

FULLY AUTOMATED SMART CROP FIELD PROTECTION FROM WEATHER AND WILD ANIMALS

A Project Report Phase - II

Submitted in the partial fulfilment of the requirements for the award of
Bachelor of Engineering degree in Electronics and Communication Engineering

by

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
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SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

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APRIL – 2023



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BONAFIDE CERTIFICATE

This is to certify that this project report is the bonafide work of **Shaik Nayeem pasha (39130421)** and **Shaik Kaleem (39130417)** who carried out the project entitled "FULLY AUTOMATED SMART CROP FIELD PROTECTION FROM WEATHER AND WILD ANIMALS" under my supervision from November 2022 to April 2023.

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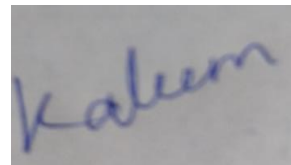
We **Shaik Nayeem pasha (39130421)** and **Shaik Kaleem (39130417)** here by declare that the Project Report on “**FULLY AUTOMATED SMART CROP FIELD PROTECTION FROM WEATHER AND WILD ANIMALS**” done by us under the guidance of **Dr. E. ANNA DEVI, M.E., Ph.D.**, at Sathyabama Institute of Science and Technology is submitted in partial fulfilment of the requirements of the award of Bachelor of Engineering Degree in Electronics and Communication Engineering.

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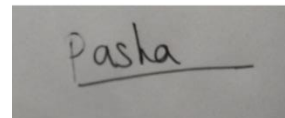
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SIGNATURE OF THE CANDIDATES

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ABSTRACT

India is the crop growing based country. Our ancient public entirely depended on the farming realizing. Agriculture is a cause of living of mainstream Indians and has great control on the economy of the country. In dry zones or in situation of lacking rainfall, irrigation comes to be difficult. So, it wants to be involuntary for correct produce and measured at all for farmer protection. Horticulture is a sub-sector of agriculture which plays significant role in economy, human nutrition, gender mainstreaming and employment. Horticultural commodities include fruits, vegetables, flowers, spices and condiments, which have grown steadily and turn into a major segment in agricultural trade. The objective of Horticulture system is to keep measure on food security and the aim of automatic irrigation control system is to minimize the efforts of the human operator (gardener) in Horticulture activities. This control system is built around Arduino programmed using embedded C language. Also using GSM technology for sending message on operator mobile about pump status. By using this method can easily know the data without wasting of time and energy. Various methods aim only at surveillance which is mainly for human intruders, but we tend to forget that the main enemies of such farmers are the animals which destroy the crops. This leads to poor yield of crops and significant financial loss to the owners of the farmland. This problem is so pronounced that sometimes the farmers decide to leave the areas barren due to such frequent animal attacks. This system helps us to keep away such wild animals from the farmlands as well as provides surveillance functionality.

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

Farming commodities especially vegetables such as red chili, red onion, tomatoes, potatoes; are essential agricultural produces in the food supply needs in Indonesia. These commodities are a significant issue because of frequent price fluctuations in the Indonesian market. The success of horticulture cultivation is highly dependent on climate and environmental factors such as local microclimate, groundwater content, the temperature of the growth environment, humidity, and light intensity.

Thus, it is essential to develop technologies that can solve these problems and ensure the horticulture in Indonesia becomes more productive both in quality and quantity. Previously, several studies have been presented in which they applied IoT-based technique for improving farming. However, a study of IoT-based horticulture that fits with Indonesia condition, in a micro-climate farming environment and prepared to be integrated with intelligence microclimate farming is still inadequate.

The crops and paddy fields cannot be always fenced. So the possibility of crops being eaten away by cows and goats are very much present. This could result in huge wastage of crops produced by the farmers. To make the best use of mobile communication technology, the objectives of this paper therefore utilizes global system for mobile communication (GSM) and provide short message service (SMS). This system helps us to keep away such wild animals from the farmlands as well as provides surveillance functionality. It has been found that the odour of rotten egg helps to keep the wild pigs and deer from destroying the crops, hence the farmers manually spray the rotten egg solution on their fields, and firecrackers are used to ward off the wild elephants that destroy the crops. This project is based on surveillance with an animal ward-off system employed in farmlands in order to prevent crop vandalization by wild animals.

1.2 EMBEDDED SYSTEM IMPLEMENTATION

An embedded system is one kind of a computer system mainly designed to perform several tasks like to access, process, and store and also control the data in various electronics-based systems. Embedded systems are a combination of hardware and software where software is usually known as firmware that is embedded into the hardware.

1.3 EMBEDDED SYSTEM:

Embedded system includes mainly two sections, they are

1. Hardware
2. Software

The embedded system hardware has elements like input output (I/O) interfaces, user interface, memory and the display. Usually, an embedded system consists of:

- Power Supply
- Processor
- Memory
- Timers

Embedded systems use different processors for its desired operation. Some of the processors used are

1. Microprocessor
2. Microcontroller
3. Digital signal processor

1.3.1 MICROPROCESSOR

- CPU on a chip.
- We can attach required amount of ROM, RAM and I/O ports.
- Expensive due to external peripherals.
- Large in size
- general-purpose

1.3.2 MICROCONTROLLER

- Computer on a chip
- Fixed amount of on-chip ROM, RAM, I/O ports
- Low cost.
- Compact in size.
- Specific –purpose

1.3.3 Embedded system software:

The embedded system software is written to perform a specific function. It is typically written in a high level format and then compiled down to provide code that can be lodged within a non-volatile memory within the hardware. An embedded system software is designed to keep in view of the three limits:

- Availability of system memory
- Availability of processor's speed
- When the system runs continuously, there is a need to limit power dissipation for events like stop, run and wake up.

1.3.4 BRINGING SOFTWARE AND HARDWARE TOGETHER FOR EMBEDDED SYSTEM

To make software to work with embedded systems we need to bring software and hardware together. for this purpose, we need to burn our source code into microprocessor or microcontroller which is a hardware component and which takes care of all operations to be done by embedded system according to our code.

Generally, we write source codes for embedded systems in assembly language, but the processors run only executable files. The process of converting the source code representation of your embedded software into an executable binary image involves three distinct steps:

1. Each of the source files must be compiled or assembled into an object file.
2. All of the object files that result from the first step must be linked together to produce a single object file, called the re-locatable program.
3. Physical memory addresses must be assigned to the relative offsets within the relocatable program in a process called relocation.

The result of the final step is a file containing an executable binary image that is ready to run on the embedded system.

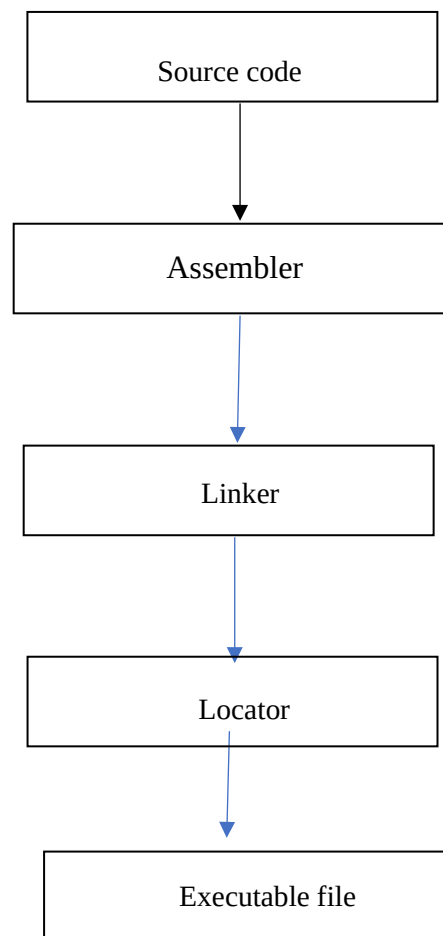


Fig 1.1 - Flow Of Source Code To Processor

Real-time system design is not simply about speed. Deadlines for real-time systems vary; one deadline might be in a millisecond, while another is an hour away. The main concern for a real-time system is that there is a guarantee that the hard deadlines of the system are always met. In order to accomplish this the system must be predictable.

The architecture of the embedded software, and its interaction with the system hardware, play a key role in ensuring that real-time systems meet their deadlines. Key software design issues include whether polling is sufficient or interrupts should be used, and what priorities should be assigned to the various tasks and interrupts. Additional forethought must go into understanding the worst-case performance requirements of the specific system activities.

1.4 APPLICATIONS

Embedded systems have different applications. A few select applications of embedded systems are smart cards, telecommunications, satellites, missiles, digital consumer electronics, computer networking, etc. Embedded systems are found in numerous applications and these systems use different electronic components in combination with computer network systems to get control of several equipment's. Embedded system consists a single-chip microprocessor or microcontroller that acts as the central control to the interfaced peripheral devices.

1.4.1 EMBEDDED SYSTEMS IN AUTOMOBILES:

- Engine or Body Safety
- Robotics in Assembly Line
- Mobile and E-Com Access
- Motor Control System

1.4.2 EMBEDDED SYSTEMS IN TELECOMMUNICATIONS

- Mobile computing
- Networking
- Wireless Communications

1.4.3 EMBEDDED SYSTEMS IN SMART CARDS

- Banking
- Telephone
- Security Systems

CHAPTER 2

LITERATURE REVIEW

2.1 RELATED WORK

Archana et.al Proposed a paper in which the humidity and soil moisture sensors are placed in the root zone of the plant. Based on the sensed values the microcontroller is used to control the supply of water to the field. This system doesn't intimate the farmer about the field status.

C.H.Chavan et.al Proposed a smart wireless sensor network for monitoring environmental parameters using Zigbee. These nodes send data wirelessly to a central server, which collects data, stores it and allows it to be analysed then displayed as needed and also be sent to the client mobile. Weather forecasting and nutrient content is not determined in this system.

G. Parameswaran et.al (2016) proposed a smart drip irrigation system using IOT in which humidity, temperature and pH sensors are used. Irrigation status is updated to the server or local host using personal computer. The farmer can't access about the field condition without internet.

Karan kansara Proposed an automated irrigation system where the humidity and temperature sensors are used to sense the soil conditions and based on that microcontroller will control the water flow. Farmer will be intimated through GSM. This system doesn't monitor the nutrient content in the soil.

KaushalJani et.al proposed In Sensor based Automated Irrigation System with IOT mentioned about using sensor-based irrigation in which the irrigation will take place whenever there is a change in temperature and humidity of the surroundings. The flow of water is managed by solenoid valve. The opening and closing of valve is done when a signal is send through microcontroller. The water to the root of plant is done drop by drop using rain gun and when the moisture level again become normal then sensor senses it and send a signal to microcontroller and the value is then closed. The GSM and microcontroller are connected using MAX232. When moisture

of the soil become low moisture sensor sense it and send signal to microcontroller, then the microcontroller gives the signal to mobile and it activate the buzzer.

