Design and Implementation of Automatic Irrigation Robot

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A Thesis
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Abstract

In today's era all sectors are moving towards the rapid growth using many advanced technologies. Of all these sectors, agriculture is also one of them. In order to meet the increasing demand of food, farmers have to implement advanced techniques so that the soil texture is not affected and the overall food production is increased. Watering the plant is the most important cultural practice and one of the labor-intensive tasks in daily greenhouse operation. Watering systems ease the burden of getting water to plants when they need it. Knowing when and how much to water is two important aspects of watering process. To make the gardener works easily, the automatic plant watering system is created.This system uses watering sprinkler system because it can water the plants located in the pots. This project uses Arduino board, which consists of ATmega328 Microcontroller. It is programmed in such a way that it will sense the moisture level of the plants and supply the water when required. the microcontroller has to be coded to water the plants in the garden or farms about two times per day.

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Notation

BCE	Before Common Era
DC	Direct current

Chapter 1

Introduction

1.1 General

Today the environmental impact of agricultural production is very much in focus and the demands on the industry are increasing. In the present scenario, most of the countries do not have sufficient skilled manpower in the agricultural sector, and that affects the growth of developing countries. Therefore, farmers have to use upgraded technology for cultivation activity (digging, seed sowing, fertilizing, spraying, etc.). So, it's time to automate the sector to overcome this problem. In India, there are 70% of people dependent on agriculture. So, we need to study improving agricultural equipment. [1-3].

At present many countries have a shortage of skilled labor in the agriculture sector, which affects the growth rate of the developing countries including Bangladesh which hugely depends on the agriculture sector. As the population of Bangladesh is rising, the demand for food is also escalating which leads to higher crop production per hectare. So, to fix these problems farmers should use the latest technological advancements for various agricultural practices like digging, sowing, irrigation, etc., which are more efficient and less time consuming. The main work of the sowing operation is to sow seeds at the required depth with specific spacing between the two sowed seeds. This can be achieved with the help of a seed sowing machine which will dig the furrow and sow the seeds. After the seeds are placed in the furrow land, it will cover the sowed seeds with soil and sprinkle water. The seed-sowing machine saves time and laborrequirements, thus saving a lot of money along with the assurance of proper irrigation system [4-5].

As day-by-day labor availability becomes a great concern for the farmers and labor costsbecome more, this machine reduces the efforts and total cost of sowing the seeds and fertilizer placement to meet the demands of farmerswho have to use new techniques in cropping to increase the yield. The requirements of small-scale sowing machines are, they should be simple in design, affordable for small-scale peasant farmers, and easy to maintain for effective handling by unskilled farmers. In this project,an attempt has been made toreduce in cost of the machine and developa multifunctional sewing machine that can perform simultaneous operations [6].

In addition, saving in cost of operation time, labor and energy are other advantages to be derived from the use of improved machinery for such operations. A traditional method of seed sowing has many disadvantages. Our proposed **"Design and implementation of Irrigation Robot"** is used to sowseeds easily. In this project, an attempt has been made to provide alow-cost sowing machine that also reduces human effort.

1.2 Objectives

The Objective of the Project isbelow:

a) To design and construction **of an automatic irrigation Robot.**

b) To test the performance of the **irrigation robot**.

Chapter 2

Literature Review

2.1 Background

A field is initially prepared with a plow to a series of linear cuts known as furrows. The field is then seeded by throwing the seeds over the field. The result is a field planted roughly in rows but having a large number of plants. Many projects are undertaken to overcome the drawbacks of the broadcasting system. Some of those projects are given below. The drawback of a manual broadcasting system is no control over the depth of seed placement. No uniformity in the distribution of seed placement. Loss of seeds & Time required for sowing is more [7].

In this era of technological revolution, we can implement new technologies in the field of agriculture for an increase in the overall production of agricultural commodities. One of the most significant components in the agricultural procedure is the seed-sowing machine. Nowadays, agricultural activities are performed by using tractors, which use fossil fuels for functioning. Harmful gases are released throughout the process, which causes a lot of damage to the environment. They work to make use of solar power which overcomes this problem and is also cost efficient. In this project, the solar power is collected by using solar panels and then the power is saved in batteries with the help of charge controllers [8].

A literature survey is a proof essay of sorts. It is a study of relevant literature materials about a topic we have been given.

2.2 Literature Review

This article [9] proposes a system model to automate the labor-intensive task of digging and seed sowing in response to Pakistan's increasing demand for food production. The proposed model utilizes solar energy and a DC Stepper Motor to automate the process of digging, sowing seeds, and leveling the soil, resulting in reduced labor costs and improved crop productivity while maintaining soil quality. The Seed Hopper is designed to discard seeds at a specific distance, ensuring uniform spacing between seeds and rows. This system model has the potential to significantly reduce seed costs while improving the accuracy of seed count

and spacing, which are often not achieved when farmers manually sprinkle seeds.

The main objective of this project [10] is to fabricate a complete functional seed sprayer machine that is fully powered by solar energy. The solar seed sprayer machine should be able to spray different types of vegetable seeds. Further analysis of the performance has been conducted through the seed amount sprayed over time and the area covered by the machine. Solar energy is used as the power supply for the machine. Wireless communication is used to remotely control the machine, and 3D printing technology is used to assist in the fabrication of required components. The solar seed sprayer machine under research is composed of four main systems: the remote driving system, solar charging system, seed storage dispenser system, and impeller spreader system. Different experiments have been conducted to assess the performance of the machine. The performance of the machine is indicated by the capability of a machine to spread different types of seeds of various sizes and shapes. The spread seed count has been also tested as well with the area covered by the machine.

In this project [11], they are developing an agricultural-based robot this robot should be useful for farmers. In this robot, automatic seed placing and pumping the water to the seed (desired location) and they are using pick and place set up to remove the dry plant and sow the seeds consecutively. They are using the sensor to find the conditions of the land. If any obstacle is noticed the robot will stop at that place and (the soil moisture sensor) is used to find the dry or wet condition in the plant if it is dry the pump motor will start and water will be supplied.

