

# Multitudinous Agro Automatic Contraption for Seed Sowing and Fertilizer Application

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**ABSTRACT:** Modern agriculture demands precision, reduced labor dependency, and cost-effective automation. Small and medium-scale farmers often depend on manual seed sowing, fertilizer spraying, and soil preparation methods, which are time-consuming and inconsistent. To address these challenges, a **solar-powered, battery-assisted, Bluetooth-controlled multi-functional seed sowing machine** is proposed.

The system integrates four major agricultural operations into a single compact platform:

1. **Power Rotating Fertilizer Sprayer Unit**
2. **Cam-Based Precision Seed Sowing Mechanism**
3. **V-Type Cultivator for Soil Opening**
4. **Soil Leveler with Motorized Control**

The machine operates using a rechargeable battery supported by a solar panel for sustainable energy harvesting. A Bluetooth module enables wireless control of motion and operation parameters via a mobile application. The cam-based seed metering mechanism ensures uniform seed spacing and depth control, improving germination rates.

The fertilizer sprayer uses a rotating disc mechanism driven by a DC motor to distribute nutrients uniformly. The V-type cultivator attachment opens furrows before seed placement, while the leveler ensures proper soil covering after sowing.

This integrated model significantly reduces manpower, enhances accuracy, minimizes seed wastage, and supports eco-friendly farming practices.



**KEYWORDS:** Precision Agriculture, Seed Sowing Machine, Cam Mechanism, Solar Powered Farming Equipment, Bluetooth Controlled Agriculture Robot, Fertilizer Rotator System, V-Type Cultivator, Sustainable Farming, Smart Agriculture System

## I. INTRODUCTION

Agriculture plays a critical role in the economic stability of developing nations. Traditional farming methods rely heavily on manual labor for ploughing, seed sowing, fertilizing, and leveling. These practices suffer from:

- Non-uniform seed spacing
- Excess fertilizer usage
- High labor cost
- Low efficiency
- Time consumption

Recent advancements in automation and IoT technologies have paved the way for smart agricultural equipment. Integrating solar energy with battery storage provides an eco-friendly power source for agricultural robots.

This project proposes a **multi-functional agricultural unit** capable of performing soil preparation, seed sowing, fertilizer distribution, and leveling in a single pass. The use of a cam-based seed metering system improves precision, while Bluetooth-based remote control enhances operational flexibility.

## II. OBJECTIVES

1. To design a compact multi-functional seed sowing machine.
2. To implement a cam-based precision seed dispensing system.
3. To integrate a rotating fertilizer sprayer mechanism.
4. To develop a Bluetooth-controlled drive system.
5. To incorporate solar charging with battery backup.
6. To reduce manual labor and improve sowing accuracy.
7. To promote sustainable and smart farming practices.

## III. EXISTING SYSTEM

Conventional seed sowing methods include:

- Manual hand broadcasting
- Animal-driven seed drills
- Tractor-mounted seed drills
- Manual fertilizer sprayers

### Problems in Existing Systems

- Uneven seed depth
- Irregular spacing
- High seed wastage
- Dependency on skilled labor
- No automation
- Separate machines for each operation

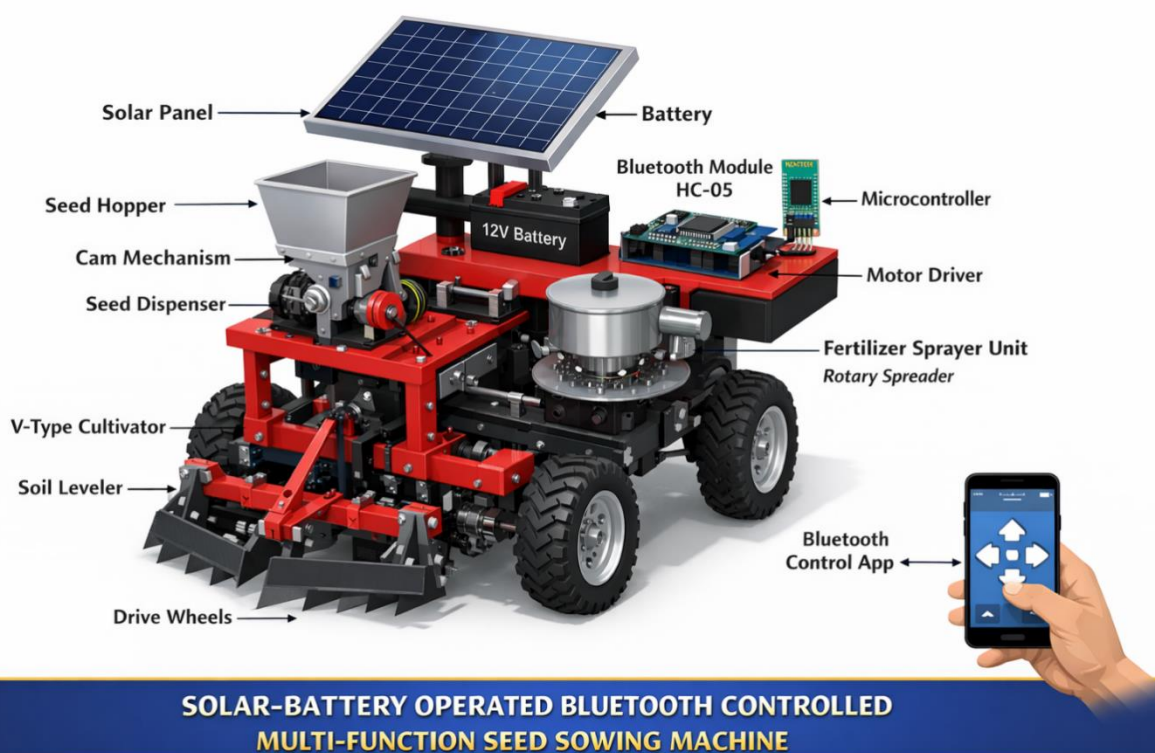
Tractor-mounted machines are costly and unsuitable for small-scale farmers.



