INTELLIGENT GREENHOUSE IRRIGATION SYSTEM

Dissertation submitted in partial fulfillment of the requirement for the degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

BY

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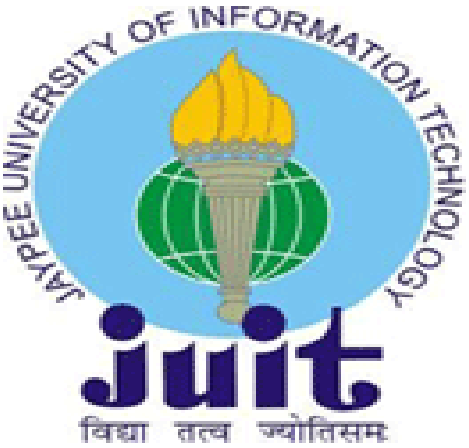
UNDER THE GUIDANCE OF

MR. MUNISH SOOD

(ASSISTANT PROFESSOR)

To



JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

May, 2018

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DECLARATION BY THE STUDENTS

We hereby declare that the work reported in the B.Tech. thesis entitled "**INTELLIGENT GREENHOUSE IRRIGATION SYSTEM"** submitted at **Jaypee University of Information Technology**, Waknaghat India, is an authentic record of my work carried out under the supervision of Mr. Munish Sood . We have not submitted this work elsewhere for any other degree or diploma.

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May, 2018

SUPERVISOR'S CERTIFICATE

This is to verify that the work reported in the B.Tech. thesis entitled "**INTELLIGENT GREENHOUSE IRRIGATION SYSTEM"** submitted by **Aman Patel(141028) , Amritya Pradeep(141033) , Abhinav Sharma(141037)** at **Jaypee University of Information Technology ,Waknaghat ,India** is a bonafide record of their original work carried out under my supervision. This work has not been submitted elsewhere for any other degree.

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CERTIFICATE

This is to certify that the work reported in the B.Tech project report entitled "…… "which is being submitted by …….. in fulfillment for the award of Bachelor of Technology in Electronics and Communication Engineering by the Jaypee University of Information Technology, is the record of candidate's own work carried out by him/her under my supervision. This work is original and has not been submitted partially or fully anywhere else for any other degree or diploma.

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ACKNOWLEDGEMENT

We are very grateful and highly acknowledge the continuous encouragement, invaluable supervision, timely suggestions and inspired guidance offered by our guide Mr. Munish Sood, Department of Electronics and Communication Engineering, Jaypee University of Information Technology Waknaghat in bringing this report to a successful completion.

We are grateful to Dr. Samir Dev Gupta, Head of the Department of Electronics and Communication Engineering, for permitting us to make the use of the facilities available in the department to carry out the project successfully.

At the last we express our sincere thanks to all of our teachers and friends who have patiently extended all sorts of help for accomplishing this undertaking.

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ABSTRACT

In the field of agriculture, to grow a plant we require many parameters upon which our plants is dependent like plant temperature, light, water need, nutrients so we have to monitor them from time to time. If all these factors are in correct ratio then the productivity of those plants is increased. Hence, to control these parameters we present this "**INTELLIGENT GREENHOUSE IRRIGATION SYSTEM"**.

Command is given to the control system to evaluate plant parameters & according to need, it will perform the action & whole process report will be received by the user. This project saves extra water consumed by plant, save time, save efforts & work according to soil condition. Moto of this project is to design an automatic circuit which monitor & record the value of parameters of crops, & controlled in order to achieve maximum plant growth & yield.

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CHAPTER 1

INTRODUCTION

1.1 AUTOMATED GREEN HOUSE SYSTEM

Greenhouse is a structure made to regulate the external factor like temperature, sunlight, pressure, humidity, amount of water. We use greenhouse for better growth of plants. But this is possible only when we control its factor & if we aren't able to control the parameter of it then we don't get desired output & to get the desired output we have to control its parameters like temperature, humidity, light, & amount of water which they need to grow properly. Hence to achieve it we designed "Automatic Green House Controlling &Monitoring over Bluetooth module using Arduino".

It is used for growing various types of vegetables, flower, & crops such as tomatoes are generally used for commercial production. And in order to produce it in large quantity, it takes a lot of hard work, water, labor, & time.

We designed our system such that it will reduce the time of caretaker & their hard work. By using phone Bluetooth we can control the motion of our vehicle which is used here for checking whether a plant needs water or not. To check this we use soil moisture sensor, photodiode which is on vehicle track, IR LED and then pump water if a plant needs water & then move on to next plant. In agriculture field, we don't know about how much water plants need. Sometimes we put more than water, & sometimes we don't even fill the thresh-hold limit by which our plants don't grow in proper ways. So our system provides this benefit by a soil sensor. It measures the moisture level of soil & measure whether it demands for water or not. In this way we can also save the water from wastage.

In this project, we use various hardware component like Arduino UNO, Bluetooth module, DC motor, sensors etc.

1.2 MOTIVATION

The purpose of this project is to introduce a low-cost robotic system that can be used in plant nurseries for watering the potted plants, to take proper care of watering needs of plants and to reduce human effort in plant nurseries. We have developed a system to water plants which control the parameter of a plant. The system involves a water pump and a soil moisture sensing system. This project also discusses about the system with its complete circuitry.

As we know agriculture is about 17% of the total GDP of India, to increase the GDP in agriculture we need a system which can save the time of users & give the desired result. According to this year's economic survey, our agriculture sector growth rate only 4.2%. To give boost-up in GDP of Indian agriculture we put a system through which we can increase the production of food.

And recently India got the rank of 100th place in Global Hunger Index in the entire world by the International Food Policy Research Institute, which shows very poor condition in the sector of food.

So overall, to put a good image of our country & to compete with other countries we need to increase the growth of service industries & agricultural rate.

1.3 OBJECTIVES

- To spare water, cash & man control within the horticulture division
- To solve the labor problem.
- Save the farmer time.
- The plan, which is able be effective & exertion diminishing for the agriculturists
- Improve the soil ripeness by doing –work concurring to soil condition
- System can be exchanged into manual mode at whatever point required
- Contribute in GDP in smart way

CHAPTER-2

HARDWARE DESCRIPTION

2.1 ARDUINO

Arduino is an item association, associated with project making, and venture for people use that fabricates and manufactures computerized hardware and gadgets, free to use, and microcontroller-based packs for producing digital devices and instinctive objects that can identify and control physical devices.

The endeavor undergrad venture relies on the microcontroller board traces, created by engineers, utilizing distinctive sorts of microcontrollers. These frameworks give sets of computerized and simple info and yield sticks that would interface be able to different sensors and power required machine and other hardware frameworks. The board highlights serial correspondence convention interface, including Universal Serial Bus (USB) on a few models, for transferring and downloading programs from PCs. For programming the microcontrollers, the arduino modules give a coordinated improvement condition (IDE) in light of a programming dialect named Processing, which additionally underpins the fundamental programming dialects i.e. C and C++.

The Mega is a microcontroller outline that is dependent upon the microprocessor inside i.e. AT mega one hundred and twenty eight. It has 54 digital input/output pins (of which 14 pin can be used as (pulse width modulated outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a "16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button". It is having everything that is /needed to support the microcontroller/processor; simply connect it to computing devices like computing with a USB/data cable or power it with a AC-to-DC adapter (charging devices) or battery to get in working state. The Mega is compatible with most shields designed for the Arduino developed projects.

Figure 2.1: Arduino

2.1.1 FEATURES

Table 2.1: Features of arduino

Microcontroller	ATmega1280
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	128 KB
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHZ(crystal oscillator speed)

An Arduino board verifiably comprises of an Atmel 8, 16 or 32 bit AVR microcontroller with correlative segments that encourage programming and fuse into different circuits. A critical part of the arduino is its standard connectors, which gives clients a chance to associate the CPU board to an assortment of tradable extra modules known as shields. A few shields speak with the arduino board straightforwardly finished different pins, however numerous shields are exclusively addressable through an I^2C serial transport.

2.1.2 WHY ARDUINO?

- The Arduino programming is particularly simple to-use for learners, yet sufficiently versatile for cutting edge clients. it keeps running on numerous product like Mac, Windows, and Linux. Instructors and understudies utilize it to assemble ease logical instruments, to demonstrate science and material science rule, or to begin with programming and mechanical technology. Originators and draftsmen construct intelligent models, artists and craftsmen utilize it for establishments and to explores different avenues regarding new melodic instruments. There are numerous different microcontrollers and microcontroller stages accessible for physical registering. The majority of alternate instruments take the parcels subtle elements of microcontroller programming and wrap it up in a simple to-utilize bundle. Arduino additionally rearranges the way toward working with microcontrollers, yet it offers some favorable position for instructors, understudies, and intrigued beginners over different frameworks.

• Inexpensive - Arduino sheets are generally cheap contrasted with other microcontroller stages. The slightest costly form of the Arduino module can be amassed by hand, and even the pre-gathered Arduino modules cost under $50

• Cross-stage - The Arduino Software (IDE) keeps running on so working framework like Windows, Macintosh OSX, and Linux. Most microcontroller frameworks are restricted to Windows.

• Simple, clear programming condition - The Arduino Software (IDE) is anything but difficult to-use for amateurs, yet sufficiently adaptable for cutting edge clients to exploit also. For educators, it's helpfully in light of the Processing programming condition, so understudies figuring out how to program in that condition will be comfortable with how the Arduino IDE functions.

• Open source and extensible programming - The Arduino programming is distributed as open source instruments, accessible for augmentation by experienced software engineers. The dialect can be extended through C++ libraries, and individuals needing to comprehend the specialized points of interest can make the jump from Arduino to the AVR C programming dialect on which it's based. Also, you can include AVR-C code specifically into your Arduino programs in the event that you need to.

• Open source and extensible equipment - The designs of the Arduino sheets are distributed under a Creative Commons permit, so experienced circuit creators can make their own particular form of the module, expanding it and enhancing it. Indeed, even moderately unpracticed clients can manufacture the breadboard adaptation of the module so as to see how it functions and spare cash.

2.2 SOIL MOISTURE SENSOR

The sensors which are used to measures the water content of soil are called soil moisture sensors. It is important to know when to water and how much to water constantly for the better production. It reduces the work of farmer by regularly measuring the water content from production to harvesting of crops. Water management can be done properly with the help of SOIL MOISTURE SENSOR.