This Project [12] is with success applied for seed sowing and spraying use. Performance of the parts can be increased once it operates on a less uneven surface and potency is inflated once the height of the crops is the same and the distance between the pair of crops is minimal. Innovative Seed sowing instrument has additional necessities in agriculture. By using this innovative seed-sowing machine, the time needed and labor price can be reduced. It is very beneficial for small-scale farmers. After comparing the various methods of seed sowing and the drawbacks of the traditional methods, it is concluded that this solar-powered seed sowing machine can:

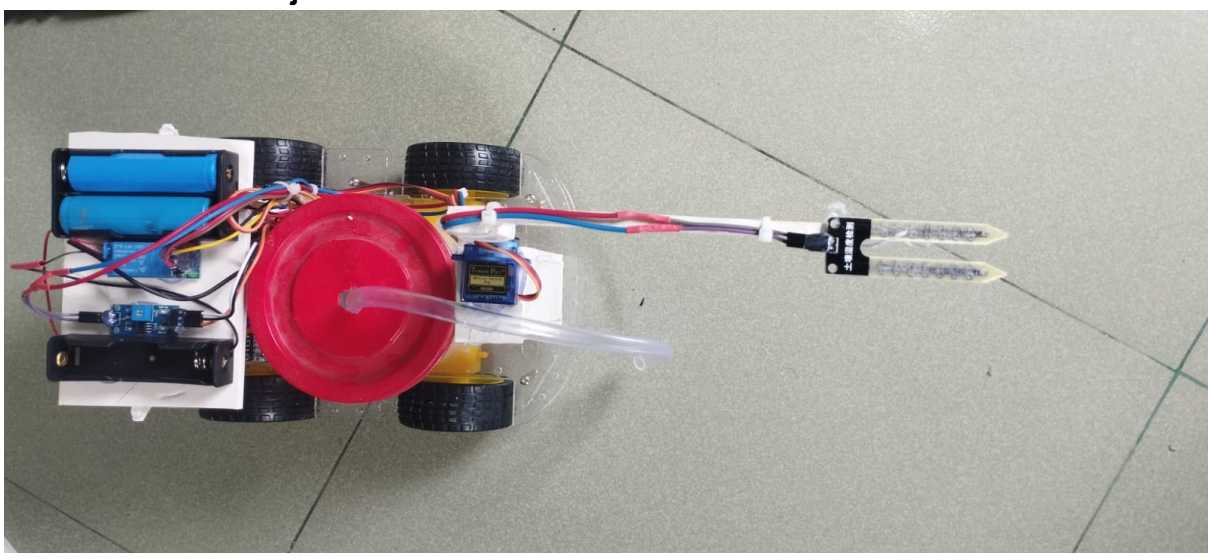
- Maintain space between rows and control the rate of sowing.
- Control the depth of seed and losses of seeds can be reduced.
- Operate various operations simultaneously.
- Saves the requirement of labor hence labor cost, time, and overall energy consumption are reduce

2.3 Apparatus Requirement

List of the hardware components:

- Arduino Uno
- Motor
- Motor Driver
- wheel
- servo motor
- HC 05
- Lithium-ion Battery
- LM2596 Buck Converter
- 2 Cell Battery Holder
- Relay module
- Cooling fan

2.4 Constructed Project



2.1 Project Picture

Arduino Uno: In a nutshell, the Arduino Uno is an open-source microcontroller board built on the ATmega328P microcontroller. Several extension boards or shields, besides additional circuits, can be interfaced with the board's digital and analog input/output pins. A form B USB cable is essential to program the board using the Arduino IDE (Integrated Development Environment). It has 6 Digital pins and 12 Analog pins. An external 9-volt battery can be used to power it, or a USB cable can be used. It is correspondingly related to the Arduino

Nano and Leonardo. It can be downloaded from the Arduino website and dispersed beneath the Creative Commons Attribution-Share Alike 2.5 license. Various outline and production files are also available.

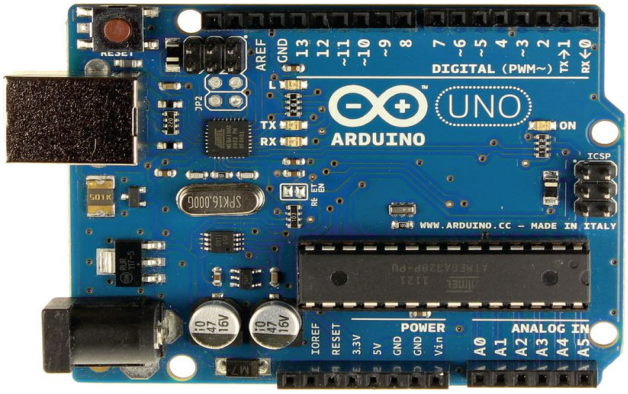


Figure 2.2: The Arduino Uno

This initial release of the Arduino Software was given the name "Uno" for its Italian meaning. Arduino Uno was the leading of a series of USB-based Arduino boards, and the Arduino IDE and Uno together were the first releases of Arduino software. A bootloader is already preprogrammed into the ATmega328, allowing programmers to upload a new code deprived of an exterior hardware systems analyst. It is the first board not to include the FTDI USB-to-serial driver chip while using the STK500 protocol as its communication protocol. The USB-to-serial converter uses the Atmega16U2 (Atmega8U2 capable of version R2) as an analog input.