#### IV. LIMITATIONS OF EXISTING SYSTEM

1. High operational cost
2. Large land requirement
3. Not suitable for small farms
4. Fuel dependency
5. Lack of precision
6. No integrated multi-functionality

#### V. PROPOSED SYSTEM



The proposed model integrates:

- Solar Panel
- Rechargeable Battery
- DC Geared Motor
- Bluetooth Module (HC-05)
- Microcontroller (Arduino / ESP32)
- Cam Mechanism for seed release
- Rotating Fertilizer Disc
- V-Type Cultivator Blade
- Soil Leveler Attachment

The machine moves forward via motorized wheels. When activated:

1. Cultivator opens soil.
2. Cam mechanism drops seed at equal intervals.
3. Fertilizer disc rotates and spreads nutrients.
4. Leveler closes soil.

All operations are controlled wirelessly.



## VI. WORKING PRINCIPLE

### 1. Power System

Solar panel charges battery. Battery supplies power to motors and controller.

### 2. Movement Control

Bluetooth command → Microcontroller → Motor Driver → DC Motors

### 3. Cam-Based Seed Sowing

- Rotating cam attached to motor shaft
- Cam profile determines seed release timing
- Seeds drop through funnel at fixed intervals

### 4. Fertilizer Rotator

- Disc plate rotates
- Centrifugal force spreads fertilizer evenly

### 5. V-Type Cultivator

- Opens soil furrow before seed drop

### 6. Leveler

- Covers soil after seed and fertilizer application

## VII. BLOCK DIAGRAM

The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

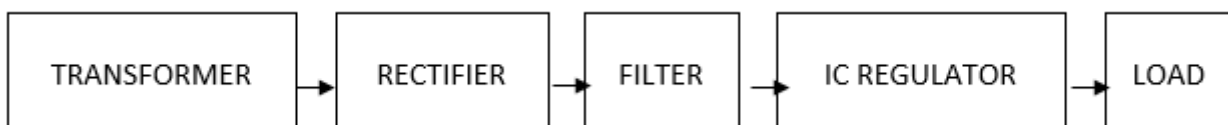


Figure7.5: Block diagram (Power supply)

## Working principle

### Transformer

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op-amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

### Bridge rectifier

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.

The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow.

The path for current flow is from point B through D1, up through RL, through D3, through the secondary of the transformer back to point B. this path is indicated by the solid arrows. Waveforms (1) and (2) can be observed across D1 and D3.

One-half cycle later the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D3. Current flow will now be from point A through D4, up through RL, through D2, through the secondary of T1, and back to point A. This path is indicated by the broken arrows. Waveforms (3) and (4) can be observed across D2 and D4. The current flow through RL is always in the same direction. In flowing through RL this current develops a voltage corresponding to that shown waveform (5). Since current flows through the load (RL) during both half cycles of the applied voltage, this bridge rectifier is a full-wave rectifier.

One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

This may be shown by assigning values to some of the components shown in views A and B. assume that the same transformer is used in both circuits. The peak voltage developed between points X and y is 1000 volts in both circuits. In the conventional full-wave circuit shown—in view A, the peak voltage from the center tap to either X or Y is 500 volts. Since only one diode can conduct at any instant, the maximum voltage that can be rectified at any instant is 500 volts.

The maximum voltage that appears across the load resistor is nearly-but never exceeds-500 v0lts, as result of the small voltage drop across the diode. In the bridge rectifier shown in view B, the maximum voltage that can be rectified is the full secondary voltage, which is 1000 volts. Therefore, the peak output voltage across the load resistor is nearly 1000 volts. With both circuits using the same transformer, the bridge rectifier circuit produces a higher output voltage than the conventional full-wave rectifier circuit.

### IC voltage regulators

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.

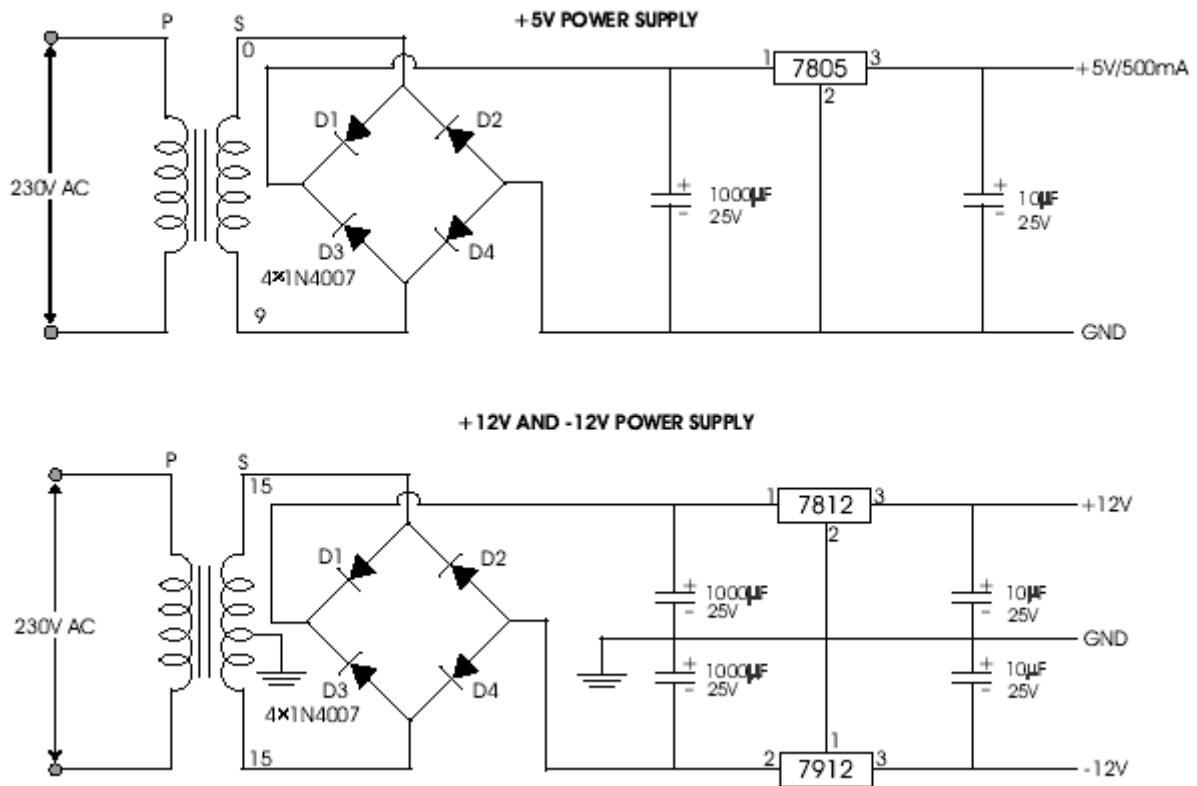


Figure2.6: Circuit diagram (Power supply)

A fixed three-terminal voltage regulator has an unregulated dc input voltage,  $V_i$ , applied to one input terminal, a regulated dc output voltage,  $V_o$ , from a second terminal, with the third terminal connected to ground.

