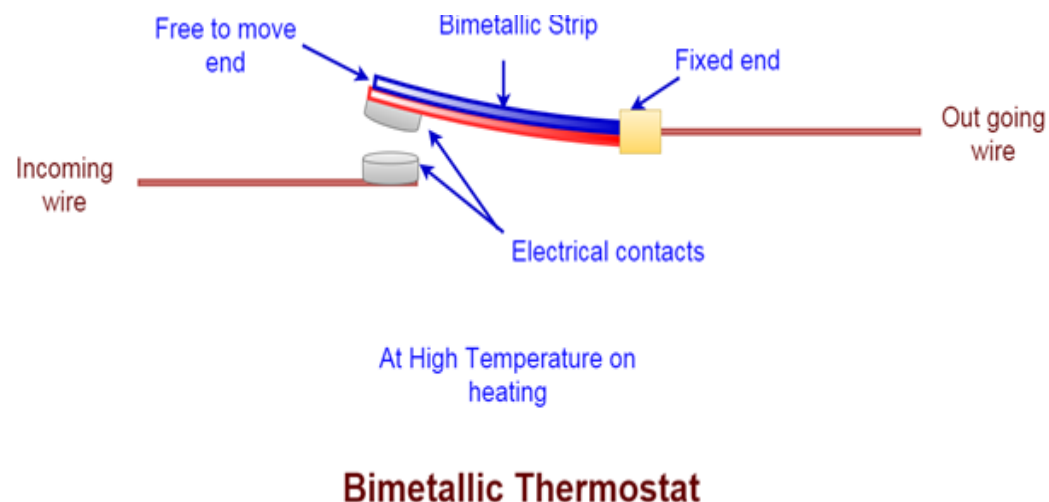


Fig. 4.17 Bimetallic Thermostatic

The thermostat consists of two thermally different metals stuck together back-to-back. When it is cold the contacts are closed and current passes through the thermostat. When it gets hot, one metal expands more than the other and the bonded bi-metallic strip bends up (or down) opening the contacts preventing the current from flowing.

On/Off Thermostat There are two main types of bi-metallic strips based mainly upon their movement when subjected to temperature changes. There are the “snap-action” types that produce an instantaneous “ON/OFF” or “OFF/ON” type action on the electrical contacts at a set temperature point, and the slower “creep-action” types that gradually change their position as the temperature changes.

Snap-action type thermostats are commonly used in our homes for controlling the temperature set point of ovens, irons, immersion hot water tanks and they can also be found on walls to control the domestic heating system.

Creeper types generally consist of a bi-metallic coil or spiral that slowly unwinds or coils-up as the temperature changes. Generally, creeper type bi-metallic strips are more sensitive to temperature changes than the standard snap ON/OFF types as the strip is longer and thinner making them ideal for use in temperature gauges and dials etc.

Although very cheap and are available over a wide operating range, one main disadvantage of the standard snap-action type thermostats when used as a temperature sensor, is that they have a large hysteresis range from when the electrical contacts open until when they close again. For example, it may be set to 20°C but may not open until 22°C or close again until 18°C.

So the range of temperature swing can be quite high. Commercially available bi-metallic thermostats for home use do have temperature adjustment screws that allow for a more precise desired temperature set-point and hysteresis level to be pre-set.

4.7 SOUND SENSOR:

The sound sensor is one type of module used to notice the sound. Generally, this module is used to detect the intensity of sound. The applications of this module

mainly include switch, security, as well as monitoring. The accuracy of this sensor can be changed for the ease of usage.

This sensor employs a microphone to provide input to buffer, peak detector and an amplifier. This sensor notices a sound, & processes an o/p voltage signal to a microcontroller. After that, it executes required processing.

This sensor is capable to determine noise levels within DB's or decibels at 3 kHz 6 kHz frequencies approximately wherever the human ear is sensitive. In smartphones, there is an android application namely decibel meter used to measure the sound level.

