# Multi-functional Agribot for Irrigation and Farm Monitoring

**Abstract—**

The paper aims on the design, development and the fabrication of the robot which can dig the soil, put the seeds, leveler to close the mud and sprayer to spray water ,these whole systems ofthe robot works with the battery power. More than 40% of the population in the world chooses agriculture as the primary occupation, in recent years the development of the autonomous vehicles in the agriculture has experienced increased interest. The vehicle is controlled by Relay switch through Bluetooth technology using mobile The idea of applying robotics technology in agriculture is very new. In agriculture, the opportunities for robot-enhanced productivity are immense - and the robots are appearing on farms in various guises and in increasing numbers. We can expect the robots performing agricultural operations autonomously such as seed sowing, mud closing and water spraying and security.

In India, near about 70% people are dependent upon agriculture. So the agricultural system in India should be advanced to reduce the efforts of farmers. Various number of operations are performed in the agriculture field like seed sowing, weeding, cutting, pesticide spraying etc. Very basic and significant operation is seed sowing. But the present methods of seed sowing are problematic. The equipments used for seed sowing are very difficult and inconvenient to handle. So there is a need to develop equipment which will reduce the efforts of farmers. This system introduces a control mechanism which aims to drop seeds at particular position with specified distance between two seeds and lines while sowing. The drawbacks of the existing sowing machine will be removed successfully in this automatic machine.

CHAPTER 1:

# INTRODUCTION

Our whole economy is based on agriculture. Agricultural field involves the effective production of food, feed, fiber, and other goods for humans and animals .Also agriculture includes operations like production of cut flowers, timber, fertilizers, animal hides, leather, and industrial chemicals .Heavy material handling is required in the farming operations. For example in vegetable cropping, handling of heavy vegetables in organic farming, handling of heavy compost bags. As compared to other fields, globalization and development in agriculture field is less. So, it is necessary to make some advancement in this field. Today's agricultural field demands to find new ways of agricultural operation to improve performance efficiency. In the field of agriculture various problems are faced by the farmers in the operations like seed sowing, pesticide spraying, weeding. Also the equipment's used to perform the operations are very heavy. Due to migration of humans in the cities the labour problem occurs. Nowadays robotics technology plays a paramount role in all sections like medical field, industries and various organizations. In other countries robots are used to perform different operations in the agricultural field. We can make the use of available technologies and the robotics technology in the farming system to reduce the efforts of farmers and also to reduce time, energy and required cost.

In addition with seed sowing, multipurpose operations such as Leveling & Plugging are also needed. But many problems are faced by farmers during seed sowing operation, like proper adjustment of distance between two crops, distance between two rows.Seed sowing is very basic and paramount operation in the agricultural field. Nowadays seed sowing is done either manually or by tractors. Manual method includes broadcasting the seeds by hand. Sometimes method of dibbling i.e. making holes and dropping seeds by hand is used. Also a pair of bullocks is used to carry the heavy equipment of leveling and seed dropping. Another method of seed sowing is to use tractor in farms. The heavy equipments of seed storage and dropping mechanism are attached to the tractor to drop the seeds. A ground wheel is attached at the base of the seed sowing machine. The power transmission system is used to transmit the motion of the rotation to the metering mechanism. The metering mechanism contains number of scoops to drop out the seeds from the hopper.

## EXISTING SYSTEM:

The existing system of multifunctional agricultural robots is a testament to the growing intersection of technology and agriculture, aimed at enhancing efficiency, productivity, and sustainability in farming practices. These robots are designed to perform various tasks traditionally carried out by humans or larger, less precise machinery. Agricultural robots are equipped with sensors, GPS, and advanced algorithms for autonomous navigation within fields. The existing system of multifunctional agricultural robots represents a promising avenue for the future of farming, offering solutions to some of the key challenges facing the agriculture industry, such as labor shortages, resource scarcity, and environmental sustainability.

## PROPOSED SYSTEM :-

Designing a proposed system of multifunctional agricultural robots involves considering various factors such as technological capabilities, agricultural requirements, and the needs of farmers.

The system should be modular, allowing for easy customization and adaptation to different farming environments and tasks. Farmers can configure the robots according to their specific needs.

Integration of various sensors for collecting data on soil conditions, crop health, and environmental factors is crucial. Machine learning algorithms can analyze this data in real-time to provide farmers with decision. .

CHAPTER - 2

# Literature Survey

1. **Title**: "Multifunctional Agricultural Robots: A Review of Design, Applications, and Challenges"
   - **Authors**: Zhang, H., Wang, J., & Li, C.
   - **Publication**: Journal of Field Robotics (Year: 2020)
   - **Abstract**: This review comprehensively examines the design principles, applications, and challenges of multifunctional agricultural robots. It covers topics such as navigation systems, task planning algorithms, and integration of various agricultural tools. The paper discusses recent advancements and future research directions in the field.
2. **Title**: "Integration of AI and Robotics in Multifunctional Agricultural Systems: A Review"
   - **Authors**: Chen, L., Liu, Y., & Li, M.
   - **Publication**: Computers and Electronics in Agriculture (Year: 2021)
   - **Abstract**: This paper provides an overview of the integration of artificial intelligence (AI) and robotics in multifunctional agricultural systems. It discusses the role of AI techniques such as machine learning and computer vision in enhancing the autonomy and intelligence of agricultural robots. Case studies and experimental results are also presented.
3. **Title**: "Challenges and Opportunities of Multifunctional Robots in Precision Agriculture"
   - **Authors**: Wu, X., Zhang, Y., & Wang, L.
   - **Publication**: Agricultural Information Technology (Year: 2019)
   - **Abstract**: This article identifies the key challenges and opportunities of multifunctional robots in precision agriculture. It discusses issues such as sensor integration, real-time data processing, and energy efficiency. The paper also proposes solutions to overcome these challenges and improve the performance of agricultural robots.

4. **Title**: "Trends and Challenges in Multifunctional Agricultural Robot Navigation"

- **Authors**: Zhou, W., Wang, Y., & Liu, Z.
- **Publication**: International Conference on Agricultural Engineering (Year: 2020)
- **Abstract**: This conference paper reviews trends and challenges in multifunctional agricultural robot navigation. It discusses navigation techniques such as GPS, LiDAR, and vision-based methods. The paper also addresses issues such as localization accuracy, obstacle avoidance, and path planning algorithms

5. **Title**: "Recent Advances in Multifunctional Agricultural Robot Development: A Review"

    - **Authors**: Kim, S., Park, H., & Lee, J.
    - **Publication**: Journal of Agricultural Machinery Science (Year: 2022)
    - **Abstract**: This review paper presents recent advances in multifunctional agricultural robot development. It covers topics such as modular design, adaptive control systems, and human-robot interaction. The paper also discusses the potential applications of multifunctional robots in various agricultural tasks.

6. **Title**: "Robotic Solutions for Weed Management in Multifunctional Agricultural Systems"

    - **Authors**: Brown, D., Smith, E., & Johnson, A.
    - **Publication**: Weed Science (Year: 2020)
    - **Abstract**: This paper reviews robotic solutions for weed management in multifunctional agricultural systems. It discusses techniques such as robotic weeders, precision spraying, and autonomous decision-making systems. The paper also evaluates the effectiveness and limitations of current weed management strategies.

7. **Title**: "Emerging Trends in Multifunctional Agricultural Robots: A Global Perspective"

    - **Authors**: Khan, A., Ahmed, R., & Zhao, X.
    - **Publication**: Journal of Agricultural Engineering Research (Year: 2022)
    - **Abstract**: This paper presents emerging trends in multifunctional agricultural robots from a global perspective. It discusses technological advancements, market trends, and policy developments shaping the future of agricultural robotics. The paper also highlights opportunities for collaboration and innovation in the field.

8. **Arad et al. (2019)** present a case study on the use of multifunctional robots in vineyard management, where robots performed tasks like pruning, spraying, and monitoring. The study demonstrates significant labor savings and improved operational efficiency .

9. **Bechar and Moses (2015)** investigate the environmental benefits of using robots for precision agriculture. They find that robots can significantly reduce the use of pesticides and fertilizers, thus minimizing the environmental footprint of farming practices .

10. **Pedersen et al. (2017)** discuss the high initial costs of multifunctional agricultural robots and the economic barriers to adoption for small-scale farmers. The study calls for more affordable solutions and government subsidies to promote wider adoption .

11. **Underwood et al. (2017)** identify technical challenges such as the reliability of navigation systems, sensor accuracy, and robot durability under varying field conditions. The study emphasizes the need for robust design and engineering solutions to enhance robot performance .

12. **Shamshiri et al. (2018)** predict that future agricultural robots will increasingly integrate with IoT, big data, and cloud computing technologies. This integration will enhance data analytics and decision-making capabilities, leading to smarter and more efficient farming practices .

The literature on multifunctional agricultural robots reveals significant advancements and a broad range of applications that enhance agricultural productivity and sustainability. However, several challenges related to cost, technical complexity, and socio-economic impacts need to be addressed. Future research and development should focus on making these technologies more accessible, reliable, and beneficial for all types of farming operations, ensuring a balanced and equitable advancement in agricultural practices.

# SYSTEM ANALYSIS

## SCOPE :-

The scope for multifunctional agricultural robots is extensive and growing, driven by the need for increased efficiency, precision, and sustainability in agriculture.

### 1)Planting and Seeding

- **Automated Planters:** Robots can plant seeds with high precision, ensuring optimal spacing and depth, which improves germination rates and crop yields.
- **Variable Rate Seeding:** Robots can adjust seeding rates based on soil conditions and crop requirements, enhancing efficiency and productivity.