The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts.

For ICs, microcontroller, LCD ----- 5 volts

For alarm circuit, op-amp, relay circuits ----- 12 volts

collector and emitter will be closed. The output is taken from collector terminal. Now the output is zero.

## ARDUINO IDE

**Introduction to Arduino IDE**, where IDE stands for Integrated Development Environment - An official software introduced by [Arduino.cc](http://Arduino.cc), that is mainly used for writing, compiling and uploading the code in almost all Arduino modules/boards. Arduino IDE is open-source software and is easily available to download & install from [Arduino's Official Site](http://Arduino's Official Site).

- **Arduino IDE** is an open-source software, designed by Arduino.cc and mainly used for writing, compiling & uploading code to almost all Arduino Modules.
- It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.
- It is available for all operating systems i.e. MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role in debugging, editing and compiling the code.
- A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more.
- Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.
- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.



- The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.
- This environment supports both C and C++ languages.



## INSTALLATION

Follow the steps below to install Arduino IDE on your laptop/desktop:

1. Go to the Arduino download page ([www.arduino.cc](http://www.arduino.cc)) and download the latest version of the Arduino software.
2. When the download is finished, run **arduino-1.8.5-windows.exe** file and click on **I Agree**.
3. Choose the components to install (It is recommended to install all components).
4. Choose the Destination Folder (It is recommended to install in the default folder).
5. The process will extract and install all the required files to execute properly the Arduino Software (IDE).
6. Close the installation window when it's complete.

The installation process is now complete..

- **For Windows 10, 8, 7, Vista and XP when using Windows ZIP file (non-admin)**

Follow the steps below to install Arduino IDE on your laptop/desktop:

1. Go to the Arduino download page and download the Zip package of the latest version of Arduino IDE for Windows.
2. When the download is finished, unzip it and open up the Arduino folder to confirm that yes, there are some files and sub-folders inside. **DO NOT** move any file around; the folder structure is **VERY** important.
3. Power up your evive by connecting it to your computer with a USB cable. You should see the Pin 13 LED light up.
4. Move the Arduino application into your Applications folder.

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

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

- **File** - You can open a new window for writing the code or open an existing one. The following table shows the number of further subdivisions the file option is categorized into
- As you go to the preference section and check the compilation section, the Output Pane will show the code compilation as you click the upload button.

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

- **Edit** - Used for copying and pasting the code with further modification for font
- **Sketch** - For compiling and programming
- **Tools** - Mainly used for testing projects. The Programmer section in this panel is used for burning a bootloader to the new microcontroller.

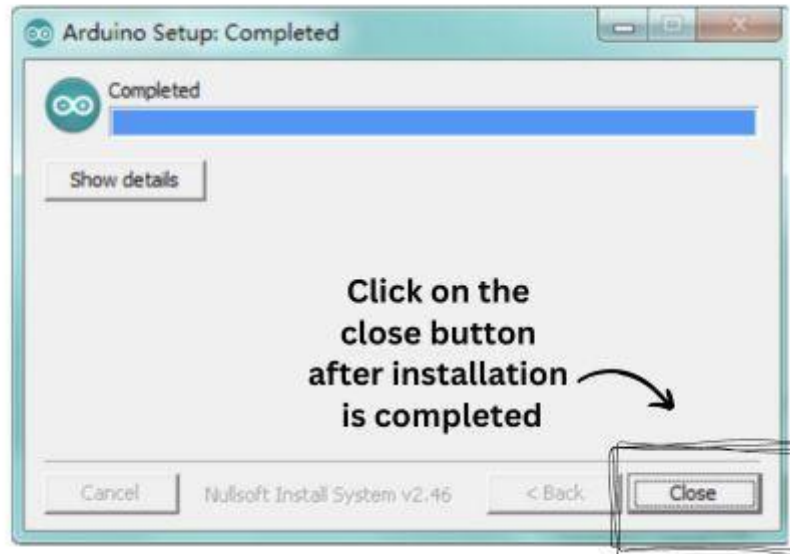


• **Help** - In case you are feeling skeptical about software, complete help is available from getting started to troubleshooting.

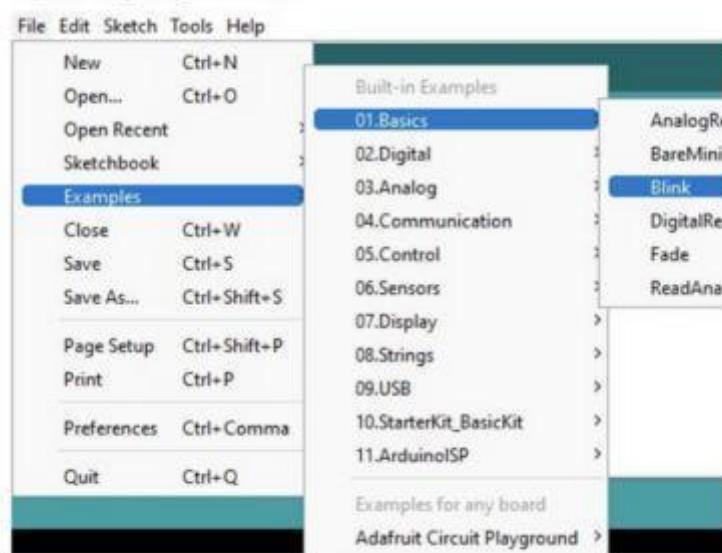
The **Six Buttons** appearing under the Menu tab are connected with the running program as follows.