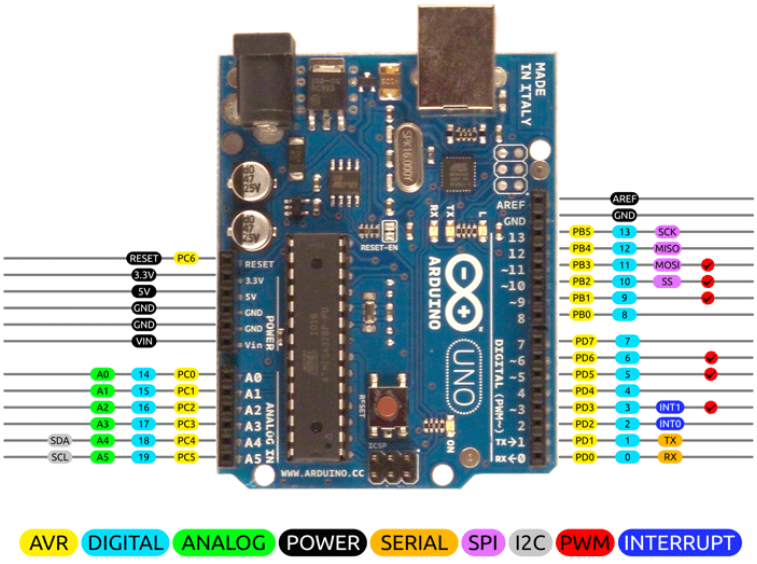


Figure 2.3: The Arduino Uno pin diagram

Motor: Electric motors turn electricity into motion by exploiting electromagnetic induction. A simple direct current (DC) motor is illustrated below. The motor features a permanent horseshoe magnet (called the stator because it's fixed in place) and a turning coil of wire called an armature (or rotor, because it rotates).

Figure 2.4: DC Gear motor

Motor Specifications

- Standard 130 Type DC motor
- Operating Voltage: 4.5V to 9V
- Recommended/Rated Voltage: 6V
- Current at No load: 70mA (max)
- No-load Speed: 9000 rpm
- Loaded current: 250mA (approx.)
- Rated Load: 10g*cm
- Motor Size: 27.5mm x 20mm x 15mm

Pin Description

Table 3.1: DC Gear Motor Pin Out

No:	Pin Name	Description
1	Terminal 1	A normal DC motor would have only two terminals. Since these terminals are connected only through a coil they have no polarity. Revering the connection will only reverse the direction of the motor
2	Terminal 2	

Use of the DC motor:

As the name suggests the Hobby DC motor is highly used by hobbyists who start exploring electronics. Hence this motor is very simple and easy to use. You can use any normal 9V battery or even a 5V supply since this motor has an operating range from 4.5V to 9V. To make it rotate just connect the positive (+) side of the battery to one terminal and the

Negative (-) sign of the battery to the other end and you should see the motor rotating. If you want to reverse the speed of the motor simply interchange the terminals and the direction will also be reversed. To control the speed of the motor you have to vary the voltage supplied to the Motor the easiest way to do this is by using a Potentiometer. There are also many other ways to achieve this. Also, remember that the motor can consume up to 250mA during loaded conditions so make sure your supply can source it. If you are controlling it through any Digital IC or any Microcontroller you should use a motor driver IC like L293D or ULN2003.

Applications

- Toy cars
- Windmill projects
- Basic Electronics projects
- As Robot wheels

Motor Driver: Interfacing the motors with the control circuits, motor drivers act as interfaces. Controller circuits work on signals with low currents, whereas motors require a high amount of current. It is the function of motor drivers to take low-current control signals and turn them into higher-current signals that can drive a motor.

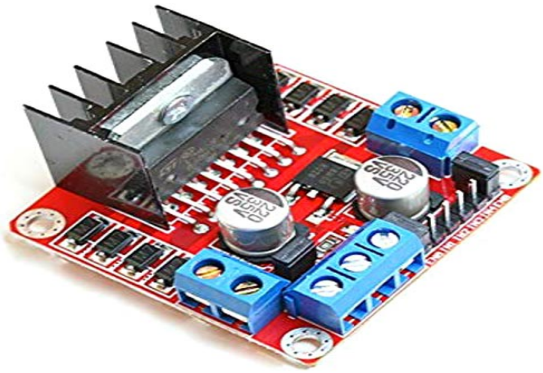


Figure2.5**:** L298N motor driver module

This driver module supports DC and stepper motors. It is a high-power motor driver module. It consists of a motor controller IC L298 and a regulator 78M05. It can control up to four DC motors or two DC motors with directional and speed control.

Specifications and features

- Driver Model: L298N 2A
- Driver Chip: Double H Bridge L298N

- Motor Supply Voltage (Maximum): 46V
- Motor Supply Current (Maximum): 2A
- Logic Voltage: 5V
- Driver Voltage: 5-35V
- Driver Current: 2A
- Logical Current:0-36mA
- Maximum Power (W): 25W
- Sensors for measuring the current at each motor
- Performance-enhancing heat sink
- Power-On LED indicator

Wheel:A circular frame or disk that rotates on an axis, typically in or around vehicles or machines. A potter's wheel, roulette wheel, or spinning wheel is any equipment, device, or instrument that is fashioned like this or has a circular frame, disk, or revolving drum as an essential element.

Figure 2.6: Wheel

Description:

- Wheels for land rovers & explorer robots with a large diameter.
- Suitable for gear motors with 6mm mounting holes.
- The semi-pneumatic rubber side allows squishing. Exploration robots are dampened by it.
- It is recommended for 3 to 10 kg robots (4 or 6-wheel usage recommended).
- Diameter: 130mm
- Thickness: 59mm

- Weight: 173 gr (each wheel with mounting hub)

20-watt Solar Panel: Through the photovoltaic effect, light energy (photons) is transformed into electricity in photovoltaic modules. The majority of modules employ thin-film or crystalline silicon wafer-based cells. A load-bearing structural element may be located at the front or back of a module. Moisture and mechanical degradation should be the two main threats to membranes. Semi-flexible modules based on thin-film cells are also available. The cells are linked in series to produce voltage, and the equivalent is an increase in current. The voltage and current of the module are multiplied to get the module wattage. It is not always the case that solar panel manufacturers base their specs on the actual conditions at the installation location. The output interface of solar panels is a PV junction box located at the rear of the panel. The majority of photovoltaic modules are linked to the rest of the system using MC4 connections to guard against weather damage. Additionally, USB power interfaces are included.