4.7.1 SOUND SENSOR PIN CONFIGURATION

This sensor includes three pins which include the following. This is shown in fig.4.18



Fig. 4.18 Sound sensor module

- Pin1 (VCC): 3.3V DC to 5V DC
- Pin2 (GND): This is a ground pin
- Pin3 (DO): This is an output pin

4.7.2 WORKING PRINCIPLE

The working principle of this sensor is related to human ears. Because human ear includes a diaphragm and the main function of this diaphragm is, it uses

the vibrations and changes into signals. Whereas in this sensor, it uses a microphone and the main function of this is, it uses the vibrations and changes into current otherwise voltage.

Generally, it includes a diaphragm which is designed with magnets that are twisted with metal wire. When sound signals hit the diaphragm, then magnets within the sensor vibrates & simultaneously current can be stimulated from the coils.

4.7.3 FEATURES

The features of the sound sensor include the following

- These sensors are very simple to use
- It gives analog o/p signal
- Simply incorporates using logic modules on the input area

SOUND DETECTION SENSOR MODULE PIN CONFIGURATION

Table 4.2 Sound Detection Sensor Module Pin Configuration

Pin Name	Description
VCC	The VCC pin powers the module, typically with +5V
GND	Power Supply Ground
DO	Digital Output Pin. Directly connected to digital pin of Microcontroller
AO	Analog Output Pin. Directly connected to an analog pin of Microcontroller

4.7.4 SPECIFICATIONS

The specifications of the sound sensor include the following

- The range of operating voltage is $3\frac{3}{5}$ V
- The operating current is 4~5 mA
- The voltage Gain 26 dB ($V=6V$, $f=1kHz$)
- The sensitivity of the microphone (1kHz) is 52 to 48 dB
- The impedance of the microphone is 2.2k Ohm
- The frequency of m microphone is 16 to 20 kHz
- The signal to noise ratio is 54 Db

4.7.5 APPLICATIONS

The applications of the sound sensor include the following.

- This sensor can be used to build various electronic projects with the help of an Arduino board. For instance, this project uses a grove sensor, which fundamentally gives your Arduino's ears. In this project, a microphone can be attached to an analog pin of the board. This can be used to notice the noise level within the nearby surroundings.
- The grove sensors support platforms like Arduino, Raspberry Pi, BeagleBone Wio, and LinkIt ONE. This sensor plays an essential role while activating the light in your office or house by detecting a precise whistle or clap sound.

Some more applications of this sensor include the following.

- Security system for Office or Home
- Spy Circuit
- Home Automation
- Robotics
- Smart Phones
- Ambient sound recognition
- Audio amplifier
- Sound level recognition (not capable to obtain precise dB value)

4.8 ESP8266 MODULE

The **ESP8266** is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by manufacturer Espressif Systems in Shanghai, China.

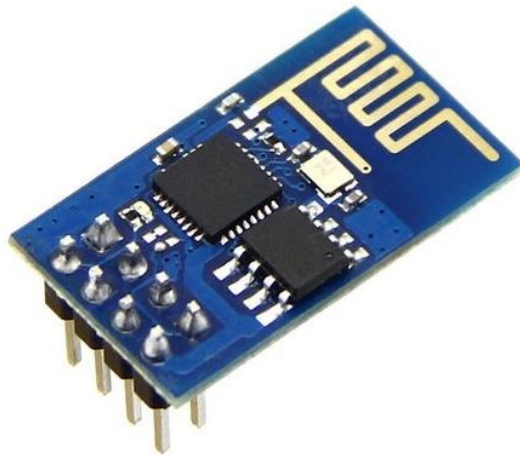
The chip first came to the attention of western makers in August 2014 with the **ESP-01** module, made by a third-party manufacturer Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connection using Hayes-style commands. However, at first there was almost no English language documentation on the chip and the commands it accepted.^[2] The very low price and the fact that there were very few external components on the module, which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation

4.8.1 FEATURE

- Memory:
- 32 KiB instruction RAM
- 32 KiB instruction cache RAM
- 80 KiB user-data RAM
- 16 KiB ETS system-data RAM
- External QSPI flash: up to 16 MiB is supported (512 KiB to 4 MiB typically included)
- IEEE 802.11 b/g/n Wi-Fi
- Integrated TR switch, balun, LNA, power amplifier and matching network
- WEP or WPA/WPA2 authentication, or open networks
- 16 GPIO pins
- SPI
- I²C (software implementation)
- I²S interfaces with DMA (sharing pins with GPIO)

- UART on dedicated pins, plus a transmit-only UART can be enabled on GPIO2.
- 10-bit ADC (successive approximation ADC)

ESP8266 is Wi-Fi enabled system on chip (SoC) module developed by Espressif system. It is mostly used for development of IoT (Internet of Things) embedded applications.