### 2)Weeding and Pest Control

- **Mechanical Weeding:** Robots can identify and remove weeds autonomously, reducing the need for chemical herbicides and promoting sustainable farming practices.
- **Targeted Spraying:** Robots can apply pesticides and herbicides precisely where needed, minimizing chemical use and reducing harm to beneficial insects and the environment

### 3)Environmental Sustainability

- **Resource Optimization:** By using resources like water, fertilizers, and pesticides more efficiently, robots help reduce the environmental footprint of agriculture.
- **Conservation Agriculture:** Robots can support conservation practices such as no-till farming, cover cropping, and precision irrigation, promoting soil health and biodiversity.

multifunctional agricultural robots have the potential to revolutionize farming by enhancing productivity, reducing costs, and promoting sustainable practices. Their versatility and continuous improvement make them a valuable asset for the future of agriculture.

**Objectives:**

The architecture contains Plant Module, Sensor module, Processor Module and Actuator Module. Plant Module For each crop the user enters the crop details such as crop name, date of report, temperature, light, moisture values.

**Sensor Module** The sensor is designed for collecting information about climate of the field. Three different types of sensors are used to collect climatic conditions. Temperature Sensor is used to collect Temperature Value, PIR Sensor to detect Human and soil Moisture Sensor is used for collecting dry/wet Value.

**Processor Module** Checks all sensed information's were up to the necessary limit for each crops. If all data's are normal, the processor continues its work. Otherwise, it activates the actuator to take corrective actions to control the environmental conditions. And also sends the sensed data's to user via Internet.

**Actuator Module** Decides the action about controls like in/out water flow control, sound control (protect from animals) and sprinkler (to maintain the humidity and temperature).

## PROBLEM DEFINITION :-

The primary problem is to develop a multifunctional agricultural robot that can enhance productivity, reduce labor dependency, optimize resource use, and support sustainable farming practices across different agricultural tasks and environments. Developing a multifunctional agricultural robot involves addressing multiple technical, environmental, and economic challenges. The robot must be versatile, efficient, adaptable, and user-friendly to meet the diverse needs of modern agriculture. Successfully implementing such a robot can lead to significant improvements in productivity, sustainability, and overall farm management.

## RELATED WORK :-

The development and deployment of multifunctional agricultural robots have been the focus of extensive research and practical applications

.1) ***AgBot II:-***

- **Institution:** Queensland University of Technology (QUT), Australia
- **Overview:** AgBot II is a multifunctional agricultural robot designed for tasks such as weeding, fertilizing, and data collection. It uses vision systems and GPS for navigation and task execution.
- **Features:** The robot can apply fertilizers precisely and detect and remove weeds autonomously. It gathers data on crop health, which helps in precision farming.

***2)Thorvald II:-***

- **Institution:** Norwegian University of Life Sciences (NMBU), Norway
- **Overview:** Thorvald II is a modular and versatile agricultural robot designed for a variety of tasks including weeding, crop monitoring, and harvesting.
- **Features:** It can be reconfigured for different tasks, equipped with various tools and sensors. It supports remote monitoring and data collection to aid in farm management.

***3)RIPPA (Robot for Intelligent Perception and Precision Application):-***

- **Institution:** Australian Centre for Field Robotics (ACFR), University of Sydney
- **Overview:** RIPPA is designed for real-time monitoring and precision application of agricultural inputs.
- **Features:** It employs machine learning for crop identification, health assessment, and precise application of pesticides and fertilizers. It also includes a mechanical weeding system.

***4)Blue River Technology's See & Spray :-***

- **Company:** Acquired by John Deere
- **Overview:** The See & Spray technology uses machine vision and machine learning to identify and spray weeds selectively.
- **Features:** It minimizes herbicide use by targeting only the weeds, preserving the crops and the environment. The technology is integrated into larger farm machinery.

# FUNCTIONAL REQUIREMENT

## HARDWARE REQUIREMENTS :-

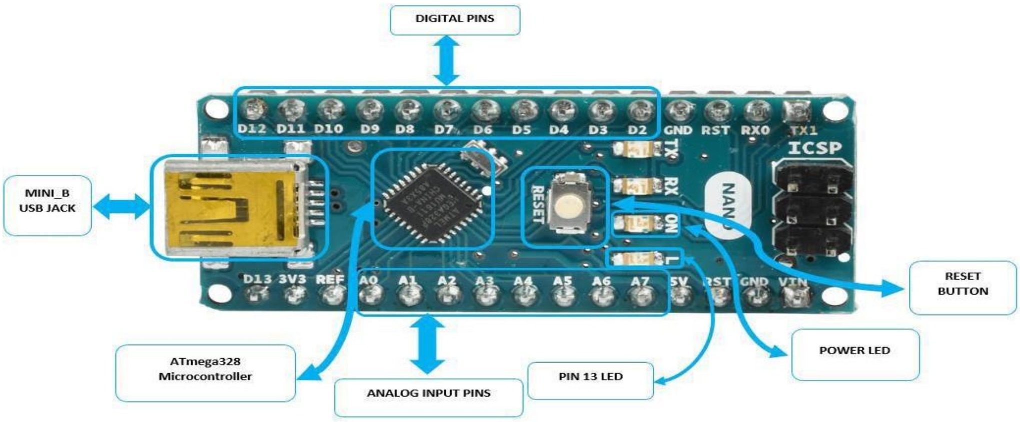



**FIG : ARDUINO NANO**

**INTRODUCTION :-**

Arduino nano differ from other Arduino as it very small so it suitable for small sized projects and it supports breadboards so it can be plugged with other components in only one breadboard.

**ARDUINO NANO PHYSICAL COMPONENTS :-**

Microcontroller

In Arduino Nano 2.x version, still used ATmega168 microcontroller while the Arduino Nano 3.x version already used ATmega328 microcontroller.

**ATmega328 Microcontroller features**

• High Performance, Low Power AVR

• Advanced RISC Architecture

131 Powerful Instructions – Most Single Clock Cycle Execution

o 32 x 8 General Purpose Working Registers

o Up to 20 MIPS Throughput at 20 MHz

o On-chip 2-cycle Multiplier

**High Endurance Non-volatile Memory Segments**

o 4/8/16/32K Bytes of In-System Self-Programmable Flash program memory

o 256/512/512/1K Bytes EEPROM

o 512/1K/1K/2K Bytes Internal SRAM

o Write/Erase Cycles: 10,000 Flash/100,000 EEPROM

**Peripheral Features**

- Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
- One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
- Real Time Counter with Separate Oscillator
- Six PWM Channels o 8-channel 10-bit ADC in TQFP and QFN/MLF package
- Temperature Measurement
- 6-channel 10-bit ADC in PDIP Package
- Temperature Measurement o Programmable Serial USART
- Master/Slave SPI Serial Interface
- Byte-oriented 2-wire Serial Interface (Philips I2 C compatible)
- Programmable Watchdog Timer with Separate On-chip Oscillator
- On-chip Analog Comparator
- Interrupt and Wake-up on Pin Change

**Special Microcontroller Features**

- Power-on Reset and Programmable Brown-out Detection
- Internal Calibrated Oscillator
- External and Internal Interrupt Sources
- Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby

**I/O and Packages**

- 23 Programmable I/O Lines
- 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF
- Operating Voltage: o 1.8 - 5.5V

**Temperature Range:**

- -40°C to 85°C

**Speed Grade:**

o 0 - 4 MHz@1.8 - 5.5V, 0 - 10 MHz@2.7 - 5.5.V, 0 - 20 MHz @ 4.5 - 5.5V

**Power Consumption at 1 MHz, 1.8V, 25°C**

o Active Mode: 0.2 mA

o Power-down Mode: 0.1 µA

o Power-save Mode: 0.75 µA (Including 32 kHz RTC)

