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# Abstract

India faces a critical challenge in waste management due to its rapidly growing population, particularly in highly populated metropolitan areas where tons of waste are generated daily. The inadequate collection of waste results in overflowing bins along roadsides, leading to unhygienic conditions, foul odors, and the spread of diseases. To address this issue,this work proposes a smart waste management system designed to ensure the proper processing of garbage.

The proposed system utilizes a microcontroller equipped with Wi-Fi connectivity, ultrasonic sensors, and a web server. Each waste bin is equipped with ultrasonic sensors to measure garbage levels, which are then transmitted to the server via the microcontroller and GSM technology. The server, located remotely, monitors garbage levels across multiple locations in the city. When a bin reaches capacity, the system automatically notifies the designated garbage truck driver via SMS, providing the optimal route based on data collected from all bins.

By implementing this system, waste management in metropolitan cities can be significantly improved, leading to more efficient collection processes and cleaner environments. This smart approach leverages IoT technology to address the pressing issue of waste management in urban areas, ultimately contributing to a healthier and more sustainable living environment.

**Keywords:** GSM technology , Sensors , IOT technology , Wi-Fi connectivity

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# Chapter One
# Overview

## 1.1 Introduction

The levels of waste rising at a very alarming rate both for industrial and residential needs are some of the great concerns in terms of environmental sustainability and public health. Such increase in the amounts of waste manufactured can be explained largely by the massive increase in people's habit of buying packaged food, clothes, plastics, and some non-biodegradable and they are elements. Crate countries may have proper techniques to manage waste resources. and they are just developing nations. So the waste management of these countries is very weak and dealing with this problem makes it more fatal as they have to deal with overflowing bins, littered streets, and adverse environmental impacts. Succeeding with this task demands creative measures to revamp waste management systems of greater magnitude and emphasizing improvement of living standard of the communities.

## 1.2 Aim of the system

The purpose of this pilot system is to realize Smart waste management with the application of the Internet of Things in the optimization of collection, segregation and disposal of waste. Making efficiency our priority, raising awareness in the community, and acting to protect both public health and environment is the goal of this program.

## 1.3 Motivation

A project idea that is ours is driven by a prima facie necessity to take the action necessary to mitigate the consequences of a growing amount of waste on society. We aspire to give communities a higher authority by which they can explore fresh waste management techniques, leading to preemptive waste disposal and sustainable lifestyles. Integration of IoT technology will be utilized and an offer of no charge for Wi-Fi for those following the responsible waste disposal rules will be made with the aim of motivating the people to engage in environmental stewardship. Ultimately, the path we are walking on leads to cleaning up the environment and getting the present and things to come more ecological.

# Chapter Two
# Literature Survey

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

## According to Patel and Patel (2016)

Internet of things is defined as a network type to link anything with internet based on stipulated protocols through equipment's of information sensing to organize communication and information exchange to accomplish smart positioning, recognition, administration, tracing and monitoring.Levallois(2017) defined internet of things as an interlink of physical devices also known as smart devices and connected devices, construction and other items involved with software, electronics, actuators, network connectivity and sensors which develop these objects to exchange and collect data.

**Arkko et al (2015)** denotes internet of things as a trend where huge set of embedded tools use services of communication provided by the protocols of internet. Most of these devices always referred smart objects which are not operated by humans directly but occur as components in vehicles or buildings or are distributed in the surroundings.

**Thaler et al (2015)** defined internet of things as a worldwide infrastructure for information society developing advanced services by interlinking virtual and physical things based on evolving and existing interoperable ICT. Through the use of recognition, data processing, communication and capture capabilities the internet of things makes complete use of things to provide services to entire types of applications whilst assuring the privacy and security needs are satisfied. The internet of things can be understood as a vision with societal and technological suggestions.

## According to GSM Association (2014)

Internet of things defines the use of intelligently linked systems and devices to leverage data collected by actuators and embedded sensors in machines and other physical devices. Internet of things is anticipated to spread rapidly in the upcoming years and this convergence will release new service dimension that develops customer's life quality and enterprises productivity. IEEE (2014) defines internet of things as an items network each involved with sensors which are linked to internet. Chebudie et al (2014) has mentioned that internet of things envisions a complex and self-designing network that interlinks things to internet through the use of standard protocols of communication. The interlinked things have virtual or physical representation in digital world, capability of actuation/sensing, and a feature of programmability and are identifiable distinctly. The representation comprises information involving the things status, identity, place or any other social, business and privately related data. The things provide services without or with intervention of humans through the use of distinct recognition, data communication capture and capability of actuation. The service is used through the use of intelligent interfaces and is made feasible anytime, anywhere and for anything considering security.

**Hung (2017)** has defined the IoT as dedicated physical objects network that comprises embedded technique to sense and interact or communicate with their external environment and internal states. The link of processes, personnel and assets enhance the seizure of events and information from which a firm can learn usage and behaviour react with preventive measures or transform or augment processes of business. The internet of things is a basic capability for the making of digital business. In the report of EY (2016) the internet of things explains the link of devices to internet using embedded sensors and software to interact, exchange and gather information with one another. The globe is wide open with internet of things providing an endless number of opportunities widely and links at work, at play and at home. Madakam et al (2015) defined IoT as a comprehensive and open network of intelligent events that have the capability to organize automatically, share data, resources and information, acting and reacting in face of circumstances and alterations in the surroundings.

**Kumar et al. [9]** in their work proposed an IoT-based unbelievable waste clean association structure where sensor frameworks are utilized to steadily checking the waste component of the garbage canisters. In this methodology, when the waste estimation over the dustbins is recognized, the framework along these lines cautions the embraced individual by strategies for GSM/GPRS. They

structure works by utilizing microcontroller which gives interface between the sensor and the GSM/GPRS framework. Also, an Android application is utilized to screen and join the important data identifying with the unmistakable component of waste found in various zones. With this framework, another client can basically choose on the structure and not simply the manager. Regardless, anybody can make a record and the framework likewise surrender access to clients not expected for. This framework can be improved by setting two holders to self-rulingly collect dry and wet squanders. For this situation, the wet waste can be moreover masterminded and be utilized for the period of biogas, made intense by making it insignificant and fiscally astute.

**Abdullah et al. [10]** built up a sharp reject watching framework which is utilized in the estimation of deny level ceaselessly and cautions the fitting expert through SMS writings. The framework is wanted to screen the waste holder and send the messages as alerts when perceived to be full or in every way that really matters full to help its evacuation of the compartment on time. The centrality of the structure is to improve the ability of strong waste trade the executives dependably. In any case, the downside is that the notice of the storehouses' status avoids the zone of the holder or its orientation, making it badly arranged to find and amass the waste canisters in a brief moment.

**Prajakta et al. [11]** proposed a garbage storing up framework that is adjusted having data gathering structure subject to the arranging of pictures taken and GSM module. To accomplish this point of confinement, the framework utilizes a camera which is set at each position where rubbish is amassed close to a stack cell sensor orchestrated at the base of the waste holder. For this situation, the camera will constantly takes surveys of the reject holder while the stack cell sensor takes the weight to pick whether full or not. Besides, an edge level is set which is utilized to separate the result of the camera and weight sensor. Exactly when the edge is practiced, the controller transmit a message by strategies for the GSM module to the suitable master urging them that the junk holder is full and ought to be engineered. Reasonably, the waste archive total vehicle is dispatched to gather the deny utilizing a robot instrument. In any case, catch is that the camera takes pictures all through disregarding the manner in which that its purpose of constrainment is come to in any case just contemplates the latest to pick gathering. As requirements be, the use of camera is senseless or unessential.

**Chaware, et al. [12]** proposed a waste get-together structure considered imaginative to help with keeping urban domains clean. The structure works by watching rubbish stores and tell the experts and the waste collection vehicles about the part of garbage set away or contained in the reject holder through a web application. Regardless, the framework utilizes ultrasonic sensors in which their distinctive precision can be affected by changes in temperature. In addition, it utilizes WiFi which is inherently a short range alliance instrument. From this time forward, these disadvantages sway the ideal execution of the structure. Kalpana, et al. [13] proposed a sharp canister the authorities framework which stores the majority of the bits of information concerning the dustbins and their district on the server. In this framework, the clients are responsible for checking the segment of the misfortune in the holder correspondingly as sending such data to the .In this structure the canister must be washed down when a client sends the status of the holder to the server through an adaptable application. Thusly, the damage is that concerned masters can't screen the waste estimation unendingly yet rather need to monitor things for messages. In like way, if a client is unfit to send the message it proposes that nature will be verified with waste when the holder is full. MohdHelmyAbdWahab et al. have proposed the likelihood of a "Talented Recycle Bin" that utilizes RFID imprints to recognize the character of the individual flinging the deny. RFID based (or any ID card based) structures are implausible to finish on a city wide condition as it is unreasonable to think each individual will pass on his RFID card dependably at whatever point he needs to engineer a type of waste into a trash holder. Besides, their framework has no game-plan for sending the information to the cloud [14].

## C.K.M. Lee and Trevor Wu have endeavored to understand a waste association structure in Hong Kong [15].

Their framework utilizes GPRS to send the sensor information to a flexible application over the cloud. This is again not attainable as fitting GSM modules to the majority of the dustbins of a city and guaranteeing that GPRS information is accessible to the majority of the canisters is preposterous. Reviewing the weaknesses of the above frameworks, we are proposing an "IoT based strong waste association structure" with an assistant game-plan giving a hard and fast review of the framework level arrangement, square estimation building, and a convention stack, which can be executed and scaled on a city wide estimation missing much hindrances.

# Chapter Three
# Existing and Proposed System

## 3.1 Introduction

The brand-new age of Web as well as Internet of Things (IoT) standard is being allowed by the expansion of different gadgets like GPS, sensing units, as well as actuators. mart tools( tools having considerable computational abilities, changing them to 'wise points') are installed in the setting to keep track of and also accumulate ambient details. In a city, this causes Smart City structures. Smart solutions might be provided in addition to such details pertaining to any kind of element of people' tasks. A case in point of solutions provided in the structure of Smart Cities is IoT-enabled waste monitoring. Waste monitoring entails not just the collection of the waste in the area yet likewise the transportation as well as disposal to the suitable areas. In this paper, we offer a thorough as well as extensive study of ICT-enabled waste monitoring versions. Especially, we concentrate on the fostering of clever gadgets as an essential allowing innovation in modern waste administration. We report on the toughness and also weak points of different designs to disclose their qualities. This study establishes the basis for supplying brand-new versions in the domain name as it exposes the requirements for specifying unique structures for waste monitoring.

## 3.2 Existing System

In India, SWACCHA BHARAT ABHIYAN is a mission started by our P.M, Which aims to clean up the roads, streets and to develop the infrastructure digitally of India’s city and rural areas. Focusing towards the clean India mission, we have provided an efficient solution for monitoring the waste level on the real time basis. Humans are collect the dust from different areas with respective of time allotted. Some area using WSN based dust bin collection filled or semi filled. Based on commands the authority persons get notification or information with help of wire less sensor network.