This buzzer indicates that valve needs to be opened by pressing the button in the called function signals are sent back to microcontroller. Microcontroller used can increase System Life and lower the power Consumption. There system is just limited to the automation of irrigation system and lacks in extra ordinary features.

Nisha G et.al Proposed an IOT based automatic irrigation system using wireless sensor networks in which various sensors are used to measure the soil parameters. This system provides a web interface to the user to monitor and control the system remotely. Weather monitoring is not done in this system.

R.Subalakshmi et.al Proposed a paper to make irrigation system simpler, the complexities involved in irrigation is tackled with automation system using microcontroller and GSM. Based on the sensed values from soil moisture, temperature and humidity sensors, the GSM sends message to the farmer when these parameters exceed the threshold value set in the program. The nutrient content in the soil is not determined by this system.

Sonali D.Gainwar et.al (2015) proposed a paper in which soil parameters such as pH, humidity, moisture and temperature are measured for getting high yield from soil. This system is fully automated which turns the motor pump ON/OFF as per the level of moisture in the soil. The current field status is not intimated to the farmer.

Sneha Nahatkar et.al proposed a home embedded surveillance system which evaluates the development of a low cost security system using small PIR ON/OFF the motor pump. Weather forecasting is not included in this system sensor built around a microcontroller with ultra-low alert power. The system senses the signal generated by PIR sensor detecting the presence of individuals not at thermal equilibrium with the surrounding environment.

On detecting the presence of any unauthorized person in any specific time interval, it triggers an alarm & sets up a call to a predefined number through a GSM modem. After the MCU sends the sensor signals to the embedded system, the program starts the Web camera which then captures the images which can be viewed and analysed later.

V. R. Balaji, et.al Proposed a paper in which the system derives power from sunlight through photo-voltaic cells. This system doesn't depend on electricity. The soil moisture sensor has been used and based on the sensed values PIC microcontroller is used ON/OFF the motor pump. Weather forecasting is not included in this system.

V. Gayathri, et.al proposed the system for monitoring the growing status of the corn (maize) plant continuously and intimate the agriculturist using wireless sensor network (WSN). But in practice, cultivator faces too much effort in the farmland. This paper makes eases the work of the farmer in cultivated land through the usage of different kind of sensors. The two LDR sensors are interfaced with PIC16F877A microcontroller whereas its top array receives solar radiation for supply current and the bottom of the LDR array is for measuring leaf area index (LAI). The humidity sensor will compute the moisture level in the corn field, if the level decreases, then it automatically switches ON the DC motor. All the particulars of farmland are sent to the farmer through GSM and reveal in the LCD screen. The temperature sensor will find the intensity of heat present in the soil. PH sensor is used to find the soil alkalinity which is essential for plant nutrition.

V Nainwal, et.al Sensors are used to detect the presence of objects in the surveillance area and the information is collected over time to extract the event of interest. The information gathered by the surveillance camera i.e., video or still images could be used for further analysis and detection of the intruding object. This system does not utilize advanced techniques for alerting the owner of that area.

Puja G, et.al proposed the system. This project is based on surveillance with an animal ward-off system employed in farmlands in order to prevent crop vandalization by wild animals. In addition to providing protection this system distinguishes between an intruder and an authorized person using RFID's, various PIR sensors are deployed in the area to detect any motion and hence turns ON a camera when movement is detected, thereby providing real time monitoring.

CHAPTER 3

METHODOLOGY

3.1 PROPOSED METHODOLOGY

Different sensors such as soil moisture, DHT11, IR (intruder detection network) are connected to Arduino microcontroller's input pins within this device. The sensed sensor values are displayed in LCD. If the sensed value exceeds the threshold values set in the system, the relay circuit automatically switches the pump ON / OFF and it is connected to the driver circuit which helps to switch the voltage. And also indication is provided through buzzer and message when intrusion is detected in the field

3.2 SCOPE OF THE PROJECT

To intimidate farmers via GSM module about the current condition of the field. By using this device, the farmer can at any time access the details of the field condition anywhere. Animal detection system is designed to detect the presence of animal and offer a warning. In this project we used IR to detect the movement of the animal and send signal to the controller.

3.3 OBJECTIVE OF THE PROJECT

It diverts the animal by producing sound and signal further this signal is transmitted to GSM, and also it captures the images of intruded animal and send the images to our device so that we can know whether its an wild or domestic animal, which gives an alert to farmers immediately, and be cautious while entering into the farm. Also, it provides the weather and humid conditions within the farm

The soil moisture sensor detects the moisture level and turn on the water motor when the moisture level is low.

Crop protection and animal intrusion system helps to develop a security system for the protection of farm and prohibit the entry of animal to the farm, system use IOT module for alerting the farmer. It also helps in Protecting crops from Wild Animals The system ensures that the alarm is not triggered by the presence of a human in the field, or via any random motion.

The system is capable of turning on/Off automatically and warding off the animals thus protecting the fields from any damage. Also, we can setup a timer as per farmer's requirement. In addition, this system avoids damage caused to crops from heavy rainfall and extreme weather conditions, generating the power from rain water and solar panel, sending information to the authorized person.

3.4 BLOCK DIAGRAM:

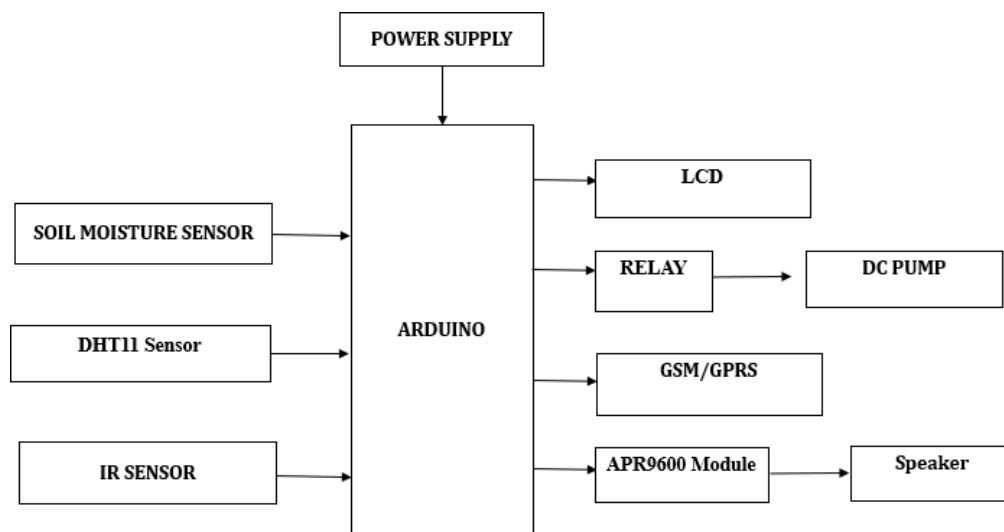


Fig-3.1-Schematic Illustration Of Hardware

The above schematic illustration of hardware in Fig-3.1 represent the overview of the project, here the Arduino is being engaged with sensors the provide weather conditions of the field atmosphere, soil moisture sensor, DHT11 sensor and ir sensors are connected directly to the Arduino, further the Arduino display the information on the LCD screen it is also designed to trigger the relay to turn ON/OFF according to the moisture levels of soil in the field the APR9600 module generate the sound through buzzer when any intrusion is detected simultaneously SMS alert is sent to the device registered in the programme.

CHAPTER 4

REQUIREMENT ANALYSIS

4.1 HARDWARE REQUIREMENTS

4.1.1 ARDUINO UNO

Arduino Uno is a very valuable addition in the electronics that consists of USB interface, 14 digital I/O pins, 6 analog pins, and Atmega328 microcontroller. It also supports serial communication using Tx and Rx pins.

There are many versions of Arduino boards introduced in the market like Arduino Uno, Arduino Due, Arduino Leonardo, Arduino Mega, however, most common versions are Arduino Uno and Arduino Mega. If you are planning to create a project relating to digital electronics, embedded system, robotics, or IoT, then using Arduino Uno would be the best, easy and most economical option.

It is an open-source platform, means the boards and software are readily available and anyone can modify and optimize the boards for better functionality.

The software used for Arduino devices is called IDE (Integrated Development Environment) which is free to use and required some basic skills to learn it. It can be programmed using C and C++ language.

Some people get confused between Microcontroller and Arduino. While former is just an on system 40 pin chip that comes with a built-in microprocessor and later is a board that comes with the microcontroller in the base of the board, bootloader and allows easy access to input-output pins and makes uploading or burning of the program very easy.



Fig 4.1 - Arduino Board, Microcontroller

4.1.2 INTRODUCTION TO ARDUINO

- Arduino Uno is a microcontroller board developed by Arduino.cc which is an open-source electronics platform mainly based on AVR microcontroller Atmega328.
- First Arduino project was started in Interaction Design Institute Ivrea in 2003 by David Cuartielles and Massimo Banzi with the intention of providing a cheap and flexible way to students and professional for controlling a number of devices in the real world.
- The current version of Arduino Uno comes with USB interface, 6 analog input pins, 14 I/O digital ports that are used to connect with external electronic circuits. Out of 14 I/O ports, 6 pins can be used for PWM output.
- It allows the designers to control and sense the external electronic devices in the real world.