## Pin configuration

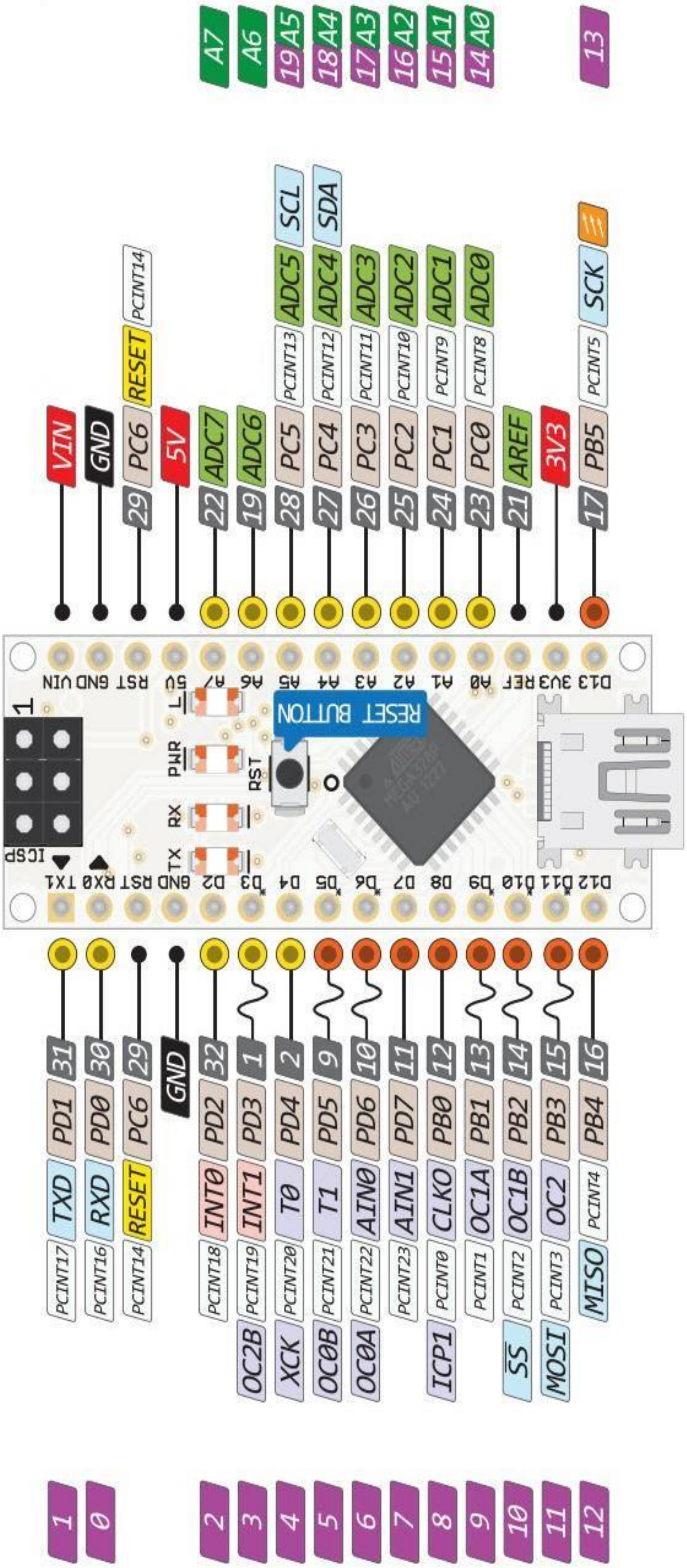



**FIG: PIN CONFIGURATION**

**Power :-**

The Arduino Nano can be powered via the Mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The power source is automatically selected to the highest voltage source.

**Memory :-**

The ATmega328P has 32 KB, (also with 2 KB used for the bootloader. The ATmega328P has 2 KB of SRAM and 1 KB of EEPROM. Input and Output Each of the 14 digital pins on the Nano can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() 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 FTDI 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 Nano has 8 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 analogReference() function. Analog pins 6 and 7 cannot be used as digital pins. Additionally, some pins have specialized functionality:

**I2C**: 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the Wire library (documentation on the Wiring website).

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 which block the one on the board.

## Communication:-

The Arduino Nano has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328P provide UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An FTDI FT232RL on the board channels this serial communication over USB and the FTDI drivers (included with the Arduino software) provide a virtual com port to software on the computer. 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 FTDI chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A SoftwareSerial library allows for serial communication on any of the Nano's digital pins. The ATmega328P also support I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus. To use the SPI communication, please see ATmega328P datasheet.

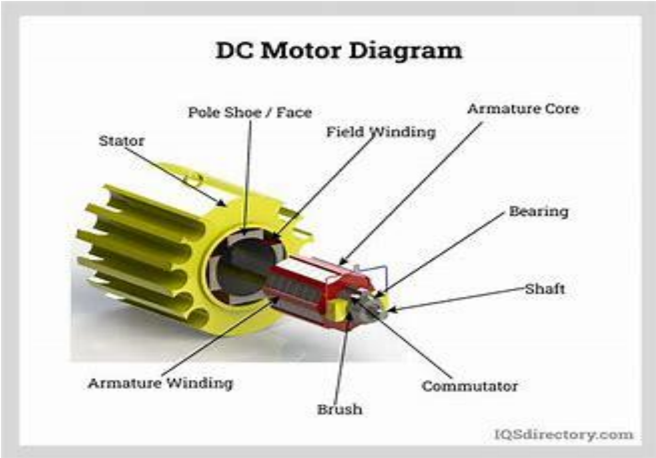
## Programming :-

The Arduino Nano can be programmed with the Arduino software (download). Select "Arduino Duemilanove or Nano w/ ATmega328P" from the Tools > Board menu (according to the microcontroller on your board). The ATmega328P on the Arduino Nano comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP or similar.

## Automatic (Software) Reset :-

Rather then requiring a physical press of the reset button before an upload, the Arduino Nano 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 FT232RL is connected to the reset line of the ATmega328P via a 100 nanofarad 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 Nano 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 Nano. 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 one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

## DC Motor:




## FIG : DC MOTOR

DC motors are configured in many types and sizes, including brush less, servo, and gear motor types. A motor consists of a rotor and a permanent magnetic field stator. The magnetic field is maintained using either permanent magnets or electromagnetic windings. DC motors are most commonly used in variable speed and torque. Motion and controls cover a wide range of components that in some way are used to generate and/or control motion. Areas within this category include bearings and bushings, clutches and brakes, controls and drives, drive components, encoders and resolves, Integrated motion control, limit switches, linear actuators, linear and rotary motion components, linear position sensing, motors (both AC and DC motors), orientation position sensing, pneumatics and pneumatic components, positioning stages, slides and guides, power transmission (mechanical), seals, slip rings, solenoids, springs. Motors are the devices that provide the actual speed and torque in a drive system. This family includes AC motor types (single and multiphase motors, universal, servo motors, induction, synchronous, and gear motor) and DC motors (brush less, servo motor, and gear motor) as well as linear, stepper and air motors, and motor contactors and starters. In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

Let's start by looking at a simple 2-pole DC electric motor (here red represents a magnet or winding with a "North" polarization, while green represents a magnet or winding with a "South" polarization).

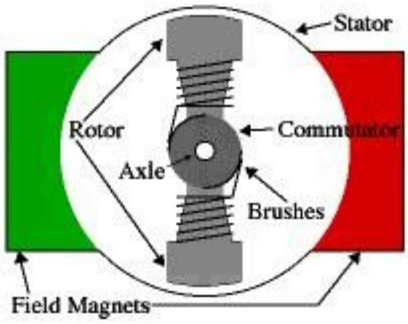
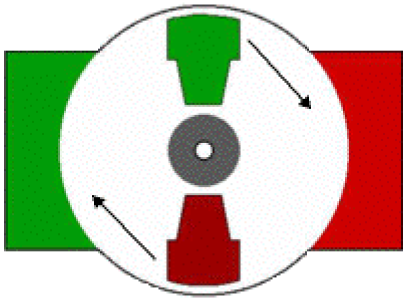



**FIG:2-pole DC MOTOR**

Every DC motor has six basic parts -- axle, rotor (a.k.a., armature), stator, commutator, field magnet(s), and brushes. In most common DC motors (and all that Beamers will see), the external magnetic field is produced by high-strength permanent magnets1. The stator is the stationary part of the motor -- this includes the motor casing, as well as two or more permanent magnet pole pieces. The rotor (together with the axle and attached commutator) rotates with respect to the stator. The rotor consists of windings (generally on a core), the windings being electrically connected to the commutator. The above diagram shows a common motor layout -- with the rotor inside the stator (field) magnets. The geometry of the brushes, commutator contacts, and rotor windings are such that when power is applied, the polarities of the energized winding and the stator magnet(s) are misaligned, and the rotor will rotate until it is almost aligned with the stator's field magnets. As the rotor reaches alignment, the brushes move to the next commutator contacts, and energize the next winding. Given our example two-pole motor, the rotation reverses the direction of current through the rotor winding, leading to a "flip" of the rotor's magnetic field, and driving it to continue rotating.

In real life, though, DC motors will always have more than two poles (three is a very common number). In particular, this avoids "dead spots" in the commutator. You can imagine how with our example two-pole motor, if the rotor is exactly at the middle of its rotation (perfectly aligned with the field magnets), it will get "stuck" there. Meanwhile, with a two-pole motor, there is a moment where the commutator shorts out the power supply (i.e., both brushes touch both commutator contacts simultaneously). This would be bad for the power supply, waste energy, and damage motor components as well. Yet another disadvantage of such a simple motor is that it would exhibit a high amount of torque" ripple" (the amount of torque it could produce is cyclic with the position of the rotor).



So since most small DC motors are of a three-pole design, let's tinker with the workings of one via an interactive animation (JavaScript required):

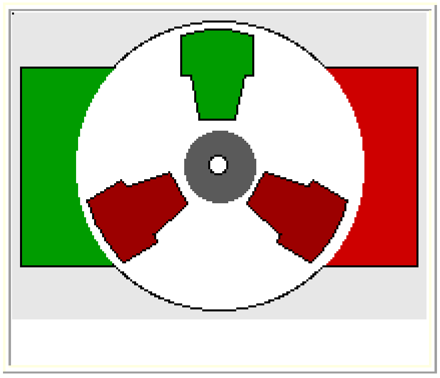


**FIG: 3-pole DC MOTOR**

You'll notice a few things from this -- namely, one pole is fully energized at a time (but two others are "partially" energized). As each brush transitions from one commutator contact to the next, one coil's field will rapidly collapse, as the next coil's field will rapidly charge up (this occurs within a few microsecond). We'll see more about the effects of this later, but in the meantime you can see that this is a direct result of the coil windings' series wiring:

## PULSE WIDTH MODULATION TECHNIQUE :-

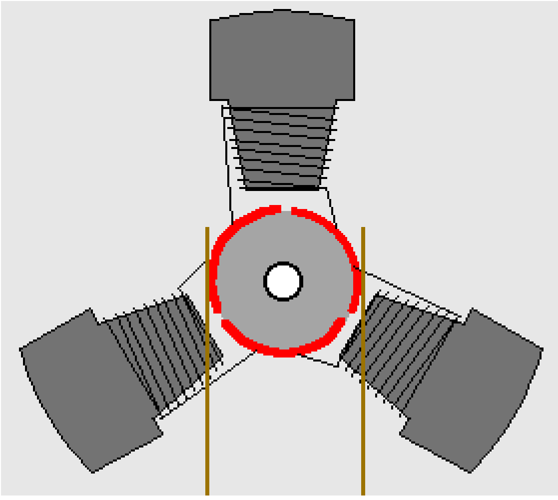


**FIG : PULSE WIDTH MODULATION TECHNIQUE**

### PWM technique:

A pulse width modulator (PWM) is a device that may be used as an efficient light dimmer or DC motor speed controller. A PWM works by making a square wave with a variable on-to-off ratio; the average on time may be varied from 0 to 100 percent. In this manner, a variable amount of power is transferred to the load. The main advantage of a PWM circuit over a resistive power controller is the efficiency, at a 50% level, the PWM will use about 50% of full power, almost all of which is transferred to the load, a resistive controller at 50% load power would consume about 71% of full power, 50% of the power goes to the load and the other 21% is wasted heating the series resistor. Load efficiency is almost always a critical factor in solar powered and other alternative energy systems. One additional advantage of pulse width modulation is that the pulses reach the full supply voltage and will produce more torque in a motor by being able to overcome the internal motor resistances more easily. Finally, in a PWM circuits, common small potentiometers may be used to control a wide variety of loads whereas large and expensive high power variable resistors are needed for resistive controllers. Pulse width modulation consists of three signals, which are modulated by a square wave. The duty cycle or high time is proportional to the amplitude of the square wave. The effective average voltage over one cycle is the duty cycle times the peak-to-peak voltage. Thus, the average voltage follows a square wave. In fact, this method depends on the motor inductance to integrate out the PWM frequency.