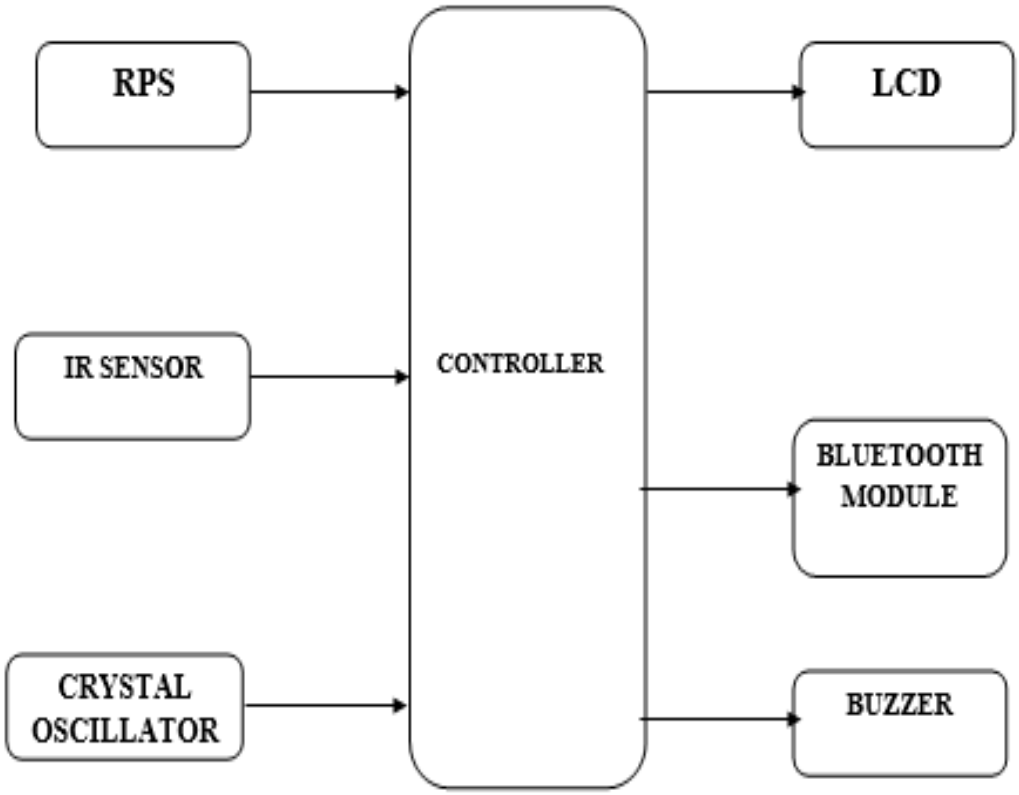



Fig 3.1 Block diagram of Exciting System

### 3.2.1 NEGATIVE ASPECTS:

1. Serious result on setting.
2. The quantity of waste created is not figured out and also for this reason one could not regulate waste.
3. Health concerns could emerge.

## 3.3 Proposed System:

In this project the following components are used: ultrasonic sensor, temperature sensor, GSM, GPS, Arduino UNO. In the Smart garbage management system the ultrasonic sensor is utilized to distinguish the waste level. The bin level can be measured in terms of centimeter. The information from the processor is send to the cloud and the User interfaces like website page and versatile mobile app can show the display level. The area of the filled garbage bin can be recognized by utilizing the GPS and the outcomes are displayed on the user interface.

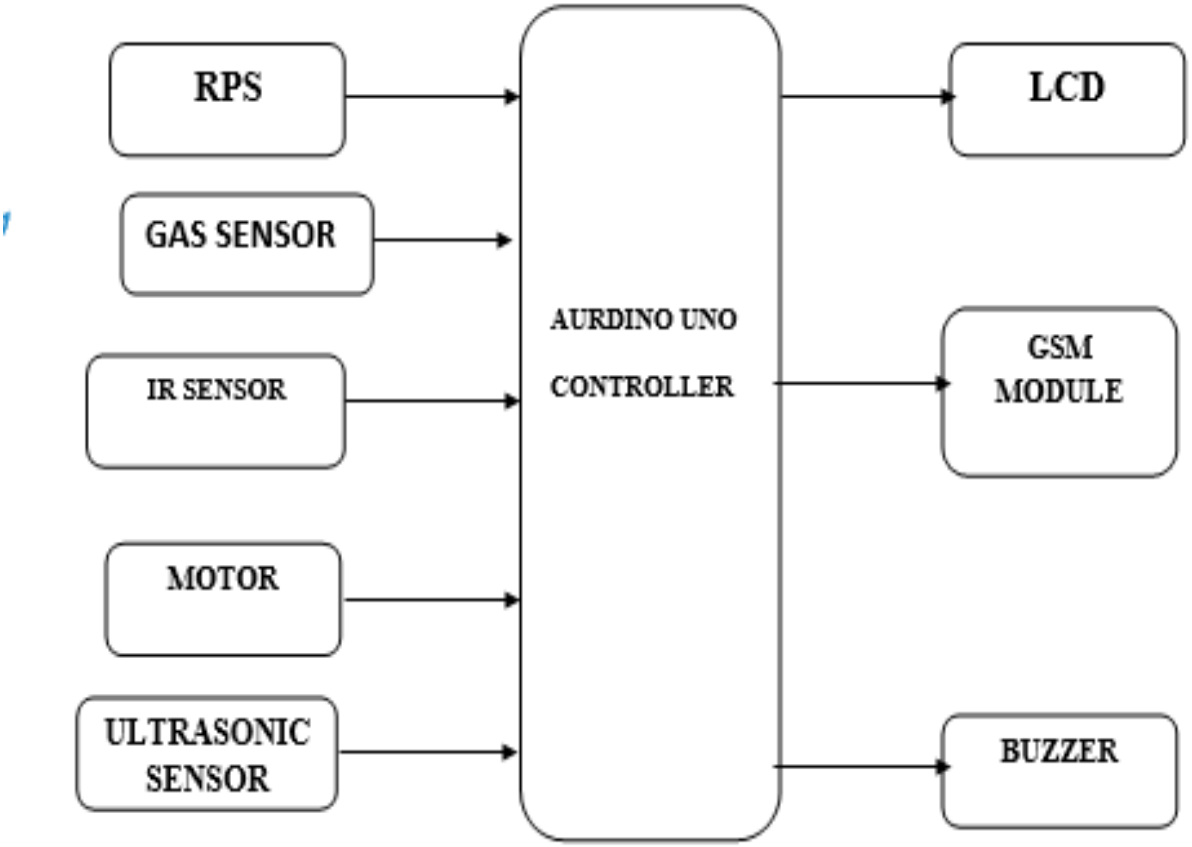



Fig 3.2 Block Diagram of Proposed System

# Chapter Four
# Arduino uno

## 4.1 Introduction to the Arduino Board

The Arduino is a family of microcontroller boards to simplify electronic design, prototyping and experimenting for artists, hackers, hobbyists, but also many professionals. People use it as brains for their robots, to build new digital music instruments, or to build a system that lets your house plants tweet you when they're dry. Arduinos (we use the standard Arduino Uno) are built around an ATmega microcontroller — essentially a complete computer with CPU, RAM, Flash memory, and input/output pins, all on a single chip. Unlike, say, a Raspberry Pi, it's designed to attach all kinds of sensors, LEDs, small motors and speakers, servos, etc. directly to these pins, which can read in or output digital or analog voltages between 0 and 5 volts. Once programmed, the Arduino can run with the USB link back to your computer, or stand-alone without it — no keyboard or screen needed, just power.

Looking at the board from the top down, this is an outline of what you will see (parts of the board you might interact with in the course of normal use are highlighted)

1. Analog Reference pin
2. Digital Ground
3. Digital Pins 2-13
4. Digital Pins 0-1/Serial In/Out - TX/RX dark green) - These pins cannot be used for digital i/o (Digital Read and Digital Write) if you are also using serial communication (e.g. Serial. begin).
5. Reset Button - S1 (dark blue)
6. In-circuit Serial Programmer (blue-green)
7. Analog In Pins 0-5
8. Power and Ground Pins
9. External Power Supply In (9-12VDC)

10. Toggles External Power and USB Power (place jumper on two pins closest to desired supply)
11. USB (used for uploading sketches to the board and for serial communication between the board and the computer; can be used to power the board)

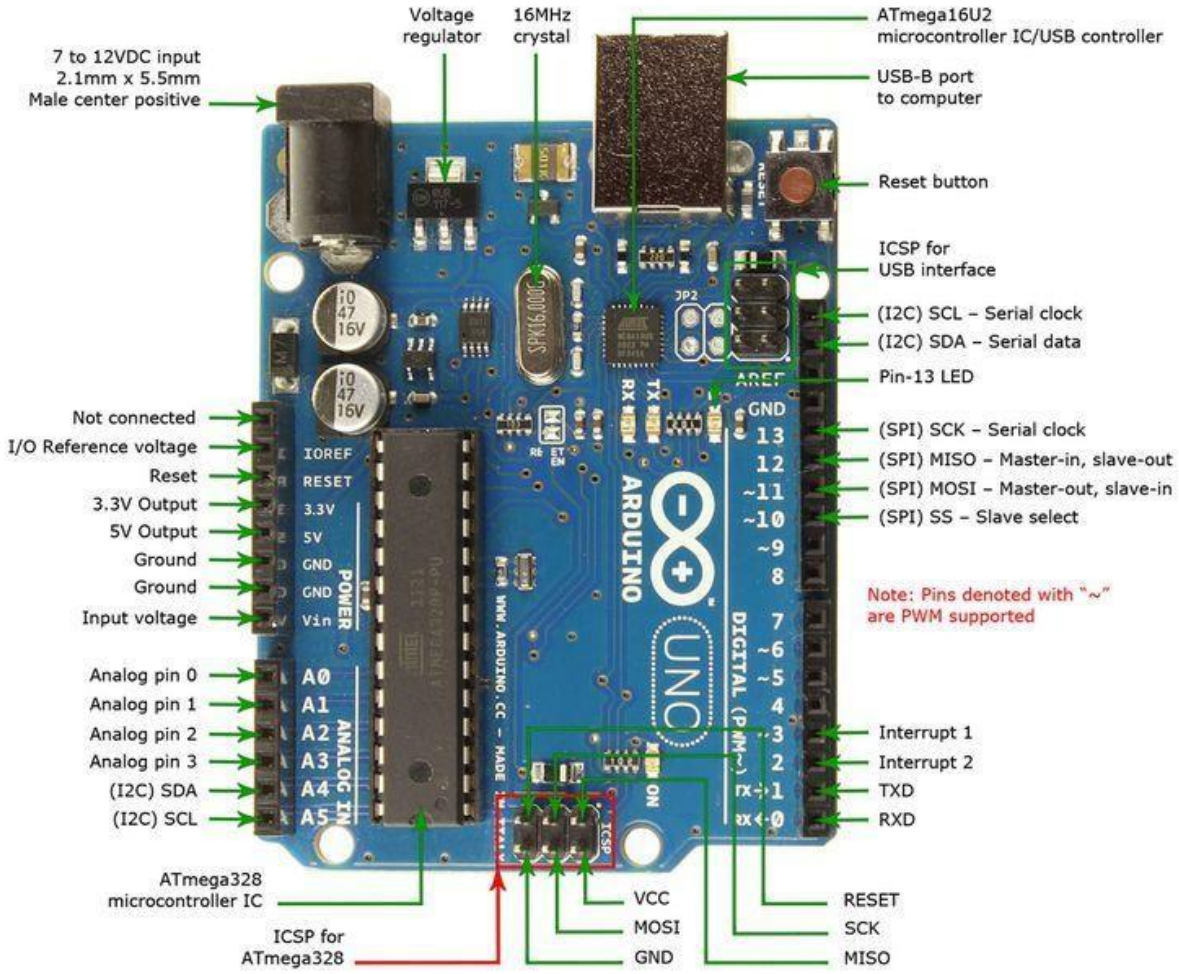



Fig 4.1 Pin Diagram of Arduino uno

## 4.2 Digital Pins

In addition to the specific functions listed below, the digital pins on an Arduino board can be used for general purpose input and output via the pin Mode, Digital Read, and Digital Write( ) commands.Each pin has an internal pull-up resistor which can be turned on and off using digital Write() (w/ a value of HIGH or LOW, respectively) when the pin is configured as an input. The maximum current per pin is 40mA.