- The checkmark appearing in the circular button is used to verify the code. Click this once you have written your code.
- The arrow key will upload and transfer the required code to the Arduino board.
- The dotted paper is used for creating a new file.
- The upward arrow is reserved for opening an existing Arduino project.
- The downward arrow is used to save the current running code.
- The button appearing on the top right corner is a **Serial Monitor** - A separate pop-up window that acts as an independent terminal and plays a vital role in sending and receiving the Serial Data. You can also go to the Tools panel and select Serial Monitor, or pressing Ctrl+Shift+M all at once will open it instantly. The Serial Monitor will actually help to debug the written Sketches where you can get a hold of how your program is operating. Your Arduino Module should be connected to your computer by USB cable in order to activate the Serial Monitor.
- You need to select the baud rate of the Arduino Board you are using right now. For my Arduino Uno Baud Rate is 9600, as you write the following code and click the Serial Monitor, the output will show as the image below.
- The main screen below the Menu bard is known as a simple text editor used for writing the required code.
- The bottom of the main screen is described as an Output Pane that mainly highlights the compilation status of the running code: the memory used by the code, and errors that occurred in the program. You need to fix those errors before you intend to upload the hex file into your Arduino Module.
- More or less, Arduino C language works similar to the regular C language used for any embedded system microcontroller, however, there are some dedicated libraries used for calling and executing specific functions on the board.
- **Step 1:** To begin with Arduino, gather an Arduino board and a USB cable (used for printers), especially if using boards like Arduino UNO, Nano, etc.
- **Step 2:** Visit the official website to download the Arduino IDE software. Choose the version that matches your computer's operating system (Windows, macOS, or Linux), then unzip the downloaded file.

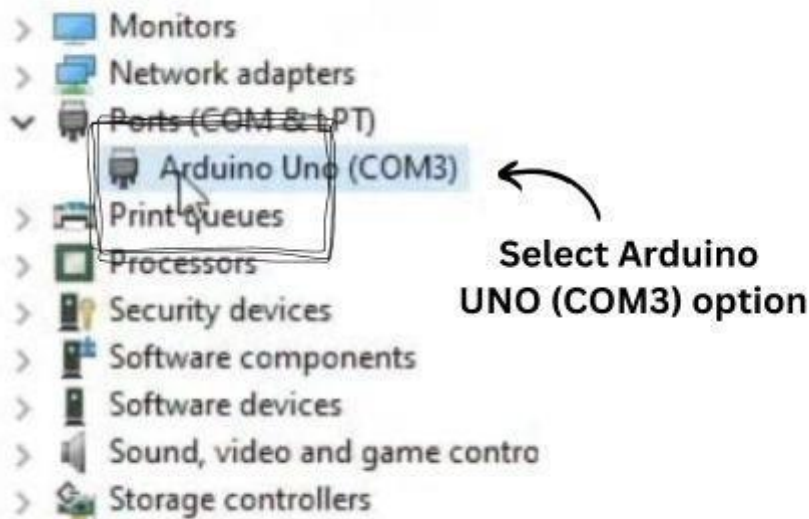




- **Step 3:** Activate your Arduino board. Boards such as Uno, Mega, and Nano derive power from either USB or an external supply. If you're using Decimila, configure it to draw power from USB using a small plastic jumper. Link the board to your computer through USB, and you should observe a green LED illumination.
- **Step 4:** To launch the Arduino IDE, download the folder, unzip it, and double-click the IDE icon (application.exe).
- **Step 5:** Open a project. You can start a new project or open an example. For instance, "Blink" turns an LED on and off. Access examples via file → Example → Basics → Blink.



- **Step 6:** Choose your Arduino board. Go to Tools → Board and select your board type (e.g., Arduino Uno) to match the one connected.
- **Step 7:** Select the serial port. Under Tools → Serial Port, pick the one associated with your Arduino board (usually COM3 or higher).



- **Step 8:** Upload the program. Click "Upload." The RX and TX LEDs on the board will flash. If "Done uploading" appears after a few seconds, the upload was successful.

### VIII. MICROCONTROLLER NOTES

#### Introduction to microcontroller

There are more than two billion microcontrollers being produced every year. Almost everyone in developed as well as in developing nations cannot think of a day without using microcontrollers. The microcontroller is an embedded computer chip that controls most of the electronic gadgets and appliances that people use on a daily basis, right from mobile phones, washing machines to anti-lock brakes in cars. The microcontroller was introduced in the electronics industry with the purpose of making our tasks easy that come with even a remote connection with automation in any way. Microcontroller is just an **on system 40 pin chip** that comes with a built-in microprocessor and Arduino is a **board that comes with the microcontroller in the base of the board** Arduino also comes with a bootloader and allows easy access to input-output pins and makes uploading or burning of the program very easy. There are many versions of Arduino boards introduced in the market like Arduino Uno, Due, Leonardo, Mega, etc. However, most common versions are Arduino Uno and Arduino Mega.

The easiest way to understand what is a microcontroller is to think about a tiny computer: it includes a processor, memory and input/output (I/O) peripherals to connect small display, buttons, motors, sensors, etc. To "control" a microcontroller, you can put programs onto it and run them. As we will see later in this lesson, we usually write programs using a laptop and then transfer the programs into the microcontroller to execute it.

#### ARDUINO UNO

##### Description

Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller.

The Arduino Uno comes with USB interface, 6 analog input pins, 14 I/O digital ports that are used to connect with external electronic circuits. Out of 14 I/O ports, 6 pins can be used for PWM output. It allows the designers to control and sense the external electronic devices in the real world. It is an open-source platform, means the boards and software are readily available and anyone can modify and optimize the boards for better functionality. The software used for Arduino devices is called IDE (Integrated Development Environment) which is free to use and required some basic skills to learn it. It can be programmed using C and C++ language.



The **ATmega328** is one kind of single-chip microcontroller formed with Atmel within the **megaAVR family**. The architecture of this Arduino Uno is a customized Harvard architecture with 8 bit **RISC processor** core. [Other boards of Arduino Uno](#) include Arduino Pro Mini, Arduino Nano, Arduino Due, Arduino Mega, and Arduino Leonardo.