The PV system or solar panels are connected in series or parallel to provide the required output of voltage or current. Depending on their capacity, the conductors that remove the current from the modules might be made of silver, copper, or other non-magnetic conductive transition metals. When a module is partially shaded, bypass diodes can be added internally or externally to increase the output of the lit areas. Mirrors or lenses in solar PV modules with concentrators direct sunlight onto smaller solar cells. It is an economical method of employing expensive per-unit cells (like gallium arsenide). In addition to the metal frame, the solar panel is supported better by troughs, reflector shapes, and brackets.

Features

- 12V off-grid solar panel.
- 0~+5W guaranteed positive power output.
- IP 65 or IP 67 rated.
- Built with an aluminum frame and sturdy tempered glass;
- Designed to survive harsh climatic conditions;
- Offers exceptional low-light performance on overcast days, early in the morning, and late at night.

Servo Motor: Servo motors are rotating actuators or motors that provide precise control of position, acceleration, and velocity. Normal motors cannot do this. There is no such thing as a servo motor; they are a combination of specific components, including both DC and AC motors that are designed to operate in closed-loop systems. Automated assembly lines, robotics, and CNC machining applications have all used them.

Position feedback controls the rotational speed and position of a closed-loop servo mechanism. Inputs such as analog or digital signals represent the position commands for the

shaft. Encoders act as sensors, providing information about speed and position. The position is generally reported from encoders. If there is a discrepancy between the final position reported to the controller and the initial position, the motor will be moved to get to the correct position.

Simple servo motors use DC motors with a potentiometer for position sensing, as well as big-bang controls, so the motor runs at maximum speed until it reaches the designated position or stops. Despite it can be quite inaccurate, this kind of servo motor is commonly employed in radio-controlled devices such as model aircraft and toy cars.

Figure 2.7: The servo motors

Specification:

- Weight: 9 g
- Size: 22 x 11.5 x 27 mm
- Operating Speed (4.8V no load): 0.12sec/60 degrees
- Stall Torque (4.8V): 17.5oz/in (1.2 kg/cm)
- Temperature Range: -30 to +60 Degrees C
- Dead Band Width: 7usec
- Operating Voltage:3.0-7.2 Volts

HC-05 Bluetooth Module:A Bluetooth module (Bluetooth module) is a chip that integrates Bluetooth functionality, which is used to provide short-range 2.4G wireless communication. Bluetooth modules are semi-finished products as far as the end-user is concerned. A common Bluetooth module, the HC-05 is capable of adding two-way (full-duplex) wireless capability.

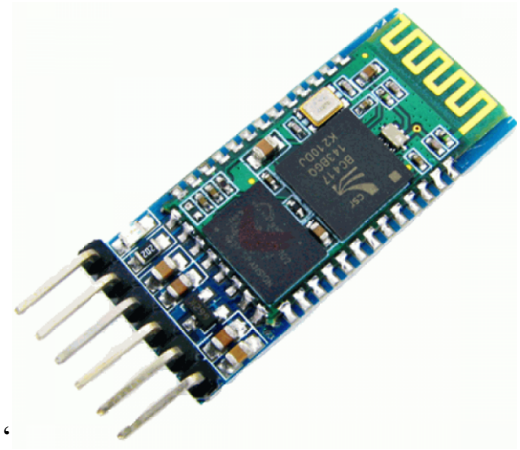


Figure 2.8: HC-05 Bluetooth module

Table 3.2: HC-02 pinout configuration

Pin Number	Pin Name	Description
1	Enable / Key	Data Mode is toggled using this pin (set low) and AT Command Mode is toggled using this pin (set high). By default, it defaults to Data Mode.
2	Vcc	Powers the module. Connect to +5V Supply voltage
3	Ground	Ground pin of module, connect to system ground.
4	TX – Transmitter	Transmits Serial Data. This pin will receive everything that's received via Bluetooth as serial data.
5	RX – Receiver	Receive Serial Data. Bluetooth will transmit all serial data given to this pin.
6	State	It can be used as feedback to check if Bluetooth is working properly since it's connected to the onboard LED.
7	LED	Point out the status of Module Blink once in 2 sec: Module has entered Command Mode Repeated Blinking: Waiting for connection in Data Mode Blink twice in 1 sec: Connection successful in Data Mode
8	Button	Controls the Key/Enable pin and toggles between Data and Command Mode.

LM2596 Buck Converter: To obtain the desired output, the voltage of the input is stepped down using a buck converter. Buck converters are primarily utilized for powering audio amplifiers, quad copper, battery chargers, USB on-the-go, point-of-load converters for PCs and laptops, and solar chargers. The voltage rating of this LM2596 DC-DC Buck Converter is 4.5-40V to 3-35V. The step-down power module is adjusted using potentiometers.

Figure 2.9: LM2596 Voltage Regulator

Structures:

- Tuning process: Main, set the input voltage (usually between 4.5-50V), then use a multimeter to observe the output voltage also regulate the potentiometer (typically clockwise turn boost, counterclockwise turn buck),
- A positive input is IN+ and a negative input is IN-
- A positive output is OUT+, a nesgative output is OUT-
- Motionless power ingestion is simply 6mA.
- Linking: Fusing, plus the pin can be straight joined after the PCB.
- Short circuit fortification: current preventive, thermal security, self-recovery.
- Buck switching regulator (BUCK) that is not isolated.
- Short circuit protection: Current preventive, self-rescue
- It is possible to adjust potentiometers in either clockwise or anti-clockwise directions.
- Non-synchronous rectify.