1. Serial : 1 (RX) and 1(TX)
2. External Interrupts: 2 and 3
3. PWM: 3, 5, 6, 9, 10, and 11
4. BT Reset: 7
5. SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK)
6. LED: 13

## 4.3 Analog Pins

In addition to the specific functions listed below, the analog input pins support 10-bit analog-to-digital conversion (ADC) using the analog Read function. Most of the analog inputs can also be used as digital pins: analog input 0 as digital pin 14 through analog input 5 as digital pin 19. Analog inputs 6 and 7 (present on the Mini and BT) cannot be used as digital pins.

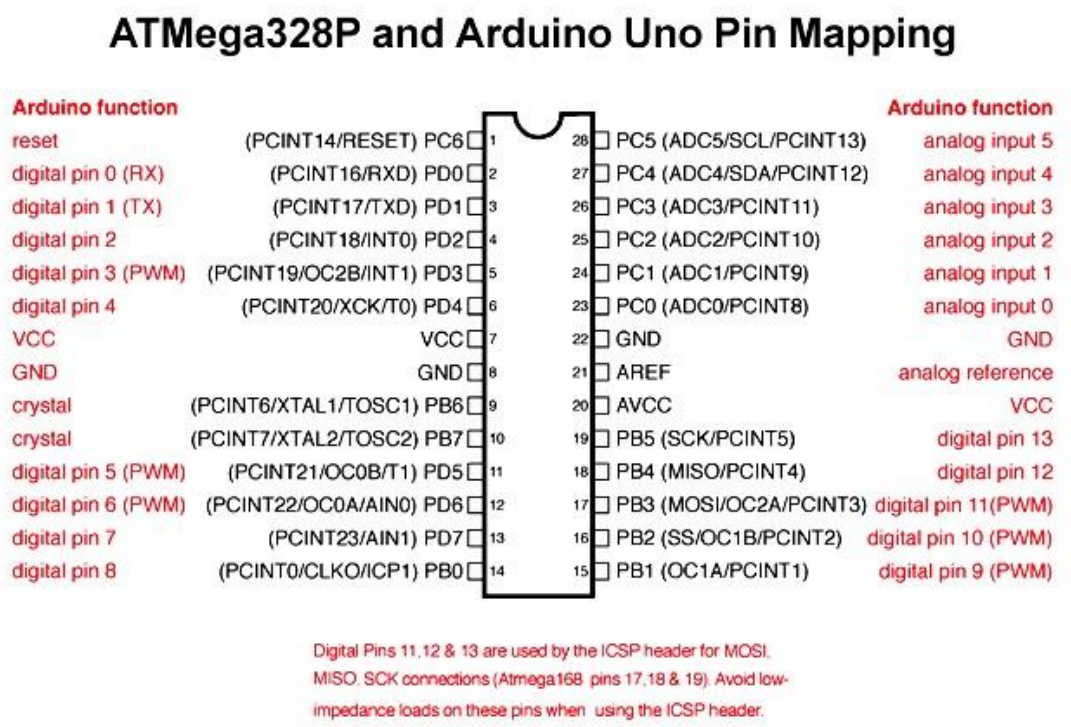
## 4.4 Power Pins

- Vin (sometimes labeled as "9V"): The input voltage to the Arduino board.
- 5V: The regulated power supply used to power the microcontroller and other components on the board.
- 3V : A 3.3 volt supply generated by the on-board
- FTDI chip.
- GND: Ground pins.

## 4.5 Other Pins

- AREF: Reference voltage for the analog inputs. Used with analog Reference).
- Reset: Bring this line LOW to reset the microcontroller.

## 3.6 Aurdino with ATMEGA328




## 4.7 Aurdino Characteristics

Arduino, a popular open-source electronics platform, possesses several key characteristics:

1. Simplicity
2. Versatility
3. Open-Source
4. Affordability
5. Interactivity

# Chapter Five
# GSM

## 5.1 Introduction

GSM modules are compact electronic devices that facilitate communication over the Global System for Mobile Communications (GSM) network. These modules serve as a crucial component in enabling wireless connectivity for a wide range of electronic devices, allowing them to send and receive data, make phone calls, and exchange text messages. Their compact size and versatile functionalities make them ideal for integration into various IoT (Internet of Things) applications, from remote monitoring systems to vehicle tracking devices. With support for standard communication interfaces and AT commands, GSM modules offer seamless integration and control, empowering developers to create innovative solutions for today's interconnected world. Whether deployed in industrial automation, smart agriculture, or consumer electronics, GSM modules play a vital role in enabling reliable and efficient wireless communication, driving the advancement of connected technologies.

## 5.2 Key Components

1. **Cellular Modem**: The core component of a GSM module is the cellular modem, which is responsible for establishing communication with the GSM network. It handles tasks such as modulation/demodulation of signals and protocol handling.

2. **SIM Card Slot**: A GSM module typically features a slot for inserting a Subscriber Identity Module (SIM) card. The SIM card contains essential subscriber information, including the user's phone number and authentication data, allowing the module to access the GSM network.

3. **Antenna Connector**: An external antenna is connected to the GSM module via an antenna connector. The antenna ensures optimal signal reception and transmission, improving the module's communication performance.

4. **Microcontroller**: Many GSM modules incorporate a microcontroller to manage various functions and interface with external devices. The microcontroller executes tasks such as processing AT commands and handling data exchange with connected devices

**Fig 5.1 SIM900A GSM MODULE**

## 5.3 Communication Interfaces

GSM modules support standard communication interfaces such as UART (Universal Asynchronous Receiver-Transmitter), SPI (Serial Peripheral Interface), and sometimes I2C (Inter-Integrated Circuit). These interfaces enable seamless communication between the module and external devices, such as microcontrollers or sensors.

## 5.4 AT Commands

GSM modules are controlled using AT (Attention) commands, a set of standardized textual commands. These commands are sent via the communication interface to configure module settings, initiate communication sessions, and perform various tasks such as making calls or sending SMS messages.


## 5.4 Applications

1. **IoT Devices**: Providing connectivity to IoT devices for remote monitoring, control, and data collection.
2. **Security Systems**: Enabling communication in alarm systems, surveillance cameras, and access control systems.
3. **Vehicle Tracking**: Facilitating vehicle tracking and fleet management systems.
4. **Industrial Automation**: Supporting communication in industrial equipment and process control systems.

# Chapter Six
# Liquid Crystal Display

## 6.1 Definition

An electronic device that is used to display data and the message is known as LCD 16×2. As the name suggests, it includes 16 Columns & 2 Rows so it can display 32 characters (16×2=32) in total & every character will be made with 5×8 (40) Pixel Dots. So the total pixels within this LCD can be calculated as 32 x 40 otherwise 1280 pixels.

## 6.2 Working of an LCD

The basic working principle of LCD is passing the light from layer to layer through modules. These modules will vibrate & line up their position on 90o that permits the polarized sheet to allow the light to pass through it. These molecules are accountable for viewing the data on every pixel. Every pixel utilizes the method of absorbing light to illustrate the digit. To display the value, the position of molecules must be changed to the angle.

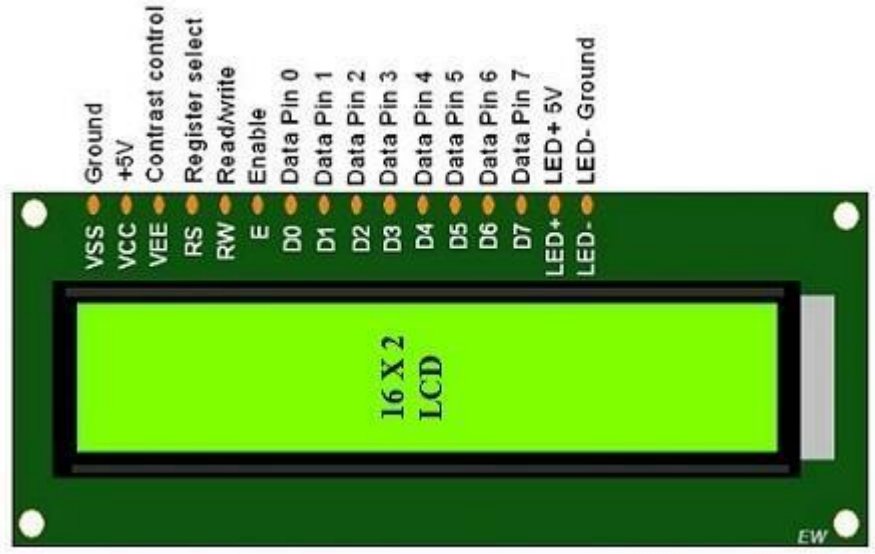



**Fig 6.1 16 X 2 LCD Pin Diagram**

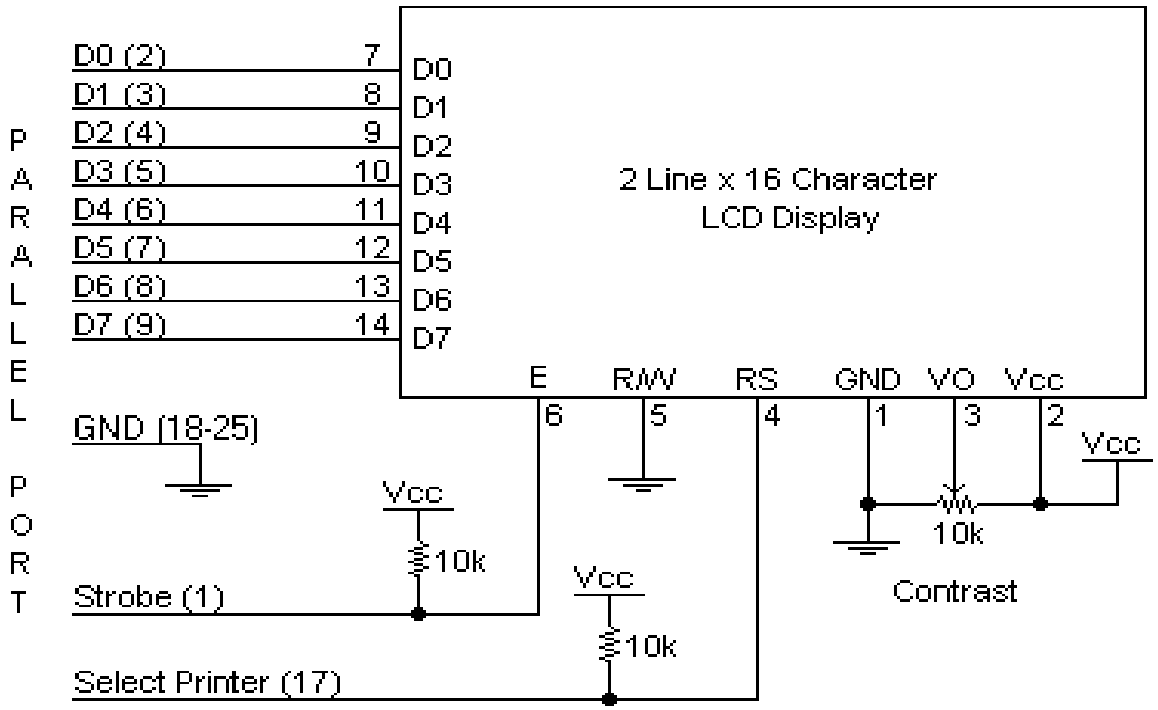



**Fig 6.2 LCD Schematic diagram**

## 6.3 Pin Description

| Pin No. | Name | Description |
|---|---|---|
| Pin no. 1 | **VSS** | Power supply (GND) |
| Pin no. 2 | **VCC** | Power supply (+5V) |
| Pin no. 3 | **VEE** | Contrast adjust |
| Pin no. 4 | **RS** | 0 = Instruction input<br>1 = Data input |
| Pin no. 5 | **R/W** | 0 = Write to LCD module<br>1 = Read from LCD module |
| Pin no. 6 | **EN** | Enable signal |

| | | |
|---|---|---|
| Pin no. 7 | **D0** | Data bus line 0 (LSB) |
| Pin no. 8 | **D1** | Data bus line 1 |
| Pin no. 9 | **D2** | Data bus line 2 |
| Pin no. 10 | **D3** | Data bus line 3 |
| Pin no. 11 | **D4** | Data bus line 4 |
| Pin no. 12 | **D5** | Data bus line 5 |
| Pin no. 13 | **D6** | Data bus line 6 |
| Pin no. 14 | **D7** | Data bus line 7 (MSB) |

## 6.4 Apllications

- mobile phones
- calculators
- computers

# Chapter seven
# Ultrasonic Sensor

## 7.1 Introduction

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emission of the sound by the transmitter to its contact with the receiver. The formula for this calculation is D = ½ T x C (where D is the distance, T is the time, and C is the speed of sound ~ 343 meters/second). For example, if a scientist set up an ultrasonic sensor aimed at a box and it took 0.025 seconds for the sound to bounce back, the distance between the ultrasonic sensor and the box would be:

**D = 0.5 x 0.025 x 343**


Fig 7.1 Ultrasonic Sensor

## 7.2 Working

Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse.

