

SMART PLANTING SYSTEM USING SOLAR POWERED ROBOT

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

By

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SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING**

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INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **SHIVANGI DHANESH** (Reg. No. 38130209) and **SRINIJA KASINADHUNI** (Reg. No. 38130105) who carried out the project entitled “**SMART PLANTING SYSTEM USING SOLAR POWERED**” under our supervision from January 2022 to March 2022.

A handwritten signature in blue ink, appearing to read 'A. Sahaya', is written over the date '29/4/2022'.

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DECLARATION

We, **SHIVANGI DHANESH** (Reg. No.38130209) and **SRINIJA KASINADHUNI** (Reg. No.38130105) hereby declare that the Project Report entitled “**SMART PLANTING SYSTEM USING SOLAR POWERED ROBOT**” done by us under the guidance of **Dr.A.SAHAYA ANSELIN NISHA M.E., Ph.D.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

DATE : 29.04.2022

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ABSTRACT

In India, 23.6 percent of the state's total population depends on agriculture as their main source of income. With the ever-increasing population and poverty, the pressure on agricultural sectors is also rising. For mass production of produce, larger fields and a lot of manpower is required.

With the introduction of technology to agricultural sector farming we can reduce the pressure on farmers and also increase the yield from the field. But as most of the population depending on agriculture have very minimum income, these technologies should be cost efficient.

Here a cost efficient and sustainable robot model which can be used to manage and monitor large fields. This way it is easier for the farmer to keep an eye on the farm all the time for intruders or sudden fires. The live video of the field is directly sent to the farmer's phone.

This way larger crop fields can be managed in an easy manner without a lot of pressure on the farmers. Also crop loss due to unwanted fires or animals can be detected and stopped as soon as possible.

A prototype is executed with the help of several sensors which helps in the detection of various factors that affect the life of a crop, such as soil moisture content, sudden fire in the field or intrusion by unknown people or animals. The prototype also has a camera installed in it which sends live video of the field to the farmers' phones. Thus, the field can be monitored by the farmer with the help of wireless modules like Bluetooth and WIFI. It also has a water pumping system, if required can spray water or pesticide according to the need.

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CHAPTER 1

INTRODUCTION

Various factors affect the work of the farmers in the agriculture field, namely issues regarding soil moisture, irrigation, fire due to lightning, pests, weeds, etc. To minimize the workload of a farmer we are implementing a solar-powered mode embedded with various sensors to resolve the issue.

The proposed solution involves the design of a smart planting system using a solar power-generated robot system that is controlled by an Arduino microcontroller. Helps in monitoring the yield for agriculture purposes using IoT and digital image processing. Various types of sensors have been used in this design such as soil moisture sensor, flame sensor, and PIR sensor. To minimize the workload of the farmer, we are implementing a solar-powered model embedded with various sensors to resolve the aforementioned issue.

The control and monitoring are based on the Internet of Things due to which the actual status of the field can be monitored and controlled from any part of the world using the internet. The robot control has a camera provided to give live feedback of the field. The whole system can be controlled with the help of a BlueTooth module and an android app. It helps in the movement of the robot

The use of clean energy in engineering endeavors cannot be understated because of the energy crisis we are heading towards if hydrocarbons are not used in a sustainable manner. Considering this as the main concern, we are using a solar panel to power the whole system, so that the whole movement process followed by the power to the Arduino and sensors all goes from the panel.

1.1 AIM OF THE PROJECT

Population increase has many downsides, some of them are poverty, lack of basic needs, shelter, clothing, education, etc. It also has a great impact on the ecosystem, such as pollution. With the coming up of more and more industries and automobiles that use hydrocarbons as the source of energy, pollution has been increasing in an exponential manner. As responsible citizens, it's our duty to reduce the emission of these harmful gasses as much as possible and protect the environment

Thus it is important to switch to more sustainable and eco-friendly energy resources. India being a country that receives sunlight almost all year-round, switching to solar-based energy is very easy.

Here in this project, we are suggesting a model that runs on solar energy and has different sensors and cameras embedded into it so that farmers from different parts of the country can make use of this technology.

CHAPTER 2

LITERATURE SURVEY

Prof. S. Rajeswari (2017) Proposed a **smart agricultural model by integrating IoT, mobile and cloud-based big data analytics**. Today, the traditional database paradigm does not have enough storage space for data generated by Internet of Things (IoT) devices, leading to the need for cloud storage. This data is analyzed using big data mining techniques. IoT technology plays an important role in smart farming proof of concept. Smart or precision farming systems are believed to play an essential role in improving agricultural activities. Mobile device use is widespread for everyone, including farmers. Information and communication technologies (ICT) play a crucial role in obtaining agricultural information in the daily life of farmers. IoT has several applications in the field of digital agriculture, such as B. monitoring plant growth, fertilizer selection and decision support for irrigation. System etc In this document, the IoT device is used to collect the agricultural data and store it in the cloud database. Cloud-based big data analytics are used to analyze the data viz. Fertilizer needs, crop analysis, market and stock requirements for the crop. Then the prediction is made based on the data mining technique, the information of the mobile application. Our ultimate goal is to increase crop production and control agricultural production costs using this predicted information.

Héctor Iván Tangarife et.al (2017) Proposed **Robotic applications in the automation of agricultural production under greenhouse**. This article presents an overview of the state of the art in automating greenhouse farming through the use of robotic platforms as a source of solutions to various problems encountered in the agricultural sector, especially under controlled conditions; The paper is part of a comprehensive review of greenhouse farming automation and a series of proposals considering applications in various research areas, localized autonomous irrigation, neural networks, machine learning, monitoring and control systems, among others. It aims to identify the latest advances in planting techniques, chemical applications for

sanitation control, fertilization and harvesting, using robotics as a source to solve agricultural problems. The review includes consultations in prestigious national and international journals, research in centers and research groups or companies dedicated to implementation for the agricultural sector, to finally determine the solutions that can be implemented to propose new themes, research directions, developments and technology transfer into agriculture.

Richa Watiasih et.al (2018) Proposed Online Gas Mapping in an Outdoor Environment using Solar-Powered Mobile Robots. To monitor gas leaks it is necessary to measure the concentrations of hazardous and combustible gasses in outdoor environments such as B. Pipeline and industrial areas to map. Deploying sensor networks will require a large number of sensors over a large area. The mobile robot can be used as a sensor node that moves to map the desired area. In this study, we developed an outdoor gas concentration mapping system using a solar-powered mobile robot. The robot uses the Proportional-Integral-Derivative control method to maneuver and follow the directional set point of waypoints provided by the Global Position System. Experimental results show that using solar panels can extend the service life of the mobile robot. The results of the gas concentration mapping by the mobile robot can be viewed online on the Google Maps integrated website on both PC and smartphone.