2.2.1 SPECIFICATIONS

- Range: threshold value lies between 30 to 40.
- Correctness : -4 to +4
- Predictable Resolution: 0.1%

- Power: 3 mA at the rate of 5VDC
- Operational temperature: –40°C to +60°C

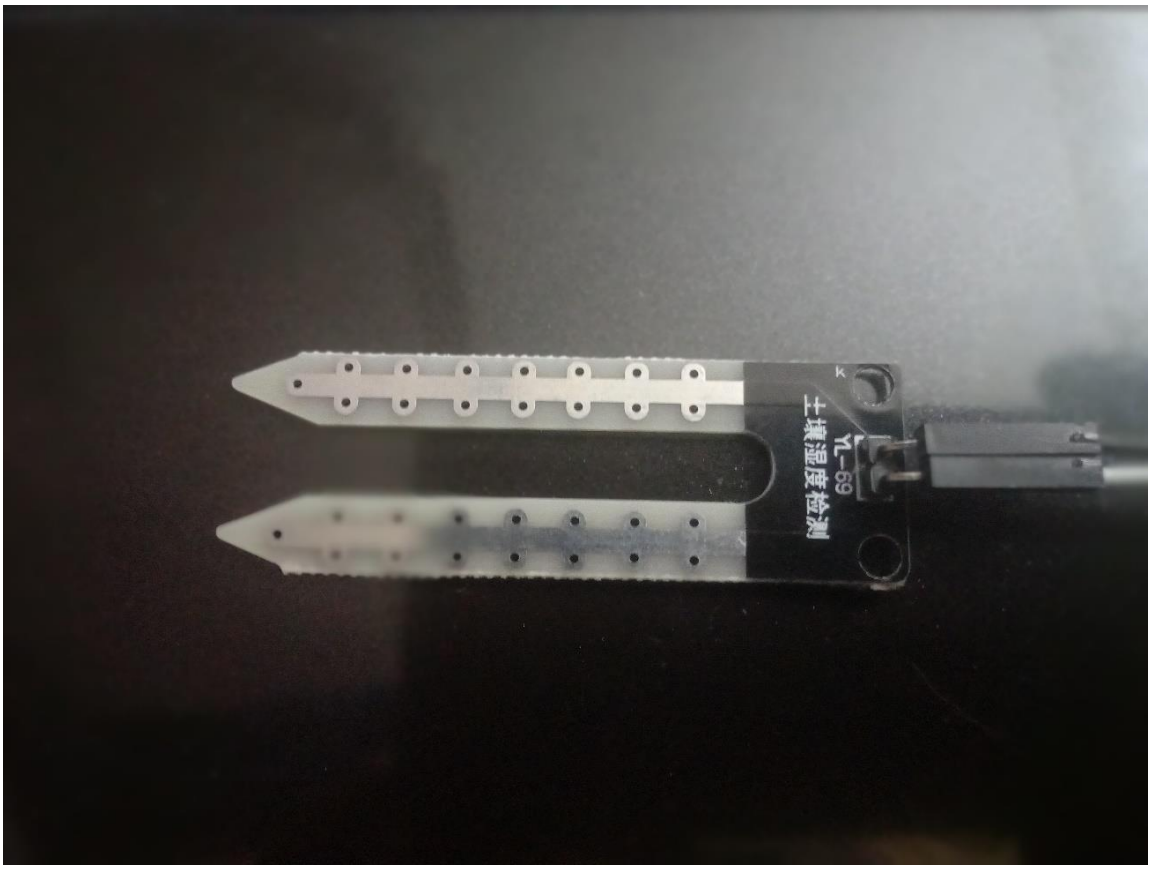


Figure 2.2: Soil Moisture Sensor

2.2.2 PRINCIPLE OF WORKING

The Soil Moisture Sensor measures the volumetric water content of soil with the help of two probes attached with it. Current flows through these two probes and pass through the soil and it receive the resistance value to measure the value of moisture in the soil based on dielectric constant of the soil. The dielectric constant can be considered as of soil potential to transmit electricity. Thedielectric constant of the soil increases as the water content of the soil increases. The value displayed on lcd screen is because of the reason that dielectric constant of water is much more than dielectric constant of soil. Potentiometer is connected through the moisture sensor, as it act as variable resistor.

2.2.3 HOW TO USE SOIL MOISTURE SENSOR

The Soil Moisture sensor is put in a horizontal position in the soil for correct measurement of moisture content of the soil, because moisture content is measured according to dielectric constant of water content in the soil. It is normally not placed in vertical position in the soil as dielectric value of soil will vary vertically and moisture sensor will not sense exact value and will display nothing.

2.2.4 REMOVING THE SENSOR

When separating the soil moisture sensor from the soil, do not pull it out directly through cable as doing so may disturb the internal connection of the system.

2.3 BLUETOOTH MODULE (HC05)

HC-05 is a Bluetooth module which is modeled for wireless transfer of data. It can be used in master or slave configuration. All serial enabled devices can be communicated with each other using hc-05 Bluetooth module. It is consist of 6 pins.

1. key/EN: Module works in command mode when key/en pin is set to high. By default it remains in data mode. The data transfer rate in command mode is 38400 bps and 9600 in data mode. It is generally used to accompany the module in AT command mode.

HC-05 modules has two modes.

1. **DATA MODE:** communication over devices take place in data mode.
2. **COMMAND MODE:**this mode activates AT commands which are used to convert previous setting of module. It uses serial port to transfer the data.

3. VCC: this pin is used to connect with 5v power source.

4. GROUND PIN: this is used to complete the circuit.

5. TXD: it is used to transmit the data serially.

6. RXD: this pin is used to receive the data serially.

7. STATE: this pin tells us about the connection of modules whether is connected or not. This is shown with the help of red led, which blinks continuously before connection and blinking slows down after connection.

2.3.1 FEATURES

- Short range wireless connectivity
- Consumes less power (3.3 v to 5 v)
- It itself get connected to the last devices paired and if disconnected as a result of beyond the connection, then it automatically reconnect in 30 seconds.
- Antenna is integrated in the module for data transfer between the devices connected.
- Baud rate (data transfer rate) is programmable and is interfaced with the devices connected.
- The hc-05 module operates in 2.4 GHZ ism (industrial scientific machine) band.

2.3.2 SPECIFICATIONS

Table 2.2: Specification of BLUETOOTH Module

Dimension	26.9mm(l) X 13mm(w) X2.2mm(h)
Indicators	status LED
Power supply	3.3-5v
Communication Protocol	UART

Figure 2.3: BLUETOOTH Module

2.3.3 WORKING PRINCIPLE

We are using Hc-05 Bluetooth module is for robot movement through phone.Which requires to install robot controller app from Google play store in the phone through which you want to make movement in the robot. When you open the app it automatically opens the Bluetooth and search devices option is open to connect the phone with the module. Once it is connected we insert 1234 as default password and then blinking of led on Bluetooth slows down. And then robot moves with the help of instructions displaying on the phone i.e. in the forward, backward, left or right and stop.

2.3.4 APPLICATION OF BLUETOOTH MODULE

- It is generally used for short range transmission of data, and is integrated for low power sensor.
- It requires very low power to operate so as can be used for small projects based on arduino.
- It is also used in smart automated project like home automation, smart farming and many more.

2.4 WI-FI MODULE

In this project, we are using the ESP8266 Wi-Fi module. ESP 8266 wi-fi module is a low cost microchip contained with tcp/ip stack and is connected with microcontroller. Advantage of using wi-fi module is making the communication between the part which is at plant and robot wireless and easy. There are two wi-fi module used, one act as a transmitter and other act as receiver. The data collected through the sensor at plant is sent to the robot with the help of module, which act as a transmitter and the w-fi module which is at robot collect these data and according to information, robot moves and water the plant when necessary.

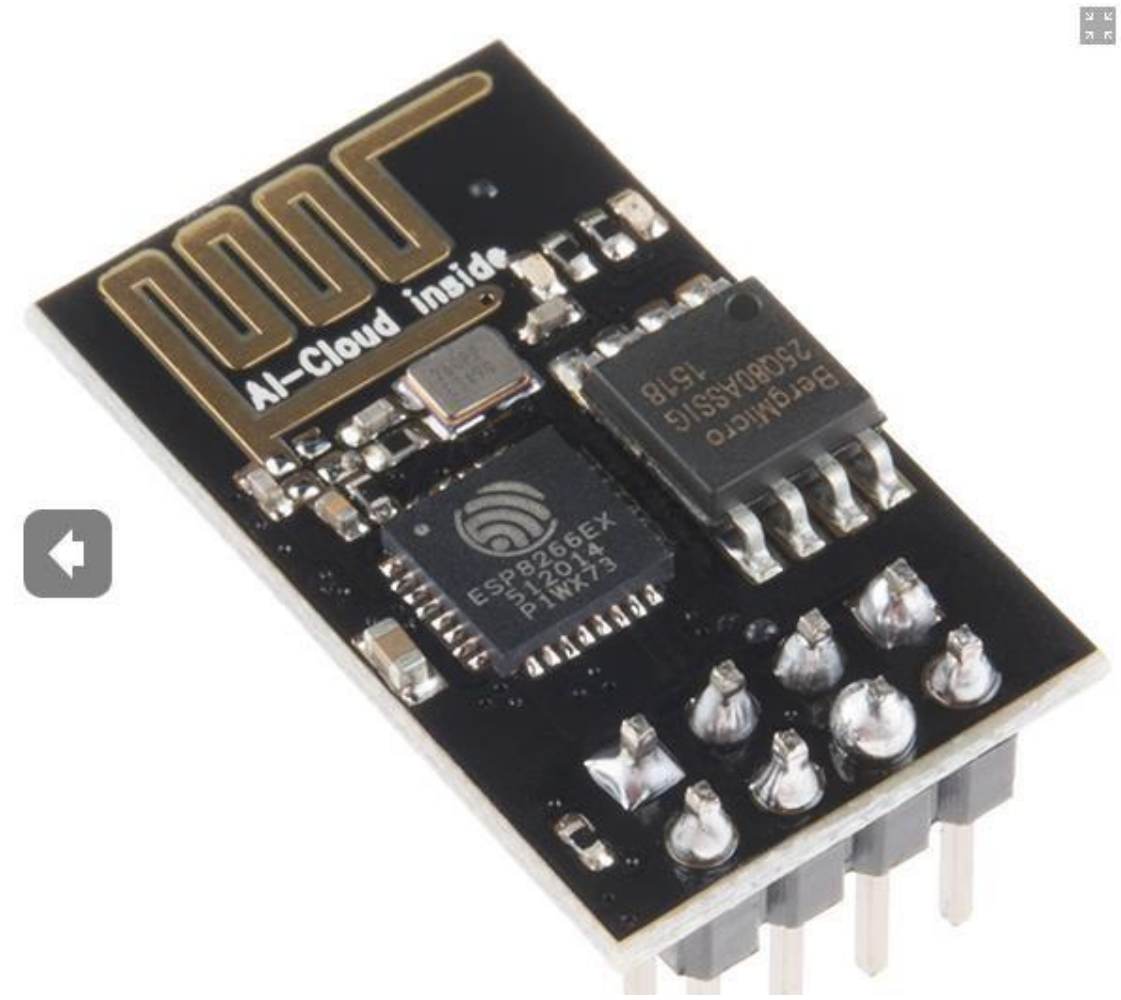


Figure 2.4: Wi-Fi Module

2.4.1 PRINCIPLE OF WORKING

Wireless fidelity uses any of the 802.11 technology that operates at 204 GHZ radio frequency. Wi-fi module generally operates at radio frequency. Any wi-fi module is made up of three essential element for its operation.

1. Signal

2. Antenna

3. Router

The signals are sent through antenna and routers and are received through wi-fi receiver.

2.4.2 SPECIFICATIONS

Network protocol	Tcp/ip
Dimension	5.02cm(l)*1.56cm(w)
Operational frequency	2.4 GHZ radio frequency
Weight	About 20 gram
Operating voltage	3.0-5.0v
Operating current	70 mA
Ambient temperature range	Normal temperature
Wi-fi protocol	802.11 b/g/n
External interface	n/a

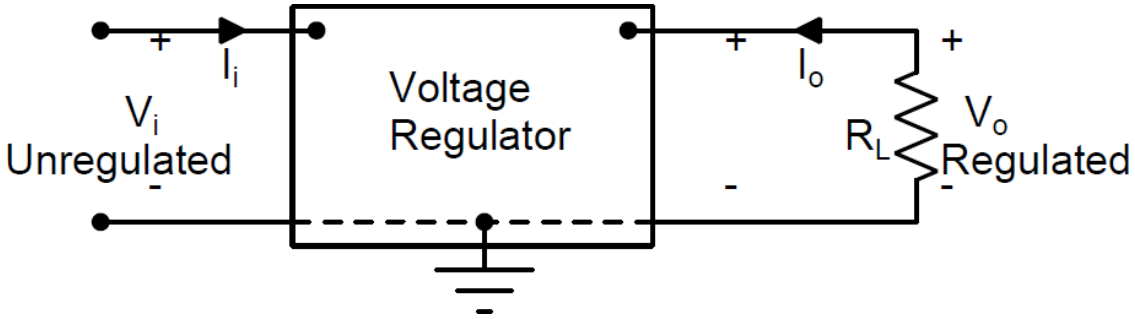
2.4.3 ADVANTAGES OF WI-FI MODULE

- They are quick acting and can be reset fast as transmission take place wirelessly.
- They are simple in use.
- They are reliable.