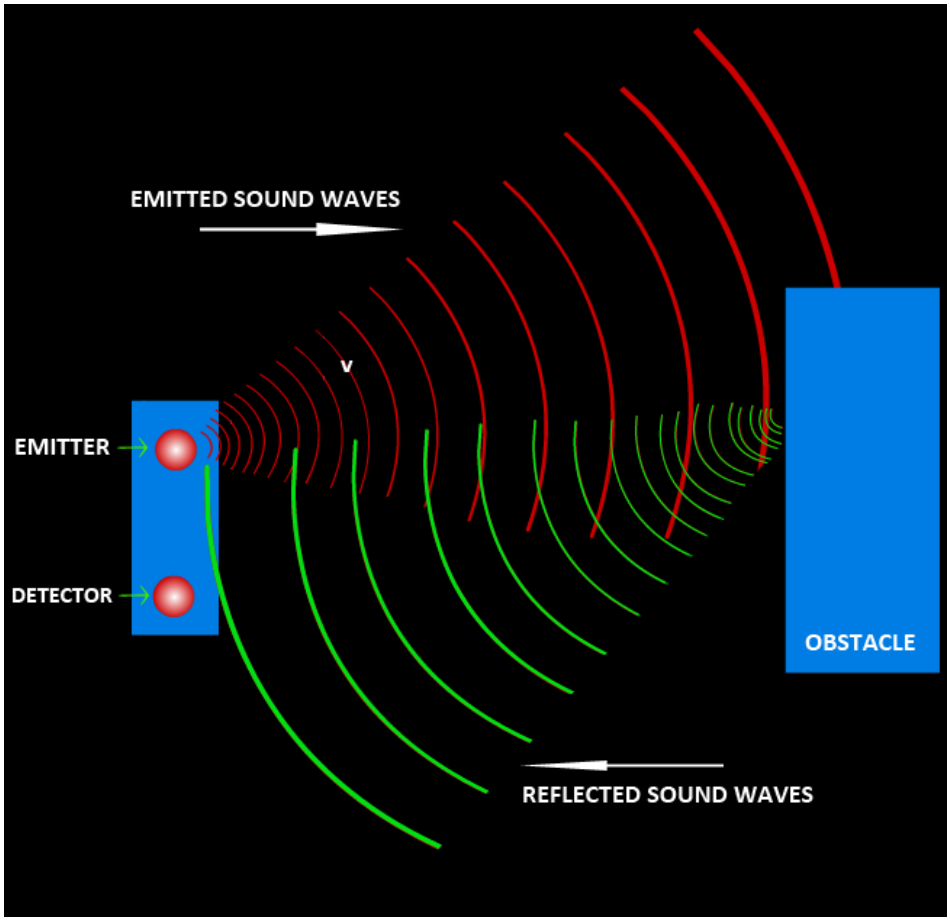



Fig 7.2 Working of Ultrasonic Sensor

The working principle of this module is simple. It sends an ultrasonic pulse out at 40 kHz, which travels through the air, and if there is an obstacle or object, it will bounce

back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated.

Ultrasonic sensors are a great solution for the detection of clear objects. For liquid level measurement, applications that use infrared sensors, for instance, struggle with this particular use case because of target translucence.


Fig 7.3 Pin diagram of Ultrasonic Sensor

## 7.3 Applications :

1. Ordering a Fully Sealed Sensor
2. Using the sensor in harsh environments
3. Choosing a Level Sensor
4. Ultrasonic Level Sensors
5. People Detection with Ultrasonic Sensors
6. Ultrasonic Distance Measuring

# Chapter Eight
# Gas Sensor (MQ2)

## 8.1 Introduction

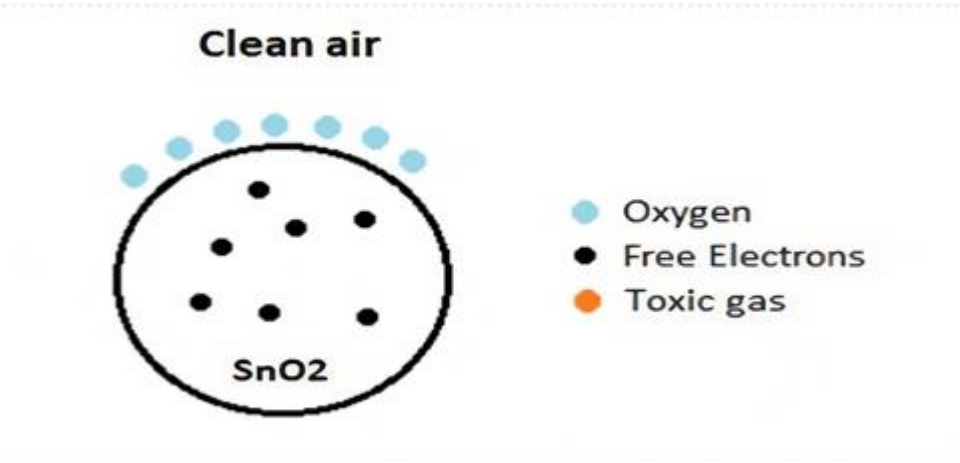
The MQ-2 gas sensor is a versatile component widely used for detecting various combustible gases in the atmosphere. Designed to detect gases such as LPG, propane, hydrogen, methane, and other combustible gases, the MQ-2 sensor utilizes a semiconductor-based sensing element to detect changes in gas concentrations. With its compact size and affordable cost, the MQ-2 sensor is commonly integrated into electronic systems and projects requiring gas detection capabilities. Its operation relies on a heating element that ensures the sensing element reaches and maintains an optimal temperature for gas detection, enhancing sensitivity and responsiveness. Connected to a circuit or microcontroller, the MQ-2 sensor outputs a signal indicative of the concentration of the detected gases. This output signal can be analog or digital, depending on the specific model and configuration of the sensor.

Applications for the MQ-2 gas sensor range from industrial gas leakage detection and home safety systems to environmental monitoring and automotive emission control. Proper calibration and periodic maintenance are essential to ensure accurate and reliable performance over time.

## 8.2 Working

This sensor contains a sensing element, mainly aluminium-oxide based ceramic, coated with Tin dioxide, enclosed in a stainless steel mesh. Sensing element has six connecting legs attached to it. Two leads are responsible for heating the sensing element, the other four are used for output signals. Oxygen gets adsorbed on the surface of sensing material when it is heated in air at high temperature. Then donor electrons present in tin oxide are attracted towards this oxygen, thus preventing the current flow.

When reducing gases are present, these oxygen atoms react with the reducing gases thereby decreasing the surface density of the adsorbed oxygen. Now current can flow through the sensor, which generated analog voltage values.These voltage values are measured to know the concentration of gas. Voltage values are higher when the concentration of gas is high.




8.2 working of gas sensor

## 8.3 Types of Gas sensors:

There are many gas sensors types, in order to choose the most suitable gas sensor, we need to understand the various sensor characteristics. For example: Which sensor can measure toxic gases? Which sensor is convenient to carry? Which sensor measures more accurately? If you know enough about the sensor, you can definitely make the right choice.

**According to different gas types**: it can be divided into combustible gas sensors (often using catalytic combustion, infrared, thermal conductivity, semiconductor type), toxic gas sensors (generally using electrochemical, metal-semiconductor, photoionization, flame ionization), Harmful gas sensors (often infrared, ultraviolet, etc.), oxygen (often paramagnetic, zirconia) and other types.

**According to different sampling methods**: it can be divided into diffusion sensors (the sensor is directly installed in the measured environment, and the measurement gas is in direct contact with the detection unit through natural diffusion), pumping sensors (through the suction pump, etc., the gas is sucked into the detection unit. According to whether the gas needs to be diluted, it is divided into complete inhalation and diluted inhalation).

**According to different functions**: it can be divided into a single gas sensor (only one gas can be detected) and a composite gas sensor (can detect multiple gases at the same time).

**According to the different detection principles**: it can be divided into semiconductor gas sensor, electrochemical gas sensor, NDIR gas sensor, catalytic gas sensor, thermal conductivity gas sensor, magnetic gas sensor and so on.

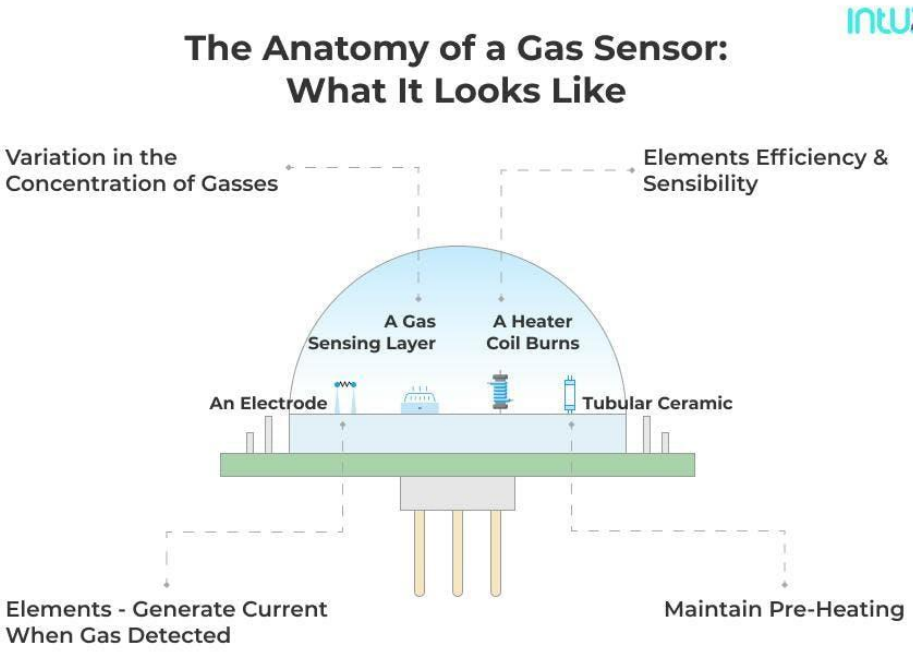



Fig 8.3 anatomy of a gas sensor

## 8.4 Specification's of gas Sensor :

The metal oxide-based gas sensor is one of the most commonly used gas sensors for smoke detection and toxic identification. It employs a chemiresistor that comes in contact and reacts with target gasses such as hydrogen and carbon monoxide. Following are the key specifications of gas sensors:

1. Poisoning immune and fail-safe operation
2. Continuous sampling of diffused gas via a mesh
3. Can be used in both fixed and portable functions
4. A wide range of gasses or vapors can be detected
5. Low consumption of power and quicker response rate
6. Stable signal levels through special gold plated optical or gas cavity
7. Stainless steel construction for robustness and corrosion resistance

## 8.5 Applications

1. These sensors are used to detect the presence of gases in the air such as methane, butane, LPG and smoke but they are unable to distinguish between gases. Thus, they cannot tell which gas it is.