Lithium-ion Battery: Lithium-ion (Li-ion) batteries are used in many products such as electronics, toys, wireless headphones, handheld power tools, small and large appliances, electric vehicles, and electrical energy storage systems. A LIB is an electrochemical device that stores/delivers electrical energy through a reversible intercalation reaction in which Li+ ions are shuttled between two dissimilar electrode materials separated by the Li+ ion conducting electrolyte solution.

Lithium is the lightest of all metals, has the greatest electrochemical potential, and provides the largest specific energy per weight. Rechargeable batteries with lithium metal on the anode (negative electrodes) could provide extraordinarily high energy densities, however, cycling produced unwanted dendrites on the anode that could penetrate the separator and cause an electrical short. The cell temperature would rise quickly and approach the melting point of lithium, causing thermal runaway, also known as "venting with flame."

Figure 2.10: Li-ion battery

2 Cell Battery Holder: An 18650 battery holder price in BD is one or more compartments or chambers for holding a battery. For dry cells, the holder must also make electrical contact with the battery terminals. For wet cells, cables are often connected to the battery terminals, as is found in automobiles or emergency lighting equipment. Where the battery is expected to last over the life of the product, no holder is necessary, and a tab welded to the battery terminals can be directly soldered to a printed circuit board.

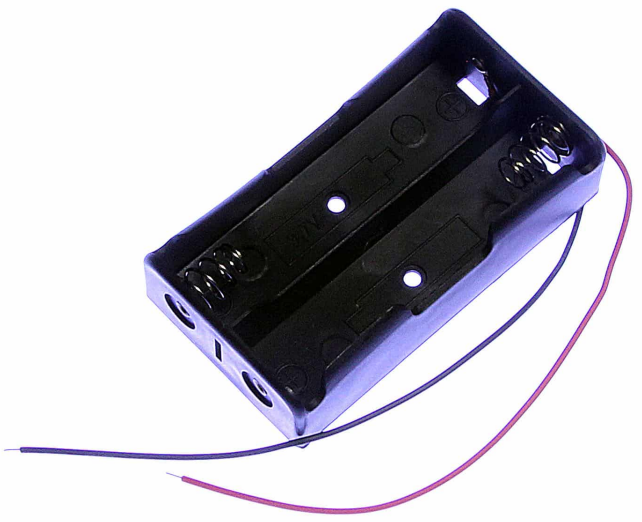


Figure: 2.11: cell battery holder

Feature:

- 2 Cell 18650 Battery Holder
- Material: Plastic + Copper
- Color: Black
- Size: approx. 77x 40 x 21mm (Not counting the wire length)
- Net weight: 15g

Relay Module:A relay is an electrically operated expedient. An input circuit or input contactor may be referred to as a control system or controlled system for the device. It is habitually utilized in the spontaneous control circuit. The device uses a low-current signal to control a high-current circuit.Relaysareautomaticswitchesthatarecommonlyusedtocontrolhighcurrentswithlowcurrent signals in automatic control circuits. An input voltage of 0 to 5V is needed for the relay signal. Using the Single Channel Relay Module, you can control high voltage, and high current loads such as motors, solenoids, lamps, and AC loads. Microcontrollers such as Arduino, PIC, etc. can be interfaced with it.

Figure 2.12: Relay module

Structures

The structures of the 1-Channel Relay module are, for instance, trails:

- Safety is good. A lower current can control a higher one in power systems and high-voltage systems.
- Providing a single-channel output for high-voltage systems.
- The extensive variety of controllable voltage.
- A high load current can be controlled, up to 240V, 10A.
- This switch is normally open (NO) and normally closed (NC).

Chapter 3

Methodology

In this chapter, we will discuss our system methodology, system description, block diagram, circuit diagram, working principle, and instrument cost analysis.

3.1Block Diagram

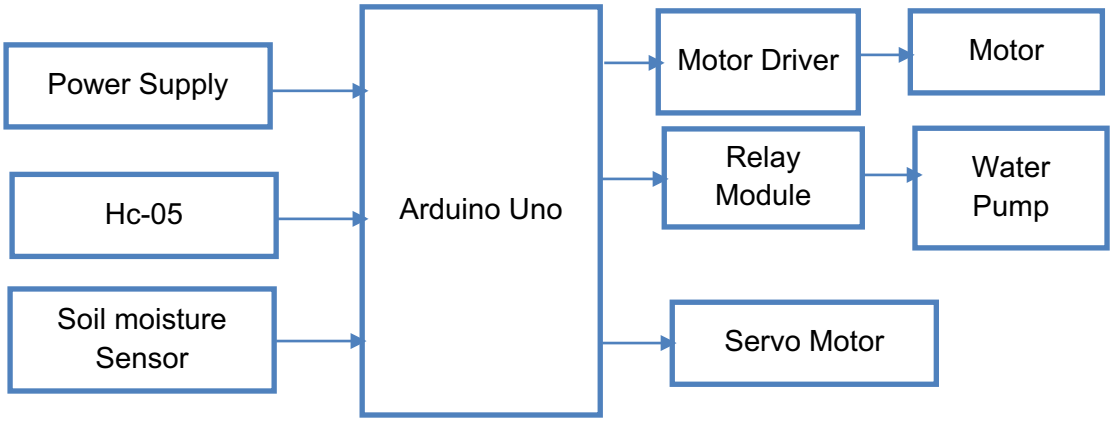


Figure 3.1: Block Diagram

In this Block diagram HC 05 and soil moisture sensorare the input of Arduino uno and motor driver, relay module, servo motor is output of Arduino Uno. Motor is output from motor driver; water pump is output from relay module. Here we are using 5 V dc for run the circuit and using 8.4 V for motor controlling also using 4.2 V for water pump controlling.