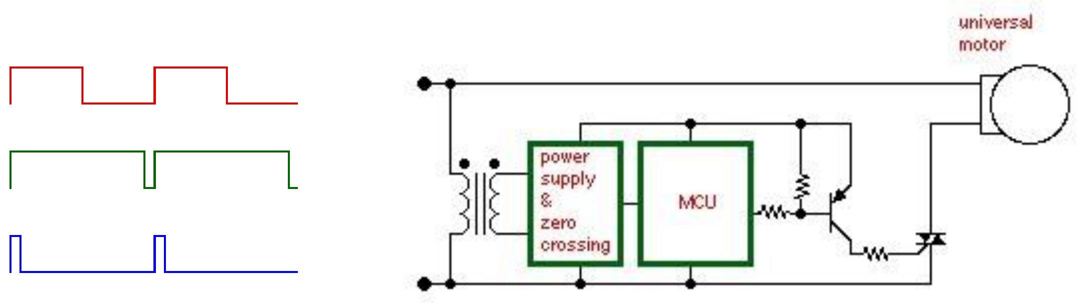



**FIG : TRIAC CONTROL**

A very simply off line motor drive can be built using a TRIAC and a control IC. This circuit can control the speed of a universal motor. A universal motor is a series wound DC motor. The circuit uses phase angle control to vary the effective motor voltage. A micro controller can also be used to control a triac. A PNP of transistor may be used to drive the triac. As shown, the MCU ground is connected to the AC line. The gate trigger current is lower if instead the MCU 5V supply is connected to the AC line. The MCU must have some means of detecting zero crossing and a timer, which can control the triac firing. A general-purpose timer with one input capture and one output compare makes an ideal phase angle control.

**L293D IC (DC MOTOR DRIVER) :**


**FIG : L293D IC (MOTOR DRIVER)**

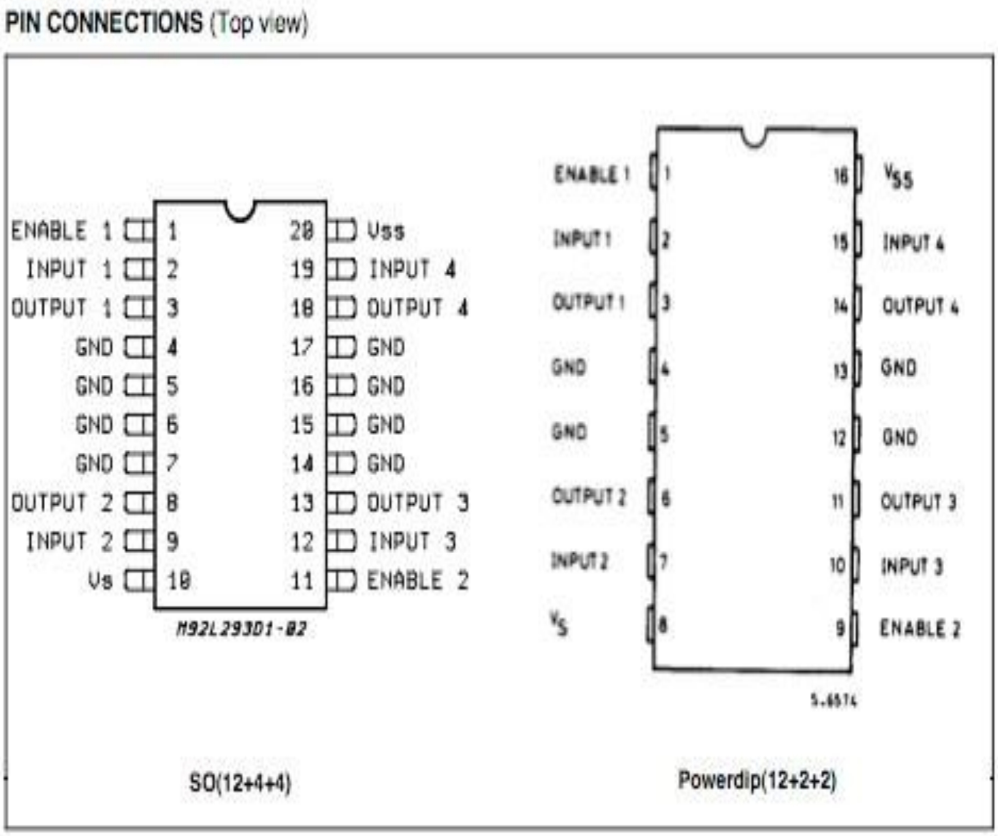



**FIG : PIN CONNECTIONS OF L293 and L293D IC**

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications. On the L293, external high-speed output clamp diodes should be used for inductive transient suppression. A VCC1 terminal, separate from VCC2, is provided for the logic inputs to minimize device power dissipation. The L293and L293D are characterized for operation from 0°C to 70°C.

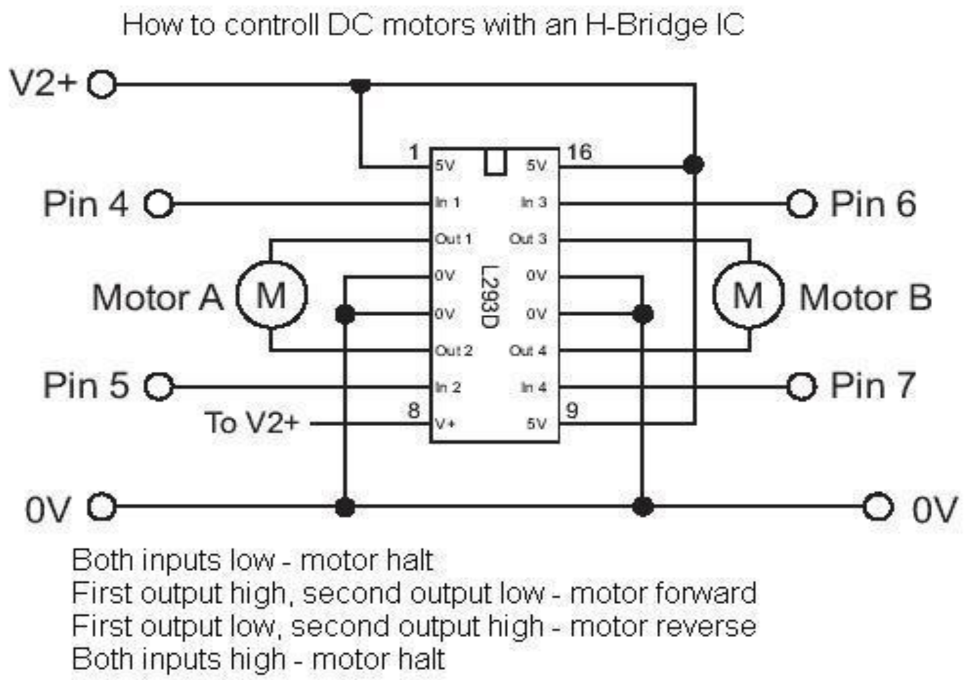
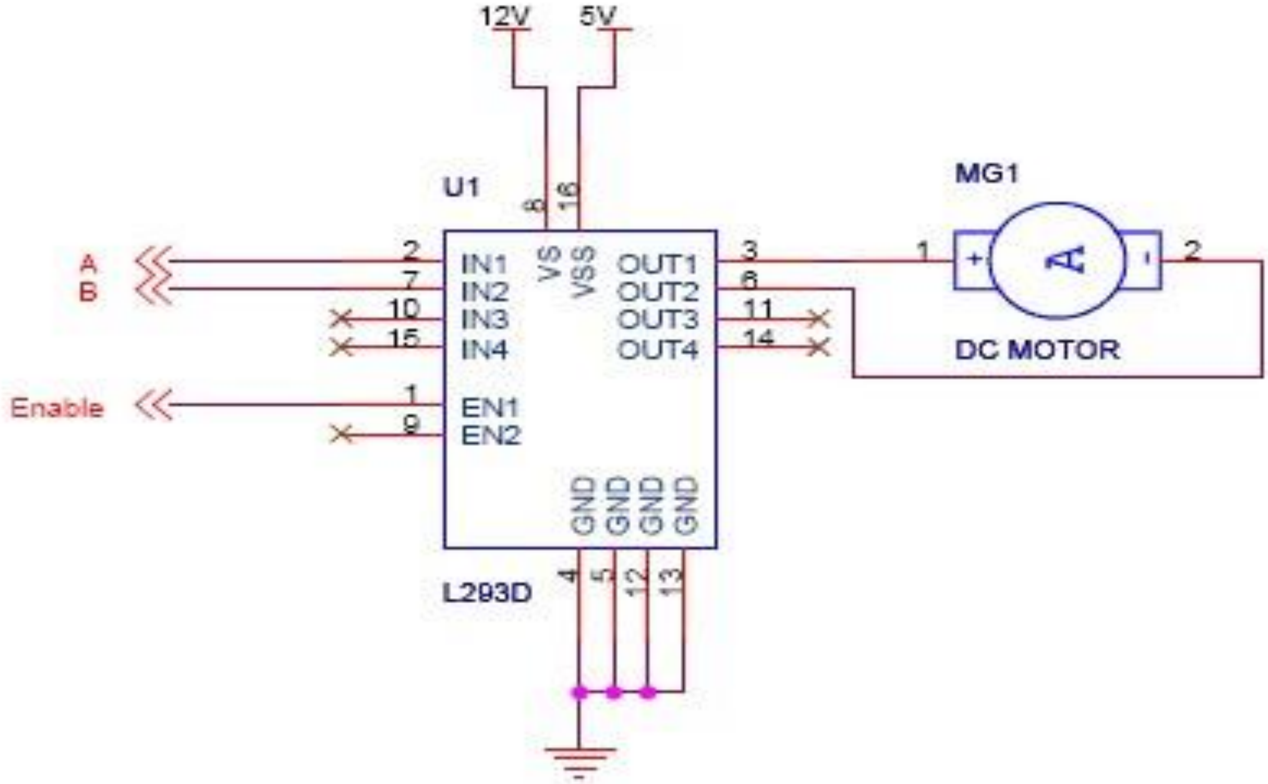