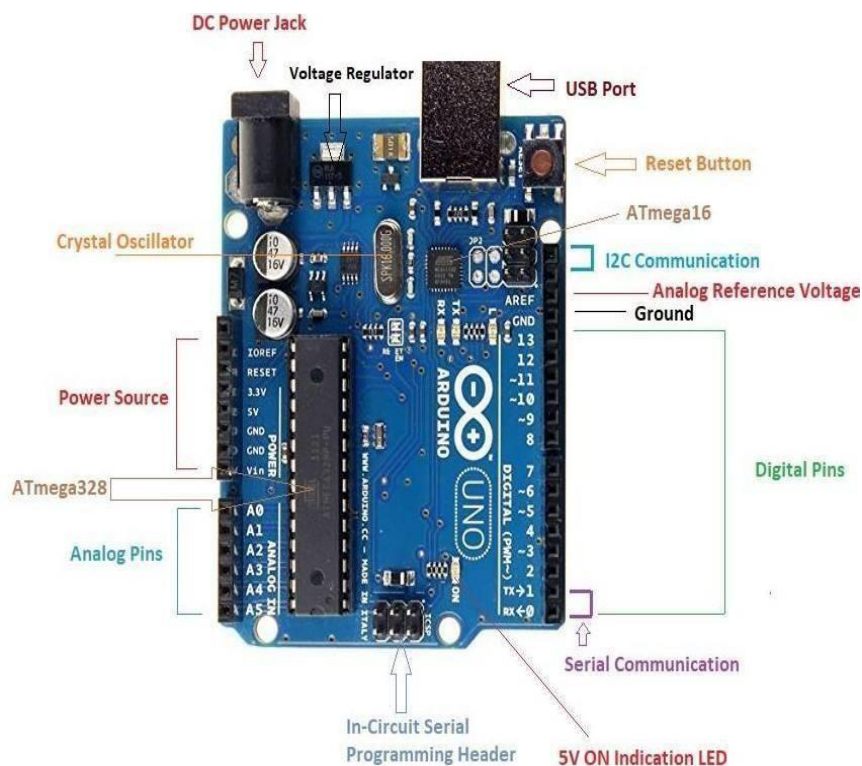


Fig 4.2- Arduino Uno

- This board comes with all the features required to run the controller and can be directly connected to the computer through USB cable that is used to transfer the code to the controller using IDE (Integrated Development Environment) software, mainly developed to program Arduino. IDE is equally compatible with Windows, MAC or Linux Systems, however, Windows is preferable to use. Programming languages like C and C++ are used in IDE.
- Apart from USB, battery or AC to DC adapter can also be used to power the board.
- Arduino Uno boards are quite similar to other boards in Arduino family in terms of use and functionality, however, Uno boards don't come with FTDI USB to Serial driver chip.

There are many versions of Uno boards available, however, Arduino Nano V3 and Arduino Uno are the most official versions that come with Atmega328 8-bit AVR Atmel microcontroller where RAM memory is 32KB.

- When nature and functionality of the task go complex, Micro SD card can be added in the boards to make them store more information. Features of Arduino
- Arduino Uno comes with USB interface i.e. USB port is added on the board to develop serial communication with the computer.
- Atmega328 microcontroller is placed on the board that comes with a number of features like timers, counters, interrupts, PWM, CPU, I/O pins and based on a 16MHz clock that helps in producing more frequency and number of instructions per cycle.
- It is an open source platform where anyone can modify and optimize the board based on the number of instructions and task they want to achieve.
- This board comes with a built-in regulation feature which keeps the voltage under control when the device is connected to the external device.
- Reset pin is added in the board that reset the whole board and takes the running program in the initial stage. This pin is useful when board hangs up in the middle of the running program; pushing this pin will clear everything up in the program and starts the program right from the beginning.
- There are 14 I/O digital and 6 analog pins incorporated in the board that allows the external connection with any circuit with the board. These pins provide the flexibility and ease of use to the external devices that can be connected through these pins. There is no hard and fast interface required to connect the devices to the board.

Simply plug the external device into the pins of the board that are laid out on the board in the form of the header.

- The 6 analog pins are marked as A0 to A5 and come with a resolution of 10bits. These pins measure from 0 to 5V, however, they can be configured to the high range using analog Reference function and AREF pin.
- 13KB of flash memory is used to store the number of instructions in the form of code. Only 5 V is required to turn the board on, which can be achieved directly using USB port or external adopter, however, it can support external power source up to 12 V which can be regulated and limit to 5 V or 3.3 V based on the requirement of the project.

4.1.3 ARDUINO PINOUT

Arduino Uno is based on AVR microcontroller called Atmega328. This controller comes with 2KB SRAM, 32KB of flash memory, 1KB of EEPROM. Arduino Board comes with 14 digital pins and 6 analog pins. ON-chip ADC is used to sample these pins. A 16 MHz frequency crystal oscillator is equipped on the board. Following figure shows the pinout of the Arduino Uno Board

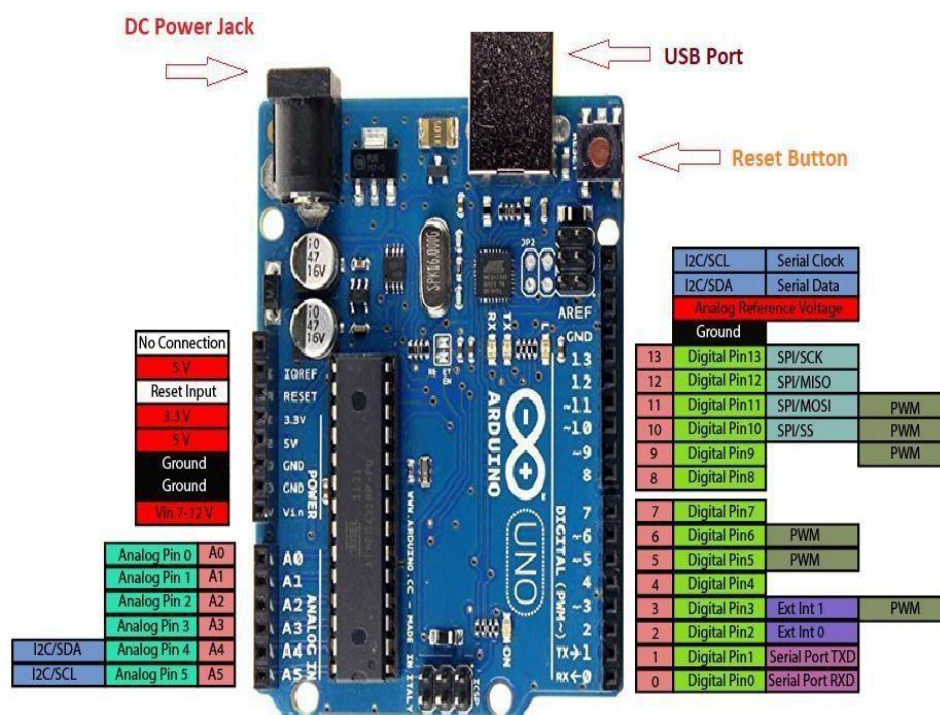


Fig 4.3- Arduino Uno Pinout

4.1.4 PIN DESCRIPTION:

There are several I/O digital and analog pins placed on the board which operates at 5V. These pins come with standard operating ratings ranging between 20mA to 40mA. Internal pull-up resistors are used in the board that limits the current exceeding from the given operating conditions. However, too much increase in current makes these resistors useless and damages the device.

LED: Arduino Uno comes with built-in LED which is connected through pin 13. Providing HIGH value to the pin will turn it ON and LOW will turn it OFF.

Vin: It is the input voltage provided to the Arduino Board. It is different than 5 V supplied through a USB port. This pin is used to supply voltage. If a voltage is provided through power jack, it can be accessed through this pin.

5V: This board comes with the ability to provide voltage regulation. 5V pin is used to provide output regulated voltage. The board is powered up using three ways i.e. USB, Vin pin of the board or DC power jack.

USB supports voltage around 5V while Vin and Power Jack support a voltage ranges between 7V to 20V. It is recommended to operate the board on 5V. It is important to note that, if a voltage is supplied through 5V or 3.3V pins, they result in bypassing the voltage regulation that can damage the board if voltage surpasses from its limit.

GND: These are ground pins. More than one ground pins are provided on the board which can be used as per requirement.

Reset: This pin is incorporated on the board which resets the program running on the board. Instead of physical reset on the board, IDE comes with a feature of resetting the board through programming.

IOREF: This pin is very useful for providing voltage reference to the board. A shield is used to read the voltage across this pin which then select the proper power source.

PWM: PWM is provided by 3, 5, 6, 9, 10, 11 pins. These pins are configured to provide 8-bit output PWM.

SPI: It is known as Serial Peripheral Interface. Four pins 10(SS), 11(MOSI), 12(MISO), 13(SCK) provide SPI communication with the help of SPI library.

AREF: It is called Analog Reference. This pin is used for providing a reference voltage to the analog inputs.

TWI: It is called Two-wire Interface. TWI communication is accessed through Wire Library. A4 and A5 pins are used for this purpose.

Serial Communication: Serial communication is carried out through two pins called Pin 0 (Rx) and Pin 1 (Tx).

Rx pin is used to receive data while Tx pin is used to transmit data.

External Interrupts: Pin 2 and 3 are used for providing external interrupts. An interrupt is called by providing LOW or changing value.

4.1.5 ARDUINO UNO TECHNICAL SPECIFICATIONS

Arduino Uno comes with an ability of interfacing with other Arduino boards, microcontrollers and computer. The Atmega328 placed on the board provides serial communication using pins like Rx and Tx.

4.1.6 COMMUNICATION AND PROGRAMMING:

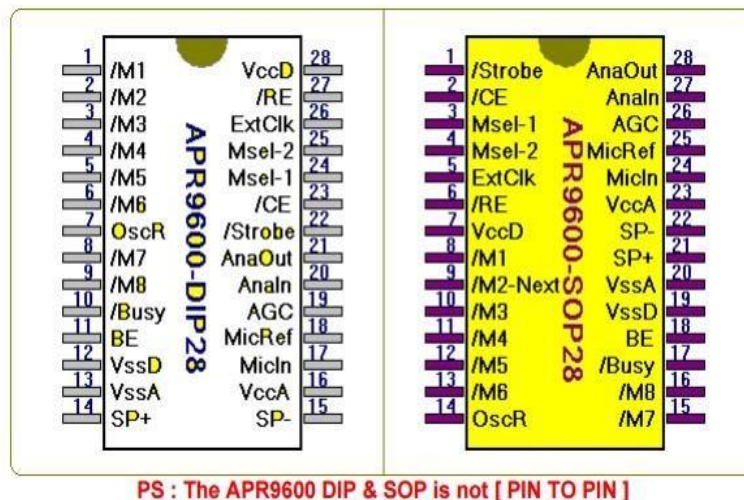
The Atmega16U2 incorporated on the board provides a pathway for serial communication using USB com drivers. Serial monitor is provided on the IDE software which is used to send or receive text data from the board. If LEDs placed on the Rx and Tx pins will flash, they indicate the transmission of data.

Arduino Uno is programmed using Arduino Software which a cross-platform application called IDE is written in Java. The AVR microcontroller Atmega328 laid out on the base comes with built-in boot loader that sets you free from using a separate burner to upload the program on the board.

4.1.7 APR9600 MODULE:

The APR9600 device offers true single-chip voice recording, non-volatile storage, and playback capability for 40 to 60 seconds. The device supports both random and sequential access of multiple messages. Sample rates are user-selectable, allowing designers to customize their design for unique quality and storage time needs. Integrated output amplifier, microphone amplifier, and AGC circuits greatly simplify system design. The device is ideal for use in portable voice recorders, toys, and many other consumer and industrial applications.

APLUS integrated achieves these high levels of storage capability by using its proprietary analog/multilevel storage technology implemented in an advanced Flash non-volatile memory process, where each memory cell can store 256 voltage levels. This technology enables the APR9600 device to reproduce voice signals in their natural form. It eliminates the need for encoding and compression, which often introduce distortion.