## Features

Arduino Uno board is an easy-to-use board that is beginner friendly. It consists of a microcontroller chip which is made up of an ATmega328p processor. It has input and output pins, Analog pins, a USB connection, a power jack and a reset button. The main component of the Arduino Uno board includes the following:

## Microcontroller

Arduino Uno Board is an open-source microcontroller board powered by an ATmega328p processor.

## Input/Output Pins

It comprises 14 input and output pins with 6 analog input pins. These pins are used to connect Arduino boards to different electronic components.

## Power Supply

The power supply components include IOREF, GND, 3.3V, 5V, and Vin, which connect sensors. Voltage regulators regulate the Power supply of the Arduino Uno board.

The **Arduino Uno power supply** can be done with the help of a USB cable or an external power supply. The external power supplies mainly include AC to DC adapter otherwise a battery. The adapter can be connected to the Arduino Uno by plugging into the power jack of the Arduino board. Similarly, **the battery** leads can be connected to the Vin pin and the GND pin of the POWER connector. The suggested voltage range will be 7 volts to 12 volts

## LED

LED indicators are used in Arduino Uno, which is used for debugging or indicating a signal.

## Reset Button

A reset button is used to restart the microcontroller.

## USB Interface

It consists of a USB port to upload the program to the arduino uno board.

## Voltage Regulator

It provides a stable and reliable voltage supply to the board's components.

## ICSP Pin

It programs the microcontroller and performs functions like debugging the code.

## Crystal Oscillator

It is an electronic oscillator that is used to create stable and precise frequency signals.

## High Voltage Protection of USB

The Arduino Uno board has a rearrangeable poly fuse that defends the USB port of the PC from the over-voltage. Though most of the PCs have their own inner protection, the fuse gives an additional coating of safety. If above 500mA is given to the USB port, then the fuse will routinely crack the connection until the over-voltage is removed.

## Physical Characteristics

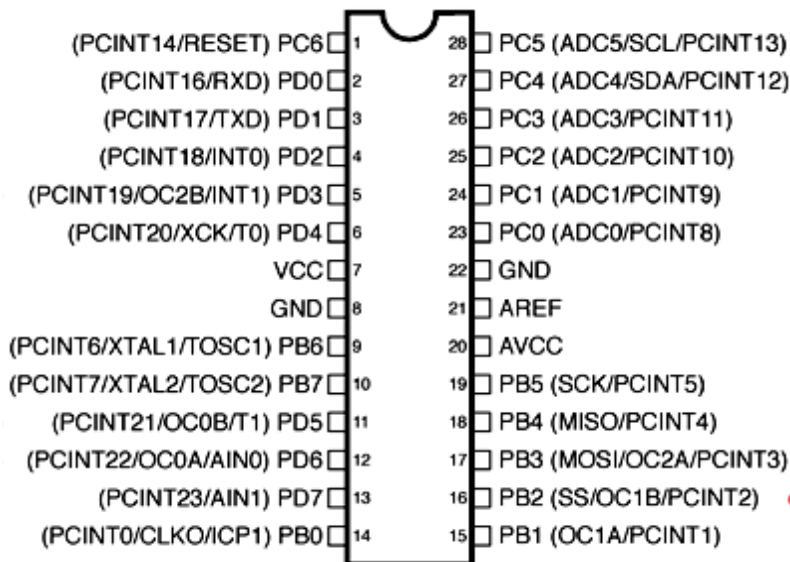
The physical characteristics of an Arduino board mainly include length and width. The **printed circuit board** of the Arduino Uno length and width are 2.7 X 2.1 inches, but the power jack and the USB connector will extend beyond the previous measurement. The board can be attached on the surface otherwise case with the screw holes.

This board comes with all the features required to run the controller and can be directly connected to the computer through USB cable that is used to transfer the code to the controller using IDE (Integrated Development Environment) software, mainly developed to program Arduino. So, let's dive into the features of Arduino Uno.



- More frequency and number of instructions per cycle:** Atmega328 microcontroller is placed on the board that comes with a number of features like timers, counters, interrupts, PWM, CPU, I/O pins and based on a 16MHz clock that helps in producing more frequency and number of instructions/cycle.
- Built-in regulation:** This board comes with a built-in regulation feature which keeps the voltage under control when the device is connected to the external device.
- Flexibility & Ease of use:** There are 14 I/O digital and 6 analog pins incorporated in the board that allows the external connection with any circuit with the board. These pins provide the flexibility and ease of use to the external devices that can be connected through these pins.
- Configurable pins:** The 6 analog pins are marked as A0 to A5 and come with a resolution of 10bits. These pins measure from 0 to 5V, however, they can be configured to the high range using analogReference() function and AREF pin.
- Quick Start:** Reset pin is available in the board that reset the whole board and takes the running program in the initial stage. This pin is useful when board hangs up in the middle of the running program; pushing this pin will clear everything up in the program and starts the program right from the beginning.
- Greater Flash Memory:** 13KB of flash memory is used to store the number of instructions in the form of code.
- Low Voltage Requirement:** Only 5 V is required to turn the board on, which can be achieved directly using USB port or external adapter, however, it can support external power source up to 12 V which can be regulated and limit to 5 V or 3.3 V based on the requirement of the project.
- Plug & Play:** There is no hard and fast interface required to connect the devices to the board. Simply plug the external device into the pins of the board that are laid out on the board in the form of the header.
- USB interface:** Arduino Uno comes with USB interface i.e. USB port is added on the board to develop serial communication with the computer.
- Power alternatives:** Apart from USB, battery or AC to DC adpoter can also be used to power the board.
- More Storage:** There is a provision of Mirco SD card to be used in the boards to make them store more information. Arduino Uno boards are quite similar to other boards in Arduino family in terms of use and functionality, however, Uno boards don't come with FTDI USB to Serial driver chip.