2.4.4 APPLICATION OF WI-FI MODULE

- It can be used in wearable electronics, home appliances, baby monitors.
- In ip cameras, it is used to send photos directly to the receiver.
- Sensor network
- Home automation
- Baby monitors
- Industrial wireless control

2.5VOLTAGE REGULATOR



Voltage regulator is a device used to maintain the output voltage coming from power supply constant irregardless of variation in load or unregulated voltage coming from source. We use voltage regulator generally in electronic circuit containing diode, transistor and tubes. As these electronic component cannot sustain fluctuation for long time and may get damage.

We are also using heat sink with the circuit of voltage regulator to drop the heat from all over components. It is necessary because components and circuit gets heated because of longer use of robot and electronic circuit.

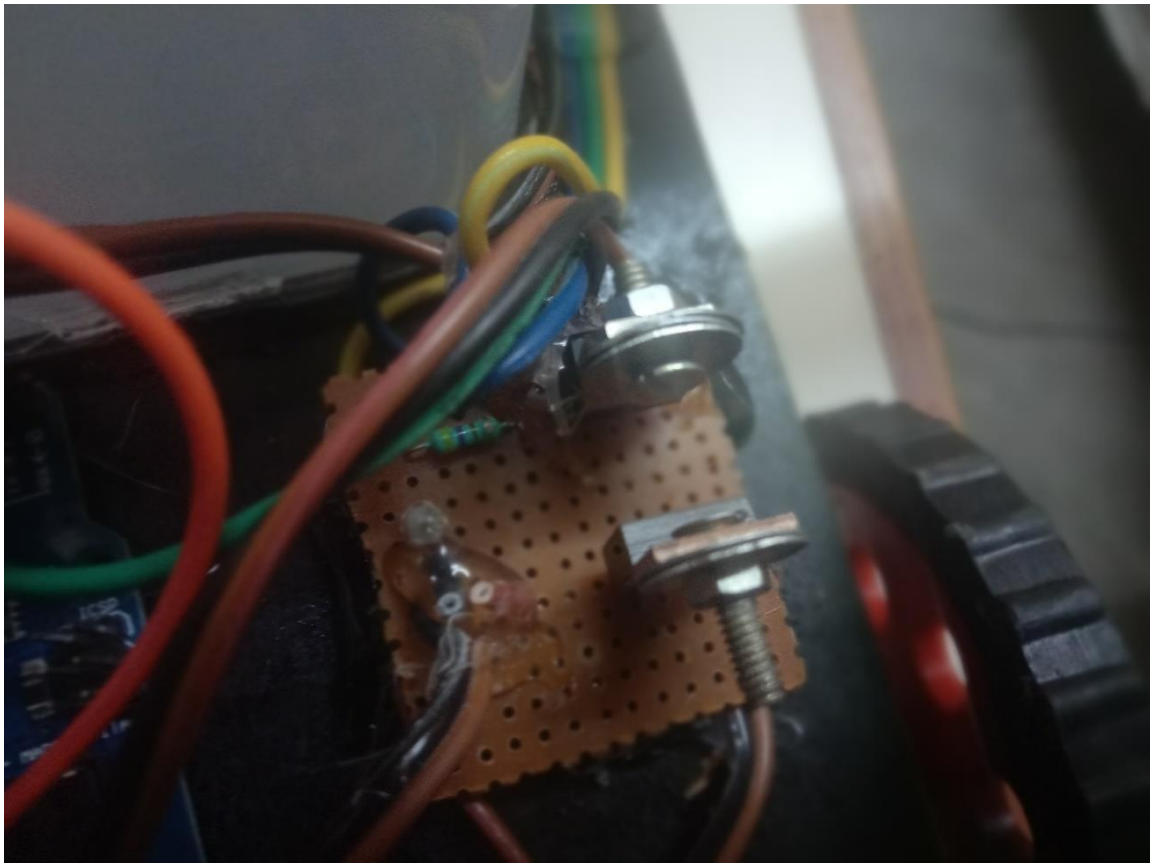


FIG 2.5: voltage regulator with heat sink

There are many types of voltage regulator. In our project, we are using transistor based voltage regulator. Every transistor has three terminals i.e. emitter, base and collector. The base voltage of transistor is kept constant. And output voltage is given by Vout=Vz-Vbe. Because of Constant output voltage, transistor conducts more. Advantage of using it is to get more stabilized voltage.

DISADVANTAGE

It is not easy to change the output voltage. As temperature play an adverse roe. Because of the temperature change Vbe get reduced at some extent.

2.6 PHOTODIODE AND INFRARED LED

Photodiode is a semiconductor device, can be considered as light detector and coverts those light energy in to electrical energy and produce current. In this project we are using photodiode to make stop the robot and water the plant for a small period of time. When moisture level of soil is shown through led lighting and robot moves, and after when it senses the infrared light, which produces photon. Photodiode senses those photon and conducts currents to water the plant with the help of water pump connected through solenoid valve. We are using infrared led to show the moisture level in the soil. Infrared led is at plant and we insert the photodiode on the robot for proper mechanism to happen. The relationship between the current and amount of light is directly proportional. As the amount of light increases, more conduction of electric current takes place. It produces current because of the creation of electron-hole pair in the intrinsic region or depletion region of semiconductor. Infrared sensor produces light which has longer wavelength than visible light i.e. not visible to eyes. In this project we are using it to detect the motion of robot.

Figure 2.6: Photodiode

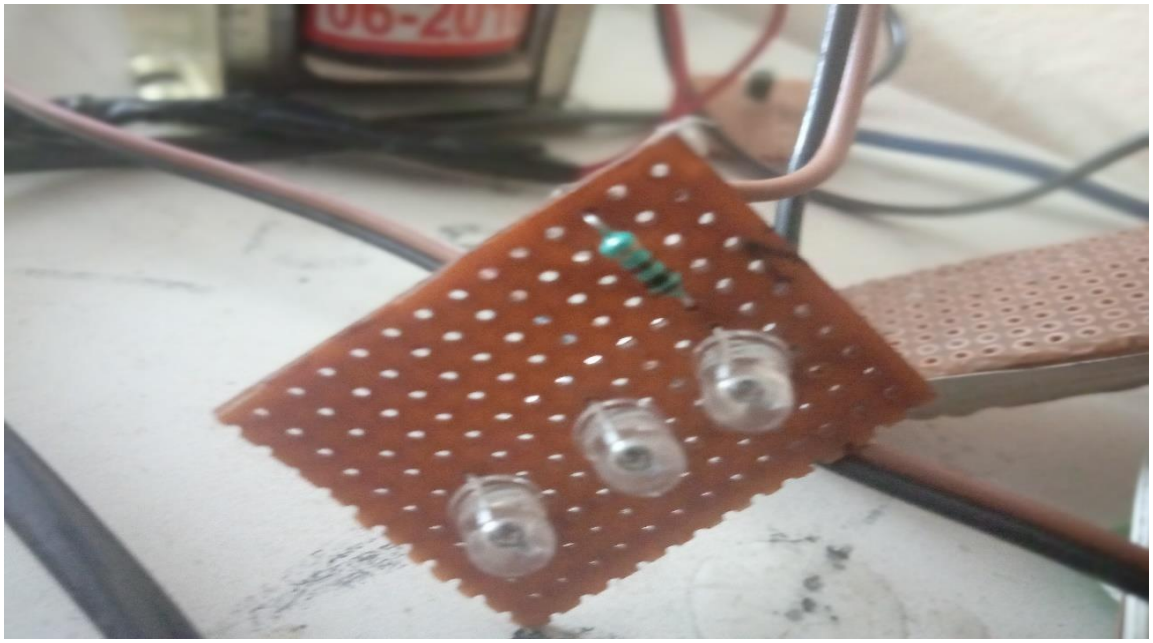


Figure 2.7: Infrared led

2.6.1 PHOTODIODE SPECIFICATION

Table 2.5: Specification of photodiode and infrared led

PARAMETER	Photodiode and infrared led
Temp Range	Within 50°C of a given center temperature
Cost	inexpensive
response time	fast
Wavelength of infrared led	High
Sensitivity	High

2.6.2 WORKING OF PHOTODIODE AND INFRA-RED LED

Photodiode conducts in reverse biased mode. When absorbed photons generate electron-hole pairs, only those electron-hole pairs generated in the depletion region, or very close to that, have a chance to contribute to electric current, because there is a strong electric

field there to separate the two different charge carriers. The ones outside the depletion region quickly recombine and vanish.

Now, in a reverse biased pn junction, the width of the depletion region increases as you increase the applied reverse bias voltage across the diode. So, by applying a larger voltage, more of the incident photons are converted to electric current, or the efficiency increases as long as leakage current remains at manageable level.On the other hand, when we forward bias apn junction, the width of the depletion region reduces, so, only a small portion of the incident photons get converted to electric current.

Infrared sensor is used to detect the motion of robot and when the robot comes in contact with the infrared led sensor, photodiode implemented on the robot detect those invisible photons and start conducting the current. And if moisture level of the soil is below 30 led does not glow and if moisture level increases over 30, led glows and transmission takes place.

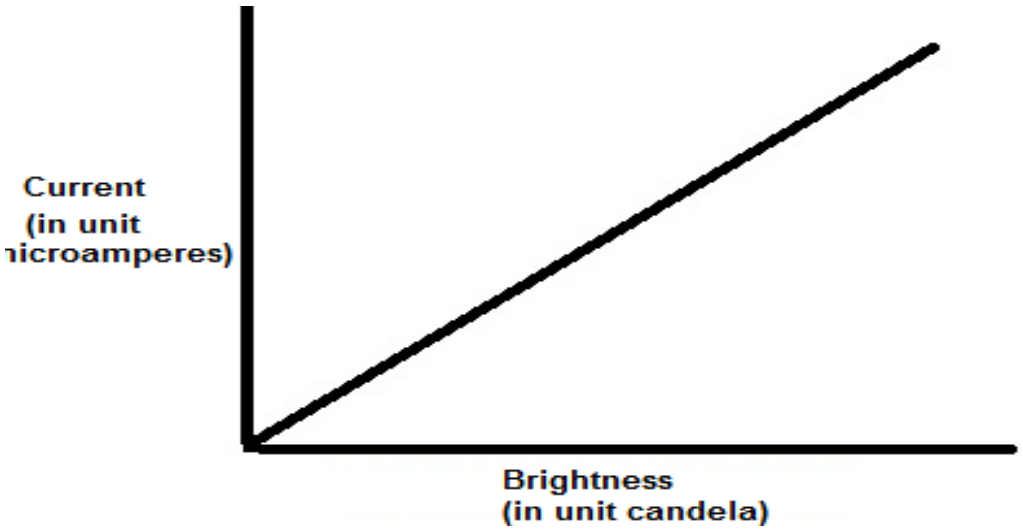


Figure 2.8: Relationship between brightness and current of photodiode

2.6.3 ADVANTAGES OF PHOTODIODE

- Durable
- Long lasting
- Highly sensitive
- Small size

- Lowest cost
- Best for detecting and controlling the motion of robot
- Linear response with the brightness of light

2.6.4 ADVANTAGES OF INFRARED LED

- Helps in measuring the threshold value of moisture value
- Sustainable temperature range
- Immediate response time
- Controlling the motion of robot with the help of wavelength generated.

2.6.5 APPLICATION OF INFRARED LED

- Helps in detection of motion, hear beat rate can also be used as door sensor.
- Helpful in production of photon through many automation take place.
- It plays an important role in artificial intelligence in today's world to control the thing via light energy.