**FIG : CONTROL OF DC MOTORS WITH AN H-BRIDGE IC**




## Truth Table

| A | B | Description |
|---|---|---|
| 0 | 0 | Motor stops or Breaks |
| 0 | 1 | Motor Runs Anti-Cloclwise |
| 1 | 0 | Motor Runs Clockwise |
| 1 | 1 | Motor Stops or Breaks |

For above truth table, the Enable has to be Set (1). Motor Power is mentioned 12V, but you can connect power according to your motors.

**FIG : TRUTH TABLE OF DC MOTOR**

## Soil Moisture Sensor:

How Soil Moisture Sensor works? The working of the soil moisture sensor is pretty straightforward. The fork-shaped probe with two exposed conductors, acts as a variable resistor (just like a potentiometer) whose resistance varies according to the water content in the soil.

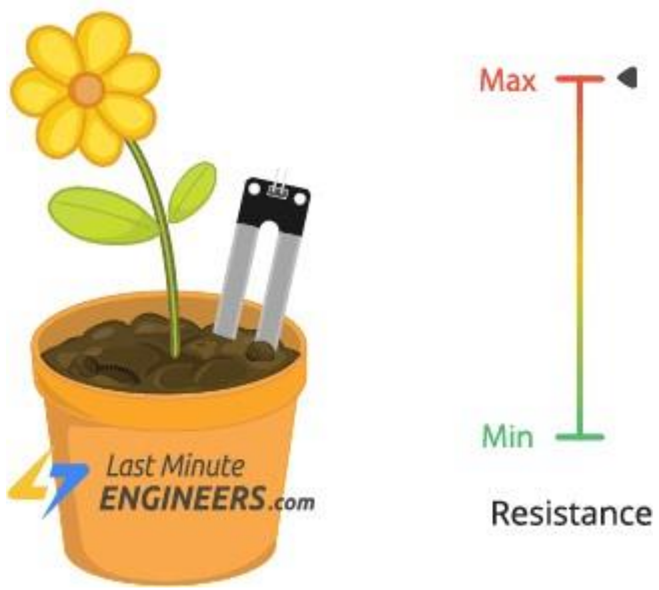



**FIG: SOIL MOISTURE SENSOR**

This resistance is inversely proportional to the soil moisture:

• The more water in the soil means better conductivity and will result in a lower resistance.

• The less water in the soil means poor conductivity and will result in a higher resistance. The sensor produces an output voltage according to the resistance, which by measuring we can determine the moisture level.

## Hardware Overview

A typical soil moisture sensor has two components.

The Probe The sensor contains a fork-shaped probe with two exposed conductors that goes into the soil or anywhere else where the water content is to be measured. Like said before, it acts as a variable resistor whose resistance varies according to the soil moisture.

**FIG : PROBE OF SOIL MOISTURE SENSOR**

**MODULE :-**

The Module The sensor also contains an electronic module that connects the probe to the Arduino. The module produces an output voltage according to the resistance of the probe and is made available at an Analog Output (AO) pin. The same signal is fed to a LM393 High Precision Comparator to digitize it and is made available at an Digital Output (DO) pin.


**FIG : LM393 Comparator**

The module has a built-in potentiometer for sensitivity adjustment of the digital output (DO). You can set a threshold by using a potentiometer; So that when the moisture level exceeds the threshold value, the module will output LOW otherwise HIGH.


## FIG :- LM393 COMPARATOR HAVING 2 LED’S

Apart from this, the module has two LEDs. The Power LED will light up when the module is powered. The Status LED will light up when the digital output goes LOW.

**Soil Moisture Sensor Pinout**

The soil moisture sensor is super easy to use and only has 4 pins to connect.

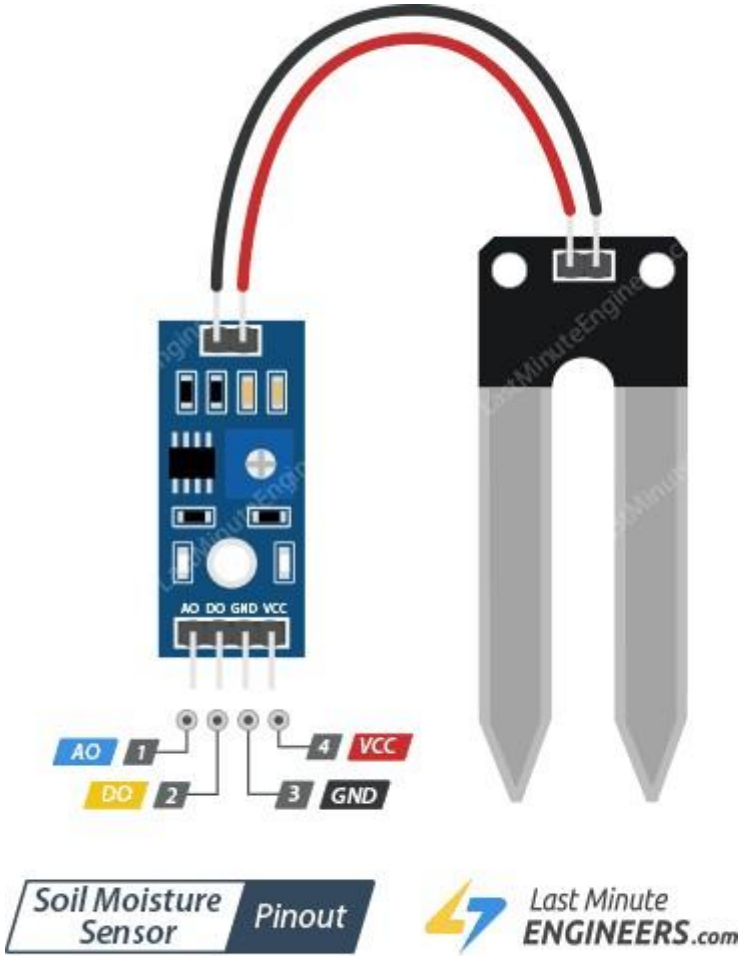



**FIG : SOIL MOISTURE SENSOR PINOUT**

AO (Analog Output) pin gives us an analog signal between the supply value to 0V and will be connected to one of the analog inputs on your Arduino.

DO (Digital Output) pin gives Digital output of internal comparator circuit. You can connect it to any digital pin on an Arduino or directly to a 5V relay or similar device.

VCC pin supplies power for the sensor. It is recommended to power the sensor with between 3.3V – 5V. Please note that the analog output will vary depending on what voltage is provided for the sensor.

GND is a ground connection.

## Sensing Soil Moisture using Analog Output :-

As you know that the module provides both analog and digital output, so for our first experiment we will measure the soil moisture by reading the analog output.

## Wiring :-

Let's hook the soil moisture sensor up to the Arduino.

First you need to supply power to the sensor. For that you may connect the VCC pin on the module to 5V on the Arduino.

However, one commonly known issue with these sensors is their short lifespan when exposed to a moist environment. Having power applied to the probe constantly speeds the rate of corrosion significantly.

To overcome this, we recommend that you do not power the sensor constantly, but power it only when you take the readings.

An easy way to accomplish this is to connect the VCC pin to a digital pin of an Arduino and set it to HIGH or LOW as per your requirement.

Also the total power drawn by the module (with both LEDs lit) is about 8 mA, so it is okay to power the module off a digital pin on an Arduino.

So, let's connect the VCC pin on the module to the digital pin #7 of an Arduino and GND pin to ground.

Finally, connect the AO pin on the module to the A0 ADC pin on your Arduino.

The following illustration shows the wiring.