M. Susmitha;I (2019) Proposed Solar Powered Fire Extirpation Robot with Night Vision Camera. In this article, we built a fireFighting robot with a solar-powered night vision camera. The agent is equipped with 4 sensors and 2 motors and can detect fire risk areas with the help of smoke and temperature sensors. It overcomes obstacles with an ultrasonic sensor and also identifies any living body in the affected area with a PIR sensor. Create a buzzer alarm and spray water or CO₂ by pumping it from the tank or cylinder mounted on the robot's chassis. Night vision camera can monitor all activities of the robot even in the dark

Khin Than Myaet. al (2020) Proposed A Design for IoT Based Smart Watering System Using LoRa. ASEAN countries are agricultural countries and rice is the country's staple food. Crop irrigation is an important factor in agriculture and can affect productivity and product yield. LoRa network is proposed) to promote smart farming in the country. The system collects data from the paddy field using IoT devices and data stored on the cloud server. It will design and monitor weather stations, sensor nodes, valve control nodes and a controller node based on the concept of low power topological wireless network platforms.

2.1 SUMMARY

Currently, the field of Agriculture has many new technologies coming up. Wireless Technology is undergoing unprecedented growth. Many exciting new technologies such as Wi-Fi, Bluetooth, Infrared, etc are in existence. This technology can transfer data at very good speeds. But all these technologies have their drawbacks such as limited line of sight, excessive power consumption, the possibility of signal interception during transmission, low throughput, etc.

Here in our project, we are trying to develop a sustainable as well as easy to use robot whose main aim is to develop an eco-friendly, sustainable model that helps the farmer to monitor and regulate a large agricultural field, which provides live video feedback with the help of an EPS32 camera.

CHAPTER 3

INVESTIGATION

3.1 EXISTING SYSTEM

Existing systems are based on different technologies and also focus on the generic automated irrigation system based on WSN with GSMZigBee for remote control and monitoring devices.

- The aim is to use wireless sensor networks and communication technologies such as ZigBee and GSM in the industrial field to produce a cost-effective automatic irrigation system to monitor soil conditions and reduce energy consumption.
- The system helps the farmer to monitor and control soil parameters such as air temperature, humidity, soil moisture.
- In case of anomalies, the farmer is informed and can take action remotely via GSM. Due to its lower energy consumption and low cost, the system has the potential to be useful in semi-arid or arid areas.

3.2 PROPOSED SYSTEM

The whole Arduino, Node MCU, Soil Moisture sensor, ultrasonic sensor, Flame sensor, water level sensor. The ultrasonic sensor is used to detect the animal presence on the land.

- A PIR sensor is used to detect the animals which enter farmers' land. An Arduino microcontroller is used to receive input from a variety of sensors and it can control automatically.

- When the soil moisture sensor goes low the water motor will be on and if it exceeds a defined level, the water motor will turn off automatically. When the water level is low in the well it will be automatically detected by an ultrasonic sensor and the details about the water in the well are updated on a webpage.
- The user can monitor and control parameters through the webpage. This device is very much helpful to the farmers to monitor and control environmental parameters at their farms. The farmers need not go to their farms.
- All sensor details are uploaded to the Bluetooth app with updated data.

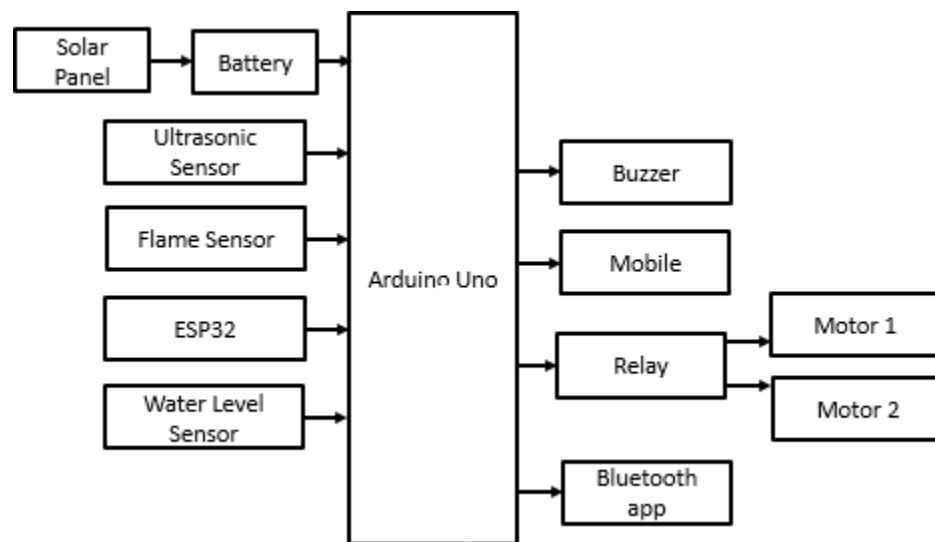


FIG 3.1: BLOCK DIAGRAM

3.3 COMPONENTS REQUIRED

- Arduino UNO Microcontroller
 - Water level sensor
 - Ultrasonic Sensor
 - Flame sensor
 - Relay