2.6.6 APPLICATION OF PHOTODIODE

- It helps in conversion of light energy to electric energy and helps in conduction of electric current.
- It is used in bar code scanners, in digital cameras, in automotive gadgets, in surveying instruments.
- It is also used in optical communication devices as in optical communication, transmission of data takes place through light energy.

2.6.7 DISADVANTAGES OF INFRARED LED

- Infrared led produces ultraviolet light, which can be biggest threat to human's eye.

2.7 SOLENOID VALVE

A solenoid valve is an electronically operated valve whichis generally used to controls the flow of liquid and gases. It is the most commonly used valve for liquid and gas circuits

and are used to combine the flow of liquid and gases in a pipe. These type of valve are used in a vast range of industries to control the flow of air, water, flammable gases and liquids.

A solenoid valve controls flow by electronic control, which means that there is an coil having an movable ferromagnetic core at its Centre, which is called plunger. When it is stationary, it is closed. When electric current flows through coil, creation of magnetic field takes place. Which apply a force on the plunger. The created magnetic field pulls the plunger towards the Centre of the coil, opening the hole. This also reduces the manual work of engineers to operate the water pumping system. It automatically fills the water in the plant.

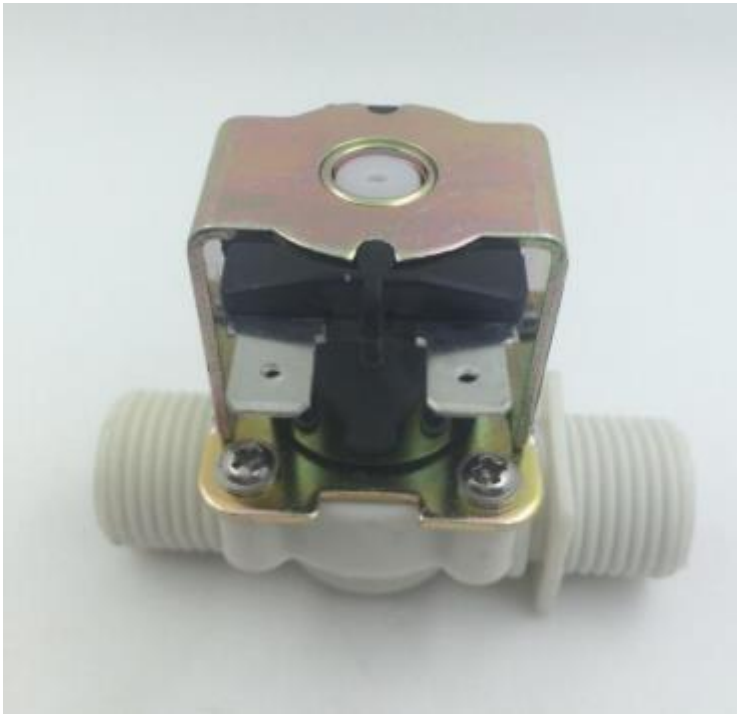


Figure 2.8: Solenoid valve

2.7.1 FEATURE OF SOLENOID VALVE

- Low power durableoperating (8-12 v).
- Automatic shut off and on.
- Self-operated power cut off after filling the water.
- Durable

- Extendable pump duration.

2.7.2 APPLICATION OF SOLENOID VALVE

- It has a wide range in industrial use.
- It can be used in automatic water pumping system.
- It can be used in factories to mix the gases, where compressed air is not available.

2.8 DC MOTOR

DC motor is a direct current rotary electrical machine, which simply converts electric energy into the mechanical energy Working principle of DC motor is based on Left Hand Thumb Rule, which says it experiences torque when a current carrying conductor is placed in a magnetic field.

2.8.1 Applications

In the various field we use DC motor

in Toys

RC servos

Gear motors because of its inexpensiveness, light-weight, speed torque advantages.

2.8.2 DRIVE CIRCUIT

We have a diode across the motor, it is there to prevent BACK ELECTROMAGNETIC FLUX voltage. BEMF is arising when the motor is spinning. It gives effect on MOSFET, when it is turned off, the winding in the motor is still charge & it produces reverse current flow to tackle this reverse current we put diode parallel to the motor which gives bypass to dissipate this current.

R1 resistor is used to protect the microcontroller from current, & R2 ensure that transistor is turned off when the input pin is tri-stated.

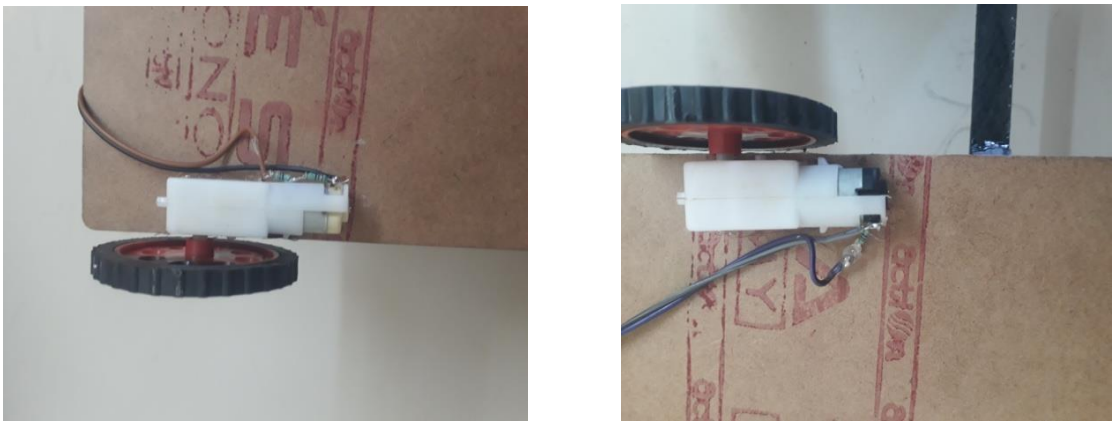


Figure 2.9

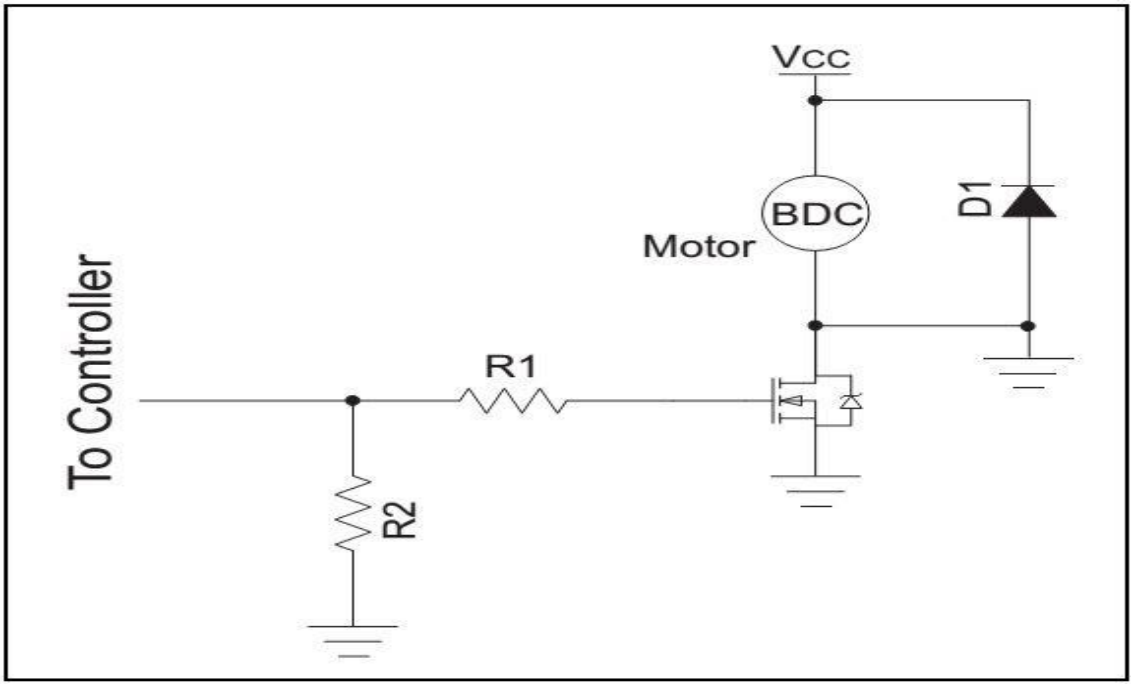


Figure 2.9

2.8.3 WORKING PRINCIPLE

Left-hand thumb rule says if the index, middle & thumb of your left hand are mutually perpendicular to each other then index finger represents the direction of magnetic field, middle finger shows the direction of a current, & thumb gave the direction in which force is experienced by the shaft of DC motor.

2.8.4 MOTOR CONTROLLER

It is an small size device which helps microcontroller to control the motor .It acts as an intermediate device between a microcontroller & the motor. Micro-controller cannot drive motor directly, this process is done with the help of motor controller which provide required voltage but not able to run the motor. So to move a motor both microcontroller & the motor controller come together, microcontroller gave instruct the

motor controller how to power the motor ,simply it use PWM communication method.

2.9 TEMPERATURE SENSOR

Temperature sensor is used to measure the temperature. We use the thermistor to sense the temperature. It is essentially a thermally sensitive resistor, giving a change in resistance for a change in temperature.

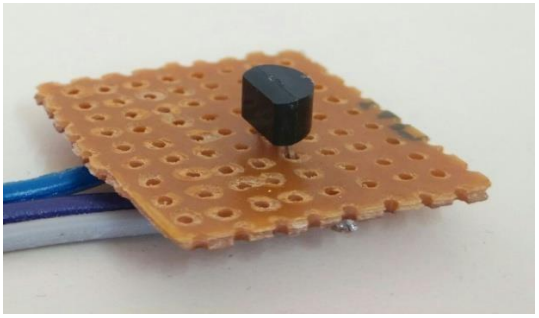


Figure 2.10: Temperature Sensor

2.9.1 THERMISTOR SPECIFICATION

Table 2.5: Specification of Thermistor

PARAMETER	THERMISTOR
temp. Range	Within 45°C-50C of a given center temperature
Cost	Low
time constant	5 to 12 seconds
Stability	Very stable, ˜0.0008°C
Sensitivity	Moderate-High

2.9.2 WORKING OF THERMISTOR

The most utilized of a thermistor is to a degree the temperature of a gadget. In a temperature controlled system, the thermistor contains a little framework but imperative piece of a bigger framework. A temperature controller screens the temperature of a thermistor.It then tells a radiator or cooler when to turn on or off to preserve the temperature. The thermistor is made up of ceramic-like semiconductor materials having the resistivity almost 100 to 450000 ohm-cm. The resistance of the thermistor is contrarily corresponding to the temperature. The resistance of the thermistor is given by:

$r = e^{k} R_o$

$k = (1/T - 1/T_o)\beta$

Where r is the resistance of the thermistor at any temperature T in ^{o}K (degree Kelvin)

R_o is the resistance of the thermistors at particular reference temperature $T_o$in ^{o}K
e is the base of the Naperian logarithms

β is a constant whose value ranges from 3000 to 3500 depending on the material used for the thermistors and its composition.

Temperature sensor sends the input to the temperature controller. Through sensor little sum of current is running called inclination current, which is sent by the temperature controller.The controller can't perused resistance thus to create reasonable it change over resistance changes to voltage changes by employing a current source to apply a predisposition current over the thermistor to deliver a control voltage. Temperature controller is primary portion of this operation. It takes the sensor data, compare it with set point & alter stream of current through the gadget to alter the temperature to coordinate the set point. Thermistor influences steadiness & precision of control framework .For great soundness. The thermistor must be set as close to the resistive radiator as conceivable. And for the exactness, the thermistor must be set as near to the gadget requiring temperature control. Thermistor is implanted within the gadget, but it can be connected utilizing thermally conductive glue. In a implanted gadget, discuss crevices ought to be disposed of utilizing warm glue .