3.2Circuit Diagram

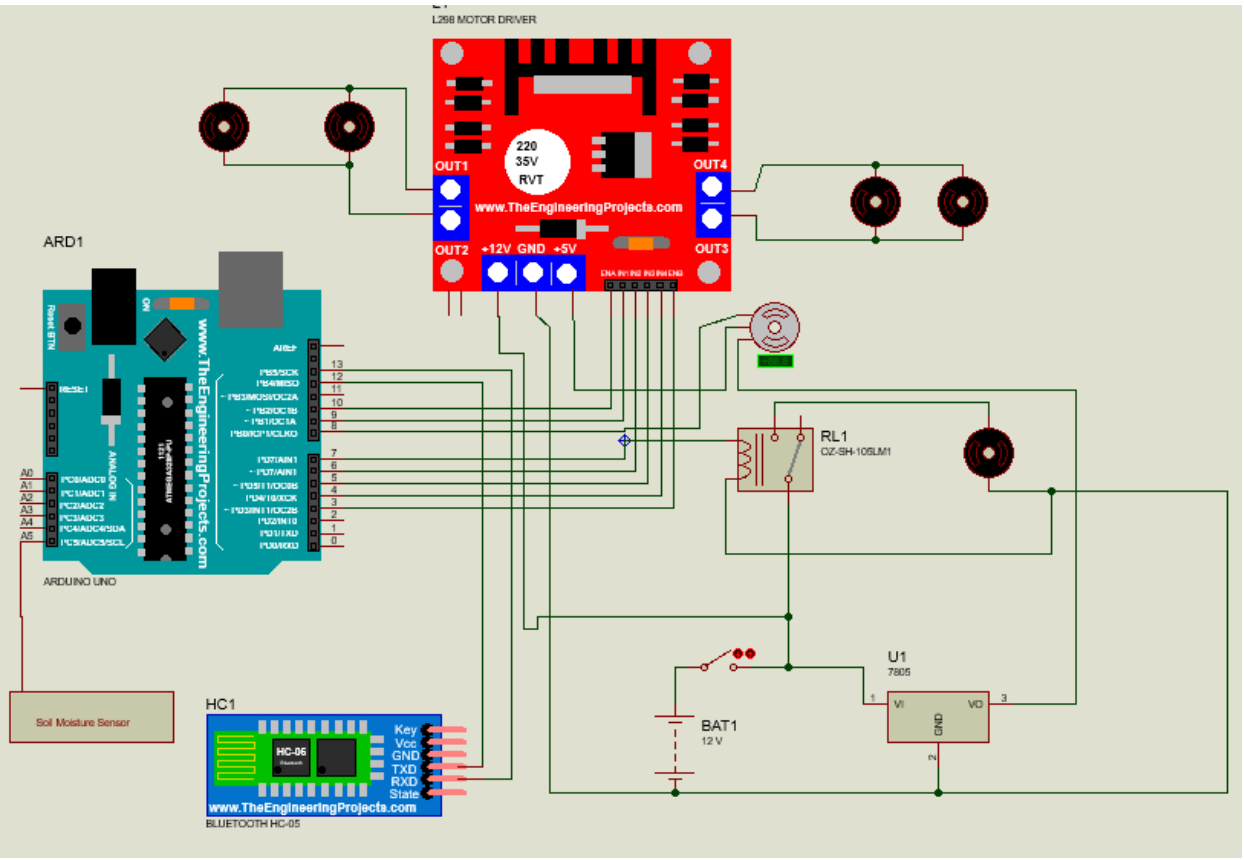


Figure 3.2: Schematic Diagram (reference- Ashiqur Rahaman , project kids bd)

In this circuit diagram Arduino is the main microcontroller board. Here, Motor Driver is connected with D3, D4, D5, D6, D9 and D10 pin of Arduino uno. Relay module connected with D7 pin of Arduino uno. Servo motor is connected with D8 pin of Arduino. HC-05 is connected with D12 and D13 pin of Arduino Uno. Total circuit run by 5 V DC; Motors are run by 12 V DC.