- Water motor
- Buzzer
- Solar panel
- Arduino IDE
 - Embedded C

3.4 EXISTING BLOCK DIAGRAM

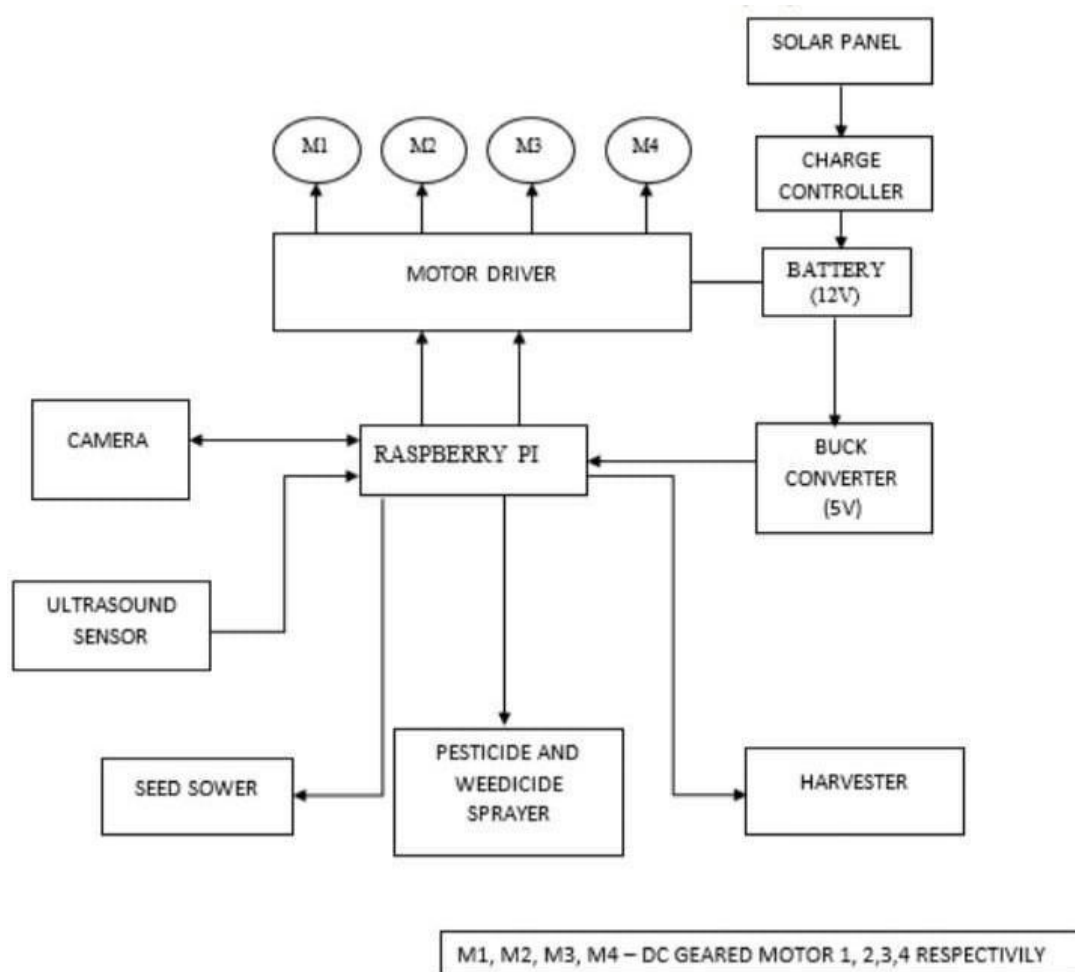


Fig 3.2: EXISTING BLOCK DIAGRAM

CHAPTER 4

HARDWARE DESCRIPTION

4.1 INTRODUCTION

This chapter mainly deals with the hardware of the project. This chapter consists of the various components used in the system, its working, and other attributes of the components. The important peripherals of the system are the various sensors and the camera(ESP32). The various sensors used in the system give us different outputs from the field and the camera used gives live video feedback directly to the farmer's phone.

4.2 ARDUINO UNO BOARD

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards and the reference model for the Arduino platform.



FIG 4.1: ARDUINO UNO BOARD

4.2.1 TECHNICAL SPECIFICATIONS

TABLE 4.1: TECHNICAL SPECIFICATIONS OF ARDUINO UNO

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage(recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 Ma
DC Current for 3.3V Pin	50 Ma
Flash Memory	32KB(ATmega328P)
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

The Arduino Uno can be powered via a USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER

connector.

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

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

5V: The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.

3V3: A 3.3 volt supply is generated by the onboard regulator. The maximum current draw is 50 mA.

GND: Ground pins.

4.2.3 MEMORY

The Atmega328 has 32 KB of flash memory for storing (of which 0,5 KB is used for the boot-loader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

4.2.4 INPUT AND OUTPUT

Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode(), digital Write(), and digital Read() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms.

In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to TTL Serial chip.

External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the `attachInterrupt()` function for details.

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

SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.

LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Uno has 6 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the `analogReference()` function.

Additionally, some pins have specialized functionality:

I2C: 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the Wire library. There are a couple of other pins on the board.

AREF: Reference voltage for the analog inputs. Used with `analogReference()`.

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

4.2.5 COMMUNICATION

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers [9]. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega8U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '8U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a *.inf file is required.

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

4.2.6 AUTOMATIC (SOFTWARE) DOWNLOAD

Rather than requiring a physical press of the reset button before an upload, the Arduino Uno is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2 is connected to the reset line of the ATmega328 via a 100 nano farad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Uno.

While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives a one-time conFIGuration or other data when it first starts, makes sure that the software with which it communicates waits for a second after opening the connection and before sending this data. The Uno contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line.

4.2.7 USB OVERCURRENT PROTECTION

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

4.2.8 PHYSICAL CHARACTERISTICS

The maximum length and width of the Uno PCB are 2.7 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Three screw holes allow the board to be attached to a surface or case. Note that the distance between digital pins 7 and 8 is 160 mil (0.16"), not an even multiple of the 100 mil spacing of the other pins.

4.2.9 OFFICIAL BOARDS

- Arduino Mega
- Arduino Leonardo
- Lilypad Arduino (rev 2007)
- Arduino Due (ARM-based)
- Arduino Nano

4.3 ATMEGA 328

The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general-purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer



FIG 4.2: ATMEGA 328

and five software selectable power saving modes. The device operates between 1.8 and 5.5 volts. The device achieves throughputs approaching 1 MIPS per MHz.

4.3.1 KEY PARAMETERS

TABLE 4.2: KEY PARAMETER

PARAMETER	VALUE
FLASH	32KB
RAM	2KB
PIN COUNT	28
MAX OPERATING FREQUENCY	20MHz
CPU	8-BIT AVR
EXT INTERRUPT	24
USB INTERFACE	NO

4.3.1 PIN DIAGRAM

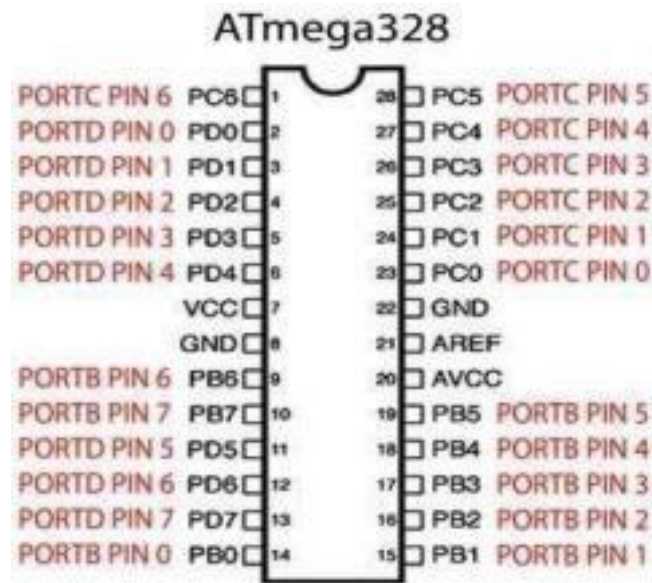


FIG 4.3: ATMEGA 328 PIN CONFIGURATION

VCC - Digital supply voltage

GND - Ground

4.3.2 PIN DESCRIPTION

Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit. Depending on the clock selection fuse settings, PB7 can be used as output from the inverting Oscillator amplifier. If the Internal Calibrated RC Oscillator is used as chip clock source, PB7..6 is used as TOSC2..1 input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each

bit). The PC5..0 output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C. If the RSTDISBL Fuse is unprogrammed, PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running.