4.8.2 ESP8266-01 WIFI Module

ESP8266 comes with capabilities of

- 2.4 GHz Wi-Fi (802.11 b/g/n, supporting WPA/WPA2),
- general-purpose input/output (16 GPIO),
- Inter-Integrated Circuit (I²C) serial communication protocol,
- analog-to-digital conversion (10-bit ADC)
- Serial Peripheral Interface (SPI) serial communication protocol,
- I²S (Inter-IC Sound) interfaces with DMA (Direct Memory Access) (sharing pins with GPIO),
- UART (on dedicated pins, plus a transmit-only UART can be enabled on GPIO2), and
- pulse-width modulation (PWM).

It employs a 32-bit RISC CPU based on the Tensilica Xtensa L106 running at 80 MHz (or overclocked to 160 MHz). It has a 64 KB boot ROM, 64 KB instruction RAM and 96 KB data RAM. External flash memory can be accessed through SPI.

ESP8266 module is low-cost standalone wireless transceiver that can be used for end-point IoT developments.

To communicate with the ESP8266 module, microcontroller needs to use set of AT commands. Microcontroller communicates with ESP8266-01 module using UART having specified Baud rate.

There are many third-party manufacturers that produce different modules based on this chip. So, the module comes with different pin availability options like,

- ESP-01 comes with 8 pins (2 GPIO pins) – PCB trace antenna. (shown in above figure)
- ESP-02 comes with 8 pins, (3 GPIO pins) – U-FL antenna connector.
- ESP-03 comes with 14 pins, (7 GPIO pins) – Ceramic antenna.
- ESP-04 comes with 14 pins, (7 GPIO pins) – No ant.

etc.

For example, below figure shows ESP-01 module pins

4.8.3 ESP8266-01 Module Pin Description

The pin description of ESP8266-01 is shown in below figure 4.19.

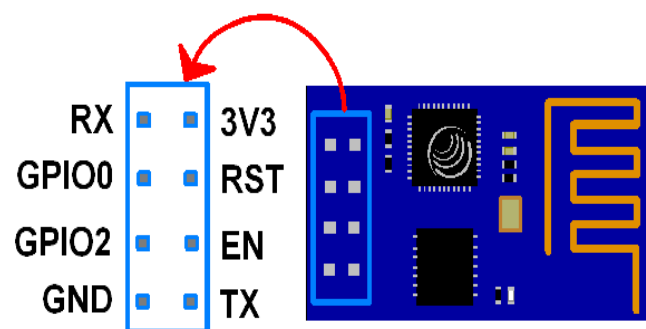


Fig. 4.19 ESP8266-01 Module Pin Description

ESP8266-01 Module Pins

3V3: - 3.3 V Power Pin.

GND: - Ground Pin.

RST: - Active Low Reset Pin.

EN: - Active High Enable Pin.

TX: - Serial Transmit Pin of UART.

RX: - Serial Receive Pin of UART.

GPIO0 & GPIO2: - General Purpose I/O Pins. These pins decide what mode (boot or normal) the module starts up in. It also decides whether the TX/RX pins are used for Programming the module or for serial I/O purpose.

To program the module using UART, Connect GPIO0 to ground and GPIO2 to VCC or leave it open. To use UART for normal Serial I/O leave both the pins open (neither VCC nor Ground).

4.9 GSM

GSM is a mobile communication modem; it stands for global system for mobile communication (GSM) and it is shown in below figure 4.20. The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams

of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.



Fig. 4.20 GSM Modem

There are various cell sizes in a GSM system such as macro, micro, pico and umbrella cells. Each cell varies as per the implementation domain. There are five different cell sizes in a GSM network macro, micro, pico and umbrella cells. The coverage area of each cell varies according to the implementation environment.

Time Division Multiple Access TDMA technique relies on assigning different time slots to each user on the same frequency. It can easily adapt to data transmission and voice communication and can carry 64kbps to 120Mbps of data rate.