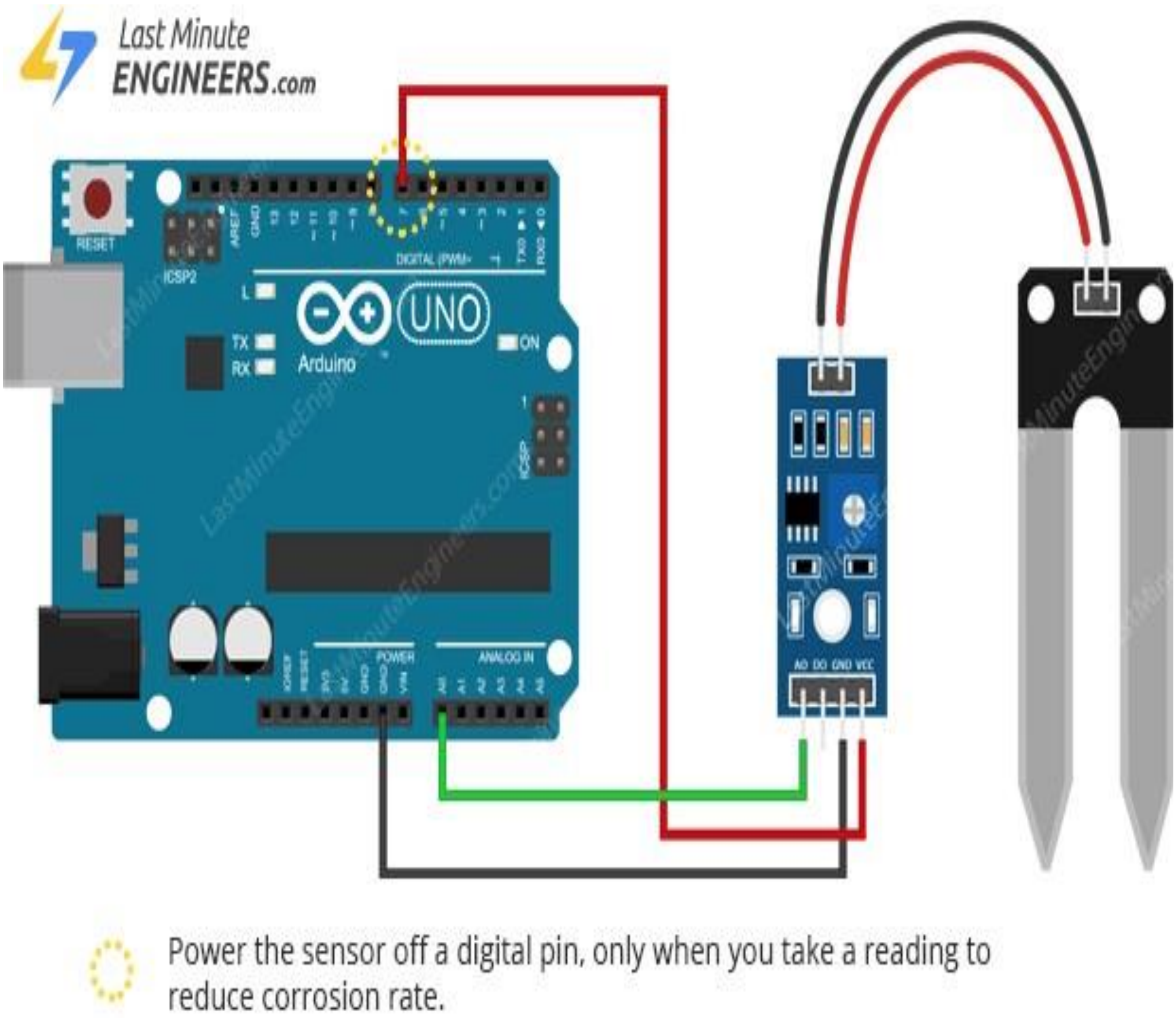



**FIG : CONNECTION OF MOISTURE SENSOR TO ARDUINO**

## BATTERY:

**FIG : LEAD ACID BATTERY**

Battery (electricity), an array of electrochemical cells for electricity storage, either individually linked or individually linked and housed in a single unit. An electrical battery is a combination of one or more electrochemical cells, used to convert stored chemical energy into electrical energy. Batteries may be used once and discarded, or recharged for years as in standby power applications. Miniature cells are used to power devices such as hearing aids and wristwatches; larger batteries provide standby power for telephone exchanges or computer data centers. Lead-acid batteries are the most common in PV systems because their initial cost is lower and because they are readily available nearly everywhere in the world. There are many different sizes and designs of lead-acid batteries, but the most important designation is that they are deep cycle batteries. Lead-acid batteries are available in both wet-cell (requires maintenance) and sealed no maintenance versions. Lead acid batteries are reliable and cost effective with an exceptionally long life. The Lead acid batteries have high reliability because of their ability to withstand overcharge, over discharge vibration and shock. The use of special sealing techniques ensures that our batteries are leak proof and non-spoilable. The batteries have exceptional charge acceptance, large electrolyte volume and low self-discharge, Which make them ideal as zero-maintenance batteries lead acid batteries Are manufactured/ tested using CAD (Computer Aided Design). These batteries are used in Inverter & UPS Systems and have the proven ability to perform under extreme conditions. The batteries have electrolyte volume, use PE Separators and are sealed in sturdy containers, which give them excellent protection against leakage and corrosion.

Features:

- Manufactured/tested using CAD
- Electrolyte volume
- PE Separators Protection against leakage

**VOLTAGE REGULATOR:**

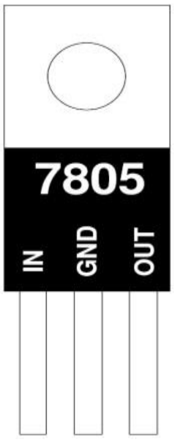



**FIG : VOLTAGE REGULATOR**

As the name itself implies, it regulates the input applied to it. A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. In this project, power supply of 5V and 12V are required. In order to obtain these voltage levels, 7805 and 7812 voltage regulators are to be used. The first number 78 represents positive supply and the numbers 05, 12 represent the required output voltage levels. The L78xx series of three-terminal positive regulators is available in TO-220, TO-220FP, TO-3, D2PAK and DPAK packages and several fixed output voltages, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation.

**SERVO MOTOR:-**


**FIG : SERVO MOTOR**

A servo motor is a rotary or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servo motors. The servo motor utilizes advanced control systems like PID and fuzzy logic to adjust movement according to input and feedback signals for optimal performance. It consists of a suitable motor coupled to a sensor for position feedback and a controller that regulates the motor's movement according to a desired setpoint. Servo motors are essential in industries like robotics, CNC machinery, and automated manufacturing due to their precision, quick responsiveness, and fluid motion.

**Types of Servo Motor :-**

Servo motors are classified into different types based on their application, such as AC servo motor, DC servo motor, brushless DC servo motor, positional rotation, continuous rotation and linear servo motor etc. Typical servo motors comprise of three wires namely, power control and ground. The shape and size of these motors depend on their applications. RC servo motor is the most common type of servo motor used in hobby applications, robotics due to their simplicity, affordability and reliability of control by microprocessors.

## DC SERVO MOTOR:-

**FIG:- DC SERVO MOTOR**

The motor which is used as a DC servo motor generally have a separate DC source in the field of winding & armature winding. The control can be archived either by controlling the armature current or field current. Field control includes some particular advantages over armature control. In the same way armature control includes some advantages over field control. Based on the applications the control should be applied to the DC servo motor. DC servo motor provides very accurate and also fast respond to start or stop command signals due to the low armature inductive reactance. DC servo motors are used in similar equipments and computerized numerically controlled machines.

## AC SERVO MOTOR:-


**FIG : AC SERVO MOTOR**

AC servo motor is an AC motor that includes encoder is used with controllers for giving closed loop control and feedback. This motor can be placed to high accuracy and also controlled precisely as compulsory for the applications. Frequently these motors have higher designs of tolerance or better bearings and some simple designs also use higher voltages in order to accomplish greater torque. Applications of an AC motormainly involve in automation, robotics, CNC machinery, and other applications a high level of precision and needful versatility.

## SUBMERSIBLE WATERPUMP

**FIG :SUBMERSIBLE WATERPUMP**

A submersible pump (or sub pump, electric submersible pump) (figure3.8) is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitation’s, a problem associated with a high elevation difference between pump and the fluid surface. Small DC Submersible water pumps push fluid to the surface as opposed to jet pumps having to pull fluids. Submersibles are more efficient than jet pumps. It is usually operated between 3v to 12v.

**SPECIFICATIONS:-**

- Voltage : 2.5-10V
- Maximum lift : 40-110cm / 15.75"-43.4"
- Flow rate : 80-120L/H
- Outside diameter : 7.5mm / 0.3"
- Inside diameter : 5mm / 0.2"
- Diameter : Approx. 24mm / 0.95"
- Length : Approx. 45mm / 1.8"
- Height : Approx. 30mm / 1.2"
- Material : Engineering plastic
- Driving mode : DC design, magnetic driving
- Continuous working life for 500 hours