2.9.3. APPLICATION OF THERMISTOR

- In security of lithium battery
- In the nourishment taking care of and handling industry
- To screen the temperature of an incubator
- It give warm to grow the wax in wax motor

2.9.4 ADVANTAGES OF THERMISTOR

- Durable
- Long lasting
- Highly sensitive
- Small size
- Lowest cost
- Best for measuring single point temperature

2.9.5 DISADVANTAGES OF THERMISTOR

- Nonlinear output

- Limited temperature range
- Slow reaction time

2.10 TRANSFORMER

A transformer is a highly efficient device for transferring electrical energy form one circuit to another. There exist no simple device that can accomplish such changes in dc voltages. Thus, the transformer has provided a feature to ac power system that lacks in dc power system.

2.10.1 WORKING PRINCIPLE

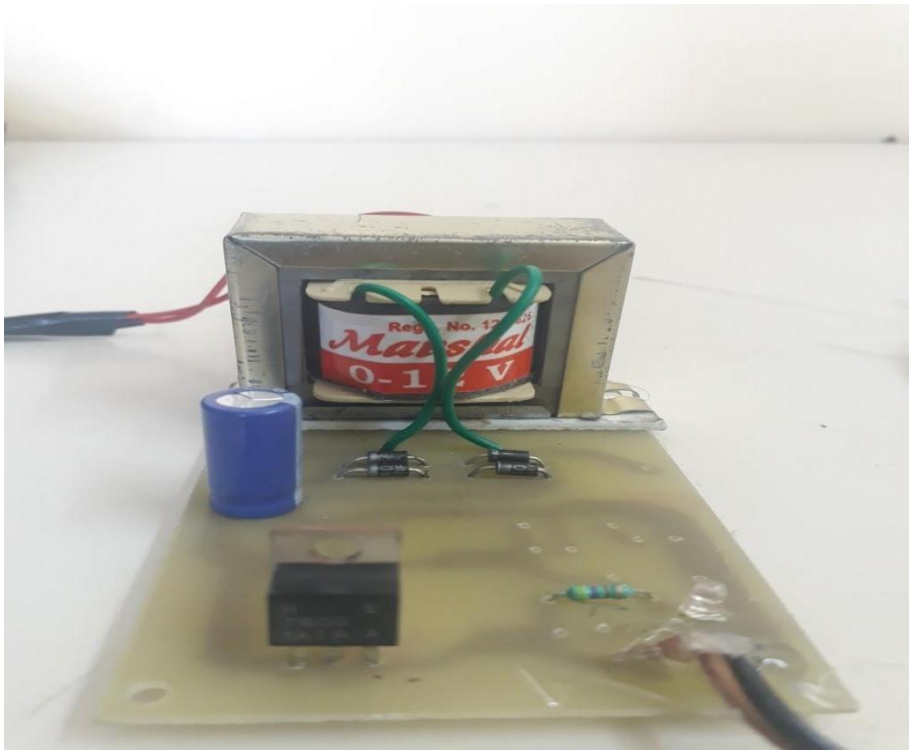
A transformer operates on the principle of mutual induction between two coils. Basically , two principles are involved in the operation of a transformer. Firstly an electric current produces a magnetic field & secondly, a changing magnetic field within a coil induces an emf across the ends of the coil. A changing current in the primary circuit create a changing magnetic field; in turn , this magnetic field induce a voltage in the secondary circuit. Thus, energy is transferred from one circuit to other.

There are two types of transformers.

Step up transformer: which is used to increase the voltage from primary winding to secondary winding.

Step down transformer: which is exactly opposite to step up. It decreases voltage from primary winding to secondary due to less number of winding in secondary coil.

In this project we use step down transformer which provide 12 volt for next circuit.



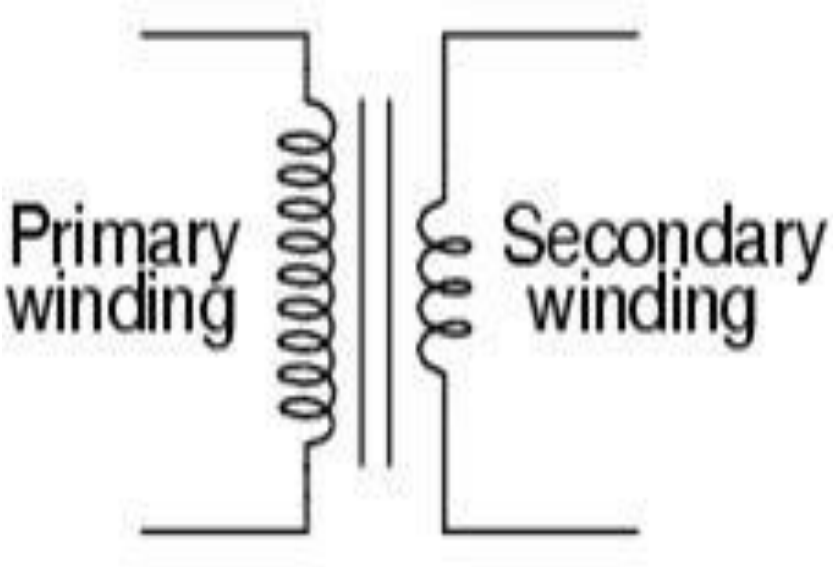


Figure 2.11

2.10.2 LOSSES IN TRANSFORMER:

Iron loss :

due to the alternating flux in the core

Copper loss :

due to resistance of the transformer windings

Hysteresis loss :

due to alternating magnetising force

Eddy current loss

Due to induced emf current flow in the circuit, & circulate it within the body of material caused eddy current.

2.10.3 APPLICATION

- It can used to prevent DC current
- Isolate two circuit electrically
- It can increase or decrease the level of voltage
- Used for impedance matching

2.11 DC POWER SUPPLY

A power supply is an electrical device which gives electric power to load. Power can be of two types AC power supply & DC power supply.AC power supply is taken from a wall outlet, can be regulated by using a step up & step down transformer. In AC voltage electric charge changes direction periodically, on the other hand in DC power, electric charge flows only in one direction.

DC power supply supplies a constant voltage to its load. In this project, we are using a 12V battery which provides power to a vehicle.

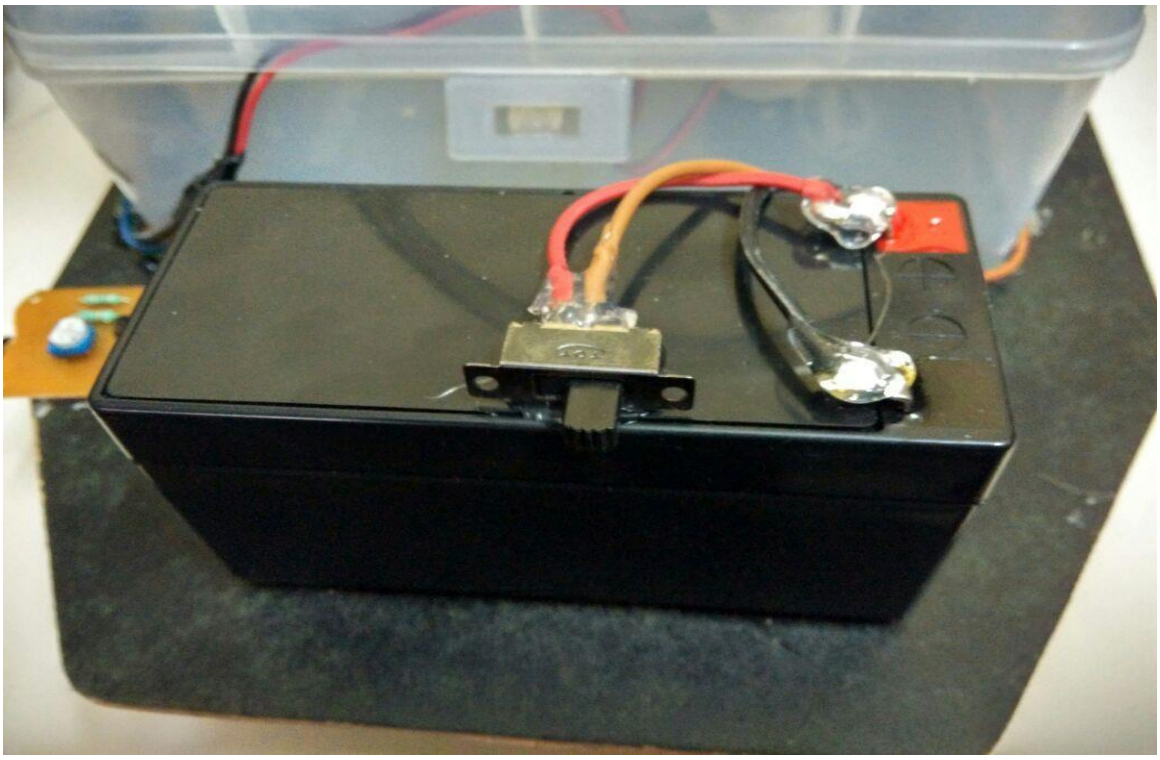


Figure 2.12

2.12 Optocoupler IC 4N35

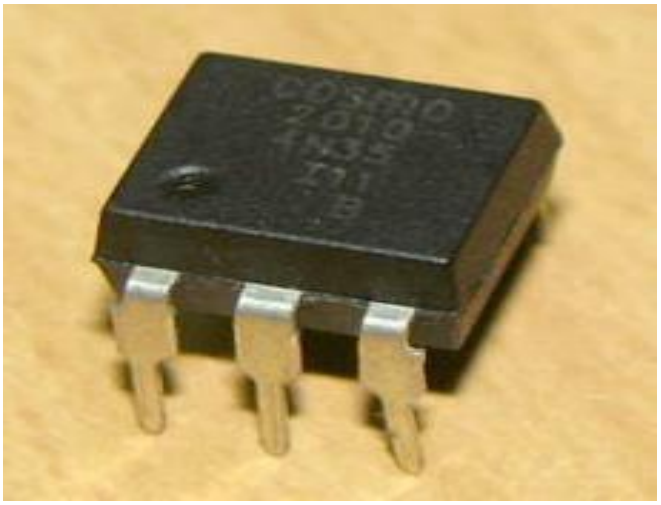


Figure 2.13

It is an optocoupler integrated circuit in which an infrared emitter diode drives a phototransistor. They may be additionally known as opto-isolators as they separate circuits optically. They permit the use of one of the circuits to switch every other one whilst they are absolutely separate. This isolation in two circuits ensures that no harm occurs in either of the circuits while the alternative one has a fault. The primary circuit is connected to a diode which emits IR light and the other circuit is attached with a phototransistor.

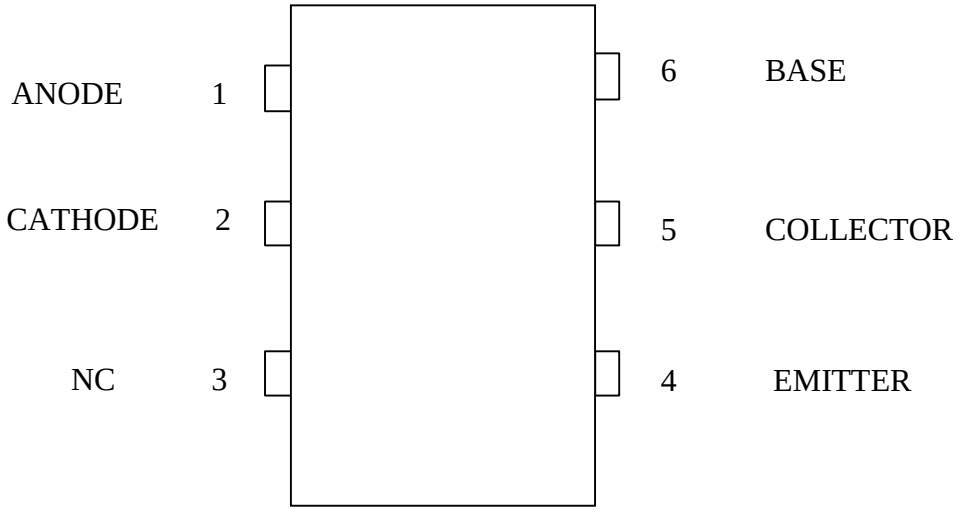


Figure 2.14 Pin Diagram

2.12.1 Specifications

Gallium-Arsenide Diode which is an Infrared Source.