**Arduino Uno Pin Description:**



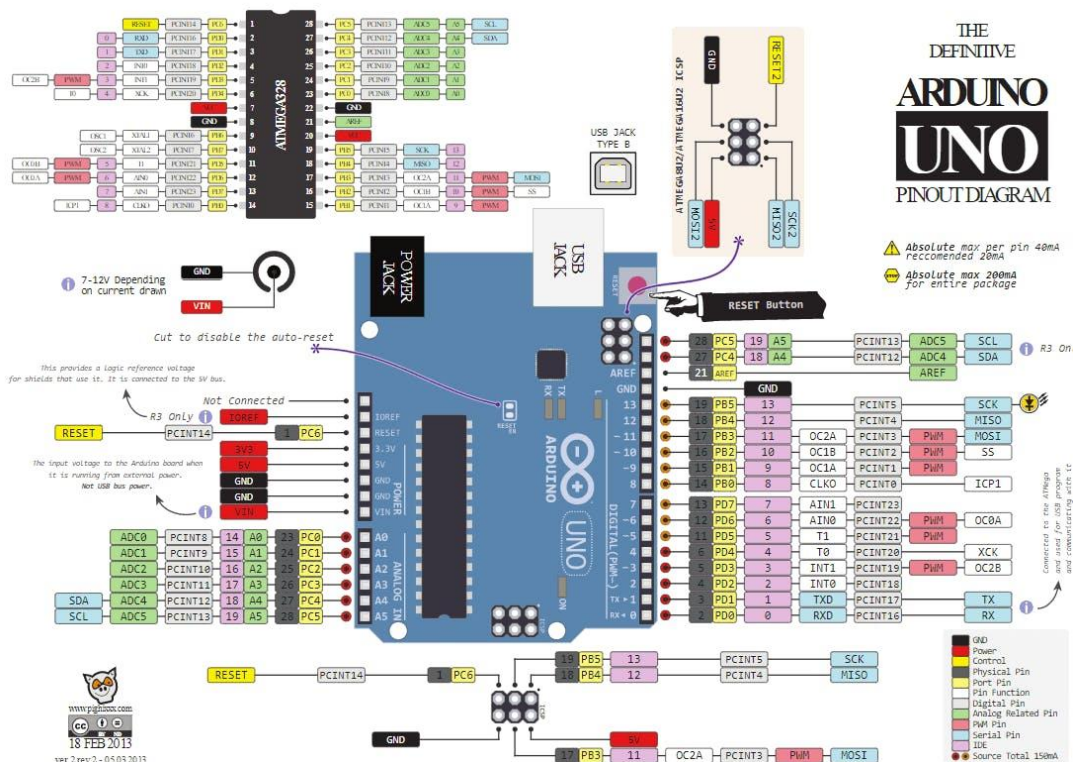
There are several arduino uno pins, more specifically, I/O digital and analog pins placed on the board which operates at 5V. But, these pins come with standard operating ratings ranging between 20mA to 40mA. Internal pull-up resistors are used in the board that limits the current exceeding from the given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

- **LED** - Arduino Uno comes with built-in LED which is connected through pin 13. Providing HIGH value to the pin will turn it ON. Providing LOW will turn it OFF.
- **Vin** - It is the input voltage provided to the Arduino Board. This pin is used to supply voltage. It is different than 5 V supplied through a USB port. If a voltage is provided through power jack, it can be accessed through this pin.



- **5V** - This board comes with the ability to provide voltage regulation. 5V pin is used to provide output regulated voltage. The board is powered up using three ways i.e. USB, Vin pin of the board or DC power jack. USB supports voltage around 5V while Vin and Power Jack support a voltage ranges between 7V to 20V.
- **GND** - These are ground pins. There are more than one ground pins are provided on the board. They can be used as per requirement.
- **Reset** - This pin is incorporated on the board which resets the program running on the board. Instead of physical reset on the board, IDE comes with a feature of resetting the board through programming.
- **IOREF** - It is the abbreviation of Input Output Voltage Reference. This pin is very useful for providing voltage reference to the board. A shield is used to read the voltage across this pin which then select the proper power source.
- **PWM** – Pulse Width Modulation is provided by 3, 5, 6, 9, 10, 11 pins. These pins are configured to provide 8-bit output PWM.
- **SPI** - It is abbreviation of Serial Peripheral Interface. Four pins 10(SS), 11(MOSI), 12(MISO), 13(SCK) provide SPI communication with the help of SPI library.
- **AREF** - It is called Analog Reference. This pin is used for providing a reference voltage to the analog inputs.
- **TWI** - It is called Two-Wire Interface. TWI communication is accessed through Wire Library. A4 and A5 pins are used for this purpose.
- **Serial Communication** - Serial communication is carried out through two pins called Pin 0 (Rx) and Pin 1 (Tx).
- **Rx. & Tx.** - Rx (Receiver) pin is used to receive data while Tx (Transmitter) pin is used to transmit data. This pin is used to transmit & receive TTL serial data, and these are connected to the ATmega8U2 USB to TTL Serial chip equivalent pins.
- **External Interrupts** - Pin 2 and 3 are used for providing external interrupts. An interrupt is called by providing LOW or changing value.

Arduino Uno comes with an ability of interfacing with other Arduino boards, microcontrollers and computer. The Atmega328 placed on the board provides serial communication using pins like Rx and Tx. The Atmega16U2 incorporated on the board provides a pathway for serial communication using USB com drivers. A Serial monitor is provided on the IDE software which is used to send or receive text data from the board. If LEDs are placed on the Rx and Tx pins will flash, they indicate the transmission of data. To understand how it does, you need to know the **programming** part of Arduino.





## Data Transmission in Arduino:

1. Arduino can be used to communicate with a computer, another Arduino board or other microcontrollers. The ATmega328P microcontroller provides UART TTL (5V) serial communication.
2. Serial communication can be done using digital pin 0 (Rx) and digital pin 1 (Tx). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer.
3. The ATmega16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a **.inf** file is required.
4. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board.
5. There are two RX and TX LEDs on the arduino board which will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (not for serial communication on pins 0 and 1).
6. A **SoftwareSerial library** allows for serial communication on any of the Uno's digital pins.
7. The ATmega328P also supports I2C (TWI) and SPI communication and the Arduino software includes a Wire library to simplify use of the I2C bus.
8. The 14 digital pins on the Arduino Uno can be used as input & output with the help of the functions like pinMode(), digitalWrite(), & Digital Read().
9. The Arduino Uno ATmega328 offers UART TTL-**serial communication**, and it is accessible on digital pins like TX (1) and RX (0). The software of an Arduino has a serial monitor that permits easy data. There are two LEDs on the board like RX & TX which will blink whenever data is being broadcasted through the USB.
10. A SoftwareSerial library permits for serial communication on Arduino Uno digital pins and the ATmega328P supports TWI (I2C) as well as **SPI-communication**. The Arduino software contains a wired library for simplifying the utilization of the I2C bus.