SYSTEM DESIGN IMPLEMENTATION

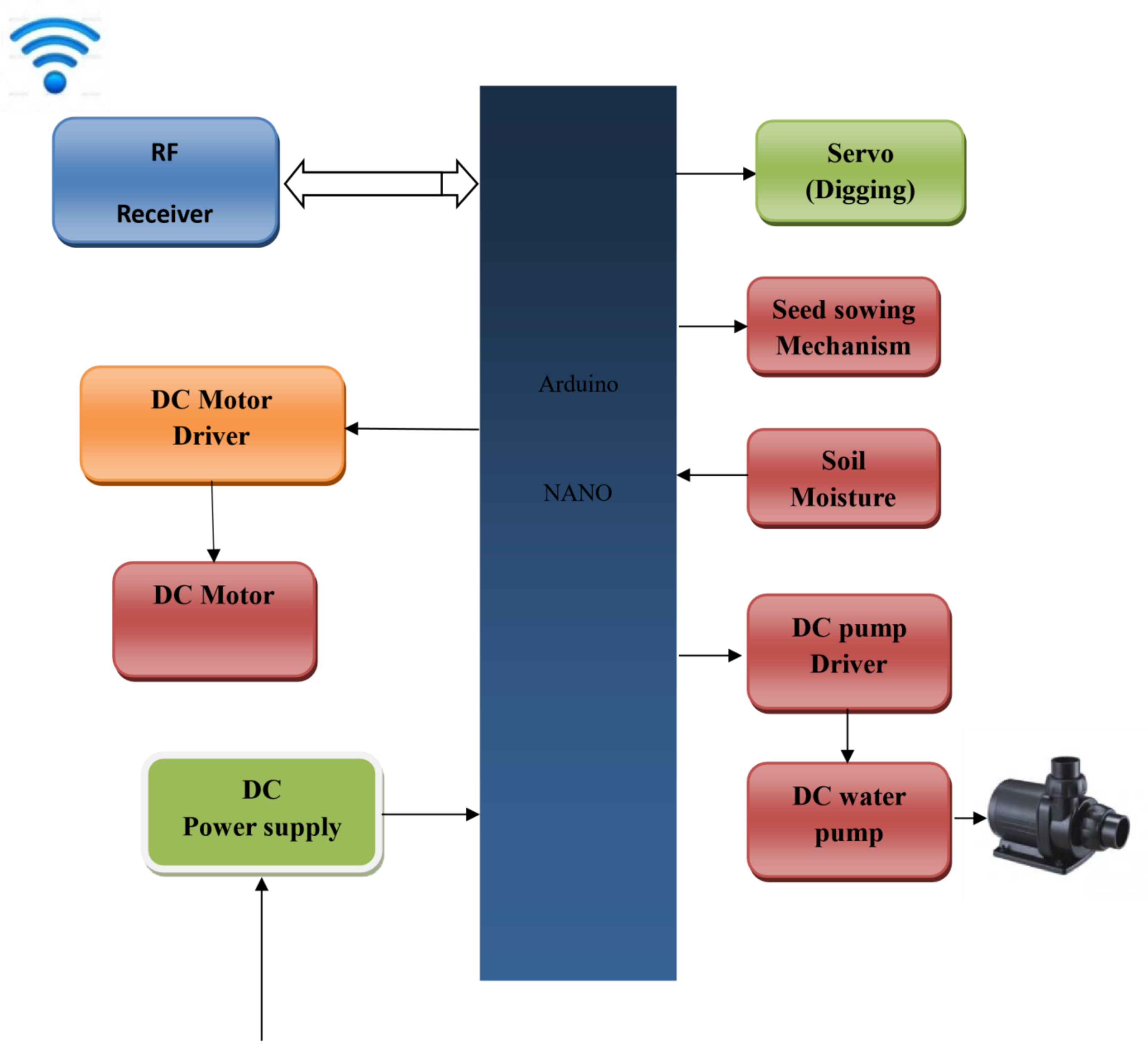



FIG : BLOCK DIAGRAM OF MULTIFUNCTIONAL AGRICULTURAL ROBOT

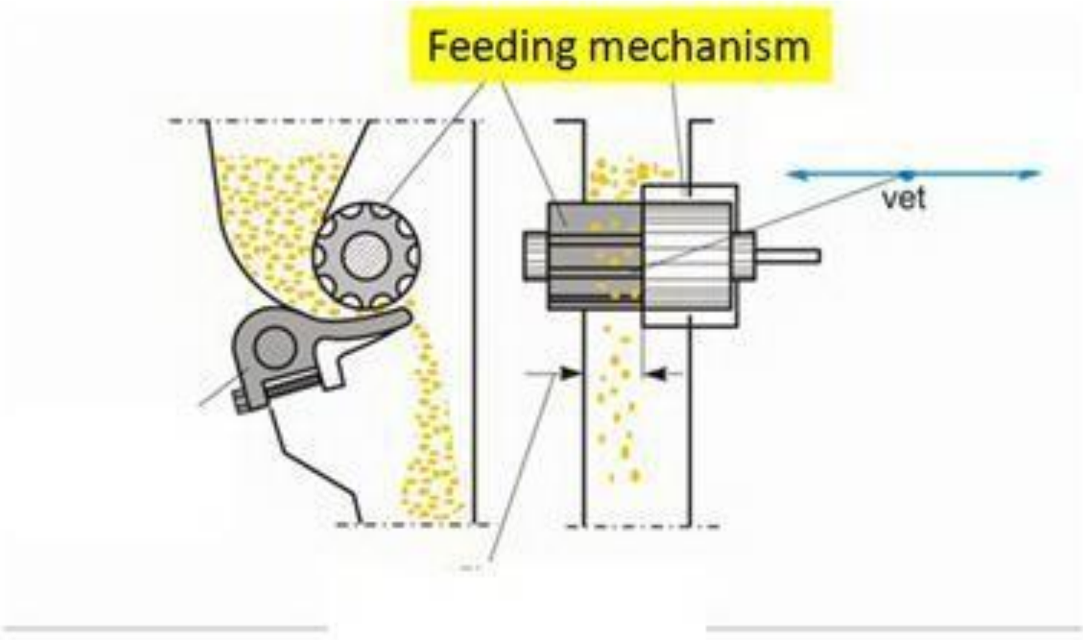



FIG : SEED SOWING MECHANISM

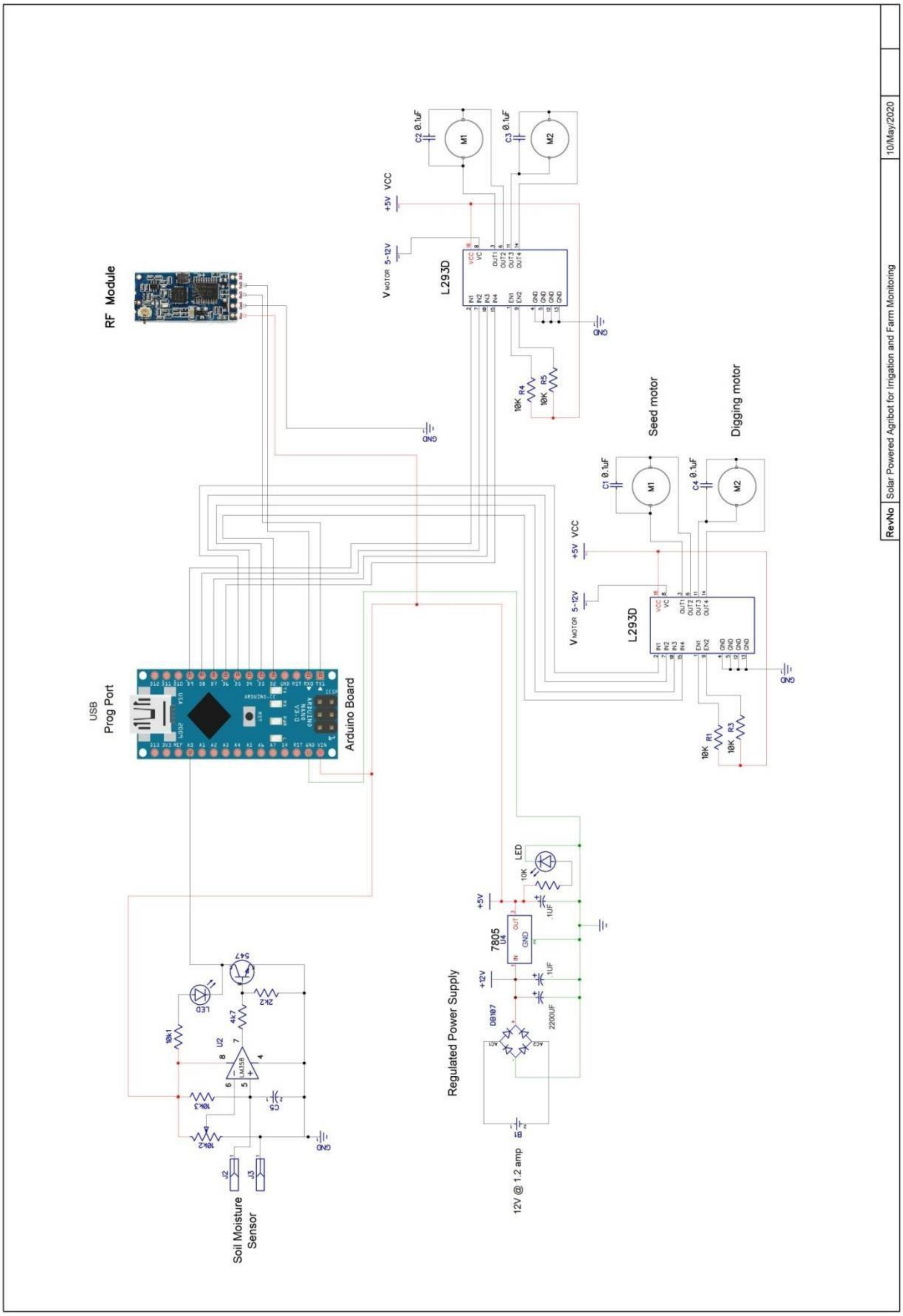



FIG : CIRCUIT DIAGRAM OF MULTIFUNCTIONAL AGRICULTURAL ROBOT

## WORKING OF ROBOT:-

In this Robot a Arduino is used to control the Robot. Here Arduino is the brain of the robot which is used to control all the operations of the Robot. That gives the desired direction to internal motors and motor drivers.

The block diagram of Agribot consists of Arduino Nano which is controller for the whole assembly as shown in block diagram. the lead-acid battery for storing energy and further it is given to power supply circuitry which is providing +5V for Arduino board and +12V supply for driving DC motors using l293d. Servomotors are used for Seed Sowing and digging, Arduino and wirelessly with RF module to controlling the whole assembly. Water sprinkler can be done by submersible pump. The hardware of agribot is mounted on Chassis which is 28cm long and 22.5 cm wide. When user press the forward key RF transmitter will transmit the data to robot, it will compares incoming data with stored data if match then the robot will move forward. Each key is having unique data to perform the robot. Whole system of robot works on the battery.