- Optically coupled to a Silicon NPN Photo-transistor.
- Direct-Current Transfer Ratio is high.
- High-Speed Switching tr = 7, μs, tf = 7 μs.
- High-Voltage Electrical Isolation 1.5-kV, 2.5-kV, or 3.55-kV Rating .
- Typical Applications Include Remote Terminal Isolation, SCR and Triac Triggers, Mechanical Relays and Pulse Transformers.

2.13 MOTOR DRIVER

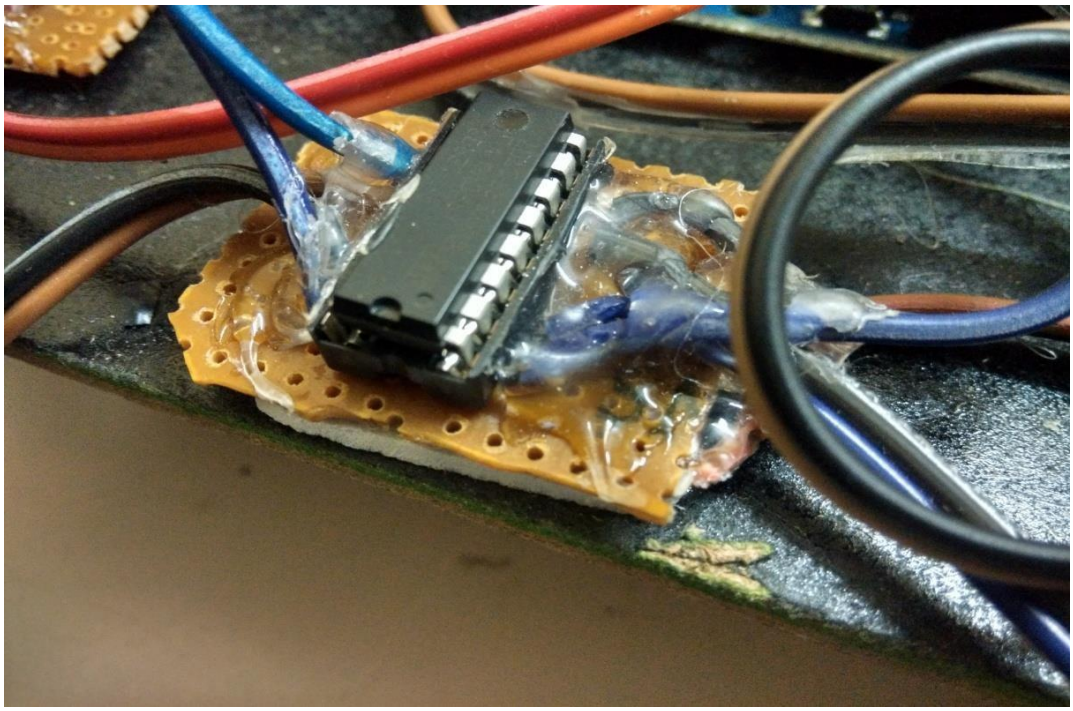


Figure 2.15

Motor driver is an IC (Integrated Chip) which is usually used to control motors in autonomous robots. In this project, motor driver IC is acting as an interface between Arduino and the motors. L293D is a 16 pins IC with 8 pins on both sides, responsible for the controlling of motor. L293D includes two H-bridge circuits. H-bridge circuit is the simplest form of circuit to control low current rated motor.Motor driver IC can be used to control/drive two motors simultaneously and can provide maximum 600mA current to each channel.

Motor driver IC deals with high currents. Because of so much current flow, the IC may get heated up which can result in explosion or IC burst. To reduce heating we need many heat sinks in the IC. That's why the motor driver IC has 4 grounds.

Characteristics of Pins are mentioned in the following table.

PIN NO.	*Function*	*Explanation*
1	Enable 1-2	When it's HIGH, the left part of the IC works, otherwise not.
2	INPUT 1	When HIGH, the current flows through output 1
3	OUTPUT 1	This pin is connected to one of the terminal of motor
4,5	GND	Ground Pin
6	OUTPUT 2	This pin should be connected to one of the terminal of motor
7	INPUT 2	When this pin is HIGH the current flows through output 2
8	VCC2	This is the voltage which will be supplied to the motor.
9	Enable 3-4	When it's HIGH, the right part of the IC works, otherwise not.
10	INPUT 3	When this pin is HIGH, the current flows through output 3
11	OUTPUT 3	This pin should be connected to one of the terminal of motor
12, 13	GND	Ground Pins
14	OUTPUT 4	This pin is connected to one of the terminal of motor
15	INPUT 4	When this pin is HIGH the current flows through output 4
16	VCC1	This is the power source to IC. This pin is supplied with 5 V

CHAPTER-3

3.1 ABOUT THE SYSTEM

We have developed a prototype that can be used in plant nurseries for watering the potted plants. This system will help to take proper care of the needs of plants and reduce human effort in plant nurseries.

The system involves a robot that travels along a line with a water pump and a system that determines plants needs. This plant watering robotic system can be implemented in any area with plants placed in a line along the predefined path on which a moving robot will travel.

3.1.1 STRUCTURE OF THE SYSTEM

The System is divided in three parts:

- Module 1: It includes the components that are fixed or attached on the soil near the plant. These components are:
    - Arduino board
    - Soil Moisture Sensor
    - Temperature Sensor
    - WIFI Transmitter module
    - Infrared (IR) LED sensor
    - Liquid Crystal Display (LCD) Screen
    - Step down Transformer

- Module 2: It includes the components that are attached to the moving robot which travels along the plants. These components encompass:
    - Arduino board
    - Water Pump
    - Switching Mechanism
    - DC Motors
    - Photodiode
    - Bluetooth Module
    - WIFI Receiver Module
    -
- Module 3: It includes a mobile phone which is connected wirelessly to the module 2 via Bluetooth module. An Andriod application will be used to control the movement of module 2. The android application will also serve a medium to see the values and data on the basis of which this system makes decisions.

The coming sections will explain in detail, how this system works and make decisions.

3.2 WORKING

3.2.1 WORKING OF MODULE 1

- Plants require proper watering for optimum growth and this system takes water needs of plant into account. Soil Moisture Sensor measures and sends data of water content to the arduino microcontroller. The microcontroller compares this value with the predefined threshold. If the data is less than the threshold value, plant needs water, otherwise not.
- If the plant needs water, the IR LEDs connected to the arduino board turn ON (or HIGH). The role of IR LEDs is well explained in next section.
- WIFI module attached on module 1 is the transmitter and the wifi module attached on Module 2 is the receiver. When the IR LEDs are off, the wifi module on Module 1 is sending '1' continuously to the receiver wifi module on Module 2. When the IR LEDS turn on, wifi tx on Module 1 starts sending '2' to the wifi rx on Module 2.
- LCD Screen is used to constantly display the soil moisture level.
- Plants need right temperature to grow. Only at the correct temperature the photosynthesis takes place optimally. Temperature sensor measures the temperature around the plant and sends the data to the arduino board. The temperature is displayed on the LCD display in Celsius degree.

3.2.2 WORKING OF MODULE 2

- Module 2 is a robot that travels along the plants using DC motors. A smartphone is paired to the robot via Bluetooth. Robot starts moving when a signal is sent to the robot from the android application (in a smart phone which is the part of module 3) to the Bluetooth module connected to the arduino board.
- As the robot reaches a plant, the photodiode, connected to the arduino board on the robot, passes the IR LEDs (which are connected to the arduino board on the plant).
- If the IR LEDs are ON, the photodiodes detect it and the robot stops moving. Now, the wifi tx on module 1 sends the value '2' to the module rx on module 2. In this way, the robot is able to know that the plant needs water. So the robot pumps water to the plant for 3-4 seconds using solenoid water pump. The water pump is triggered using a switching mechanism which acts like a switch but instead of user physically touching it to switch it on/off; we supply voltage to toggle it.
- If the IR LEDs are OFF (or not high) the robot will keep moving to the next plant.
- When the robot finishes pumping water to the plants, wifi tx on Module 1 starts sending '1' again to the wifi rx on the Module2.

3.2.2.1 How robot travels along plants

In our project we are controlling the robot (or module 1) by android app for demonstration purposes. When we send signal 'F' to the robot via Bluetooth, robot starts moving and when we send 'S' to the robot, it stops. Also, if photodiode on the robot (Module 2) detects IR LEDs on the Module 1, the robot stops and waters the plant and starts mobbing again.

Path follower robot

"A path/line follower robot is a robot which follows a predefined pathway controlled by a feedback mechanism."

Principle of working:

The path following robot is a self-operating robot that detects and follows a line drawn on the area. Concept of working of line follower is related to light. The behavior of light is used at black and white surface. When light drops on the white surface it is almost full reflected and in case of black floor, light is completely absorbed. This behaviour of light is used in building a line/path follower robot.

We have to use IR (infrared) Transmitters/senders and IR receivers also called photo diodes. They are being used for transmitting/sending and receiving light rays. IR LEDs transmits infrared lights. When infrared rays fall on white surface, it's reflected back and caught by photodiodes which generates some voltage changes. When IR (Infrared) light falls on a black/dark surface/floor, light is absorbed by the black surface/floor and no rays are reflected back, in which case, photo diode does not receive any light or rays.

We have not used concept of line following just for simplicity and ease of demonstration of the main idea of our project.

3.2.2.2 Switching mechanism

"A transistor is a 3-terminal s/c (semiconductor) gadget which is used for switching applications/purposes, amplification of feeble/weak signals/indicators and quantities of thousands of transistors are inter-connected and embedded into minute (or very small) integrated chips".

We are using transistor as a switch to drive '12V' solenoid water pump from arduino uno board which can supply maximum of '5V'.

A Transistor working as a switch is used for opening (or closing) of a circuit. The transistor is normally used as a switch in the electronic devices/gadgets only for the applications where voltage requirement is small because of small power usage. Transistor works as a switch when it is in cut-off or saturation region.

In a transistor, if no current flows in the base circuit, then no current can flow in the collector part. This property will allow a transistor to be used as a switch. The transistor can be turned ON or OFF by changing the base. There are a few applications of switching circuits operated by transistors.

3.2.3 WORKING OF MODULE 3

- This module consists of a smart phone which is connected to module 1 via Bluetooth.
- User can start and stop the robot using an android application.
- All the information is displayed on the android application which module 3 receives from module 2 via Bluetooth. This information includes, soil moisture, temperature level and light intensity level. Module 2 receives this information about from module 1 via wifi modules. Information regarding whether robot is moving or stopped is also visible on the android application.