PS : The APR9600 DIP & SOP is not [PIN TO PIN]

Fig 4.4- APR9600 Pin Diagram

APR9600 block diagram is included in order to describe the device's internal architecture. At the left hand side of the diagram are the analog inputs. A differential microphone amplifier, including integrated AGC, is included on-chip for applications requiring use. The amplified microphone signals fed into the device by connecting the ANA_OUT pin to the ANA_IN pin through an external DC blocking capacitor. Recording can be fed directly into the ANA_IN pin through a DC blocking capacitor, however, the connection between ANA_IN and ANA_OUT is still required for

playback. The next block encountered by the input signal is the internal anti-aliasing filter. The filter automatically adjust its response according to the sampling frequency selected so Shannon's Sampling Theorem is satisfied. After anti-aliasing filtering is accomplished, the signal is ready to be clocked into the memory array.

This storage is accomplished through a combination of the Sample and Hold circuit and the Analog Write/Read circuit. These circuits are clocked by either the Internal Oscillator or an external clock source. When playback is desired the previously stored recording is retrieved from memory, low pass filtered, and amplified as shown on the right hand side of the diagram.

The signal can be heard by connecting a speaker to the SP+ and SP- pins. Chip-wide management is accomplished through the device control block shown in the upper right hand corner. Message management is provided through the message control block represented in the lower centre of the block diagram. More detail on actual device application can be found in the Sample Application section. More detail on sampling control can be found in the Sample Rate and Voice Quality section. More detail on Message management and device control can be found in the Message Management section.

4.1.8 BLOCK DIAGRAM:

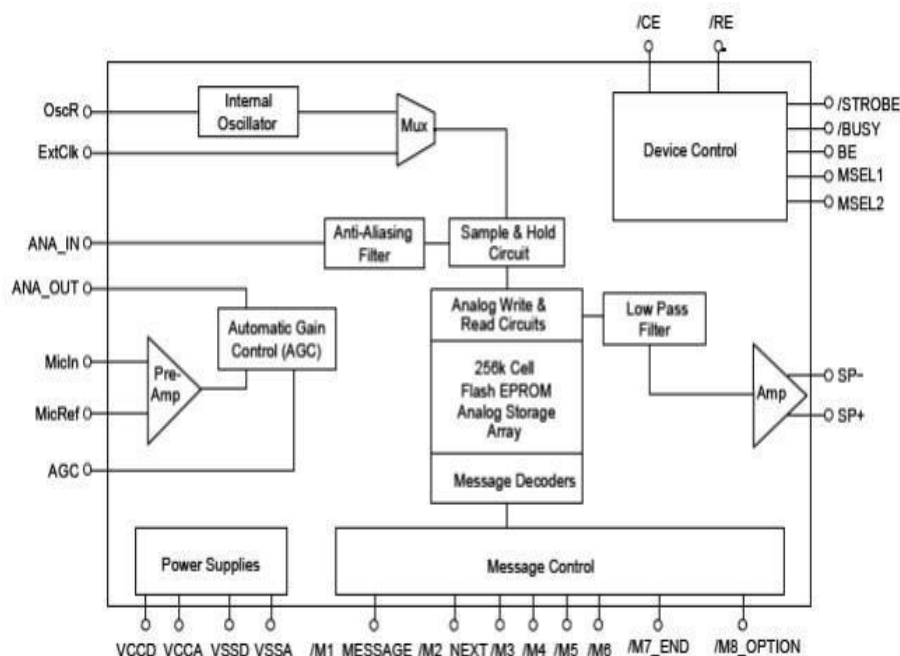


Fig 4.5- Block Diagram Of APR9600

Features

- Single-chip, high-quality voice recording & playback solution - No external ICs required - Minimum external components
- Non-volatile Flash memory technology - No battery backup required
- User-Selectable messaging options - Random access of multiple fixed-duration messages - Sequential access of multiple variable-duration messages
- User-friendly, easy-to-use operation - Programming & development systems not required - Level-activated recording & edge-activated play back switches
- Low power consumption - Operating current: 25 mA typical - Standby current: 1 uA typical Automatic power-down
- Chip Enable pin for simple message expansion.

4.1.9 SPEAKER:

Speakers are one of the most common output devices used with computer systems. Some speakers are designed to work specifically with computers, while others can be hooked up to any type of sound system. Regardless of their design, the purpose of speakers is to produce audio output that can be heard by the listener. Speakers are transducers that convert electromagnetic waves into sound waves. The speakers receive audio input from a device such as a computer or an audio receiver. This input may be either in analog or digital form. Analog speakers simply amplify the analog electromagnetic waves into sound waves. Since sound waves are produced in analog form, digital speakers must first convert the digital input to an analog signal, then generate the sound waves.



Fig 4.6- Speaker

4.1.10 SOIL MOISTURE SENSOR:

Soil clamminess sensors recognition the volumetric water content in soil. Since the direct gravimetric estimation of loosened soil moistness requires wiping out, drying, and weighting of a case, soil suddenness sensors degree the volumetric water content texture indirect by utilizing the utilization of some specific possessions of the tidy, containing electrical opposition, dielectric tenacious, or exchange with neutrons, as a mediator for the clamminess content material texture. The relationship some of the arranged assets and soil suddenness must be adjusted and would variety be able to dependent upon environmental added substances, for instance, soil kind, temperature, or electric fuelled controlled conductivity. Considered microwave radiation is roused with the guide of the utilization of the earth moistness and is actualized for identifying in hydrology and cultivating.

This sensor may be used to test the moisture of soil, when the soil is having water scarcity, the module output is at high level, and else the output is at low degree. Via using this sensor you may routinely water the flower plant, or any other flowers requiring automated watering approach. Module triple output mode, digital output is easy, analog output greater correct, serial output with exact readings.

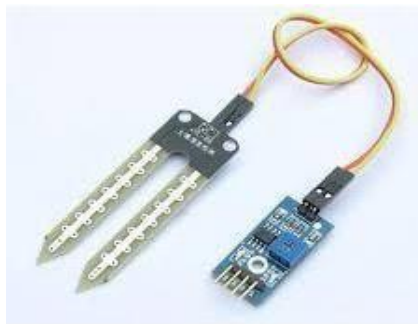


Fig 4.7- Soil Moisture Sensor

Features

- Sensitivity adjustable.
- Has fixed bolt whole, convenient installation.
- Module triple output mode, digital output is simple, analog output more accurate, serial output with exact readings.

Applications

- Agriculture
- Landscape irrigation

Specifications:

Parameter	Value
Operating Voltage	+5v dc regulated
Soil moisture	Digital value is indicated by out pin

Table 4.1 – Soil Moisture Sensor Specifications

4.1.11 DHT11 SENSOR (TEMPERATURE/HUMIDITY):

The DHT11 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds.

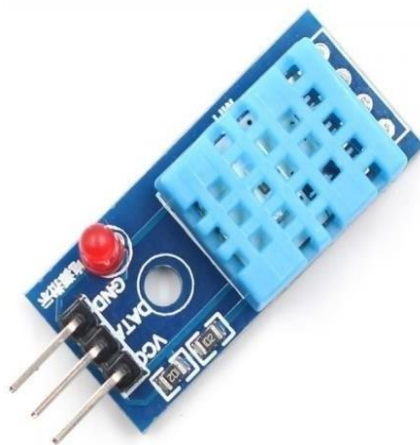


Fig 4.8 – DHT11 Sensor

4.1.12 IR SENSOR:

An infrared sensor is an electronic device, which emits in order to sense some aspects of the surroundings. 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, which 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.

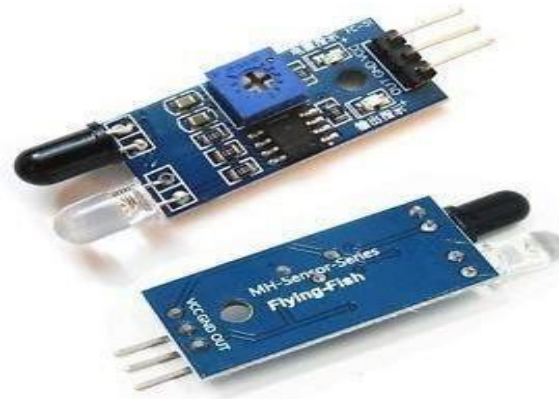


FIG 4.9 – IR Sensor

Working Principle of Infrared Sensor

Infrared Sensors work on three fundamental Physics laws:

- **Planck's Radiation Law:** Any object whose temperature is not equal to absolute Zero (0 Kelvin) emits radiation.
- **Stephan Boltzmann Law:** The total energy emitted at all wavelengths by a black body is related to the absolute temperature.
- **Wein's Displacement Law:** Objects of different temperature emit spectra that peak at different wavelengths that is inversely proportional to Temperature.

4.1.13 IR TRANSMITTER

IR Transmitter acts as source for IR radiation. According to Plank's Radiation Law, every object is a source of IR radiation at temp T above 0 Kelvin. In most cases black body radiators, tungsten lamps, silicon carbide, infrared lasers, LEDs of infrared wavelength are used as sources.

Transmission Medium

As the name suggests, Transmission Medium provides passage for the radiation to reach from IR Transmitter to IR Receiver. Vacuum, atmosphere and optical fibers are used as medium.

IR receiver

Generally, IR receivers are photo diode and photo transistors. They are capable of detecting infrared radiation. Hence IR receiver is also called as IR detector. Variety of receivers are available based on wavelength, voltage and package.

IR Transmitter and Receivers are selected with matching parameters. Some of deciding specifications of receivers are photosensitivity or responsivity, noise equivalent power and detectivity.

Working of Infrared Sensor

An Infrared Sensor works in the following sequence:

IR source (transmitter) is used to emit radiation of required wavelength.

This radiation reaches the object and is reflected back.

The reflected radiation is detected by the IR receiver.

The IR Receiver detected radiation is then further processed based on its intensity.

Generally, IR Receiver output is small and amplifiers are used to amplify the detected signal.

Typical working of IR sensor detection system can be understood by Figure 2 below.

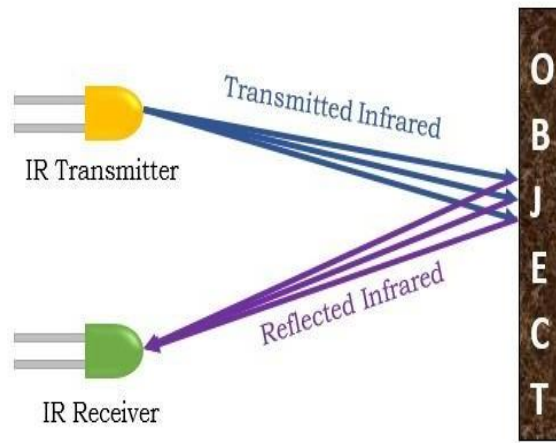


Fig 4.10-Working Of Infrared Sensor

Incidence in an IR Detection System may be direct or indirect. In case of Direct Incidence, there is no hindrance in between transmitter and receiver. Whereas, in Indirect Incidence IR Transmitter and Receiver are kept side by side and the object is in front of them.