4.9.1 GSM Architecture

A GSM network consists of the following components:

- **A Mobile Station:** It is the mobile phone which consists of the transceiver, the display and the processor and is controlled by a SIM card operating over the network.
- **Base Station Subsystem:** It acts as an interface between the mobile station and the network subsystem. It consists of the Base Transceiver Station which contains the radio transceivers and handles the protocols for communication with mobiles. It also consists of the Base Station Controller which controls the Base Transceiver station and acts as a interface between the mobile station and mobile switching centre.

- **Network Subsystem:** It provides the basic network connection to the mobile stations. The basic part of the Network Subsystem is the Mobile Service Switching Centre which provides access to different networks like ISDN, PSTN etc. It also consists of the Home Location Register and the Visitor Location Register which provides the call routing and roaming capabilities of GSM. It also contains the Equipment Identity Register which maintains an account of all the mobile equipments wherein each mobile is identified by its own IMEI number. IMEI stands for International Mobile Equipment Identity.

4.9.2 FEATURES OF GSM MODULE

- Improved spectrum efficiency
- International roaming
- Compatibility with integrated services digital network (ISDN)
- Support for new services.
- SIM phonebook management
- Fixed dialing number (FDN)
- Real time clock with alarm management
- High-quality speech
- Uses encryption to make phone calls more secure
- Short message service (SMS)

The security strategies standardized for the GSM system make it the most secure telecommunications standard currently accessible. Although the confidentiality of a call and secrecy of the GSM subscriber is just ensured on the radio channel, this is a major step in achieving end-to- end security.

4.9.3 GSM Modem

A GSM modem is a device which can be either a mobile phone or a modem device which can be used to make a computer or any other processor communicate over a network. A GSM modem requires a SIM card to be operated and operates over a network range subscribed by the network operator. It can be connected to a computer through serial, USB or Bluetooth connection.

A GSM modem can also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port or USB port on your computer. GSM modem is usually preferable to a GSM mobile phone. The GSM modem has wide range of applications in transaction terminals, supply chain management, security applications, weather stations and GPRS mode remote data logging.

4.9.3.1 Working of GSM Module Buzzer

From the below circuit figure 4.21, a GSM modem duly interfaced to the MC through the level shifter IC Max232. The SIM card mounted GSM modem upon receiving digit command by SMS from any cell phone send that data to the MC through serial communication. While the program is executed, the GSM modem receives command 'STOP' to develop an output at the MC, the contact point of which are used to disable the ignition switch. The command so sent by the user is based on an intimation received by him through the GSM modem 'ALERT' a programmed message only if the input is driven low. The complete operation is displayed over 16×2 LCD display.