3.3 BLOCK DIAGRAMS OF THE SYSTEM

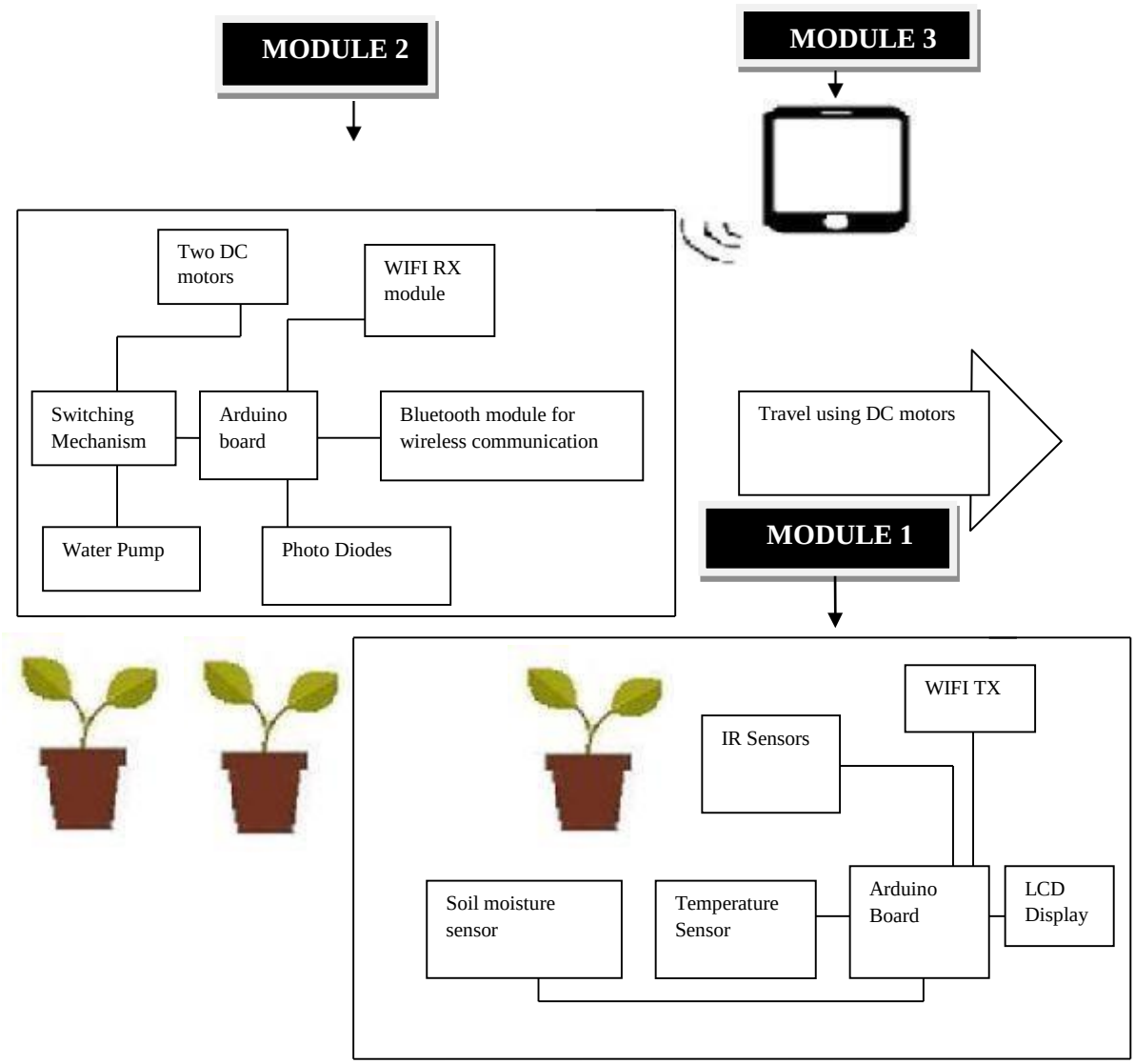


Figure 3.1: When module 1 and 2 are not in contact

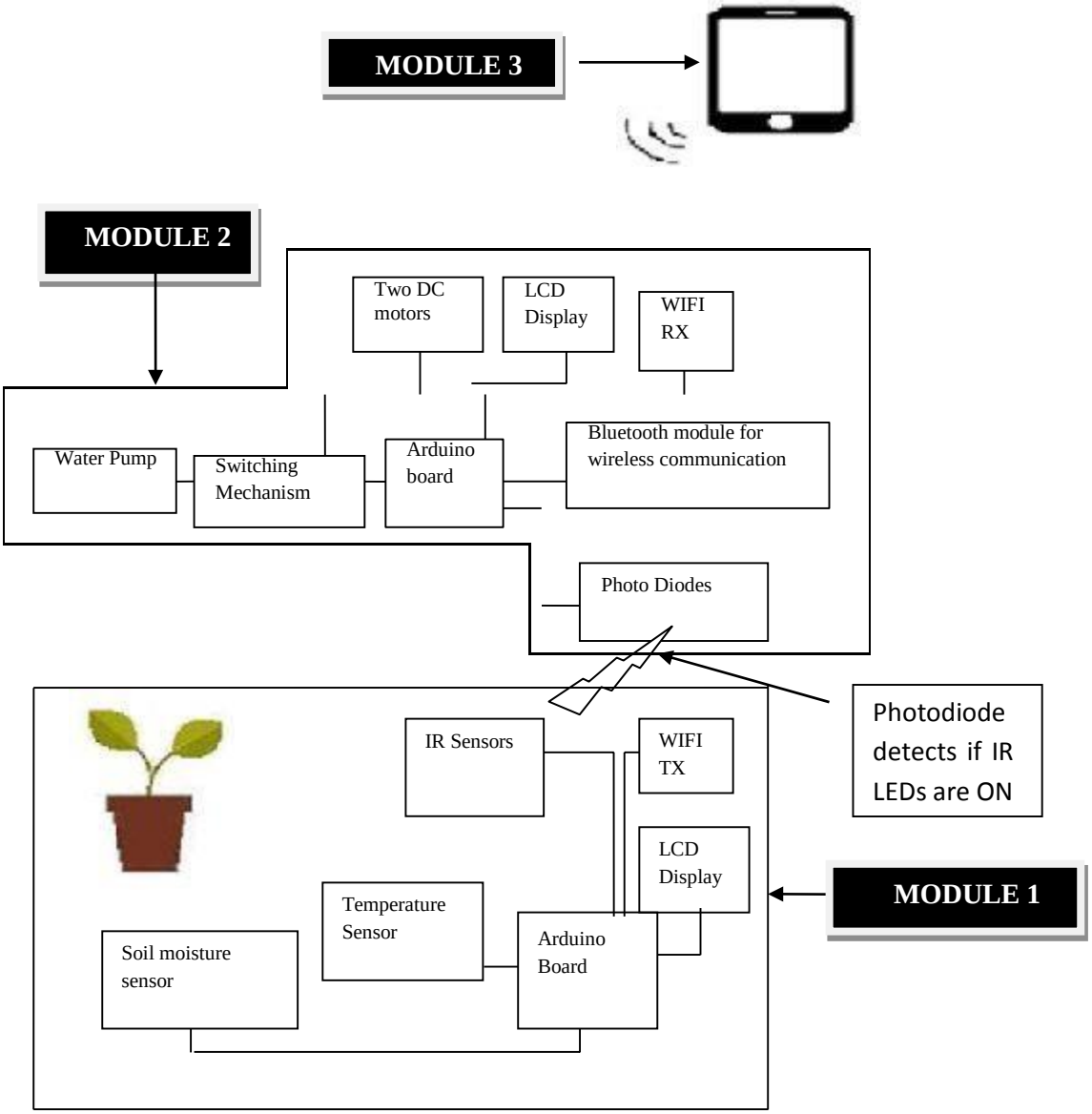


Figure 3.2: When module 1 and 2 are in contact

Pictures of Our Project implemented at plant

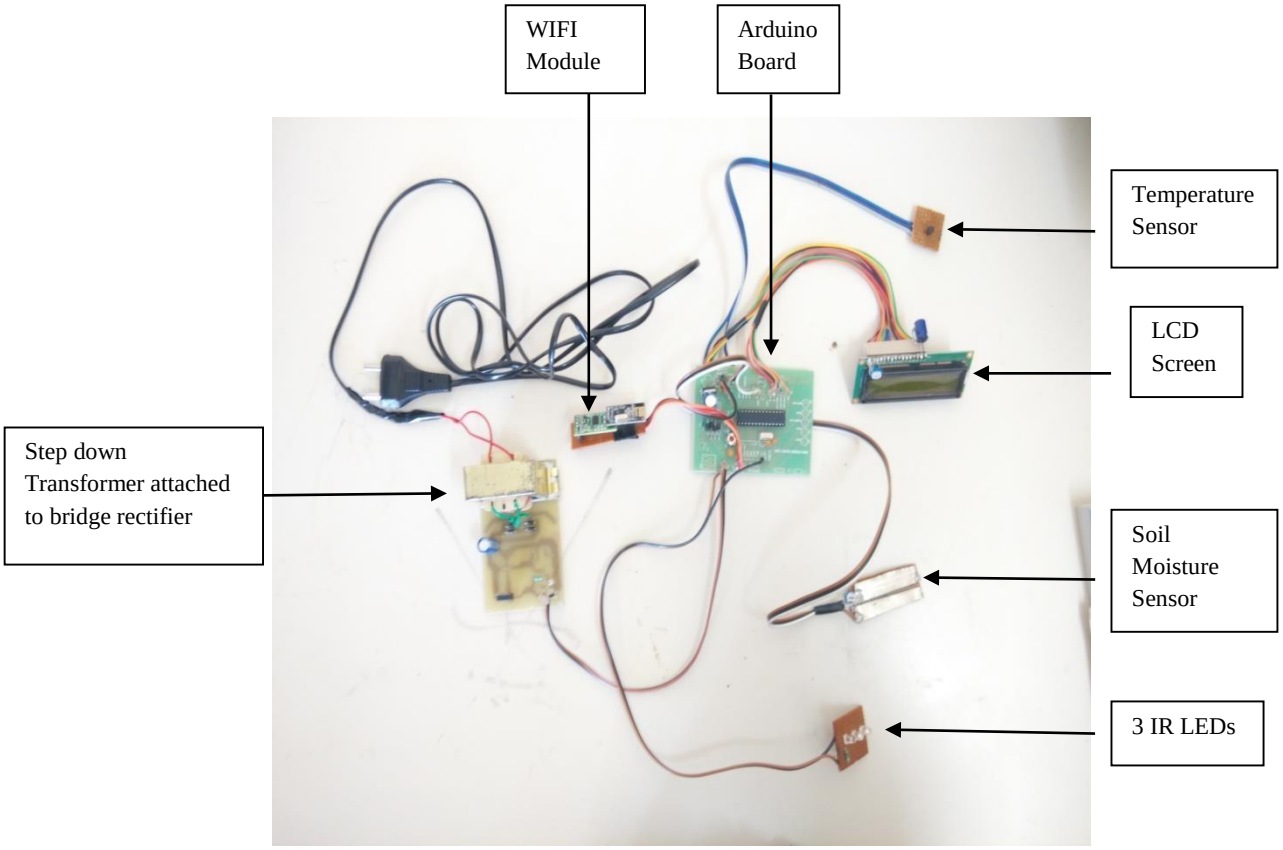


Figure 3.3 Module 1

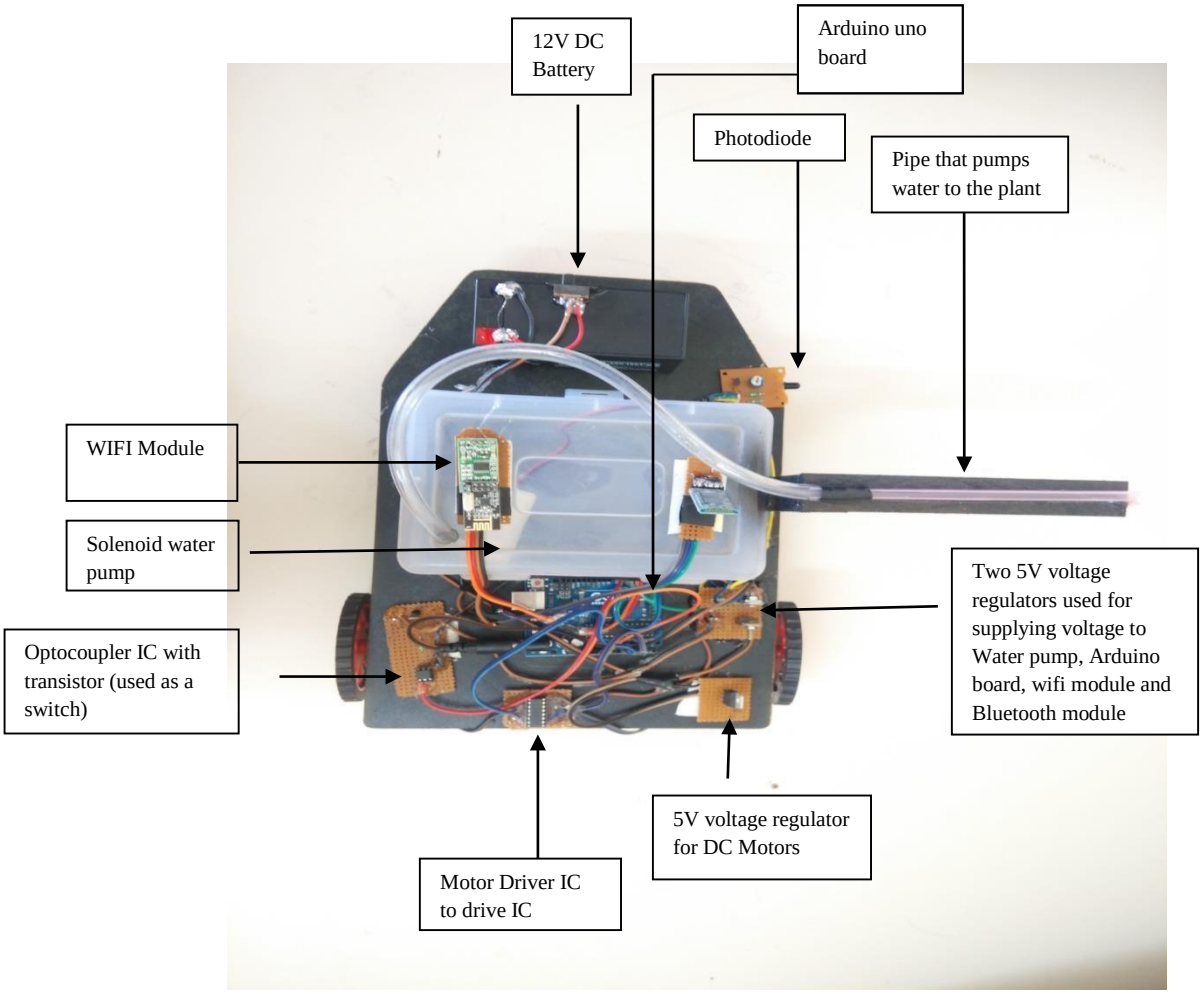


Figure 3.4 Module 2 (top view)

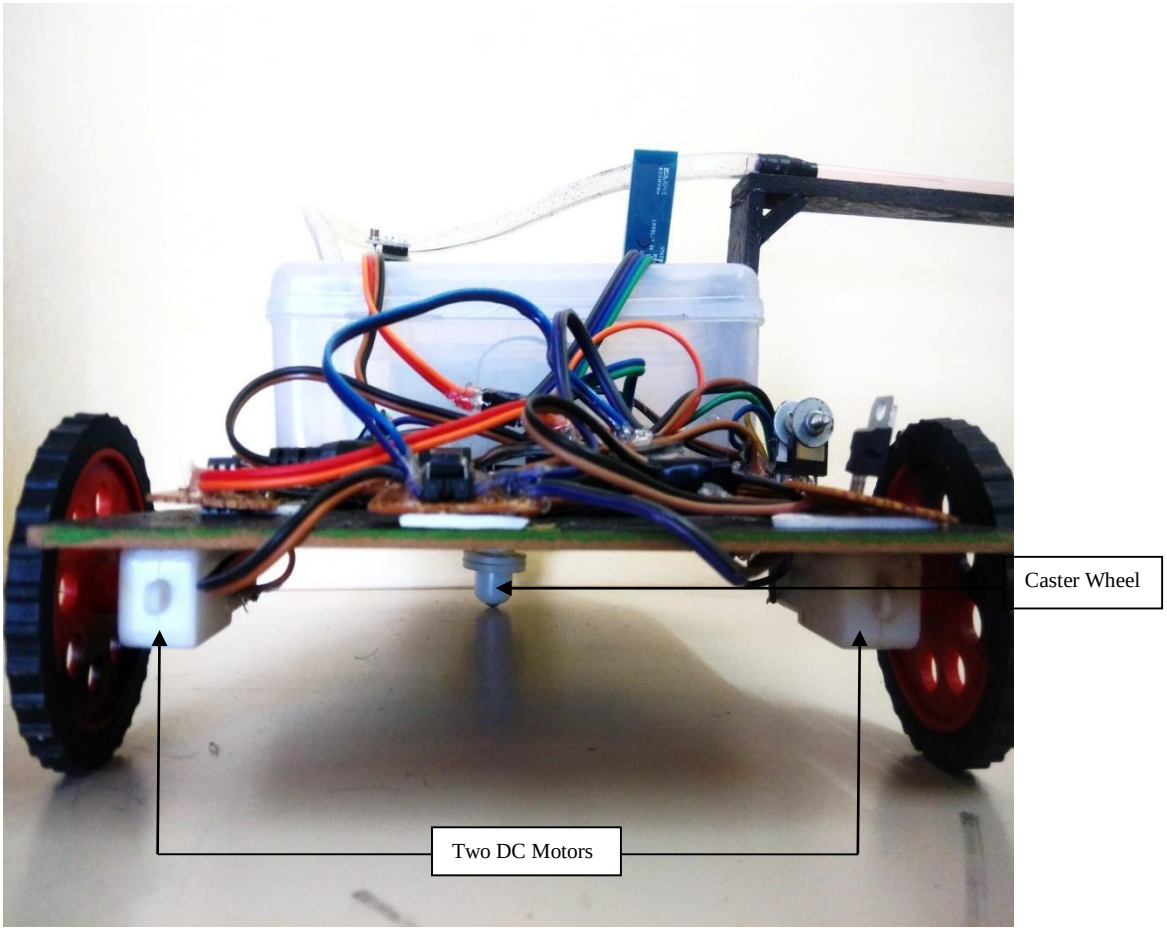


Figure 3.5 Module 2 (rear view)

3.4 CODE

3.4.1 Code for Module 1

```
#include<SoftwareSerial.h>
#include<LiquidCrystal.h>
LiquidCrystal lcd(8,9,10,11,12,13);
SoftwareSerial serial1(2,3);

#define m1 A0
#define m2 A1
#define m3 A2
#define m4 A3

#define sensor 5
#define mtr 7

unsigned char snsr_val;
char data_m,data_c;



void forward()
{
  digitalWrite(m1,HIGH);
  digitalWrite(m2,LOW);
  digitalWrite(m3,HIGH);
  digitalWrite(m4,LOW);
}
```

```
void Stop()
{
  digitalWrite(m1,LOW);
  digitalWrite(m2,LOW);
  digitalWrite(m3,LOW);
  digitalWrite(m4,LOW);
}



void setup() {

  pinMode(m1,OUTPUT);
  pinMode(m2,OUTPUT);
  pinMode(m3,OUTPUT);
  pinMode(m4,OUTPUT);
  pinMode(mtr,OUTPUT);
  digitalWrite(mtr,HIGH);
  pinMode(sensor,INPUT_PULLUP);

  Stop();
  Serial.begin(9600);
  serial1.begin(9600);
  lcd.begin(16,2);
  lcd.clear();

  lcd.setCursor(0,0);
```

```
  lcd.print(" Wireless based ");


  lcd.setCursor(0,1);
  lcd.print("plant wtring sys");
  delay(2000);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Monitoring..... ");
  delay(2000);
  lcd.clear();


}


void loop() {


  snsr_val=digitalRead(sensor);
  if(serial1.available()>0)
  {
    data_m=serial1.read();
  }
  if(Serial.available()>0)
  {
    data_c=Serial.read();
  }
  /*  if(data_c=='F')
    {
      forward();
```

```
  data_m=serial1.read();
  if(data_m=='1' && (snsr_val==LOW))
  {
   Stop();
   lcd.setCursor(0,1);
   lcd.print("Low Moisture ");
  }
  else if(data_m=='2')
  {
   lcd.setCursor(0,1);
   lcd.print("High Moisture");
  }

 lcd.setCursor(0,0);
 lcd.print("    Forward     ");
 }
else if(data_c=='S')
{
  Stop();
  lcd.setCursor(0,0);
  lcd.print("      Stop      ");
} */

while(data_c=='F')
{
   forward();
   snsr_val=digitalRead(sensor);
```

```
    data_m=serial1.read();
    if(data_m=='2')
    {
      data_c='F';