3.3 Flow Chart

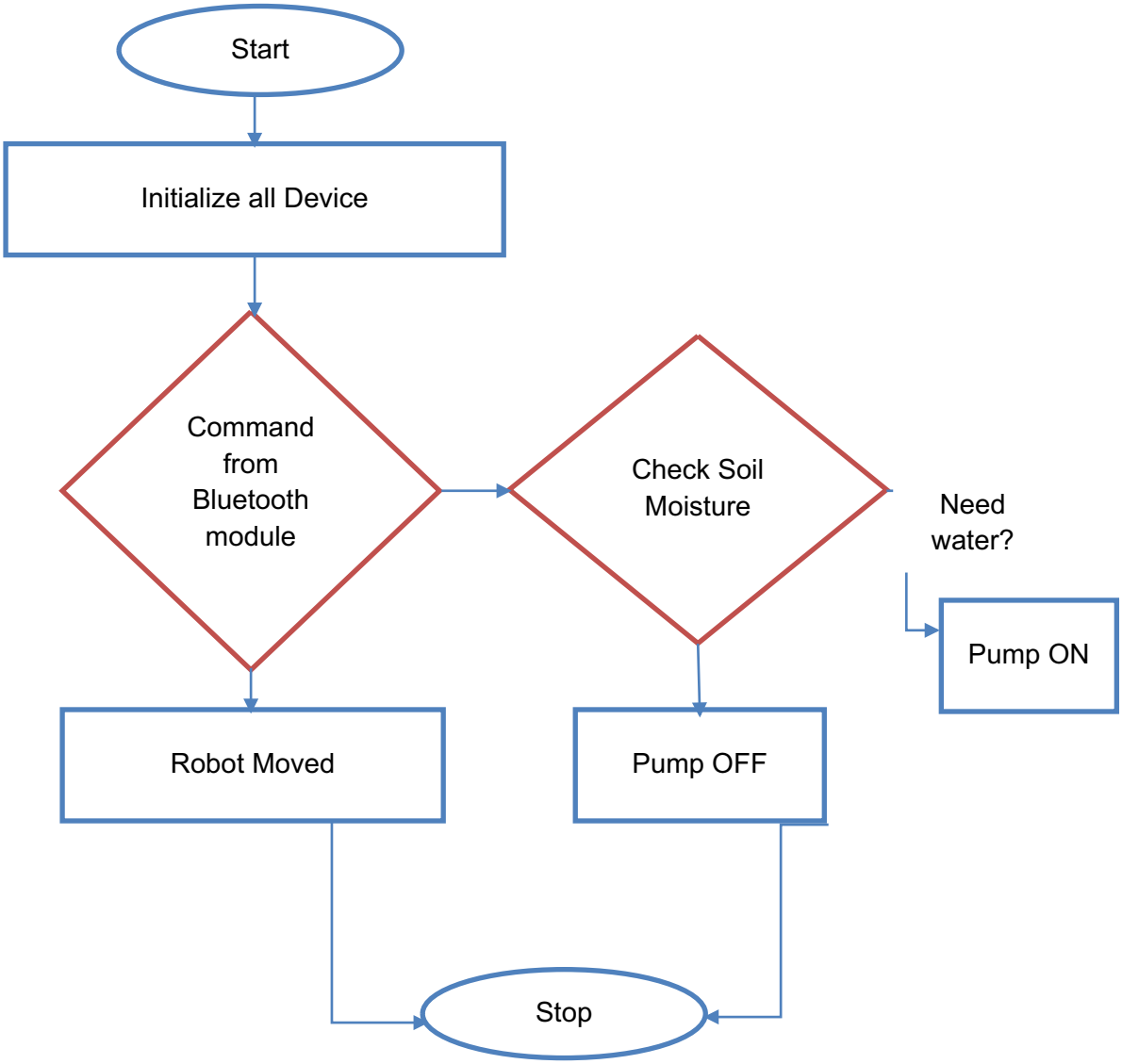


Figure 3.3: Flow Chart

3.4 Working Principles

- Here irrigation robot controlled via Bluetooth module.
- Soil moisture sensor detected the moisture of soil.
- If need water for soil then water pump automatically on.
- Otherwise, water pump off.
- Soil Moisture Sensor Automatically will go up.

Chapter 4

Result and Discussion

In this chapter here we discuss our project result analysis and outcome, advantages, limitations, application, and discussion of our system.

4.1Result Analysis

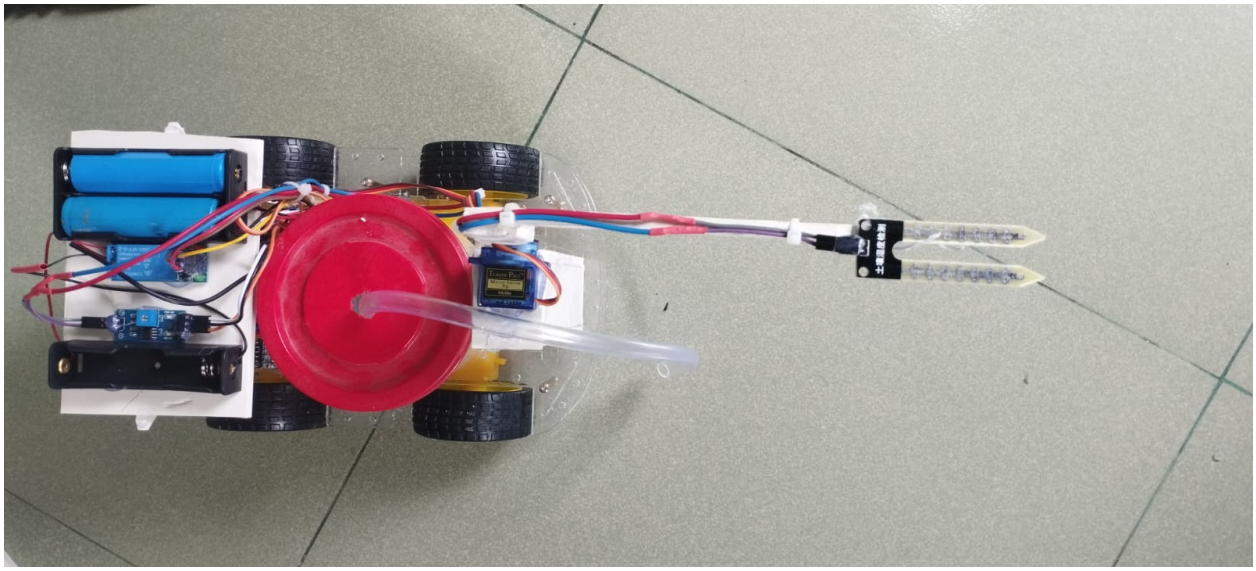


Figure 4.1: Project Picture

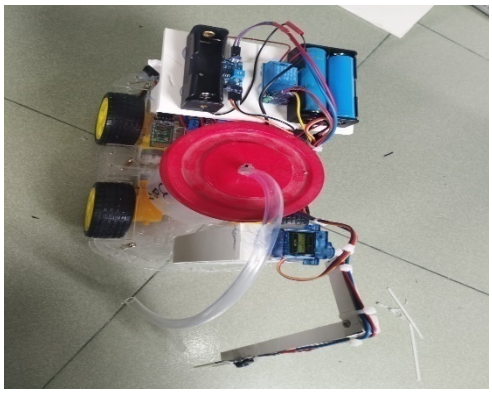


Figure 4.2: Soil Test time

Table 4.1: Device Power Rating

Serial No	Device Name	Operating Voltage
01	Arduino Uno	5V
02	*Relay Module*	5V
03	Servo Motor	5V
04	Soil Moisture Sensor	5V
05	HC-05	5V
06	Water Pump	4.2V
07	Motor	8.4 V

Table 4.2: Pump, Jar and Soil moisture level

Water Jar Capability	Water Pump Rating	Soil for 1 sq feet
450 mL	5 Liter per minute	It takes 4 minutes to soak 1 foot if moisture level 10 %
450 mL	The motor takes 6 seconds to finish 450 ml of water	