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

AVCC is the supply voltage pin for the A/D Converter, PC3:0, and ADC7:6. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter. AREF is the analog reference pin for the A/D Converter. In the TQFP and QFN/MLF package, ADC7:6 serve as analog inputs to the A/D converter. These pins are powered from the analog supply and serve as 10-bit ADC channels.

4.3.3 APPLICATIONS

Today the ATmega328 is commonly used in many projects and autonomous systems where a simple, low-powered, low-cost microcontroller is needed. Perhaps the most common implementation of this chip is on the popular Arduino development platform, namely the Arduino Uno and Arduino Nano models.

4.4 WATER LEVEL SENSOR



FIG 4.4: WATER LEVEL SENSOR

Water sensor. The water sensor or water level sensor is used to detect water leaks, rain, tank overflow or to measure the water level.

- This sensor works on the principle of variable resistance. The sensor consists of a series of parallel exposed conductors. Together, this series acts as a variable resistor, the resistance value of which varies depending on the water level in the water tank.
- The deeper the sensor is immersed in water, the better the conductivity and the lower the resistance. The less the sensor is immersed in water, the poorer the conductivity and the higher the resistance.
- The output of the water level sensor is a function of the resistance of the water produced. That is, a voltage proportional to the resistance is generated.

4.4.1 SPECIFICATIONS

- Operating voltage: DC3-5V.

- Operating current: less than 20mA.
- Sensor Type: Analog.
- Detection Area: 40mmx16mm.
- Operating temperature: 10°C-30°C
- Humidity: 10% -90% non-condensing.

4.5 ULTRASONIC OR ULTRASOUND SENSOR

Ultrasonic sensors are devices that use electrical-to-mechanical energy conversion, where the mechanical energy is in the form of ultrasonic waves, to measure the distance from the sensor to the target object. Ultrasonic waves are longitudinal mechanical waves that propagate through the medium as a series of compressions and rarefactions along the direction of wave propagation. Any sound wave above the human hearing range of 20,000 Hz is called ultrasound. Based on the type of application, the frequency range has been broadly categorized as shown in the Figure below.

When ultrasonic waves are incident on an object, diffused reflection of the energy takes place over a wide solid angle which might be as high as 180 degrees. Thus some fraction of the incident energy is reflected back to the transducer in the form of echoes and is detected. The distance to the object (L) can then be calculated through the speed of ultrasonic waves (v) in the medium by the relation

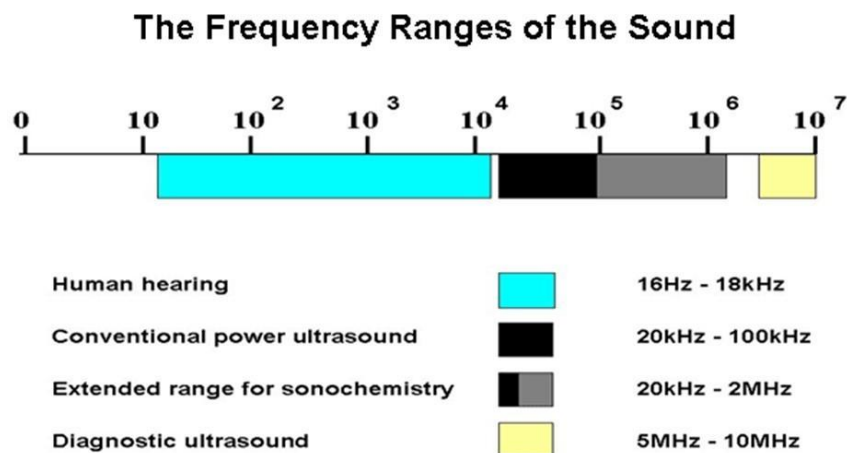


FIG 4.5: FREQUENCY RANGES OF THE SOUND IN UV SENSOR



FIG 4.6: ULTRASONIC SENSOR

4.6 RELAY

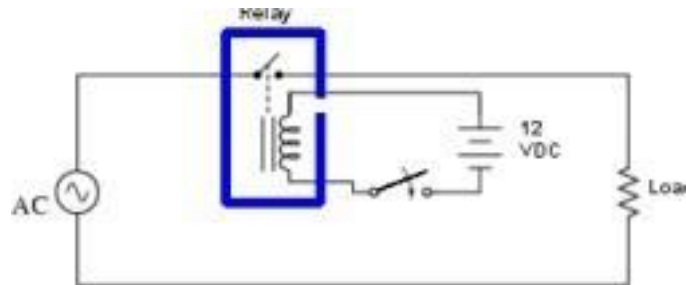


FIG 4.7: RELAY CIRCUIT

A relay is usually an electromechanical device that is actuated by an electrical current. The current flowing in one circuit causes the opening or closing of another circuit. Relays are like remote control switches and are used in many applications because of their relative simplicity, long life, and proven high reliability. Relays are used in a wide variety of applications throughout industry, such as in telephone exchanges, digital computers and automation systems. Highly sophisticated relays are utilized to protect electric power systems against trouble and power blackouts as well as to regulate and control the generation and distribution of power.

In the home, relays are used in refrigerators, washing machines and dishwashers, and heating and air-conditioning controls. Although relays are generally associated with electrical circuitry, there are many other types, such as pneumatic and hydraulic. Input may be electrical and output directly mechanical, or vice versa.

4.6.1 WORKING OF RELAY

All relays contain a sensing unit, the electric coil, which is powered by AC or DC current.

When the applied current or voltage exceeds a threshold value, the coil activates the armature, which operates either to close the open contacts or to open the closed contacts. When a power is supplied to the coil, it generates a magnetic force that actuates the switch mechanism. The magnetic force is, in effect, relaying the action from one circuit to another. The first circuit is called the control circuit; the second is called the load circuit. There are three basic functions of a relay: On/Off Control, Limit Control and Logic Operation.

On/Off Control: Example: Air conditioning control, used to limit and control a—high power load, such as a compressor.

Limit Control: Example: Motor Speed Control, used to disconnect a motor if it run slower or faster than the desired speed
Logic Operation: Example: Test Equipment, used to connect the instrument to a number of testing points on the device under test

4.6.2 CHANNEL RELAY MODULE

This is a 4-Channel Relay interface board that allows you to control various appliances, and other equipments with large current. It can be controlled directly by Micro-controller (Arduino, Raspberry Pi, 8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic).