      digitalWrite(mtr,HIGH);
    }
    else if(data_m=='1' && (snsr_val==LOW))
    {
      Stop();
      digitalWrite(mtr,LOW);
      delay(4000);
      digitalWrite(mtr,HIGH);
      delay(500);
      forward();
      delay(2000);
      data_c=Serial.read();
      if(data_c=='S')
      {
        Stop();
        break;
      }
      //data_c='F';
      data_m=' ';
    }
  }
  while (data_c=='S')
  {
```

```
    Stop();
    data_c=' ';
    lcd.setCursor(0,0);
    lcd.print("      Stop      ");
  }
delay(500);
}
```

Code for Module 2

```
#include<LiquidCrystal.h>
LiquidCrystal lcd(8,9,10,11,12,13);

#define mois A0
#define temp A1
#define snsr 6



unsigned char mois_v, temp_v;

void displaypval(int d)
{
  unsigned int temparray[3],temp;
  for(temp=3;temp>0;temp--)
  {
    temparray[temp-1]= d%10;
    d=d/10;
  }

  for(temp=0;temp<3;temp++)
  {
   lcd.print(temparray[temp]);
   delay(50);
  }
}
```

```
void setup() {
  pinMode(mois,INPUT);
  pinMode(temp,INPUT);
  pinMode(snsr,OUTPUT);

  Serial.begin(9600);
  lcd.begin(16,2);
  lcd.clear();

  lcd.setCursor(0,0);
  lcd.print(" Wireless based ");

  lcd.setCursor(0,1);
  lcd.print("plant wtring sys");
  delay(2000);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Monitoring..... ");
  delay(2000);
  lcd.clear();
  digitalWrite(snsr,LOW);
}

void loop() {
  mois_v=analogRead(mois);
  temp_v=analogRead(temp);
  temp_v=temp_v/2;
```

```
  lcd.setCursor(0,0);
  lcd.print("Moist:");
  lcd.setCursor(6,0);
  displaypval(mois_v);

  lcd.setCursor(0,1);
  lcd.print("Temp:");
  lcd.setCursor(5,1);
  displaypval(temp_v);

  if(mois_v<20)
  {
    Serial.print('1');
  }
  else if (mois_v>20)
  {
    Serial.print('2');
  }
  delay(1000);


}
```

CHAPTER 4

4.1 CONCLUSION AND FUTURE SCOPE

This is a robotic system that will help in fulfilling the needs of the plant while reducing human intervention .The robot can also be initiated by the user or human via cell phone. This system can help to reduce the cost and human efforts in plant nurseries. The present system is a model to modernize the plant nurseries at a mass scale with optimum expenditure.

In future we plan to add pH sensor that will help in estimating the nutrients requirement of the plant.

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