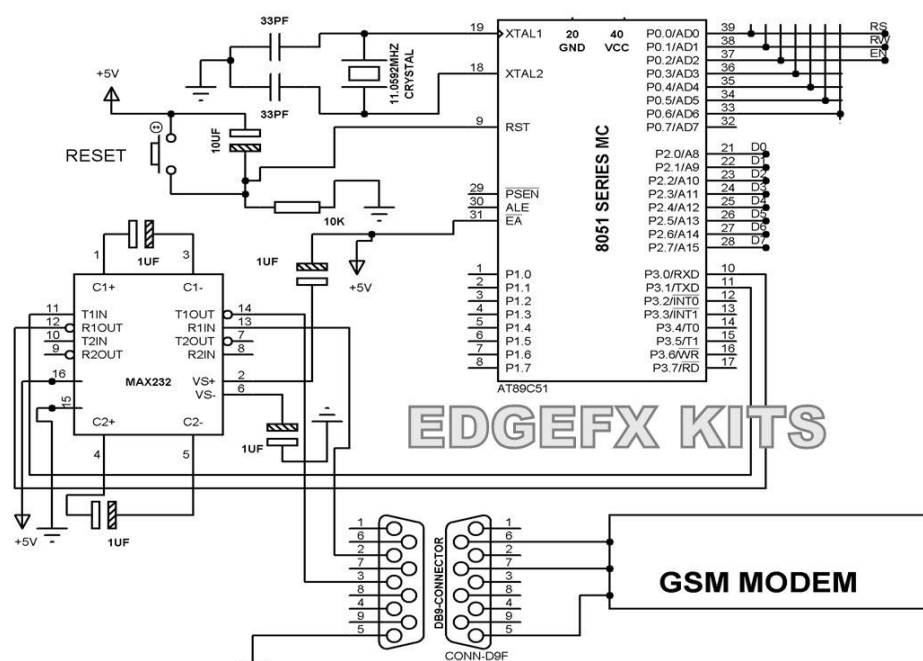


Fig. 4.21 GSM Modem Circuit

Intelligent GSM Device for Automation and Security

In these days, the GSM mobile terminal has become one of the items that are constantly with us. Just like our wallet/purse, keys or watch, the GSM mobile terminal provides us a communication channel that enables us to communicate with the world. The requirement for a person to be reachable or to call anyone at any time is very appealing.

In this project, as the name says project is based on GSM network technology for transmission of SMS from sender to receiver. SMS sending and receiving is used for ubiquitous access of appliances and allowing breach control at home. The system proposes two sub-systems. Appliance control subsystem enables the user to control home appliances remotely and the security alert subsystem gives the automatic security monitoring.

The system is capable enough to instruct user via SMS from a specific cell number to change the condition of the home appliance according to the user's needs and requirements. The second aspect is that of security alert which is achieved in a way that on the detection of intrusion, the system allows automatic generation of SMS thus alerting the user against security risk.

4.10 BUZZER

A **buzzer** or **beeper** is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short) and this is shown in below figure 4.22. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.



Fig. 4.22 Buzzer

4.10.1 TYPES OF BUZZER

Electromechanical Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.

Mechanical A joy buzzer is an example of a purely mechanical buzzer and they require drivers. Other examples of them are doorbells.

Piezoelectric A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep.

A piezoelectric buzzer/beeper also depends on acoustic cavity resonance or Helmholtz resonance to produce an audible beep

4.10.2 APPLICATIONS

While technological advancements have caused buzzers to be impractical and undesirable, there are still instances in which buzzers and similar circuits may be used. Present day applications include:

- Novelty uses
- Judging panels
- Educational purposes
- Annunciator panels
- Electronic metronomes
- Game show lock-out device
- Microwave ovens and other household appliances
- Sporting events such as basketball games
- Electrical alarms
- Joy buzzer (mechanical buzzer used for pranks)

4.10.3 PIEZO BUZZER

Piezo buzzers are one of the most common buzzers available around, they got their name from the piezoelectric material used as the active element and it is shown in below figure 4.23. These buzzers are usually driven at a relatively higher voltage but low current, consumes a little power, but still capable of producing very high sound. The Piezo element must be a three terminal one, like in the picture.

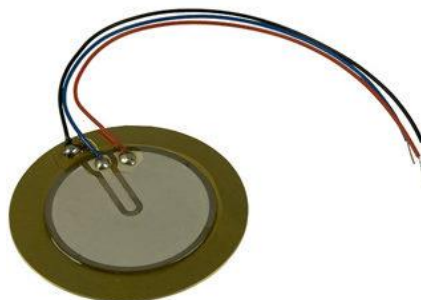


Fig. 4.23 Piezo Buzzer

The blue wire is connected to feedback(**F**) terminal, red wire to the main (**M**) terminal and the black wire to the piezo element's ground(**G**) plate.

The inductor coil's value and shape is not crucial. You can use any coil from **1mH** to **10mH** or more, or even no measured value at all. I used a 40 turn coil on a small ferrite toroid in the final design.