4.6.3 SPECIFICATIONS

- 4-Channel Relay interface board, and each one needs 15-20mA Driver Current.
- Both controlled by 12V and 5V input Voltage
- Equipped with high-current relay, AC250V 10A; DC30V 10A
- Standard interface that can be controlled directly by microcontroller (Arduino, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic active low)
- Opto-isolated inputs and
- Indication LED's for Relay output status.

4.7 FLAME SENSOR



FIG 4.8: FLAME SENSOR

A flame detector is a sensor designed to detect and respond to the presence of a flame or fire.

- Responses to a detected flame are facility dependent but may include activating an alarm, disabling a fuel line (such as a propane or natural gas line), and activating a fire suppression system.
- When used in applications such as industrial furnaces, their function is to confirm that the furnace is properly fired; In these cases, they take no direct action other than notifying the operator or control system.

Specifications

- Nominal Sensitivity: 1.5 %/ft
- Operating Voltage: 8.5 - 35 VDC (24 VDC nominal)
- Operating
- Temperature: 32° to 120° F (0° to 49° C)
- Operating Humidity: 10 % - 93 % relative humidity

- Air Velocity: 1,200 FPM
- Altitude: 10,000 ft.
- Construction: Off-white flame retardant plastic
- Diameter: 6.2 inches (15.7 cm)
- Height: 3.2 inches (8.1 cm)
- Weight: 0.5 lb (277 g)

4.8 DC MOTOR

In a dc motor, the stator poles are supplied by dc excitation current, which produces a dc magnetic field. The rotor is supplied by DC current through the brushes, commutator and coils. The interaction of the magnetic field and rotor current generates a force that drives the motor. The magnetic field lines enter into the rotor from the north pole (N) and exit toward the south pole (S). The poles generate a magnetic field that is perpendicular to the current carrying.

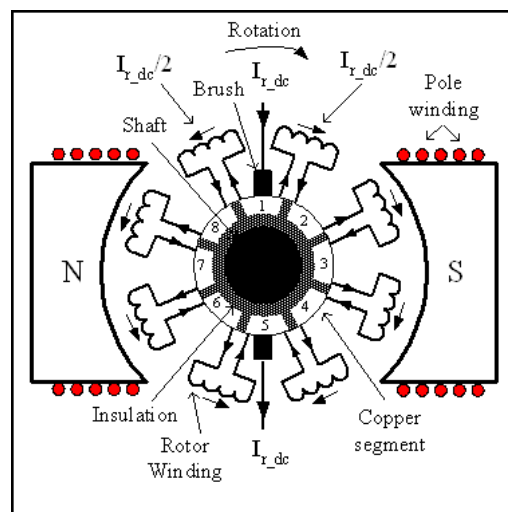


FIG 4.9: DC MOTOR

DC Motor Equivalent circuit: The following Figures show the equivalent circuit of a separately excited dc motor. Equivalent circuit is similar to the generator only the current directions are different. The operation equations are:

Armature voltage equation

$$V_{dc} = E_{am} + I_{am} R_a + V_{brush}$$

The induced voltage and motor speed vs angular frequency

$$\omega = 2\pi n_m$$

$$E_{am} = K_m I_f \omega$$

The combination of the equations results in

$$K_m I_f \omega = E_{am} = V_{dc} - I_{am} R_m$$

The current is calculated from this equation. The output power and torque are:

$$P_{out} = E_{am} I_{am} \quad T = \frac{P_{out}}{\omega} = K_m I_{am} I_f$$

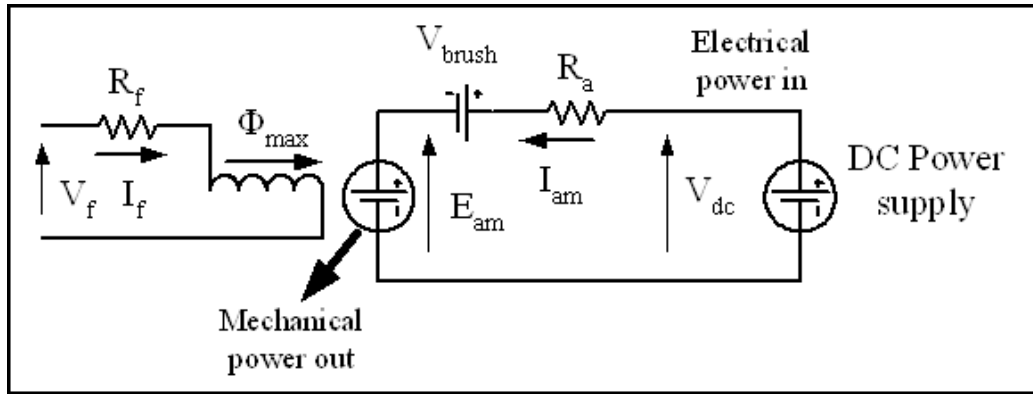


FIG 4.10: DC MOTOR WORKING

4.9 WATER PUMP

DC 3-6 V Mini Micro Submersible Water Pump is a low cost, small size Submersible Pump Motor which can be operated from a 2.5 ~ 6V power supply. It can take up to 120 liters per hour with a very low current consumption of 220mA. Just connect the tube pipe to the motor outlet, submerge it in water and power it.

Specifications

- Operating Voltage : 3 ~ 6V.
- Operating Current : 130 ~ 220mA.
- Flow Rate : 80 ~ 120 L/H.
- Maximum Lift : 40 ~ 110 mm.
- Continuous Working Life : 500 hours.
- Driving Mode : DC, Magnetic Driving.
- Material : Engineering Plastic.
- Outlet Outside Diameter : 7.5 mm.

4.10 SOLAR PANEL

- A panel designed to absorb the sun's rays as a source of energy for generating electricity or heating.
- Simply put, a solar panel works by allowing photons, or particles of light, to knock electrons free from atoms, generating a flow of electricity. Solar panels actually comprise many, smaller units called photovoltaic cells.
- The most commonly used solar technologies for homes and businesses are solar photovoltaics for electricity, passive solar design for space heating and cooling, and solar water heating. Businesses and industry use solar technologies to diversify their energy sources, improve efficiency, and save money.

4.11 SOFTWARE REQUIREMENTS

- Arduino IDE
- Embedded C

4.11.1 ARDUINO IDE

Arduino IDE(Integrated Development Environment) is the software for Arduino. It is a text editor like a notepad with different features. It is used for writing code, compiling the code to check if any errors are there and uploading the code to the Arduino. It is a cross- platform software which is available for every Operating System like Windows, Linux, macOS. It supports C/C++ language. It is open-source software, where the user can use the software as they want it to. They can also make their own modules/functions and add them to the software. It supports every available Arduino board including Arduino mega, Arduino Leonardo, Arduino Ethernet and more. A Word file is called a Document similarly, an Arduino file is called a **Sketch** where the user writes code. The format of Arduino is saved as **.ino**

When a user writes code and compiles, the IDE will generate a Hex file for the code.