2. Module version of this sensor can be used without interfacing to any microcontroller and is useful when detecting only one particular gas. This can only detect the gas. But if ppm has to be calculated then the sensor should be used without module.

3. This sensor is also used for Air quality monitoring, Gas leak alarm and for maintaining environmental standards in hospitals. In industries, these are used to detect the leakage of harmful gases.

4. Some of the alternatives of the MQ2 gas sensor are MQ-6, M-306A, AQ-3 sensors. To detect which gas have you used the MQ2 Gas sensor?

# Chapter Nine
# IR Sensor

## 9.1 Introduction

IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations.

The emitter is simply an IR LED **(Light Emitting Diode**) and the detector is simply an IR photodiode . Photodiode is sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and Infrared LED's of specific wavelength used as infrared sources. The three main types of media used for infrared transmission are vacuum, atmosphere and optical fibers. Optical components are used to focus the infrared radiation or to limit the spectral response.

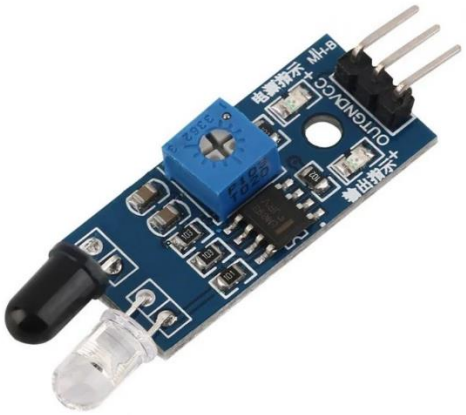


Fig 9.1 IR Sensor

## 9.2 Pin Configuration

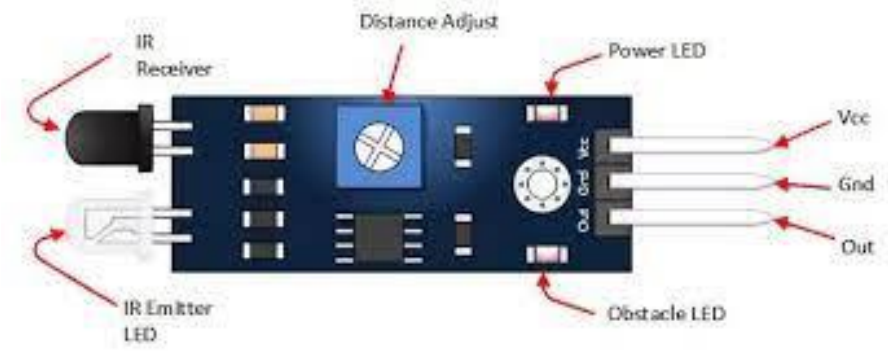



Fig 9.2 Pin Configuration

| Pin Name | Description |
|---|---|
| VCC | Power Supply +5v |
| GND | Power Supply Ground |
| OUTPUT | Active High Output |

## 9.3 Working

Various types of infrared based applications are available in the market. The circuit for infrared based applications is designed along with the transmitter and receiver sections i.e. we can't use it for other application. But the infrared communication project which we have done here can be used in any application just by replacing the application at the place of infrared LED in the circuit diagram of infrared communication. By using this project we can design infrared based applications easily.

The entire circuit consists of two sections named as

1. Transmitter section and
2. Receiver section

## 1. Transmitter section:

The transmitter section consists of a 555 timer IC functioning in astable mode. It is wired as shown in figure. The output from astable mode is fed to an IR LED via resistor which limits its operating current. Infrared LED in the transmitter section emits IR radiation which is focused by a plastic lens (optics) in to a narrow beam.

## 2. Receiver section:

The receiver section consists of a silicon phototransistor to convert the infrared radiation to an electric current. It responds only to the rapidly pulsing signal created by the transmitter, and filters out slowly changing infrared radiation from ambient light. The receiver section comprises an infrared receiver module, and a led indicator. When the signals are interrupted, the IR Led goes off after a few seconds depending upon the value of RC combination.

We can increase the distance between the IR transmitter and receiver just by placing the lens between them. After connecting the IR transmitter and receiver circuit, we

can get the output by applying 6V Power supply to the circuit. We can use this circuit with any application very simply. For example a buzzer circuit is placed at the output of IR circuit, when the signals are interrupted, the buzzer produces sound. Both the transmitter and receiver parts can be mounted on a single bread board or PCB. The infrared receiver must be placed behind the IR Led to avoid false indication due to infrared leakage. An object moving nearby actually reflects the IR rays emitted by the IR Led.

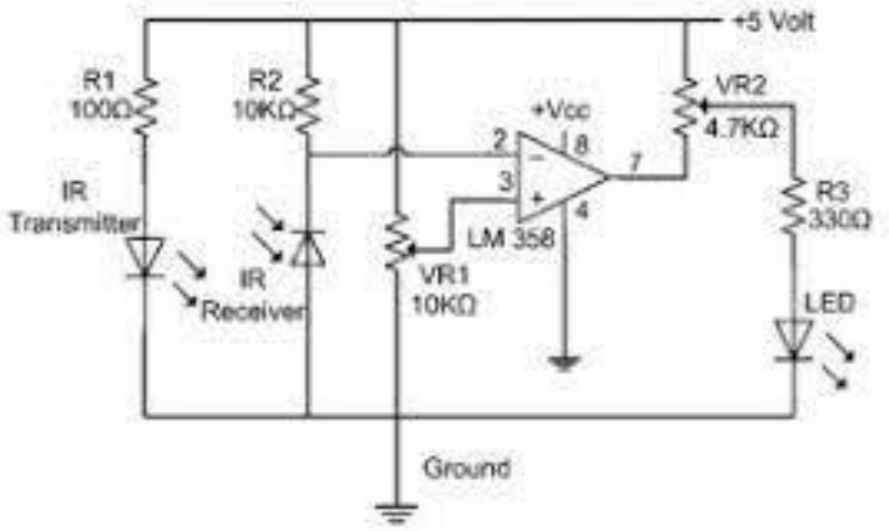



Fig 9.3 Circuit Diagram of IR Sensor

## 9.4 Applications

1. Climatology
2. Meteorology
3. Photobiomodulation
4. Flame Monitors
5. Gas detectors
6. Water analysis
7. Moisture Analyzers
8. Anesthesiology testing
9. Petroleum exploration

# Chapter Ten
# Buzzer

## 10.1 Introduction

A buzzer is a simple yet effective electroacoustic device designed to produce sound when an electric current is applied to it. It typically consists of a vibrating membrane or diaphragm and an electromagnetic coil. When an electrical signal is sent through the coil, it generates a magnetic field that causes the diaphragm to vibrate rapidly, creating an audible sound wave. Buzzer devices are commonly used for alarms, notifications, and signaling in a wide range of applications, from household appliances and electronic gadgets to industrial machinery and emergency systems. Their straightforward design and versatility make buzzers invaluable for providing auditory feedback and alerts in various settings.

## 10.2 Pin Configuration

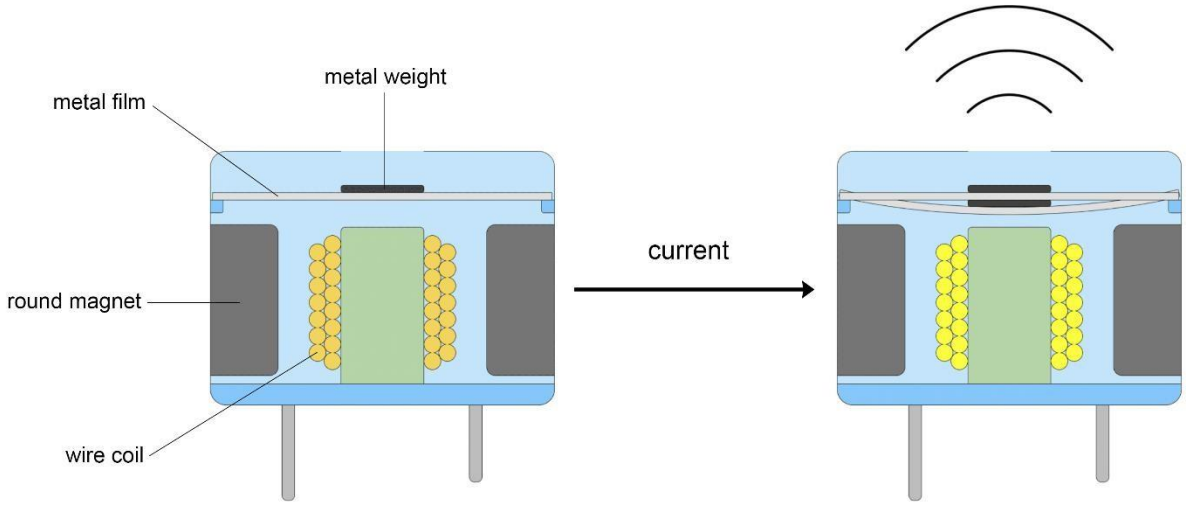



Fig 10.1 Buzzer

## 9.3 Applications

- Alarm Systems • Fire Alarms
- Burglar Alarms
- Smoke Detectors
- Carbon Monoxide Detectors
- Home Security Systems
- Industrial Machinery
- Manufacturing Equipment

# Chapter Eleven

# DC Motor

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## 11.1 Introduction :

A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The reverse process, producing electrical energy from mechanical energy, is accomplished by an alternator, generator or dynamo. Many types of electric motors can be run as generators, and vice versa. The input of a DC motor is current/voltage and its output is torque (speed).

**Fig 11.1 DC Motor**

The DC motor has two basic parts: the rotating part that is called the armature and the stationary part that includes coils of wire called the field coils. The stationary part is also called the stator. Figure shows a picture of a typical DC motor, Figure shows a picture of a DC armature, and Fig shows a picture of a typical stator. From the picture you can see the armature is made of coils of wire wrapped around the core, and the core has an extended shaft that rotates on bearings. You should also notice that the ends of each coil of wire on the armature are terminated at one end of the armature. The termination points are called the commutator, and this is where the brushes

make electrical contact to bring electrical current from the stationary part to the rotating part of the machine.

## 11.2 Operation:

The DC motor you will find in modem industrial applications operates very similarly to the simple DC motor described earlier in this chapter. Figure 12-9 shows an electrical diagram of a simple DC motor. Notice that the DC voltage is applied directly to the field winding and the brushes. The armature and the field are both shown as a coil of wire. In later diagrams, a field resistor will be added in series with the field to control the motor speed.

When voltage is applied to the motor, current begins to flow through the field coil from the negative terminal to the positive terminal. This sets up a strong magnetic field in the field winding. Current also begins to flow through the brushes into a commutator segment and then through an armature coil. The current continues to flow through the coil back to the brush that is attached to other end of the coil and returns to the DC power source. The current flowing in the armature coil sets up a strong magnetic field in the armature.