Types of Infrared Sensor

IR sensors can be classified in two types based on presence of IR source:

Active Infrared Sensor

Passive Infrared Sensor

4.1.14 GSM/GPRS:

GSM GPRS modules are one of the normally utilized correspondence modules in implanted gadgets. A GSM GPRS module is utilized to speak with the GSM/GPRS arrange by a microcontroller (or coordinated circuits). GSM is the Global Mobile Communication System and GPRS would be the General Packet Radio Service. A GSM GPRS MODEM consolidates a GSM GPRS module similarly as various fragments, for instance, correspondence interface, (for instance, Serial Communication-RS-232), control supply and a couple of pointers.

GSM

For cell phone frameworks, GSM or Global Mobile Communication System is a Wireless Communication Standard. It was created as a substitute for the first Generation Analog Cellular Network by the European Telecommunications Standards Institute (ETSI).

Consequently, GSM is regularly alluded to as the Digital Cellular Network of the second Generation or essentially 2G. GSM has developed quickly with an expected piece of the overall industry of more than 90 percent in more than 200 nations since its organization in Finland in 1991.

GPRS

An expansion of the GSM arrange is GPRS or General Packet Radio Service. GPRS is an incorporated piece of the GSM organize that gives a productive method to exchange information with the equivalent GSM arrange assets. The information benefits in the GSM organize, (for example, web, mixed media informing, and so on.) initially utilized a circuit exchange association. In this sort, the system get to time is long and the information charges depended on the association time. This sort of association is likewise not reasonable for information blasts transmission. The information administrations scene has changed with the reconciliation of GPRS, a bundle – exchanging based information administration, into the GSM organize. The client gadget does not hold the assets for a constant time in GPRS-based bundle exchanging systems, yet utilizes a typical pool productively.

4.1.15 GSM/GPRS MODULE

A GSM/GPRS module is an IC or chip that utilizes a SIM (Subscriber Identity Module) and Radio Waves to interface with the GSM arrange. Basic radio frequencies are 850MHz, 900MHz, 1800MHz and 1900MHz in which a run of the mill GSM module works.



Fig 4.11- GSM Module

It comprises of the GSM/GPRS module, SIM card addition space, PC or microcontroller association RS-232 interface, LED flag status, control supply and mouthpiece and speaker association arrangement.

Each GSM/GPRS module is remarkable and its IMEI number makes it conceivable to separate it. IMEI or International Mobile Equipment Identity Number is a one of a kind 15-digit number for cell phones, satellite telephones and other GSM organize gadgets. With the help of this GSM/GPRS Module, we can do the following tasks.

- Make, receive, or reject voice calls
- Send, receive or delete SMS messages in the SIM Card
- Add, read and search the contacts in the SIM Card
- Send and receive data to / from the GSM/GPRS Network through GPRS

With the assistance of Attention Commands or AT Commands, all the above errands can be cultivated. AT Commands is a piece of Hayes Command Set that was initially characterized for a modem. GSM Network additionally executes an AT like its GSM module commands. The processor or controller that is associated with the GSM/GPRS module is in charge of sending the AT directions to the module. The GSM Module performs explicit assignments, for example, reacting to a telephone call, sending a SMS message, and so on.

Indeed, even through the AT Commands may appear to be nonexclusive, it is prudent to allude to right and finish rundown of AT Commands with the information given by the GSM Module producer.

4.1.17 LCD:

LCD (Liquid Crystal Display) is the innovation utilized in scratch pad shows and other littler PCs. Like innovation for light-producing diode (LED) and gas-plasma, LCDs permit presentations to be a lot more slender than innovation for cathode beam tube (CRT). LCDs expend considerably less power than LED shows and gas shows since they work as opposed to emanating it on the guideline of blocking light.

A 16x2 LCD implies 16 characters can be shown per line and 2 such lines exist. Each character is shown in a lattice of 5x7 pixels in this LCD. There are two registers in this LCD, in particular Command and Data.

The directions given to the LCD are put away by the order register. An order is a direction given to LCD to play out a predefined assignment, for example, introducing

it, clearing its screen, setting the situation of the cursor, controlling presentation, and so forth. The information register will store the information that will be shown on the LCD. The information is the character's ASCII incentive to show on the LCD.

Pin Diagram:

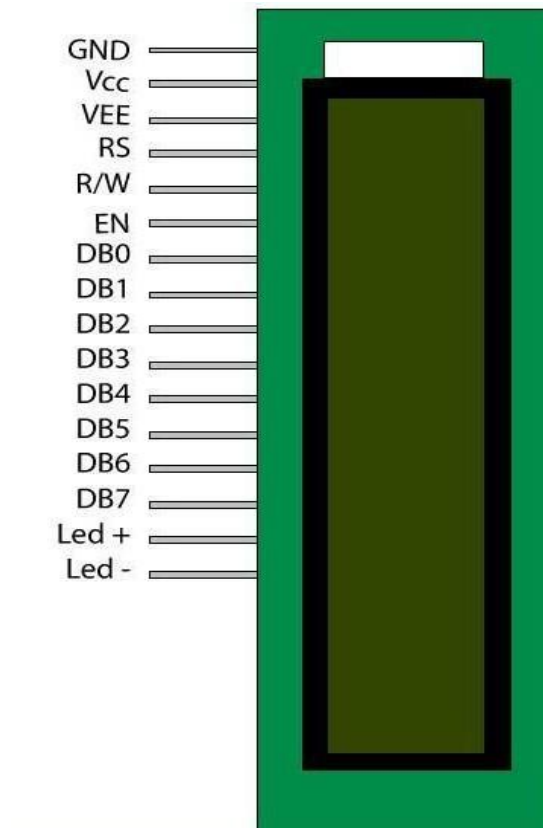


Fig 4.12- LCD Pin Diagram

4.1.18 RELAY:

What is a relay

A relay is an electromagnetic switch that is used to turn on and turn off a circuit by a low power signal, or where several circuits must be controlled by one signal. Most of the high-end industrial application devices have relays for their effective working. Relays are simple switches which are operated both electrically and mechanically. Relays consist of an electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. There are also other operating principles for its working. But they differ according to their applications. Most of the devices have the application of relays.

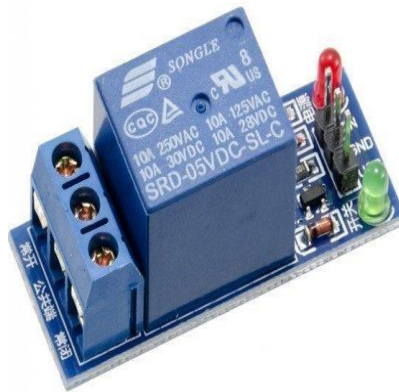


Fig 4.13 - Relay

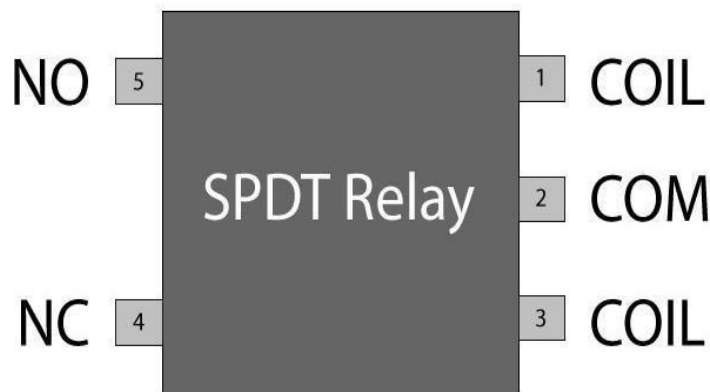


Fig 4.14 – Relay Pin Diagram

Relay uses

The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. The application of relays started during the invention of telephones. They played an important role in switching calls in telephone exchanges. They were also used in long distance telegraphy. They were used to switch the signal coming from one source to another destination. After the invention of computers they were also used to perform Boolean and other logical operations. The high end applications of relays require high power to be driven by electric motors and so on. Such relays are called contactors.

Relay Design

- There are only four main parts in a relay. They are
- Electromagnet
- Movable Armature
- Switch point contacts
- Spring

The figures given below show the actual design of a simple relay.

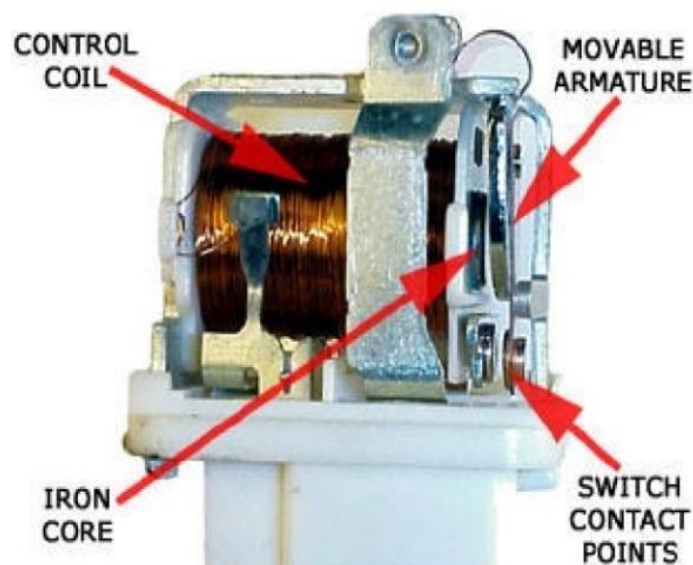


Fig 4.15 – Relay Construction

Relay Construction

It is an electro-magnetic relay with a wire coil, surrounded by an iron core. A path of very low reluctance for the magnetic flux is provided for the movable armature and also the switch point contacts.

The movable armature is connected to the yoke which is mechanically connected to the switch point contacts. These parts are safely held with the help of a spring. The spring is used so as to produce an air gap in the circuit when the relay becomes de-energized.

Working of relay

The relay function can be better understood by explaining the following diagram given below.