There are a lot of other microcontrollers available in the market that are more powerful and cheap as compared to the Arduino board. So, why you prefer Arduino Uno? Actually, Arduino comes with a big community that is developing and sharing knowledge with a wide range of audiences. Quick support is available pertaining to the technical aspects of any electronic project. When you decide Arduino board over other controllers, you don't need to arrange extra peripherals and devices as most of the functions are readily available on the board that makes your project economical in nature and free from a lot of technical expertise

## Applications

Arduino Uno comes with a wide range of applications. Following are some of the main applications of the board.

- Parking Lot Counter
- Arduino Uno is used in Do-it-Yourself projects prototyping.
- Traffic Light Count Down Timer
- Emergency Light for Railways
- Embedded System
- In developing projects based on code-based control
- Medical Instrument
- Security and Defense System
- Weighing Machines
- Home Automation
- Industrial Automation
- Development of Automation System
- Digital Electronics and Robotics
- Designing of basic circuit designs.

## Advantages

Here are some advantages of the Arduino Uno board.

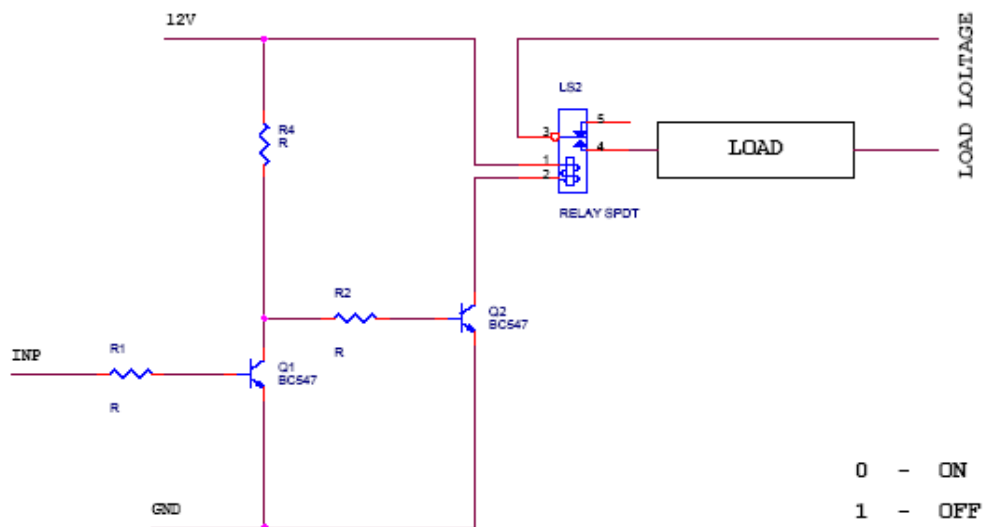
- It is simple and easy to use. It is easily programmable, which makes it beginner friendly. Arduino Uno can be used to build many projects, including LED blinkers, Robots etc.
- It consists of various pins, which makes it more compatible and can be used to connect different electronic components.
- Arduino Uno boards are cheap in comparison to other microcontroller boards.
- Arduino has a large community of active users, making support or any help that is needed for Arduino boards widely available.

**Disadvantages**

While the Arduino Uno board has many advantages, there are some significant disadvantages to look up to.

- The ATmega328p processor has limited memory and low processing power, which makes it slower than other microcontroller chips.
- Arduino Uno boards can process only one task at a time as it has a single-core processor.
- Arduino Uno boards do not have various connectivity options.

**RELAY CIRCUIT - SPST**



**Relay:**

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

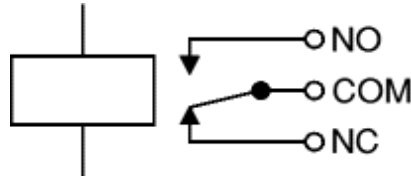
The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.



Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but you can solder wires



directly to the pins providing you take care to avoid melting the plastic case of the relay. The animated picture shows a working relay with its coil and switch contacts. You can see a lever on the left being attracted by magnetism when the coil is switched on. This lever moves the switch contacts. There is one set of contacts (SPDT) in the foreground and another behind them, making the relay DPDT.



The relay's switch connections are usually labeled COM, NC and NO:

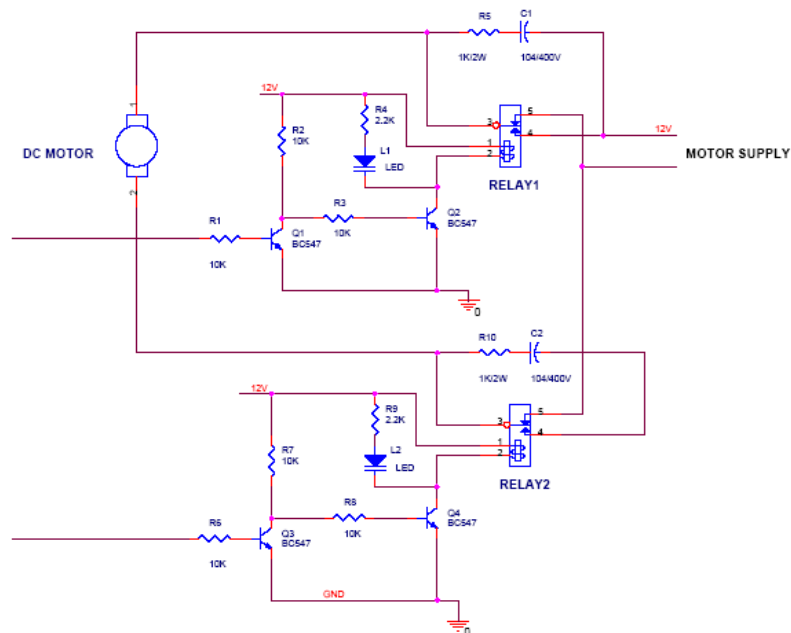
- **COM** = Common, always connect to this, it is the moving part of the switch.
- **NC** = Normally Closed, COM is connected to this when the relay coil is **off**.
- **NO** = Normally Open, COM is connected to this when the relay coil is **on**.