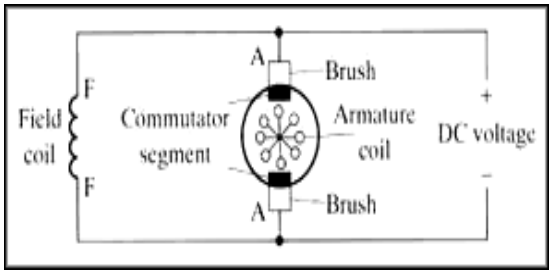



**Fig 11.2: Simple electrical diagram of DC motor**

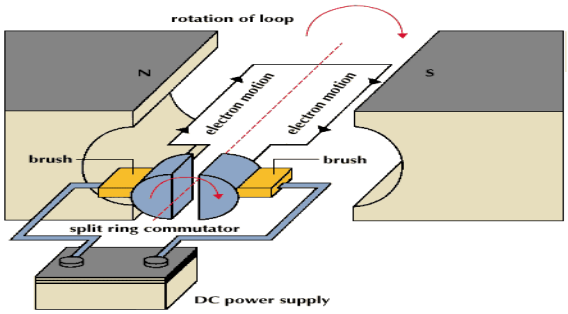



**Fig 11.3: Operation of a DC Motor**

The magnetic field in the armature and field coil causes the armature to begin to rotate. This occurs by the unlike magnetic poles attracting each other and the like magnetic poles repelling each other. As the armature begins to rotate, the commutator segments will also begin to move under the brushes. As an individual commutator segment moves under the brush connected to positive voltage, it will become positive, and when it moves under a brush connected to negative voltage it will become negative. In this way, the commutator segments continually change polarity from positive to negative. Since the commutator segments are connected to the ends of the wires that make up the field winding in the armature, it causes the magnetic field in the armature to change polarity continually from north pole to south pole. The commutator segments and brushes are aligned in such a way that the switch in polarity of the armature coincides with the location of the armature's magnetic field and the field winding's magnetic field. The switching action is timed so that the armature will not lock up magnetically with the field. Instead the magnetic fields tend to build on each other and provide additional torque to keep the motor shaft rotating.

When the voltage is de-energized to the motor, the magnetic fields in the armature and the field winding will quickly diminish and the armature shaft's speed will begin to drop to zero. If voltage is applied to the motor again, the magnetic fields will strengthen and the armature will begin to rotate again.

## 11.3 Types of DC motors:

1. DC Shunt Motor,

2. DC Series Motor,

3. DC Long Shunt Motor (Compound)

4. DC Short Shunt Motor (Compound)

## 11.4 Applications:

1. Electric Train: A kind of DC motor called the DC Series Motor is used in Electric Trains. The DC Series Motors have the property to deliver more power when they are loaded more. So the more the people get on a train, the more powerful the train becomes.
2. Elevators: The best bidirectional motors are DC motors. They are used in elevators. Compound DC Motors are used for this application.
3. PC Fans, CD ROM Drives, and Hard Drives: All these things need motors, very miniature motors, with great precision. AC motors can never imagine any application in these places.
4. Starter Motors in Automobiles: An automobile battery supplies DC, so a DC motor is best suited here. Also, you cannot start an engine with a small sized AC motor,
5. Electrical Machines Lab in Colleges.

# Chapter Twelve
# Software Explanation

## 12.1. Introduction:

This project is implemented using following software's:

- Express PCB – for designing circuit
- Arduino IDE compiler - for compilation part
- Proteus 7 (Embedded C) – for simulation part

## 12.2 The Interface:

When a project is first started you will be greeted with a yellow outline. This yellow outline is the dimension of the PCB. Typically after positioning of parts and traces, move them to their final position and then crop the PCB to the correct size. However, in designing a board with a certain size constraint, crop the PCB to the correct size before starting.

Fig: 12.1 show the toolbar in which the each button has the following functions:

**Fig: 12.1 Tool bar necessary for the interface**

The select tool: It is fairly obvious what this does. It allows you to move and manipulate parts. When this tool is selected the top toolbar will show buttons to move traces to the top / bottom copper layer, and rotate buttons.

**The zoom to selection tool:** does just that.

**The place pad:** button allows you to place small soldier pads which are useful for board connections or if a part is not in the part library but the part dimensions are available. When this tool is selected the top toolbar will give you a large selection of round holes, square holes and surface mount pads.

**The place component:** tool allows you to select a component from the top toolbar and then by clicking in the workspace places that component in the orientation chosen using the buttons next to the component list. The components can always be rotated afterwards with the select tool if the orientation is wrong.

**The place trace:** tool allows you to place a solid trace on the board of varying thicknesses. The top toolbar allows you to select the top or bottom layer to place the trace on.

**The Insert Corner in trace:** button does exactly what it says. When this tool is selected, clicking on a trace will insert a corner which can be moved to route around components and other traces.

The remove a trace button is not very important since the delete key will achieve the same result.

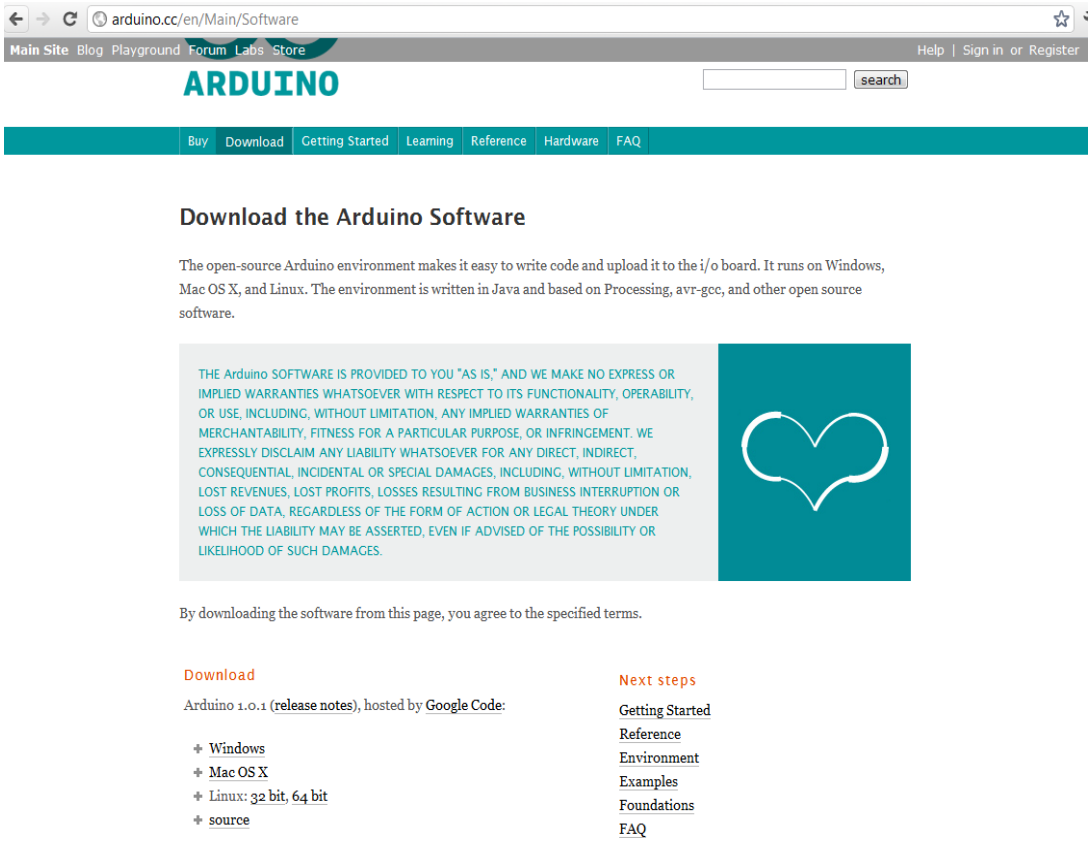
## 12.3 Design Considerations:

Before starting a project there are several ways to design a PCB and one must be chosen to suit the project's needs. Single sided, or double sided?

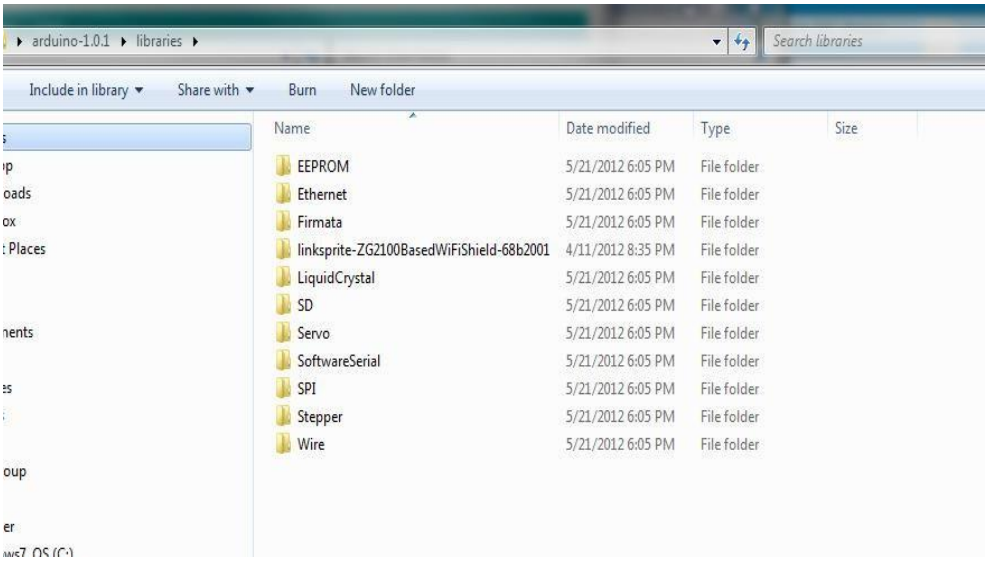
When making a PCB you have the option of making a single sided board, or a double sided board. Single sided boards are cheaper to produce and easier to etch, but much harder to design for large projects. If a lot of parts are being used in a small space it may be difficult to make a single sided board without jumpering over traces with a cable. While there's technically nothing wrong with this, it should be avoided if the signal travelling over the traces is sensitive (e.g. audio signals).

A double sided board is more expensive to produce professionally, more difficult to etch on a DIY board, but makes the layout of components a lot smaller and easier. It should be noted that if a trace is running on the top layer, check with the components to make sure you can get to its pins with a soldering iron. Large capacitors, relays, and similar parts which don't have axial leads can NOT have traces on top unless boards are plated professionally.

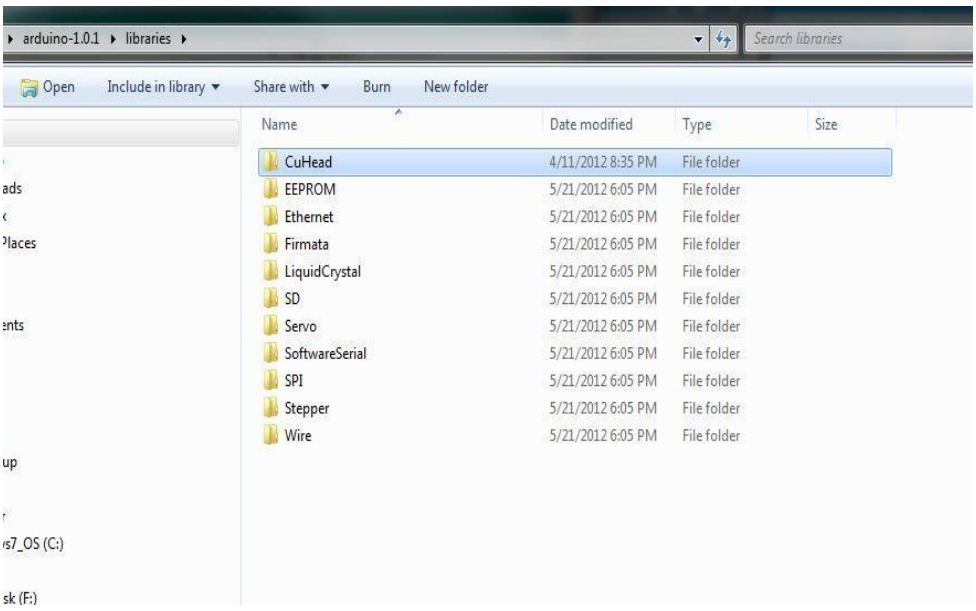
## 12.4 Aurdino Compiling:



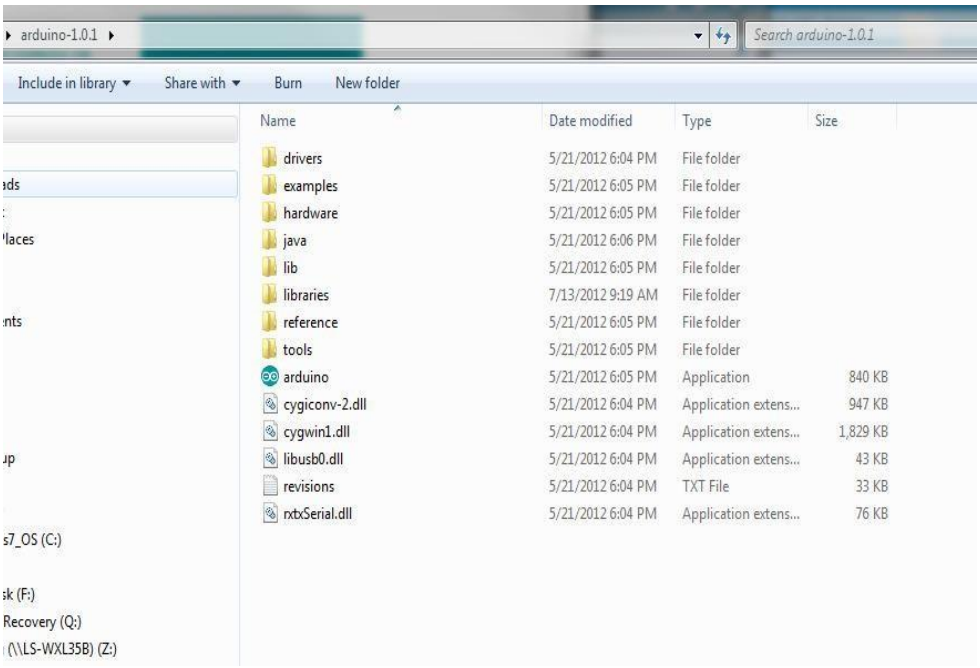
In next step download library



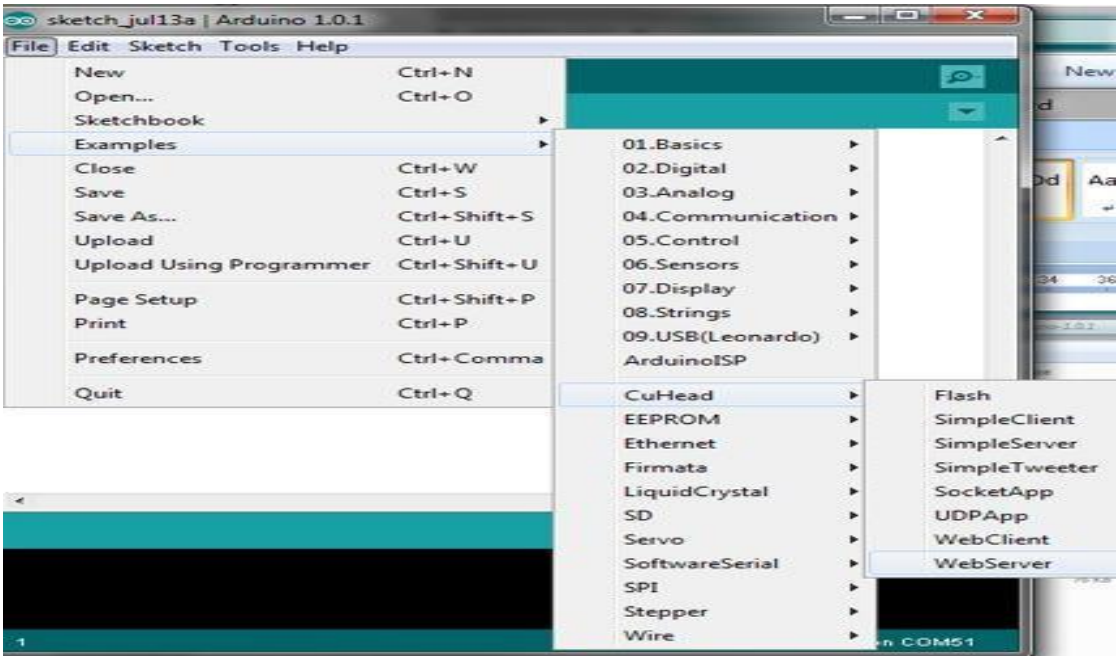

As Arduino doesn't recognize the directory name, please rename it



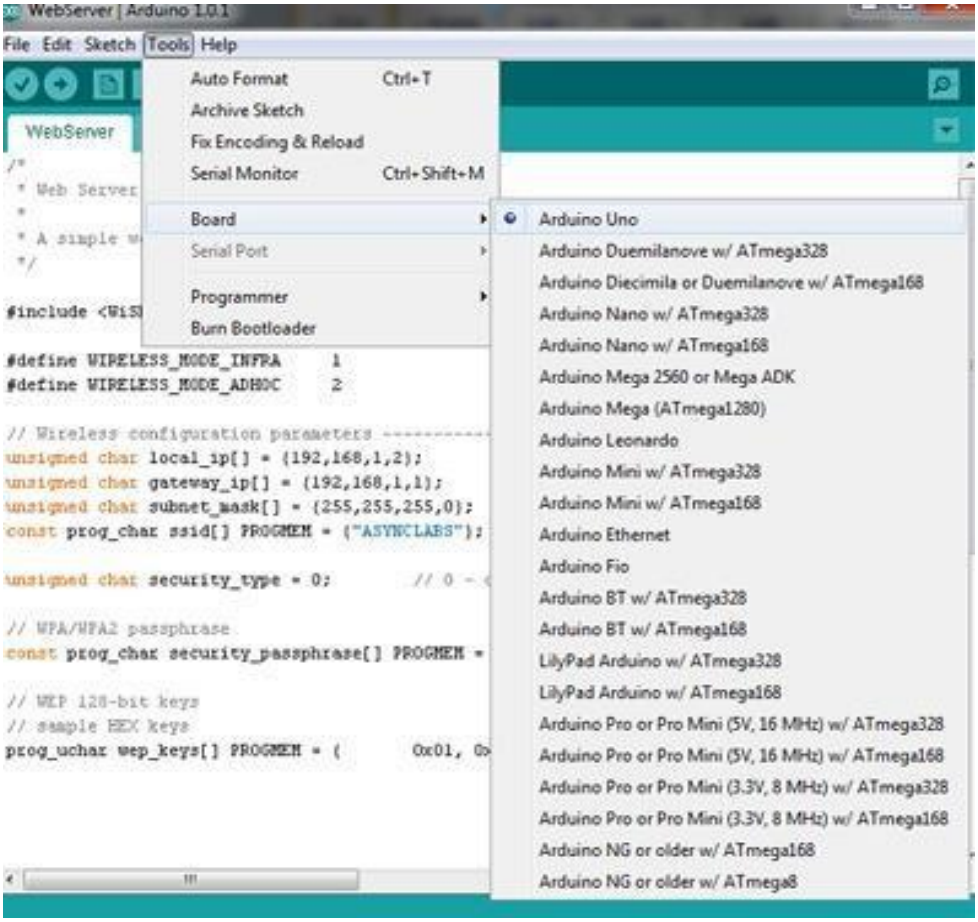
Launch Arduino by double click “Arduino” below



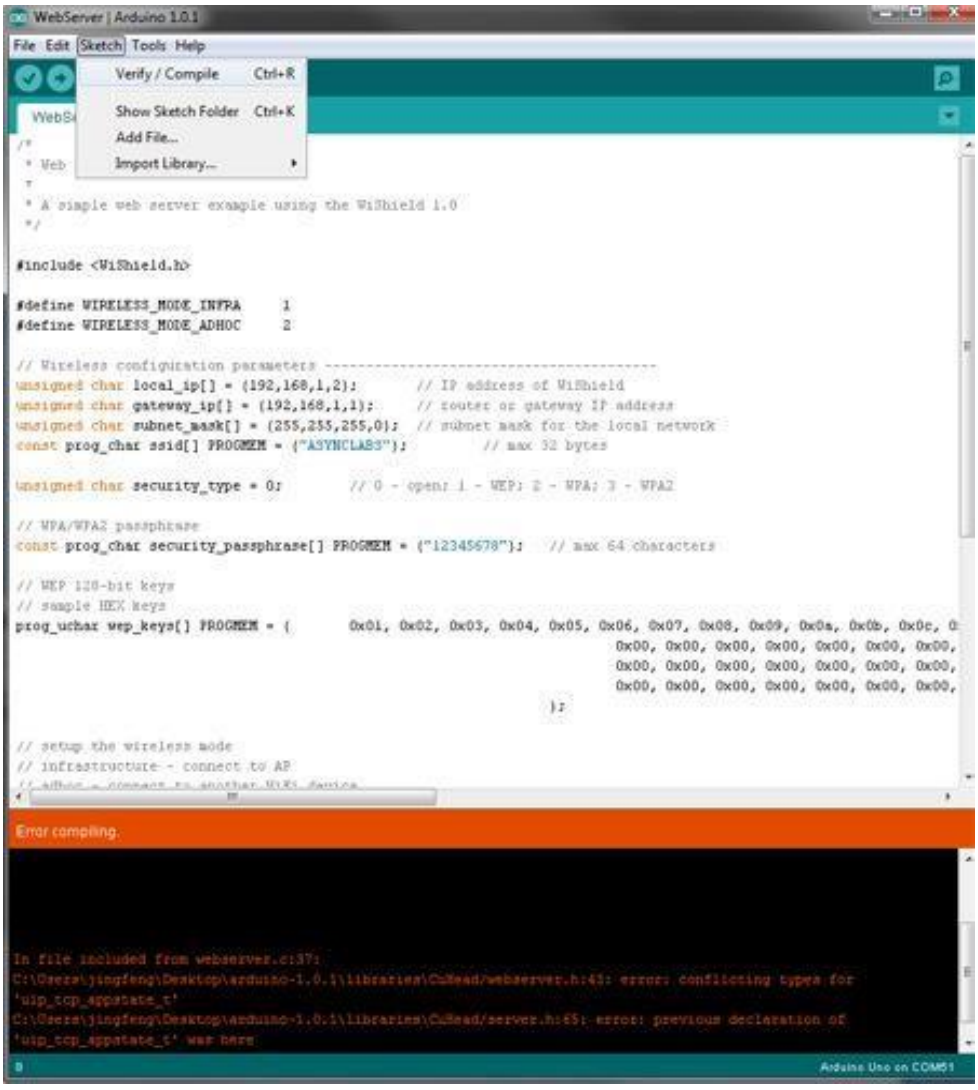

Let’s try for an example



Select the target board as “Arduino Uno”:



Click Sketch-> Verify/Compile:



# Chapter Thirteen
# Working of Project

## 13.1 Working

When the power of Arduino is ON then it will wait until the system is connected to server from GSM module . When the Gsm module is connected to the server then it starts to detect the threshold values from Ultrasonic Sensor and Gas sensor.

When a man/woman was came to through the waste in bin the Ir sensor which is placed in front of bin detects the object and open's the top of bin using DC motor by 90 degrees. And when the object is moved by throwing the waste into bin then dc motor will close the top of Bin.