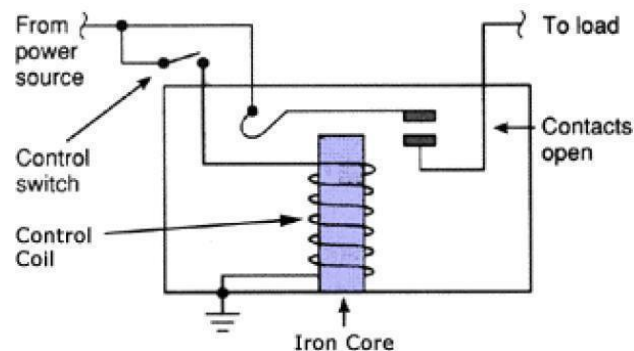


Fig 4.16 – Relay Design

Relay Basics

The basics for all the relays are the same. Take a look at a 4 pin relay shown below. There are two colours shown. The green colour represents the control circuit and the red colour represents the load circuit. A small control coil is connected onto the control circuit. A switch is connected to the load. This switch is controlled by the coil in the control circuit. Now let us take the different steps that occur in a relay.

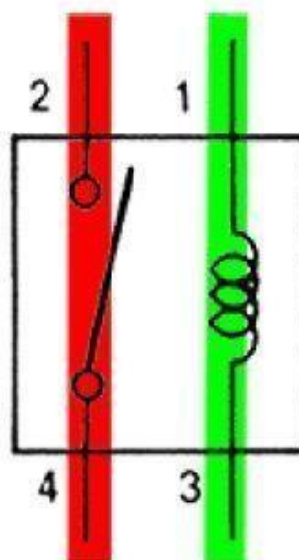


Fig 4.17 - Relay Operation

- **Energized Relay (ON)**

As shown in the circuit, the current flowing through the coils represented by pins 1 and 3 causes a magnetic field to be aroused. This magnetic field causes the closing of the pins 2 and 4. Thus the switch plays an important role in the relay working. As it is a part of the load circuit, it is used to control an electrical circuit that is connected to it. Thus, when the electrical relay is energized the current flow will be through the pins 2&4.

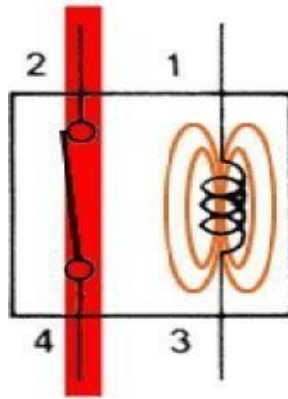


Fig 4.18 - Energized Relay (On)

- **De – Energized Relay (OFF)**

As soon as the current flow stops through pins 1 and 3, the relay switch opens and thus the open circuit prevents the current flow through pins 2 and 4. Thus the relay becomes deenergized and thus in off position.

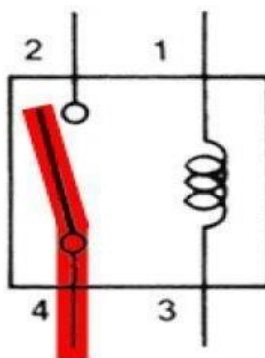


Fig 4.19- De-Energized Relay (Off)

Relay Applications

- A relay circuit is used to realize logic functions. They play a very important role in providing safety critical logic.
- Relays are used to provide time delay functions. They are used to time the delay open and delay close of contacts.
- Relays are used to control high voltage circuits with the help of low voltage signals. Similarly they are used to control high current circuits with the help of low current signals.
- They are also used as protective relays. By this function all the faults during transmission and reception can be detected and isolated.

Relay Selection

You must note some factors while selecting a particular relay. They are

- Protection Different protections like contact protection and coil protection must be noted. Contact protection helps in reducing arcing in circuits using inductors. A Coil protection helps in reducing surge voltage produced during switching.
- Look for a standard relay with all regulatory approvals.
- Switching time Ask for high speed switching relays if you want one.
- Ratings There are current as well as voltage ratings. The current ratings vary from a few amperes to about 3000 amperes. A In case of voltage ratings, they vary from 300 Volt AC to 600 Volt AC. There are also high voltage relays of about 15,000 Volts.
- Type of contact used whether it is a NC or NO or closed contact.
- Select Make before Break or Break before Make contacts wisely.
- Isolation between coil circuit and contacts

4.1.19 BUZZER:

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. Buzzer is an integrated structure of electronic transducers, DC power supply, widely used in computers, printers, copiers, alarms, electronic toys, automotive electronic equipment, telephones, timers and other electronic products for sound devices.



Fig 4.20 - Buzzer

Buzzer Features and Specifications

- Rated Voltage: 6V DC, Operating Voltage: 4-8V DC
- Rated current: <30mA, Sound Type: Continuous Beep
- Resonant Frequency: ~2300 Hz

How to use a Buzzer

A buzzer is a small yet efficient component to add sound features to our project/system. It is very small and compact 2-pin structure hence can be easily used on breadboard, Perf Board and even on PCBs which makes this a widely used component in most electronic applications.

There are two types of buzzers that are commonly available. The one shown here is a simple buzzer which when powered will make a Continuous Beep sound, the other type is called a readymade buzzer which will look bulkier than this and will produce a Beep Sound due to the internal oscillating circuit present inside it. But, the one shown here is most widely used because it can be customized with help of other circuits to fit easily in our application.

4.2 SOFTWARE REQUIREMENT

4.2.1 ARDUINO IDE:

Arduino IDE where IDE stands for Integrated Development Environment – An official software introduced by Arduino.cc, that is mainly used for writing, compiling and uploading the code in the Arduino Device. Almost all Arduino modules are compatible with this software that is an open source and is readily available to install and start compiling the code on the go.

4.2.2 INTRODUCTION TO ARDUINO IDE:

- Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module.
- It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.
- It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.
- A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more.
- Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.
- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.
- The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.
- This environment supports both C and C++ languages.

4.2.3 INSTALLATION OF ARDUINO IDE:

You can download the Software from Arduino main website. As I said earlier, the software is available for common operating systems like Linux, Windows, and MAX, so make sure you are downloading the correct software version that is easily compatible with your operating system.

- If you aim to download Windows app version, make sure you have Windows 8.1 or Windows 10, as app version is not compatible with Windows 7 or older version of this operating system.

The IDE environment is mainly distributed into three sections

1. Menu Bar
2. Text Editor
3. Output Pane

As you download and open the IDE software, it will appear like an image below.

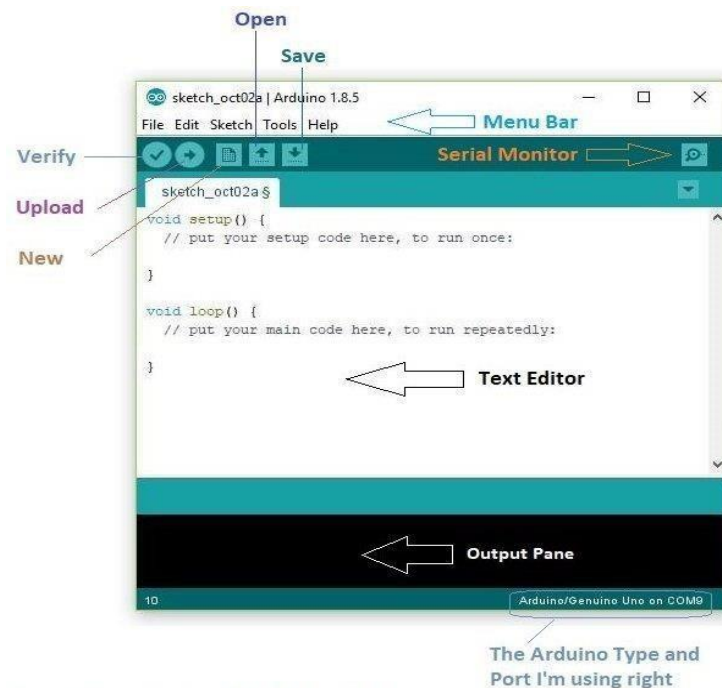


Fig 4.21- Arduino IDE

The bar appearing on the top is called Menu Bar that comes with five different options as follow

- **File** – You can open a new window for writing the code or open an existing one. Following table shows the number of further subdivisions the file option is categorized into.

File	
New	This is used to open new text editor window to write your code
Open	Used for opening the existing written code
Open Recent	The option reserved for opening recently closed program
Sketchbook	It stores the list of codes you have written for your project
Examples	Default examples already stored in the IDE software
Close	Used for closing the main screen window of recent tab. If two tabs are open, it will ask you again as you aim to close the second tab
Save	It is used for saving the recent program
Save as	It will allow you to save the recent program in your desired folder
Page setup	Page setup is used for modifying the page with portrait and landscape options. Some default page options are already given from which you can select the page you intend to work on
Print	It is used for printing purpose and will send the command to the printer
Preferences	It is page with number of preferences you aim to setup for your text editor page
Quit	It will quit the whole software all at once

Fig 4.22 - File

As you go to the preference section and check the compilation section, the Output Pane will show the code compilation as you click the upload button.

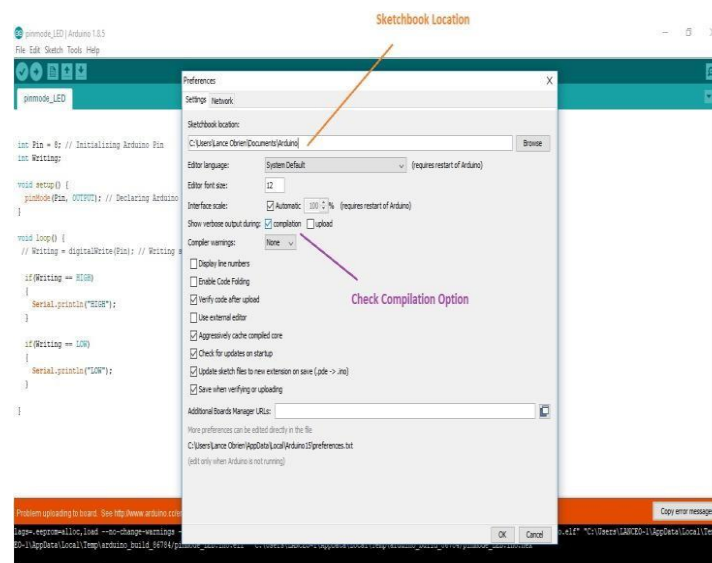


Fig 4.23 – Preference

And at the end of compilation, it will show you the hex file it has generated for the recent sketch that will send to the Arduino Board for the specific task you aim to achieve.

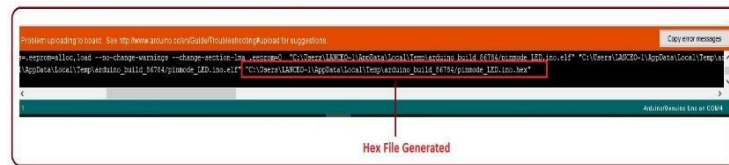


Fig 4.24 – Hex File Generation

- **Edit** – Used for copying and pasting the code with further modification for font
- **Sketch** – For compiling and programming
- **Tools** – Mainly used for testing projects. The Programmer section in this panel is used for burning a bootloader to the new microcontroller.
- **Help** – In case you are feeling sceptical about software, complete help is available from getting started to troubleshooting.