(Hex files are Hexadecimal files which are understood by Arduino) and then sent to the board using a USB cable. Every Arduino board is integrated with a microcontroller; the microcontroller will receive the hex file and run as per the code written.

Arduino IDE consists of different sections

1. WindowBar
2. MenuBar
3. ShortcutButtons
4. Text Editor
5. Output Panel

Window Bar:

The window bar consists the name of File and the Arduino IDE software version

Menu Bar:

The menu bar consists of

- File
- Edit
- Sketch
- Tools
- Help

File:

- **New**
It creates a new File. **(Ctrl+N)**
- **Open**
It is used to open the file which was saved before. **(Ctrl+O)**
- **Open Recent**
It shows the shortlist of Recently opened programs.
- **Sketchbook**
Shows the current sketches which you have used for your project
- **Examples**

Examples of a few basic problems for reference.

- **Close**
Closes the main screen window. **(Ctrl+W)**
- **Save**
It is used to save the current sketch. **(Ctrl+S)**
- **Save as...**
Allows saving the current sketch with a different name. **(Ctrl+Shift+S)**
- **Page Setup**
Page settings for modifying the page(Text). **(Ctrl+Shift+P)**
- **Print**
Used to print the current program. **(Ctrl+P)**
- **Preferences**
Settings of the IDE software can be changed here. **(Ctrl+,)**
- **Quit**
Closes all IDE windows. **(Ctrl+Q)**

Edit:

- **Undo/Redo**
Goes back to one or more steps you did while editing.
- **Cut**
Cuts the selected text from the editor.
- **Copy**
Copies the selected text from the editor
- **Copy for Forum**
It copies and changes the style of code suitable for the forum.
- **Copy as HTML**
It copies and changes the style of code suitable for the Html.
- **Paste**
It pastes the text from the copied text.
- **Select All**
Select's all the content from the editor.
- **Comment/Uncomment**

It is used to comment and uncomment selected lines of code.

- **Increase/Decrease Indent**

Adds or removes a space at the beginning of each selected line

- **Find**

Finds the typed text in the editor

- **Find Next**

Finds the next position of the searching word.

- **Find Previous**

Finds the previous position of the searching word.

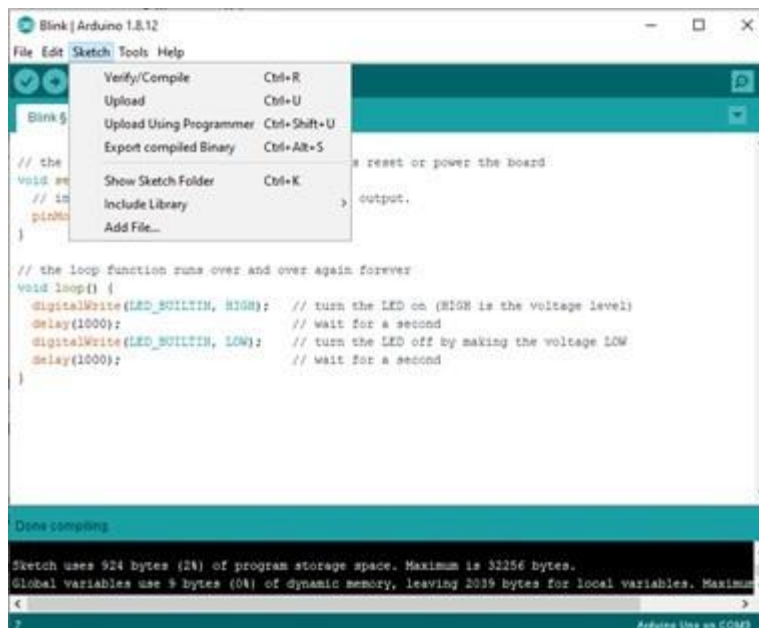


FIG 4.11: SKETCH

- **Verify/Compile**

Checks or verifies your program if any error is there, and displays in the output panel.

- **Upload**

It compiles and also uploads the code to the Arduino board.

- **Upload Using Programmer**

Uploads code using Programmer which is available in Tools Tab.

- **Export Compiled Binary**

Saves a .hex file in the System

- **Show Sketch Folder**

Open the current sketch folder.

- **Include Library**

Adds a library to your sketch by inserting #include statements at the start of your code

- **Add File...**

Adds a file to the sketch and the new file appears in a new tab in the window.

Tools

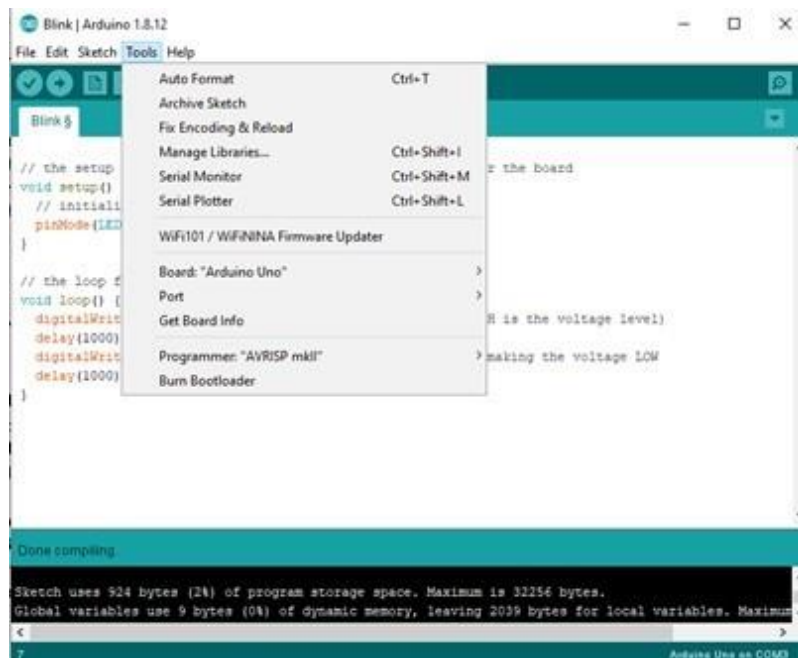


FIG 4.12: TOOLS

- **Auto Format**

This option formats your code to a nice format so everyone can understand.

- **Archive Sketch**

Copies the code into winrar format(.zip)

- **Fix Encoding & Reload**

Fixes possible discrepancies between the editor char map encoding and other operating systems char maps.

- **Serial Monitor**

Serial monitor shows the visual communication by sending and receiving data

- **Board**

To select the type of Arduino Board

- **Port**

To select the port where you have connected the Arduino

- **Programmer**

For selecting a hardware programmer when programming a board or chip and not using the USB type of communication.