## 13.2 Block Diagram

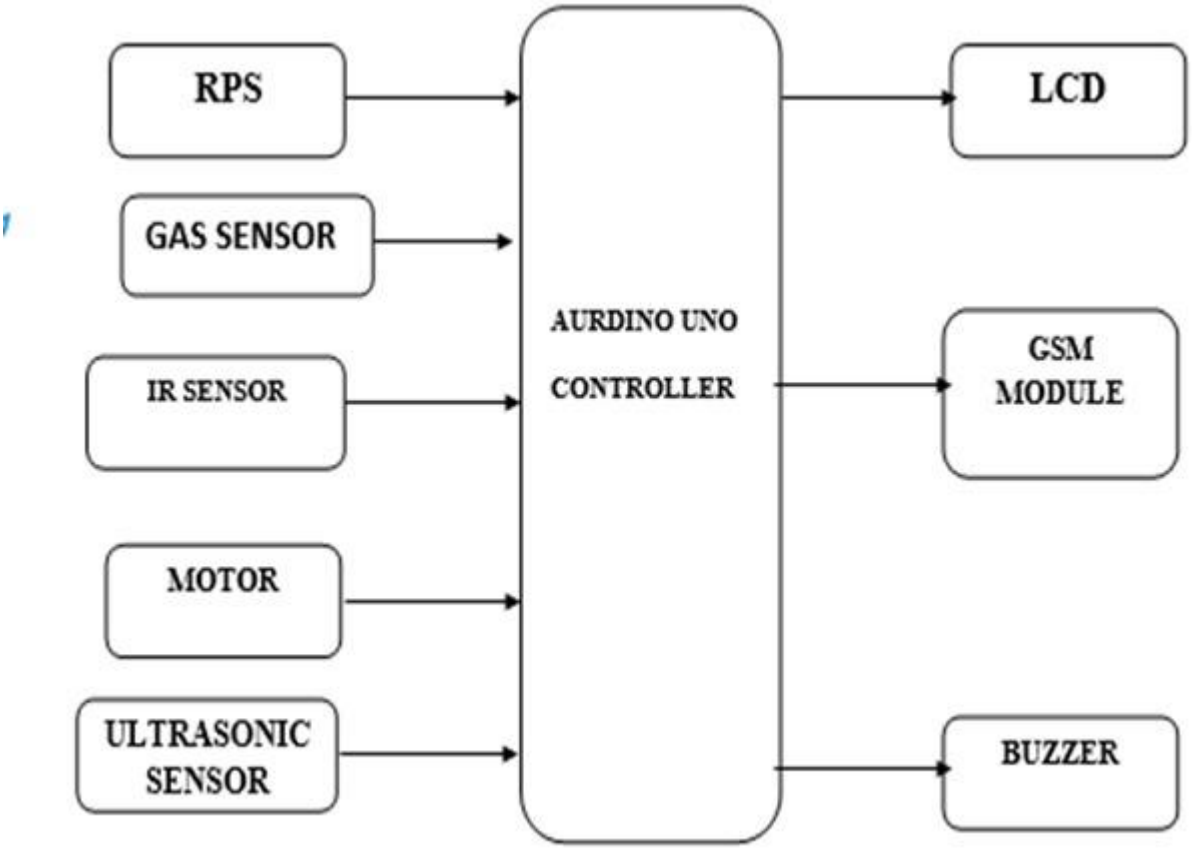



Fig 13.1 Block diagram of project

## 13.3 Circuit Connections:

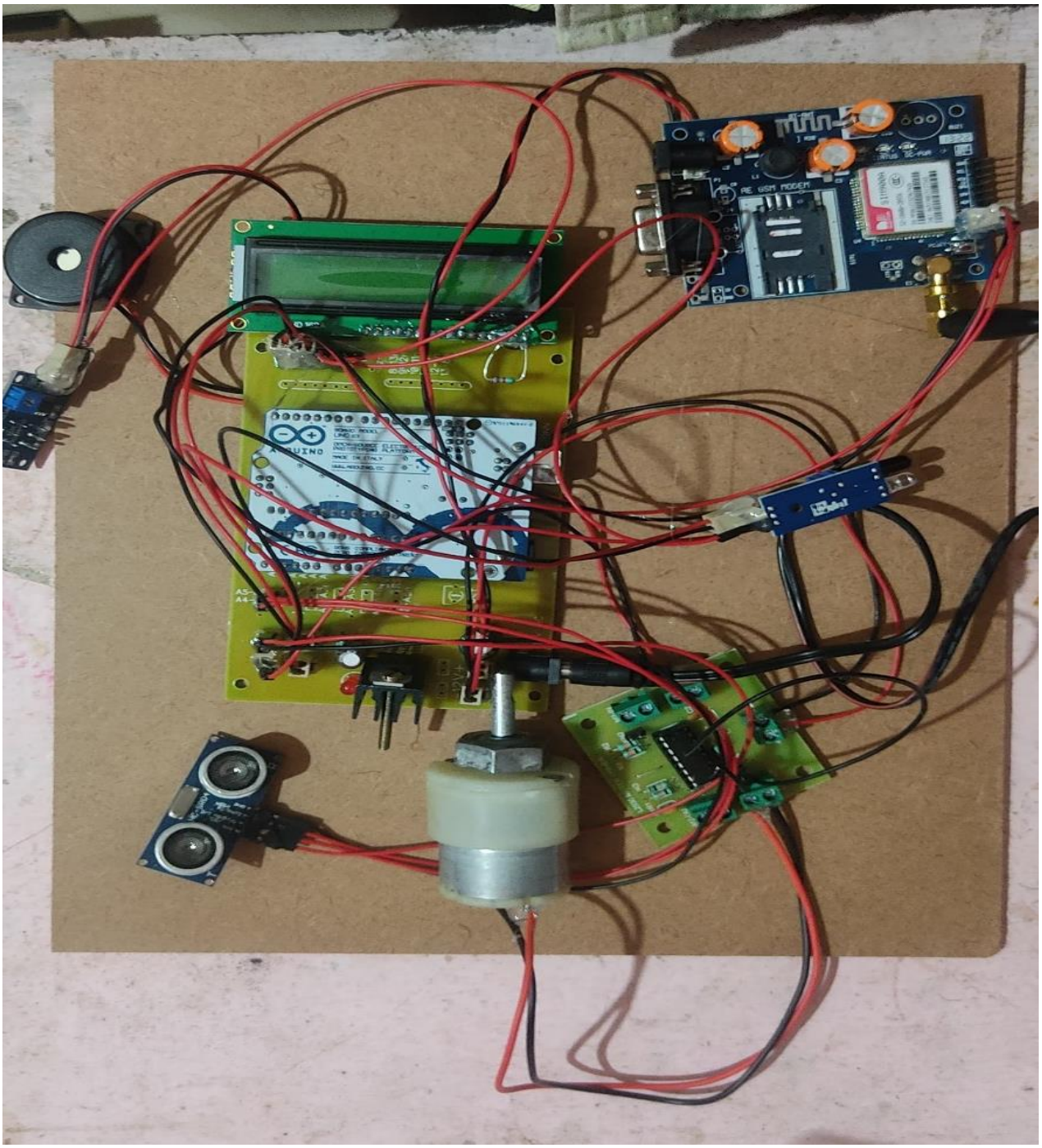


Fig 13.2 Circuit Connections of the project

## 13.4 Result

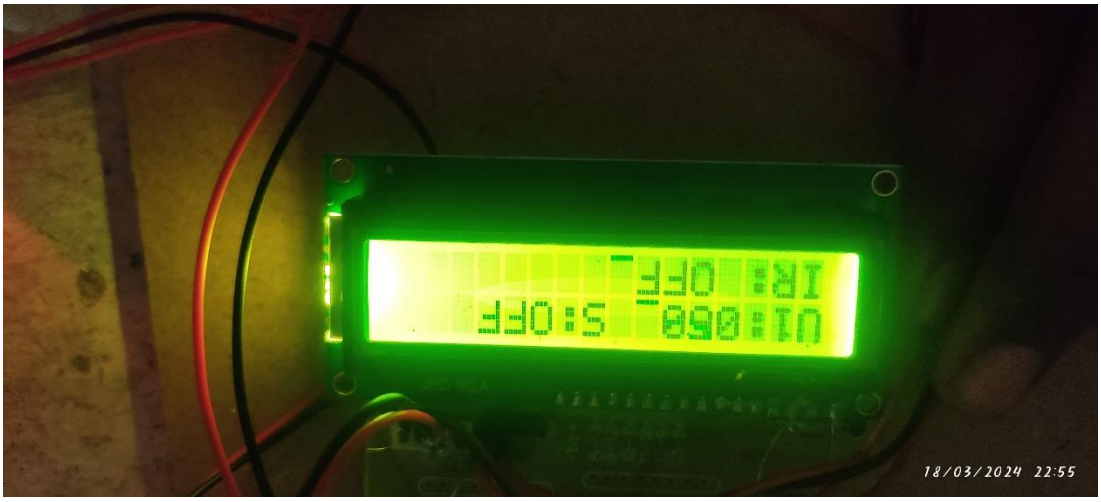



Fig 13.3 Lcd output interfaced to bin

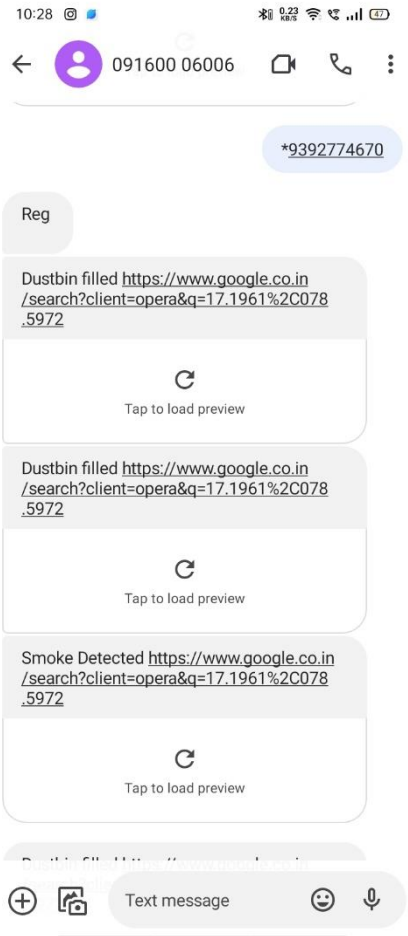



Fig 13.4 Message output interfaced to the driver

## 13.5 Advantages:

1) Highly Sensitive, Low cost and Reliable circuit.
2) Works according to the Dustbin size condition.
3) Complete elimination of manpower.
4) Can handle heavy loads up to 7A.
5) System can be switched into manual mode when even required.

## 13.6 Limitations :

1) This is applicable for only large farms.
2) Have limited life after installation.

# Conclusion and Future Scope

## Conclusion

In this project, we propose a new solution to enhance waste collection efficiently using the Arduino Uno with Arduino Ethernet Shield technology and ultrasonic sensor systems. In this proposed system, the garbage overflow of garbage can be avoided and managed efficiently. This will intimate or send SMS or email to the authorized person through Ubidots platform. The garbage managing system and the facility of collecting the garbage presently doesn't fit to the current requirement. Hence better facility of collecting garbage and transportation should be provided. Since, this system provides the information when the bin gets completely filled with garbage, it reduces the number of times the arrival of vehicle which collects the garbage. This method finally helps in keeping the environment clean. Thus, the waste collection is made more efficient.

## Future Scope

The future of waste management with IoT entails automated sorting, predictive maintenance, and optimized collection routes using real-time data. Smart technologies will enable energy recovery from waste and resource optimization through closed-loop systems. Community engagement will be enhanced through interactive mobile apps and educational platforms, fostering participation in recycling and sustainability initiatives.

Environmental monitoring via IoT sensors will ensure compliance with regulations and promote transparency in waste disposal processes. Blockchain technology may facilitate traceability and accountability in waste management activities. Overall, these advancements promise to make waste management systems more efficient, sustainable, and responsive to environmental challenges, contributing to a cleaner and healthier planet..

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