Seed sowing robots represent a significant advancement in agricultural technology, offering precision, efficiency, and labor savings. By automating the planting process, these robots help farmers increase productivity, optimize resource use, and ultimately enhance crop yields. As technology continues to advance, seed sowing robots will likely become more sophisticated, further improving the efficiency and sustainability of agricultural practices.

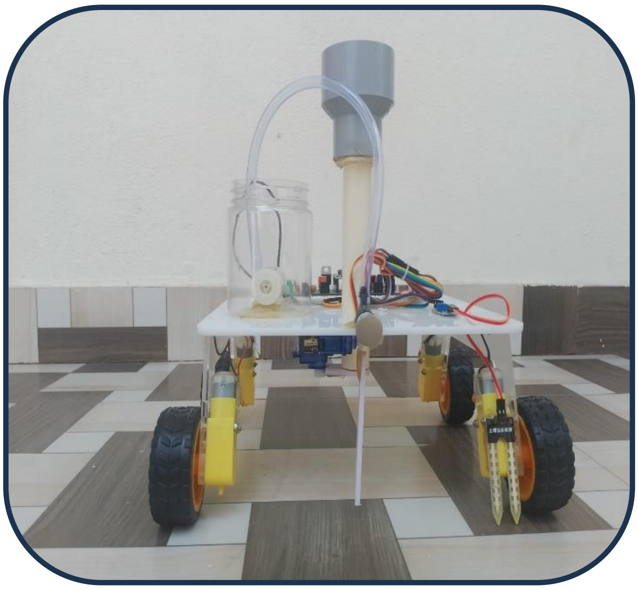
## SOURCE CODE

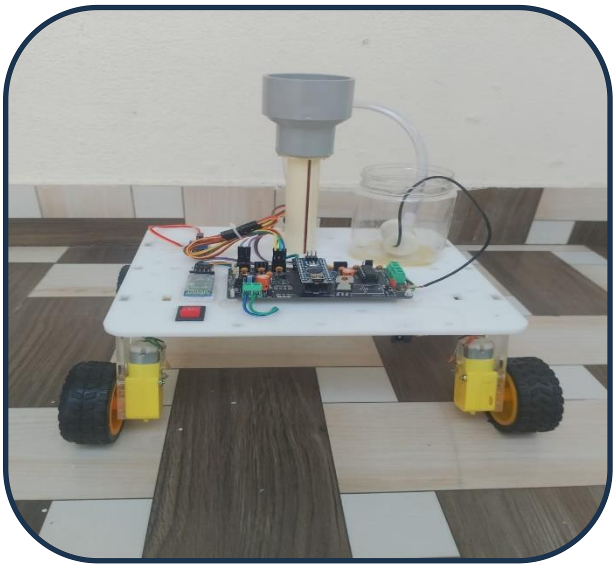
```
/*/       Android Based Robot Car                //

//       Interface  : HC-05 Bluetooth           //

//       Powered by e-logic Embedded   //

*/
//**************************************************************
#include <Servo.h>

Servo servoDig;
Servo servoSeed;

int digg1 = 90;
int digg = 50;
int seed = 90;
int seed1 = 75;

int count = 0;
#define maximum 255
#define minimum 150

#define BAUDRATE 9600

const int MotR_B = 4;
const int MotR_A = 5;
const int MotL_B = 6;
const int MotL_A = 7;

const int Soil = A1;
const int pump_A = 3;

String command;
byte GetValue;
int valor = 0;
int cm = 0;

boolean flag = 0;
boolean flag1 = 0;

//**************************************************************
void setup()
  {
  Serial.begin(BAUDRATE);
  servoDig.attach(8);   servoDig.write(digg1);
  servoSeed.attach(2);  servoSeed.write(seed);

  //pinMode (enable_R, OUTPUT); pinMode (enable_L, OUTPUT);
  //analogWrite(enable_R, maximum); analogWrite(enable_L, maximum);
 pinMode(Soil, INPUT);
```

```
  pinMode(MotR_A, OUTPUT); pinMode(MotR_B, OUTPUT);
  pinMode(MotL_A, OUTPUT); pinMode(MotL_B, OUTPUT);
  pinMode(pump_A, OUTPUT); digitalWrite(pump_A, LOW);

  delay(1000);
  Serial.println("Wel-Come");
 }

//*****************************************************************
void loop()
 {
  while(Serial.available())
   {
    delay(20);
    char c = Serial.read(); command = c;
    //Serial.println(command);
   }
//................................................................
 if (command.length() > 0)
  {
   delay(10);
   if(command == "F")       { Robot_Forword(); }
   else if (command == "B")  { Robot_Reverse(); }
   else if (command == "L")  { Robot_Left(); }
   else if (command == "R")  { Robot_Right(); }
   else if (command == "S")  { Robot_Stop(); }
   else if (command == "U")  { servoDig.write(digg1); }
   else if (command == "D")  { servoDig.write(digg); }
   else if (command == "s")  { Seed(); }
   else if (command == "P")  { Pwm_pump(); }
   else if (command == "A")
     {
      if(digitalRead(Soil) == 1 && flag1 == 0)
       {
        Serial.println("Soil:Dry");
        flag1 = 1;
       }
      else if(digitalRead(Soil) == 0 && flag1 == 1)
       {
        Serial.println("Soil:Wet");
        flag1 = 0;
       }
     }
   command = "";
  }
//....................................................

 }  //loop

//*****************************************************************
  void Pwm_pump()
   {
    for(int motorSpeed = 0; motorSpeed < minimum; motorSpeed++)
     { analogWrite(pump_A, motorSpeed); delay(10); }
   }
```

```
//*************************************************************
 void Seed()
   {
    servoSeed.write(seed1); delay(1000);
    servoSeed.write(seed);  delay(1000);
   }
//*************************************************************
 void Robot_Forword()
  {
    digitalWrite(MotR_A, LOW);  digitalWrite(MotR_B, HIGH);
    digitalWrite(MotL_B, HIGH); digitalWrite(MotL_A, LOW);
    delay(500);
  }

//*************************************************************
 void Robot_Reverse()
   {
    digitalWrite(MotR_A, HIGH); digitalWrite(MotR_B, LOW);
    digitalWrite(MotL_B, LOW);  digitalWrite(MotL_A, HIGH);
   }
//*************************************************************
  void Robot_Left()
   {
    digitalWrite(MotR_A, HIGH); digitalWrite(MotR_B, LOW);
    digitalWrite(MotL_B, HIGH); digitalWrite(MotL_A, LOW);
   }
//*************************************************************
  void Robot_Right()
   {
    digitalWrite(MotR_A, LOW);  digitalWrite(MotR_B, HIGH);
    digitalWrite(MotL_B, LOW);  digitalWrite(MotL_A, HIGH);
   }
//*************************************************************
   void Robot_Stop()
   {
    digitalWrite(MotR_A, LOW);  digitalWrite(MotR_B, LOW);
    digitalWrite(MotL_B, LOW);  digitalWrite(MotL_A, LOW);
    analogWrite(pump_A, 0);
   }

//*************************************************************
//*******************************************
```

# RESULT





CHAPTER 8

## Advantages :-

1. Reducing the risk of electric shocks, deaths due to poisonous creatures in the fields.

2. Watering depends on the moisture level present in the field.

3. Automatic controlling of water pump.

4. It saves water and energy.

5. Fast response

6. User friendly.

7.Enhanced Sustainability

## Disadvantages:

1. Limited RF Range.

2. Initial Cost is high.

3.Dependence on Technology

4.Technical complexity

## Applications:

1. Framers field monitoring

2. Public gardening

3. Domestic gardening

4. Green house monitoring

## CONCLUSION :-

This Automated seed sowing Agribot has considerable potential to increase productivity. The chassis handles the complete weight of solar, battery and the hardware mounted on Agribot which is able to perform each and every operation skillfully and successfully. The system is beneficial to the farmers for the basic seed sowing operation. The mode of operation of this machine is very simple even to the lay man.. Low germination percentage leading to wastage of seeds can be reduced by the use of this system. Creation of gap due to non-germination of seeds can be avoided. Total yield percentage can be increased effectively. Labor problem can be reduced. As compared to the manual and tractor based sowing time, energy required for this robot machine is less. Also wastage of seed is less. So this system will be a better option for the farmers who want to perform the seed sowing operation in a well-organized manner. Multifunctional agricultural robots represent a transformative advancement in modern farming, offering a wide array of benefits that address critical challenges faced by the agricultural sector. These robots enhance productivity, efficiency, and precision, thereby supporting sustainable farming practices and optimizing resource use. By automating various tasks such as planting, weeding, spraying, and harvesting, they significantly reduce labor dependency and operational costs.

## FUTURE SCOPE :-

The future scope of multifunctional agricultural robots is vast and promising, driven by ongoing advancements in technology, increasing demand for sustainable farming practices, and the need to meet the growing global food demand. Improved AI algorithms will enable robots to make better real-time decisions based on comprehensive data analysis, enhancing their efficiency and effectiveness. Machine learning models will predict crop yields, disease outbreaks, and pest infestations, allowing for proactive management and intervention. Advanced sensors will provide more accurate data on soil health, moisture levels, nutrient content, and crop health, enabling even more precise applications of water, fertilizers, and pesticides. Continuous monitoring of environmental conditions and crop status will help in timely interventions and better crop management. Multiple robots working together in a coordinated manner can cover larger areas more efficiently and perform complex tasks collaboratively. Different robots can specialize in various tasks (e.g., one for planting, another for weeding), optimizing the overall farming process.

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