- **Burn Bootloader**

It is used to burn bootloader to the Arduino board

Output panel:

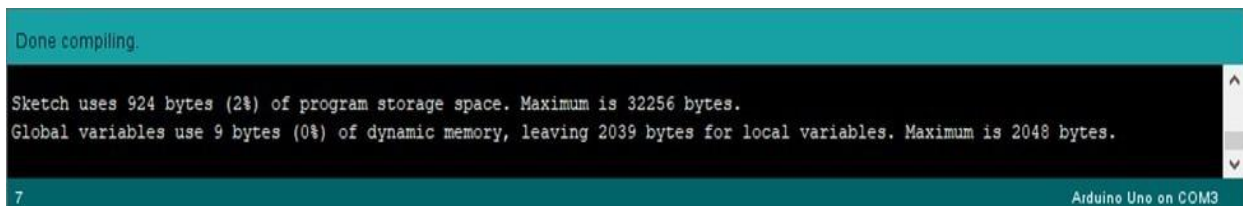


FIG 4.13: OUTPUT PANEL

This output panel is used to give comments about the code

- if the code is successfully compiled or any error occurs.
- If the code has been successfully uploaded to the board.

4.11.2 EMBEDDED C

Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different embedded systems. Embedded C programming typically requires nonstandard extensions to the C language in order to support enhanced microprocessor features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations. In 2008, the C Standards Committee extended the C language to address such capabilities by providing a common standard for all implementations to adhere to.

It includes a number of features not available in normal C, such as fixed-point arithmetic, named address spaces and basic I/O hardware addressing. Embedded C

uses most of the syntax and semantics of standard C, e.g., `main()` function, variable definition, data type declaration, conditional statements (if, switch case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, etc.

A Technical Report was published in 2004 and a second revision in 2006.

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 BLUETOOTH CONTROLLER APP

The app is used for the movement of the robot alongwith providing sensor output. The Arduino BlueControl app is easy and convenient to use and can be easily downloaded from the google play store. We can control the robot with buttons and sliders or voicenotes, but in this project we are limiting to buttons and sliders.

The terminal tab gives the sensor output. Given below is the homepage of the aforementioned app that has been used for executing this project

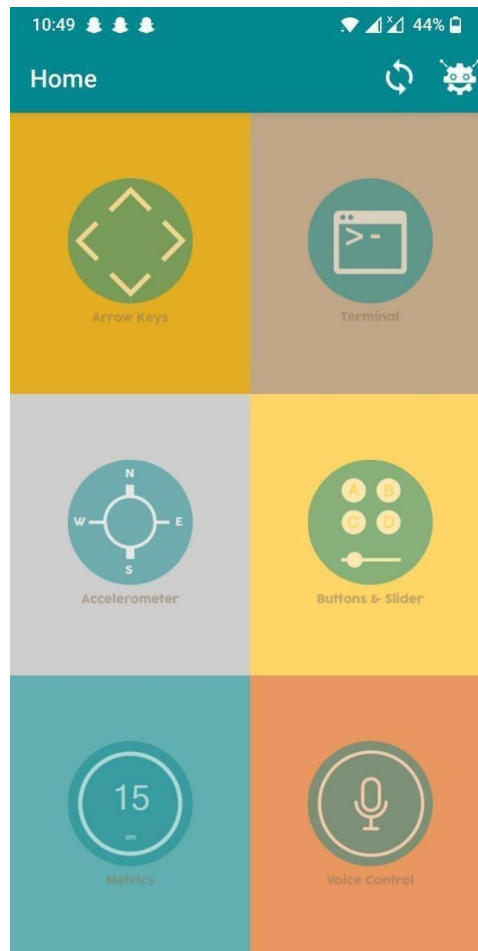


FIG 5.1: BLUETOOTH APP INTERFACE

5.2 CAMERA

Here we are using ESP32 camera which is being attached to the front of the robot. To enable wireless connectivity between the camera and the phone of the user, mobile hotspot is used. The IP address of the livestream page can be searched through the address bar of any browser to give the livestream page as shall be illustrated underneath. However, as of now, the IP address shall only be executed in Google Chrome and Mozilla Firefox browsers.

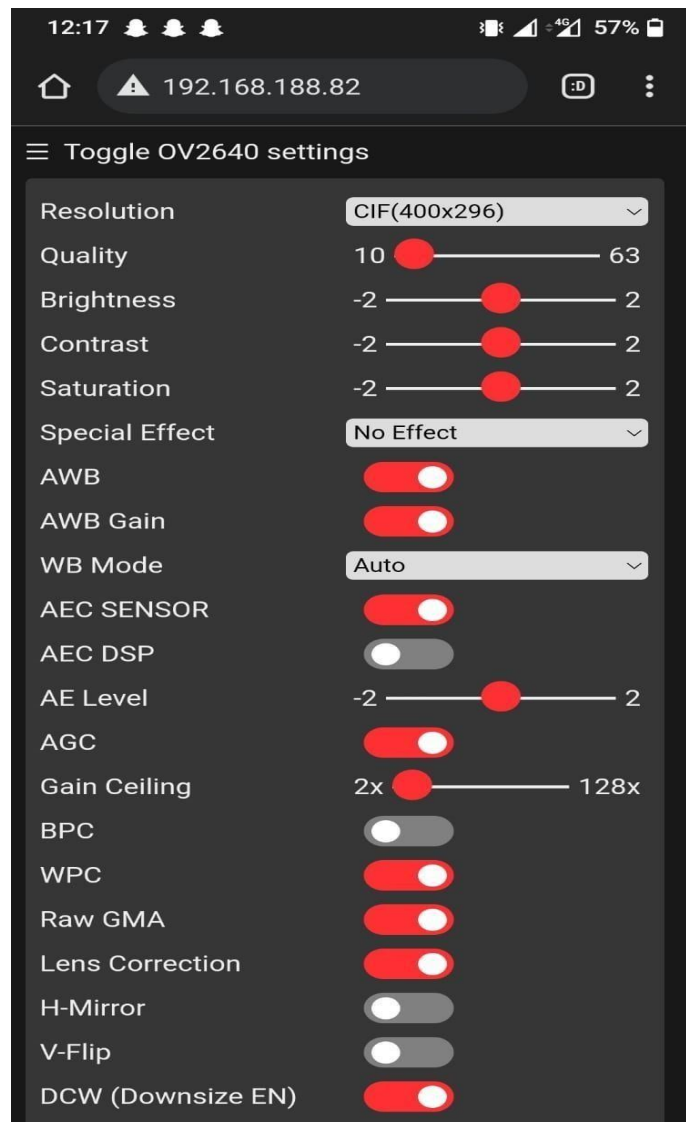


FIG 5.2: LIVESTREAM VIDEO HOME PAGE

5.3 OUTPUT

Numerous factors have been affecting the workload of farmers in the agriculture field, including soil moisture, irrigation, pests, weeds, etc. The solar-powered robotic system with four wheels is designed to reduce the manual effort of a farmer by integrating various sensors embedded within the solar-powered model in order to reduce the work involved in resolving the aforementioned problem.