If the capacity of the water jar is increased to two litter ;

Table 4.3: Pump, Jar and Soil moisture level

Water Jar Capability	Water Pump Rating	Soil for 5 sq feet
2 litter	5 Liter per minute	It takes 10.5 minutes to soak 5 foot if moisture level 30 %
2 litter	The motor takes 24 seconds to finish 2 litter of water	It takes 7.5 minutes to soak 5 foot if moisture level 50 %

4.2Discussion

In the irrigation robot, we have used battery-powered wheels and a DC motor builtinto these wheels. When the soil moisture empty it detects the level of limitation of seeds and sets off the alarm. When any obstacle comes in the front part of the machine or divert path the seed-sowing machine can detect this obstacle effortlessly. In each complete rotation of the rotating wheel seeds fall from this seed drum and the seed plantation process can take place neatly and without wastage of seeds. The end of the system machine reached and set off the created alarm. In this work, we replace complicated and bulky gear systems for easier seed sowing and also reduce the need and cost of labor. Also, there is an adjustable system for sowing at various distances. By using this machine, the sowing can be done row-row and distance will be easily maintained. In this machine solar panel is used to absorb the solar energy and then it is converted into electrical energy which in turn is used to charge the 12 Volts, which then gives the necessary power to a shunt wound DC motor. This power is then transmitted to the DC motor to drive the wheels of the machine.

Chapter 5

Conclusion

5.1Conclusion

There is a need for improvement in the agriculture sector, which can be achieved by using advanced technological methods for farming processes like digging, sowing irrigation, etc. Automation reduces laborcosts and improves overall productivity without affecting the quality of soil. The irrigation robot is a key component of the agricultural field. The various techniques used in Bangladesh for seed sowing and fertilizer placement are manual, ox, and tractor operator. The manual and ox operator techniques are time-consuming and productivity is low. Also, the fossil fuel used by the tractor causes emissions to the atmosphere which is hazardous in some quantity. The main aim of this project is saving water.

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Appendix

```
#include <Servo.h>

Servo myservo1;

#define motor1     3
#define motor2     4
#define motor3     9
#define motor4     10

#define RELAY1                  7
#define servopin1               8

int adc = 250;

void setup() {
  Serial.begin(9600);
  Serial1.begin(9600);
  pinMode(motor1_E, OUTPUT);
  pinMode(motor2_E, OUTPUT);
  pinMode(motor1, OUTPUT);
  pinMode(motor2, OUTPUT);
  pinMode(motor3, OUTPUT);
  pinMode(motor4, OUTPUT);

  pinMode(RELAY1, OUTPUT);
  digitalWrite(RELAY1, HIGH);
  myservo1.attach(servopin1);
  myservo1.write(0);
  delay(200);
  myservo1.detach();
}

void loop() {
  if (Serial1.available() > 0) {
    char command = Serial1.read();
    switch (command) {
      case 'F':
        forward();
        break;
      case 'B':
        back();
        break;
      case 'L':
        left();
        break;
      case 'R':
```

```
  right();
  break;
case 'S':
  Stop();
  break;
case 'G':
  Fleft();
  break;
case 'I':
  Fright();
  break;
case 'H':
  Bleft();
  break;
case 'J':
  Bright();
  break;
case '0':
  adc = 0;
  break;
case '1':
  adc = 80;
  break;
case '2':
  adc = 85;
  break;
case '3':
  adc = 95;
  break;
case '4':
  adc = 100;
  break;
case '5':
  adc = 125;
  break;
case '6':
  adc = 150;
  break;
case '7':
  adc = 175;
  break;
case '8':
  adc = 200;
  break;
case '9':
  adc = 225;
  break;
case 'q':
  adc = 255;
  break;
```

```
      case 'X':
        digitalWrite(RELAY1, LOW);
        myservo1.attach(servopin1);
        myservo1.write(180);
        delay(200);
        myservo1.detach();
        break;
      case 'x':
        digitalWrite(RELAY1, HIGH);
        myservo1.attach(servopin1);
        myservo1.write(0);
        delay(200);
        myservo1.detach();
        break;
    }
  }
}

void forward()
{
  digitalWrite(motor1, 1);
  digitalWrite(motor2, 0);
  digitalWrite(motor3, 1);
  digitalWrite(motor4, 0);
}

void back()
{
  digitalWrite(motor1, 0);
  digitalWrite(motor2, 1);
  digitalWrite(motor3, 0);
  digitalWrite(motor4, 1);
}

void left()
{
  digitalWrite(motor1, 0);
  digitalWrite(motor2, 1);
  digitalWrite(motor3, 1);
  digitalWrite(motor4, 0);
}

void right()
{
  digitalWrite(motor1, 1);
  digitalWrite(motor2, 0);
  digitalWrite(motor3, 0);
  digitalWrite(motor4, 1);
}
```

```
void Stop()
{
  digitalWrite(motor1, 1);
  digitalWrite(motor2, 1);
  digitalWrite(motor3, 1);
  digitalWrite(motor4, 1);
}

void Fleft()
{
  digitalWrite(motor1, 1);
  digitalWrite(motor2, 0);
  digitalWrite(motor3, 1);
  digitalWrite(motor4, 0);
}

void Fright()
{
  digitalWrite(motor1, 1);
  digitalWrite(motor2, 0);
  digitalWrite(motor3, 1);
  digitalWrite(motor4, 0);
}

void Bleft()
{
  digitalWrite(motor1, 0);
  digitalWrite(motor2, 1);
  digitalWrite(motor3, 0);
  digitalWrite(motor4, 1);
}

void Bright()
{
  digitalWrite(motor1, 0);
  digitalWrite(motor2, 1);
  digitalWrite(motor3, 0);
  digitalWrite(motor4, 1);
}
```