The Six Buttons appearing under the Menu tab are connected with the running program as follow.

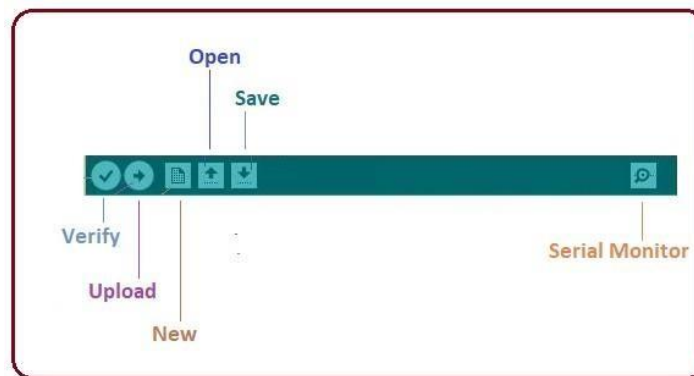


Fig 4.25 – Menu Tab

- The check mark appearing in the circular button is used to verify the code. Click this once you have written your code.
- The arrow key will upload and transfer the required code to the Arduino board.
- The dotted paper is used for creating a new file.
- The upward arrow is reserved for opening an existing Arduino project.
- The downward arrow is used to save the current running code.
- The button appearing on the top right corner is a Serial Monitor – A separate pop-up window that acts as an independent terminal and plays a vital role for sending and receiving the Serial Data. You can also go to the Tools panel and select Serial Monitor, or pressing Ctrl+Shift+M all at once will open it instantly. The Serial Monitor will actually help to debug the written Sketches where you can get a hold of how your program is operating.

Your Arduino Module should be connected to your computer by USB cable in order to activate the Serial Monitor.

- You need to select the baud rate of the Arduino Board you are using right now. For my Arduino Uno Baud Rate is 9600, as you write the following code and click the Serial Monitor, the output will show as the image below.

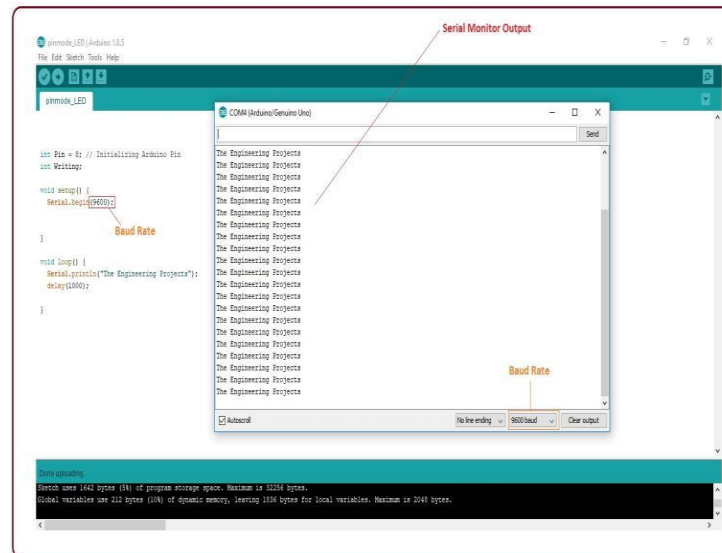


Fig 4.26 – Serial Monitor

The main screen below the Menu bard is known as a simple text editor used for writing the required code.



Fig 4.27 – Text Editor

The bottom of the main screen is described as an Output Pane that mainly highlights the compilation status of the running code: the memory used by the code, and errors occurred in the program. You need to fix those errors before you intend to upload the hex file into your Arduino Module.

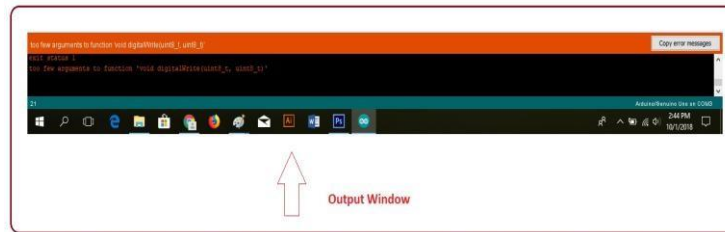


Fig 4.28 – Output Window

More or less, Arduino C language works similar to the regular C language used for any embedded system microcontroller, however, there are some dedicated libraries used for calling and executing specific functions on the board.

4.2.4 LIBRARIES:

Libraries are very useful for adding the extra functionality into the Arduino Module. There is a list of libraries you can add by clicking the Sketch button in the menu bar and going to Include Library.

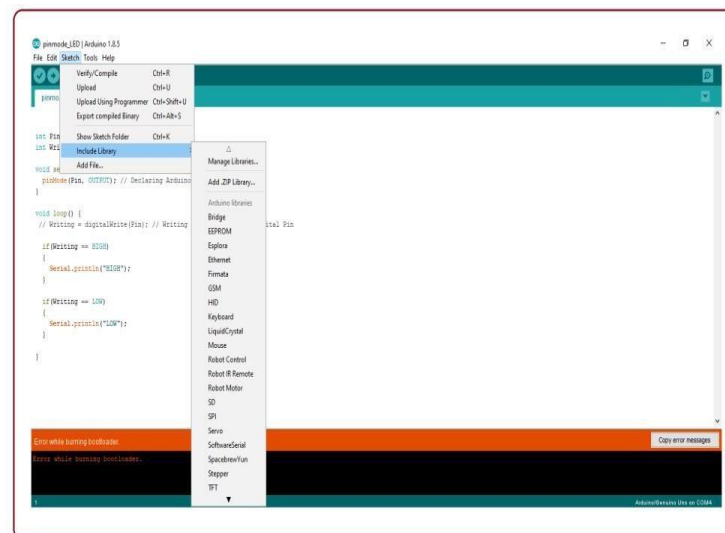


Fig 4.29 - Libraries

As you click the Include Library and Add the respective library it will on the top of the sketch with a #include sign. Suppose, I Include the EEPROM library, it will appear on the text editor as

#include <EEPROM.h>.

Most of the libraries are preinstalled and come with the Arduino software. However, you can also download them from the external sources.

4.2.5 MAKING PINS INPUT AND OUTPUT:

The digital Read and digital Write commands are used for addressing and making the Arduino pins as an input and output respectively.

These commands are text sensitive i.e. you need to write them down the exact way they are given like digital Write starting with small “d” and write with capital “W”. Writing it down with Digital write or digital write won’t be calling or addressing any function.

4.2.6 SELECTION OF THE BOARD:

In order to upload the sketch, you need to select the relevant board you are using and the ports for that operating system. As you click the Tools on the Menu, it will open like the figure below.

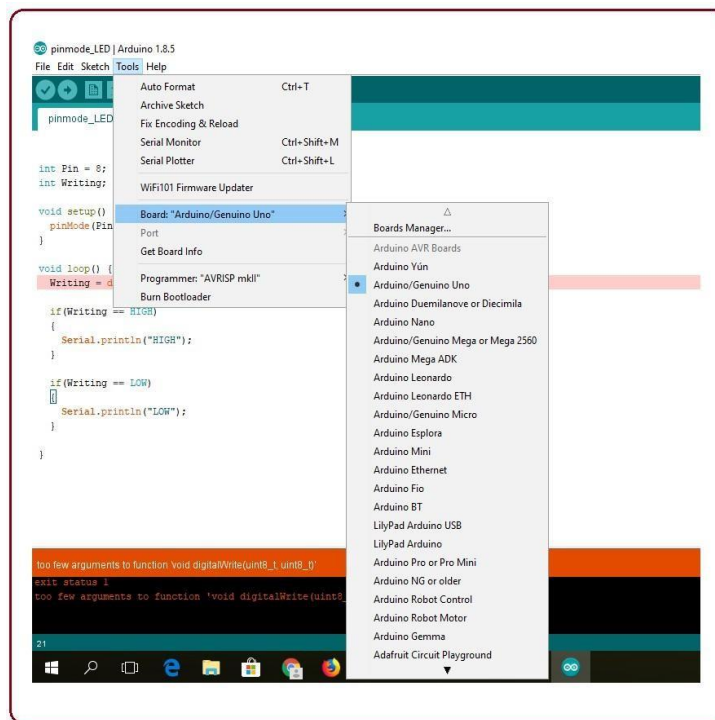


Fig 4.30 – Tools

- Just go to the “Board” section and select the board you aim to work on. Similarly, COM1, COM2, COM4, COM5, COM7 or higher are reserved for the serial and USB board. You can look for the USB serial device in the ports section of the Windows Device Manager.

Following figure shows the COM4 that I have used for my project, indicating the Arduino Uno with COM4 port at the right bottom corner of the screen.

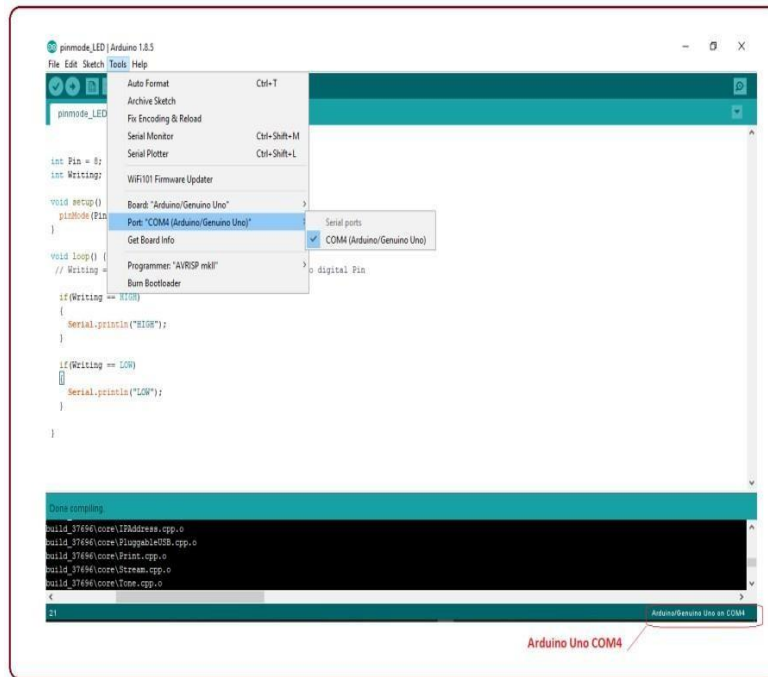


Fig 4.31 – Serial Ports

- After correct selection of both Board and Serial Port, click the verify and then upload button appearing in the upper left corner of the six button section or you can go to the Sketch section and press verify/compile and then upload.
- The sketch is written in the text editor and is then saved with the file extension .ino. It is important to note that the recent Arduino Modules will reset automatically as you compile and press the upload button the IDE software, however, older version may require the physical reset on the board.
- Once you upload the code, TX and RX LEDs will blink on the board, indicating the desired program is running successfully.