Given below are the screenshots of the output:

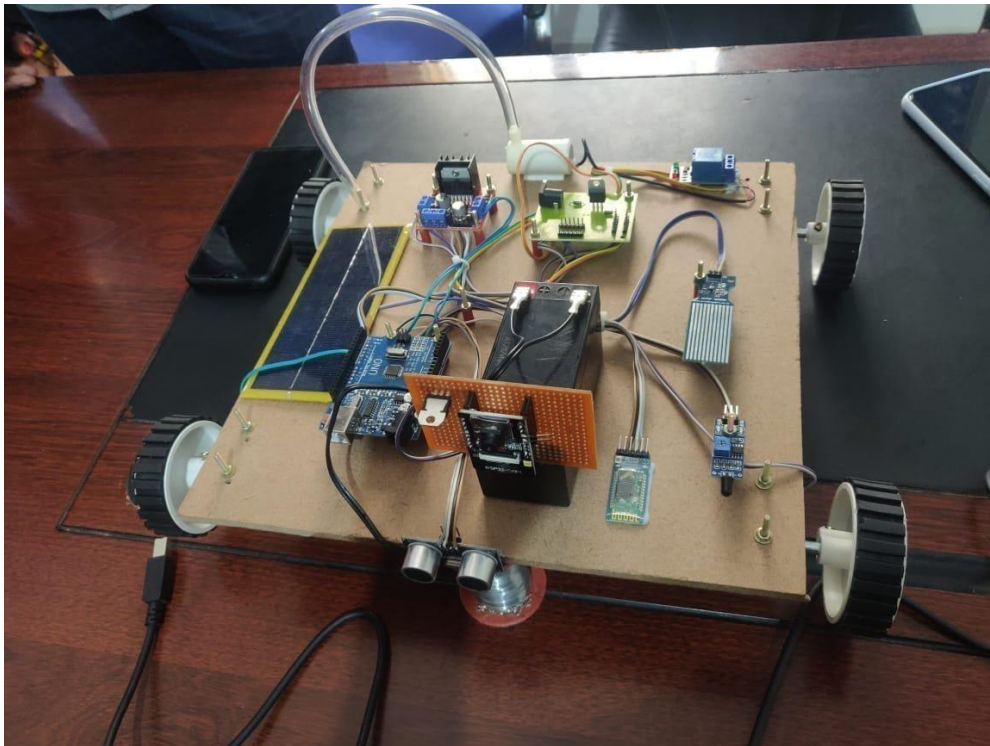


FIG 5.3: ARCHITECTURE OF THE PROTOTYPE

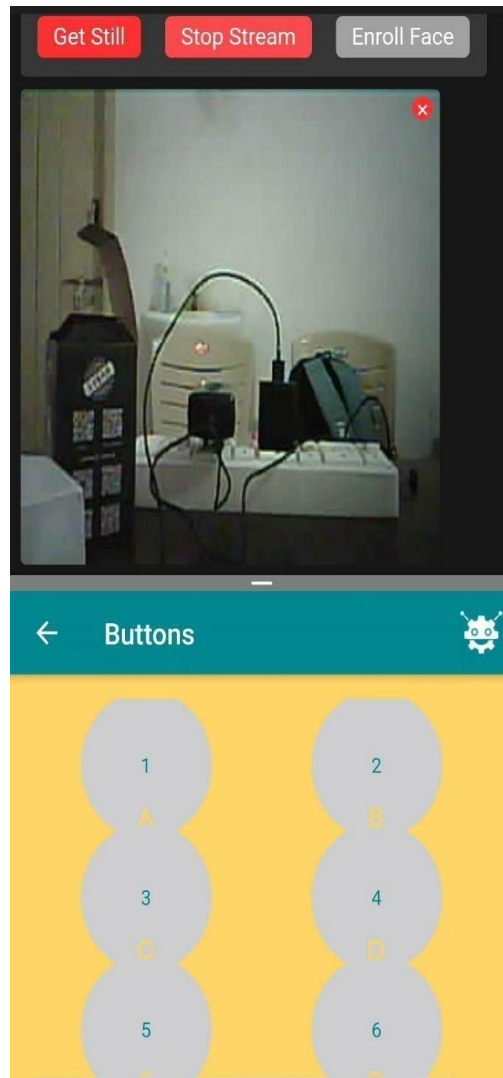


FIG 5.4: CONTROL SYSTEM OF THE APP WITH THE LIVE VIDEO

The above image is a screenshot of the control system of the app along with a live stream of the video. Here the buttons 1, 2, 3, 4, 5, and 6 are pressed for forward, backward, left, right, stop, and water pumping action respectively, along with the video which is visible on chrome when the IP address is fed to the address bar.



FIG 5.5: TERMINAL SCREENSHOT FROM THE BLUETOOTH INTERFACE

The terminal option on the Bluetooth app gives the output generated by the sensors. As we can see above, the soil moisture is shown zero since the sensor is in no contact with the soil, and the flames sensor shows 1 as no fire is detected. Furthermore, the ultrasonic sensor output is shown in centimetres.

CHAPTER 6

CONCLUSION

6.1 CONCLUSION

Over the years we have seen a huge development in a lot of sectors in our country. Agriculture being one of the main incomes of 70% of the Indian economy, development in this sector is very important. It plays a critical role in transforming economies to reach the goal alone with achieving other essential development goals. With depletion of non-renewable resources, it's important to come up with more eco-friendly inventions.

Solar powered robots are the best way to maintain and manage a very large field as it is powered from the sun directly. They extract electrical energy stored in the batteries to run its electrical and electronic devices to perform several tasks for industrial as well as commercial work.

Also using such robots can improve the crop production and gives the farmer detailed information about the crops, mapping the yield and identifying problematic areas as it takes care of the minute details and reports everything to the farmer.

Thus, in this prototype we are developing an eco-friendly and suitable model which not only is less harmful to the environment but also cost effective as it does not require other power sources to recharge it again and again. Also, the sensors used in the system are easily available and economical which makes the system more reliable.

6.2 FUTURE SCOPE

- Face recognition features can be added to camera so that if any intruder comes into the field the message reaches the farmer.
- Pest and weed detection features can be added and then program the robot to spray pesticide/ weedicide as required
- A harvesting mechanism can also be added so that the robot can harvest the crop whenever ready, so it doesn't start rotting.

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