4.10.3.1 Circuit diagram and construction

Lets have a look at the circuit diagram shown in below figure 4.24,

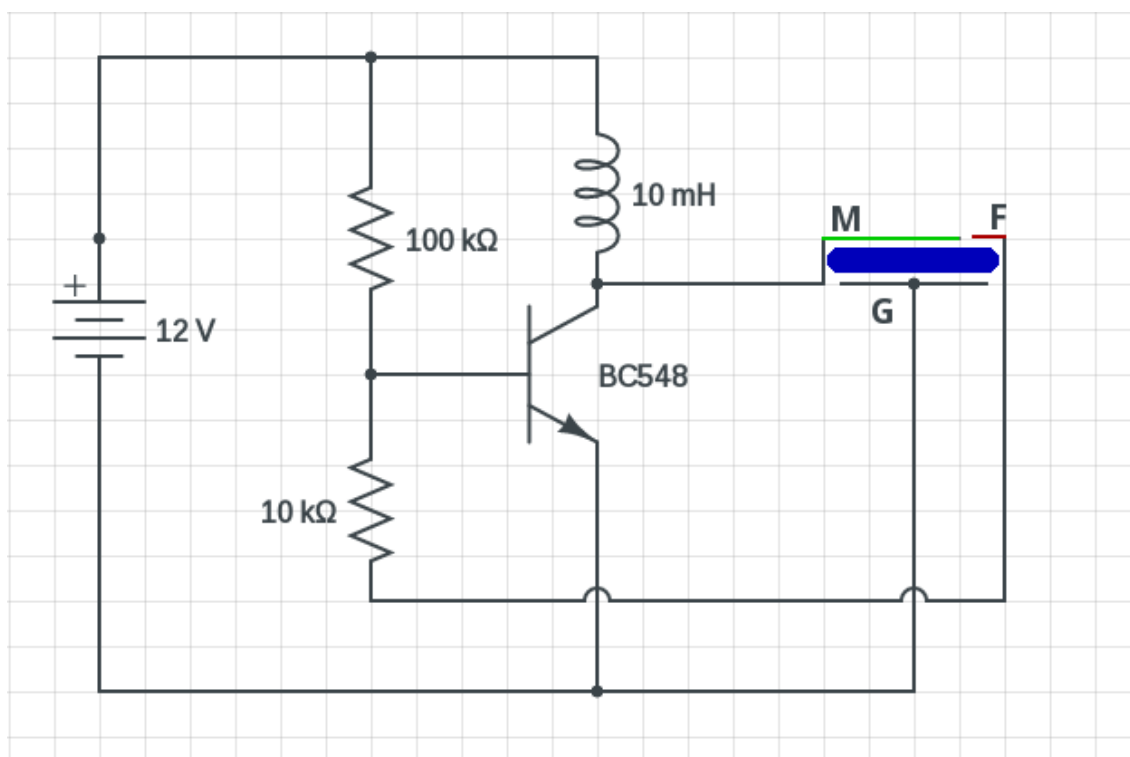


Fig. 4.24 Piezo Buzzer Circuit diagram

Note the piezoelectric element's pinout, **M** is the main terminal, **F** is the feedback terminal and **G** is the ground plate.

The circuit is fairly simple, you can use a little piece of strip board to make it. As this piezo buzzer circuit uses very few components, so it also could be

constructed by soldering the components to each other. And the working of piezo buzzer is shown in below figure 4.25.

When A voltage is applied to the electrodes of the piezo element, they produces flex in either way. This flex force bends the ground plate up and down.