Note: The port selection criteria mentioned above is dedicated for Windows operating system only, you can check this Guide if you are using MAC or Linux.

- The amazing thing about this software is that no prior arrangement or bulk of mess is required to install this software, you will be writing your first program within 2 minutes after the installation of the IDE environment.

4.2.7 BOOTLOADER:

As you go to the Tools section, you will find a bootloader at the end. It is very helpful to burn the code directly into the controller, setting you free from buying the external burner to burn the required code.

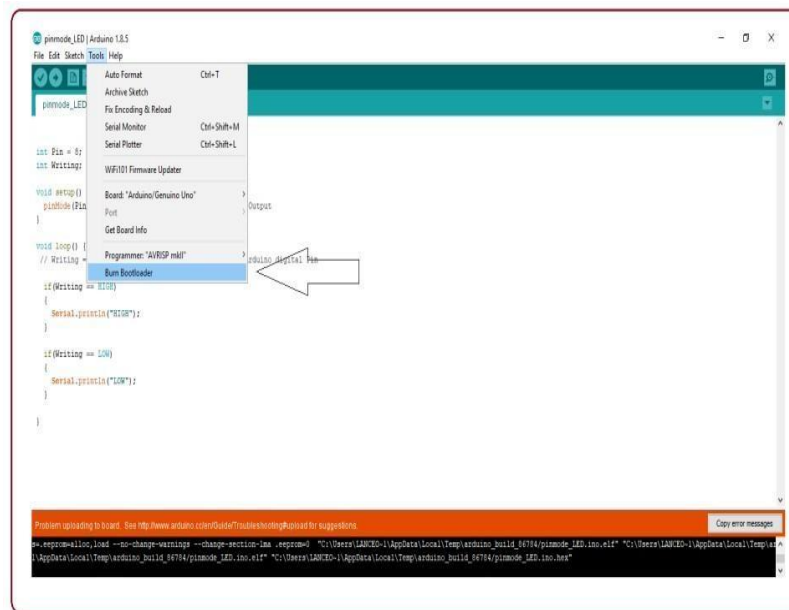


Fig 4.32 – Bootloader

When you buy the new Arduino Module, the bootloader is already installed inside the controller. However, if you intend to buy a controller and put in the Arduino module, you need to burn the bootloader again inside the controller by going to the Tools section and selecting the burn bootloader.

CHAPTER 5

RESULT AND DISCUSSION

Sensors such as soil moisture sensor, Relay, Pump. DHT11, IR (intruder detection network), GSM Module, Speaker, LCD are connected to Arduino. After the power is given the system is activated as shown in fig 5.1.

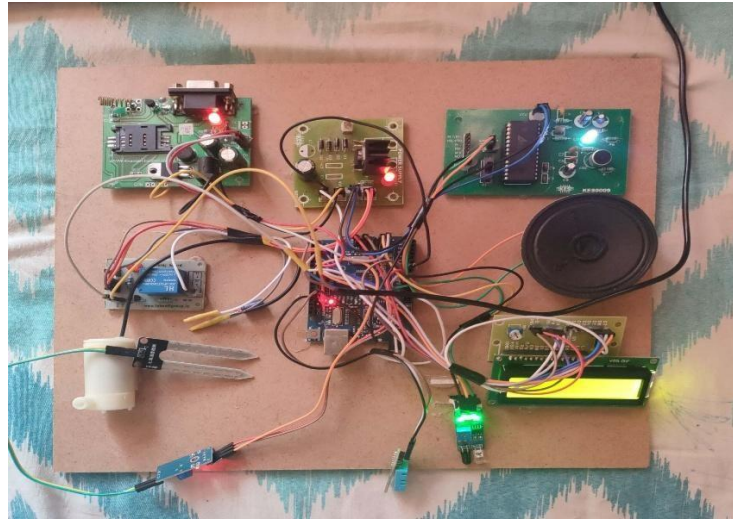


FIG 5.1 CIRCUIT BOARD

Soil moisture sensor is connected to the Arduino board and relay is connected to the Arduino and water pump. The soil moisture sensor will detect the moisture levels in the soil and it will send the signal to the Arduino, from Arduino relay gets the signals and relay automatically turn ON/OFF the pump according to the moisture levels in the soil. The temperature around the plants are detected, the temperature detected using the sensor is shown in fig 5.2.



FIG 5.2 TEMPERATURE DETECTED

By using the DTH11 sensor, the humidity levels near the plants can be detected. The sensed sensor values are displayed in LCD. The humidity values are displayed in LCD are shown in fig 5.3



FIG 5.3 HUMIDITY DETECTED

IR sensor to detect the movement of the animal and send signal to the controller. It diverts the animal by producing sound and signal further this signal is transmitted to GSM, and also it captures the images of intruded animal and send the images to our device so that we can know whether it's an wild or domestic animal, which gives an alert to farmers immediately, and be cautious while entering into the farm. Animal alert was displayed in fig 5.4. And the message alert was



FIG 5.4 ANIMAL ALERT DETECTED

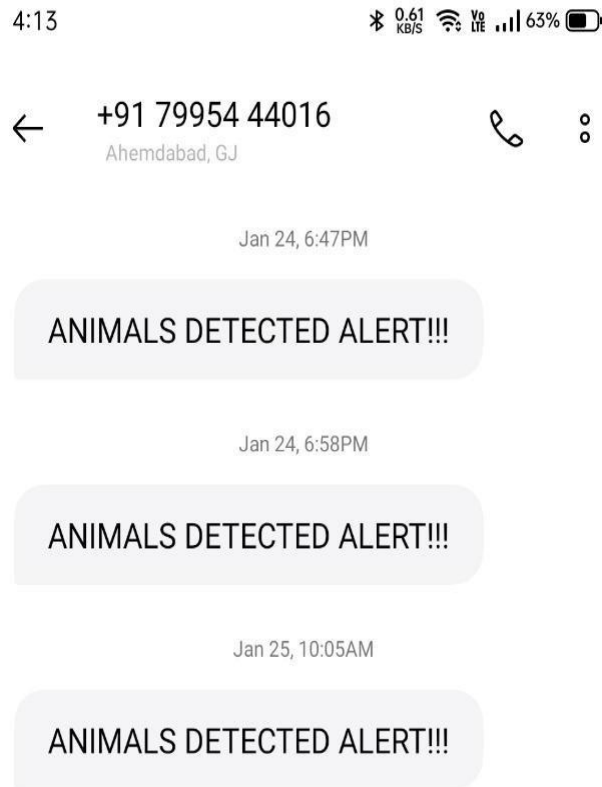


FIG 5.5 SMS ALERT TO MOBILE FROM GSM MODULE

A GSM/GPRS module is an IC or chip that utilizes a SIM (Subscriber Identity Module) and Radio Waves to interface with the GSM arrange. Basic radio frequencies are 850MHz, 900MHz, 1800MHz and 1900MHz in which a run of the mill GSM module works. Fig 5.5 represent a text box where SMS alert message the GSM module receives the signal of intusion alert from the IR sensor and delivers the intrusion message alert to the respective device connected.

CHAPTER – 04

CONCLUSION

The problem of crop vandalization by wild animals has become a major social problem in the current time. It requires urgent attention and an effective solution. Thus this project carries a great social relevance as it aims to address this problem. Hence we have designed a smart embedded farmland protection and surveillance based system which is low cost, and also consumes less energy. The main aim is to prevent the loss of crops and to protect the area from intruders and wild animals which pose a major threat to the agricultural areas. Such a system will be helpful to the farmers in protecting their orchards and fields and save them from significant financial losses.

In this study, a monitoring system for the micro-climate horticulture system is presented. An electronic sensors board is implemented to monitor air, water, and soil conditions and any intrusion of wild animal's are also detected using IR sensor then alert message is automatically sent to registered device. The results are collected into a monitoring database. This database is also be integrated with the IOT, which consists of weather data at the horticulture area. This study limitation is only on the design and development of monitoring system. By using GSM module And IR sensors, we detect the intrusion of wild animals in to the farming area which helps protecting the crop getting damaged, implementation of this monitoring system helps the farmers to have a automated irrigation system and intimidation if weather and humidity gets changed which helps to take required measures.

REFERENCES

- [1] Archana and Priya, "Design and Implementation of Automatic Plant Watering System" presented at International Journal of Science, Engineering and Technology Research (IJSETR), vol-04, Issue 11, Nov 2015.
- [2] C.H.Chavan et.al Proposed a "smart wireless sensor network for monitoring environmental parameters" using Zigbee.
- [3] G. Parameswaran proposed a "smart drip irrigation system using IOT" in which humidity, temperature and pH sensors are used. (2014) Engineering and Technology Research (IJSETR).
- [4] Joaquin Gutierrez, Juan Francisco Villa-Medina, and Alejandra Nieto-Garibay, Miguel Angel Porta-Gandara, "Automated Irrigation System Using a Wireless Sensor Network and GPRS Module", IEEE Transaction on Instrumentation and Measurement, 2013.
- [5] KaushalJani, Nivas V M, Kiruthika R and Lalitha S, "Automated drip Irrigation system", IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development, 2016.
- [6] Karan Kansara and Vishal Zaweri, "Sensor Based Automated Irrigation System with IOT" Sixth International Conference in 2012.
- [7] Nisha.G and Megala.J, "Wireless Sensor Network Based Automated Irrigation and Crop Field", Sixth International Conference on Advanced Computing ICoAC, 2014.
- [8] Pramod P. J, S. V Srikanth, Vivek N, Mahesh U Patil, Sarat Chandra Babu "Intelligent Intrusion Detection System (In2DS) using Wireless Sensor Networks", Proceedings of the 2009 IEEE International Conference on Networking, Sensing and Control, Okayama, Japan, March 26-29, 2009.

[9] Subalakshmi.R and Anu Amal, "GSM Based Automated Irrigation using Sensors" presented at Special Issue published in International Journal of Trend in Research and Development (IJTRD), March-2016.

[10] Sonali.D.Gainwar and Dinesh.V.Rojatkar "Sensor based Automated Irrigation System with IOT", International Journal of Science, Engineering and Technology Research (IJSETR), vol-04, Issue 11, Nov 2015.

[11] V.R.Balaji and M.Sudha , "Solar Powered Auto Irrigation System" presented at International Journal of Emerging Technology in Computer Science and Electronics (IJETCSE), vol-20 Issue-2, Feb-2016.