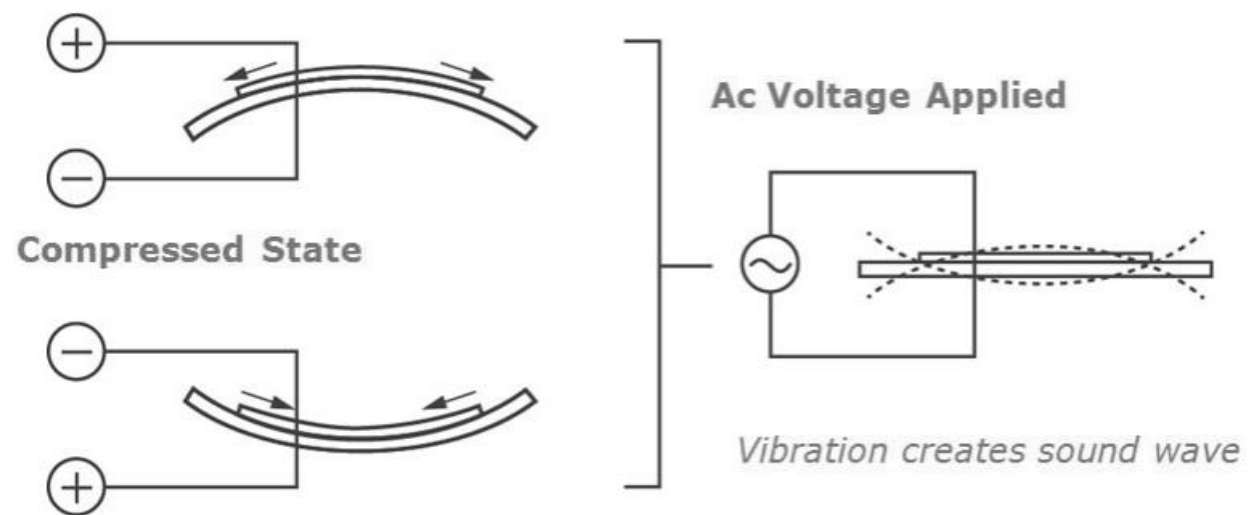


Fig. 4.25 Working of piezo buzzer

The exact opposite thing happens too, when a a piezoelectric element is subjected to varying pressure, it produces voltage.

As you've seen before, self drive piezo buzzers are constructed with an extra electrically isolated feedback electrode. The voltage created by the flex force is available in the feedback terminal.

The piezo buzzer is placed in a resonant cavity, there is a hole in the opposite side of the resonant cavity from where the buzzing sound comes out.

The driver circuit and piezo buzzer co-operates soon between themselves and they starts oscillating on the resonant frequency of the piezo buzzer.

4.10.3.2 Piezo Buzzer Characteristics

- Wide operating voltage: 3~250 V
- Lower current consumption: less than 30 mA higher rated frequency
- Larger footprint
- Higher sound pressure level

4.10.3.3 STRUCTURE OF PIEZO BUZZER

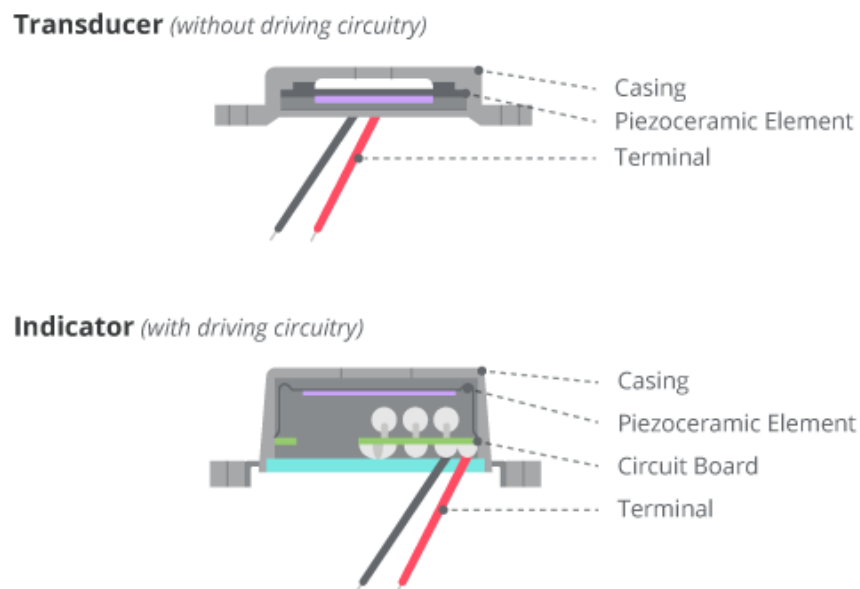


Fig.4.26 Structure of Piezo Buzzer

The structure of Piezo buzzer is shown in above figure 4.26. There are two types of piezo buzzers - transducers and indicators. Transducers consist of a casing, a piezoceramic element and a terminal. In order to operate a transducer, the user must send a square wave signal to the buzzer. Indicators consist of a casing, a piezoceramic element, a circuit board and a terminal. In order to operate an indicator, the user must send the buzzer a specified dc voltage.

CHAPTER 6

CONCLUSION

The research describes a low-cost and adaptable medical gadget concept for detecting and tracking COVID 19 symptoms. The most basic arrangement, which simply requires headphones and mobile phones, is capable of identifying respiratory disorders. The concept may be expanded to include additional sensors for monitoring heart rate, temperature, and oxygen saturation. The most basic analogue circuits for signal pre processing are provided. On the microcontroller side, the approach for software processing and feature extraction is also described. The method produced good and consistent results, and it might be considered as one of the viable alternatives for symptom identification during COVID-19.

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