**Circuit description:**

This circuit is designed to control the load. The load may be motor or any other load. The load is turned ON and OFF through relay. The relay ON and OFF is controlled by the pair of switching transistors (BC 547). The relay is connected in the Q2 transistor collector terminal. A Relay is nothing but electromagnetic switching device which consists of three pins. They are Common, Normally close (NC) and Normally open (NO). The relay common pin is connected to supply voltage. The normally open (NO) pin connected to load. When high pulse signal is given to base of the Q1 transistors, the transistor is conducting and shorts the collector and emitter terminal and zero signals is given to base of the Q2 transistor. So the relay is turned OFF state. When low pulse is given to base of transistor Q1 transistor, the transistor is turned OFF. Now 12v is given to base of Q2 transistor so the transistor is conducting and relay is turned ON. Hence the common terminal and NO terminal of relay are shorted. Now load gets the supply voltage through relay.

Voltage Signal from	Transistor Q1	Transistor Q2	Relay	Microcontroller or PC
1	on	off	off	off
0	off	on	on	on

**DC MOTOR FORWARD REVERSE CONTROL**



### Circuit working Description:

This circuit is designed to control the motor in the forward and reverse direction. It consists of two relays named as relay1, relay2. The relay ON and OFF is controlled by the pair of switching transistors. A Relay is nothing but electromagnetic switching device which consists of three pins. They are Common, Normally close (NC) and normally open (NO). The common pin of two relay is connected to positive and negative terminal of motor through snubber circuit respectively. The relays are connected in the collector terminal of the transistors T2 and T4.

When high pulse signal is given to either base of the T1 or T3 transistors, the transistor is conducting and shorts the collector and emitter terminal and zero signals is given to base of the T2 or T4 transistor. So the relay is turned OFF state.

When low pulse is given to either base of transistor T1 or T3 transistor, the transistor is turned OFF. Now 12v is given to base of T2 or T4 transistor so the transistor is conducting and relay is turn ON. The NO and NC pins of two relays are interconnected so only one relay can be operated at a time.

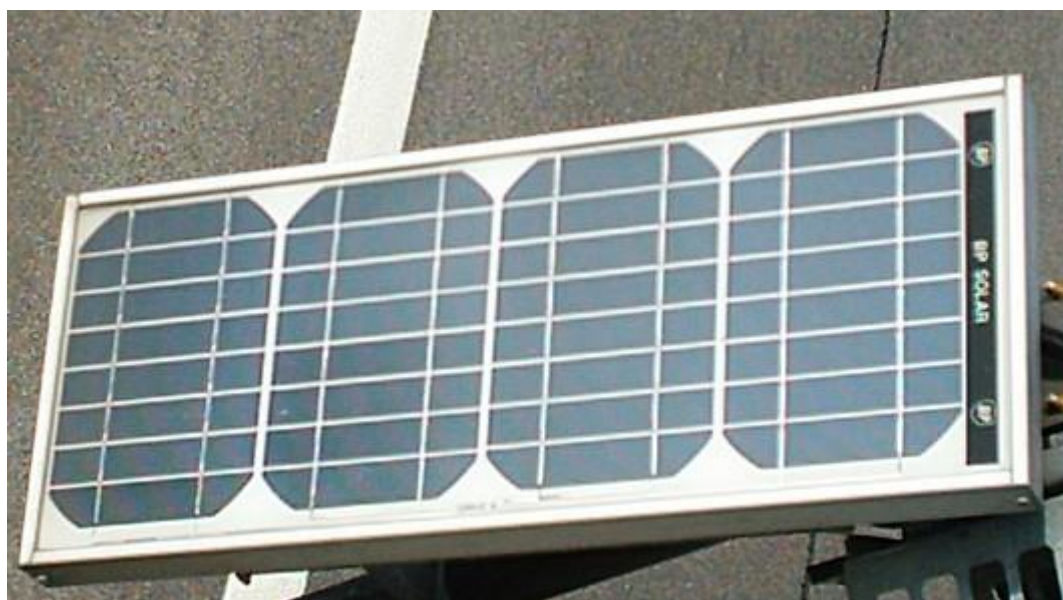
The series combination of resistor and capacitor is called as snubber circuit. When the relay is turn ON and turn OFF continuously, the back emf may fault the relays. So the back emf is grounded through the snubber circuit.

- When relay 1 is in the ON state and relay 2 is in the OFF state, the motor is running in the forward direction.
- When relay 2 is in the ON state and relay 1 is in the OFF state, the motor is running in the reverse direction.

### IX. SOLAR PANEL

The term solar panel is best applied to a flat **solar thermal collector**, such as a **solar hot water** or air panel used to heat **water**, air, or otherwise collect **solar thermal energy**. But 'solar panel' may also refer to a **photovoltaic module** which is an assembly of **solar cells** used to generate **electricity**. In all cases, the panels are typically flat, and are available in various heights and widths.

An **array** is an assembly of solar-thermal panels or photovoltaic (PV) modules; the panels can be connected either in parallel or series depending upon the design objective. Solar panels typically find use in residential, commercial, institutional, and light industrial applications.



Solar-thermal panels saw widespread use in Florida and California until the 1920's when tank-type **water heaters** replaced them. A thriving manufacturing business died seemingly overnight. However, solar-thermal panels are still in production, and are common in portions of the world where energy costs, and solar energy availability, are high.

Recently there has been a surge toward large scale production of PV modules. In parts of the world with significantly high **insolation** levels, PV output and their economics are enhanced. PV modules are the primary component of most



small-scale solar-electric power generating facilities. Larger facilities, such as [solar power plants](#) typically contain an array of reflectors (concentrators), a receiver, and a thermodynamic power cycle, and thus use solar-thermal rather than PV.

The largest solar panel in the world is under construction in the south of [Portugal](#). A 52,000 photovoltaic module, 11-megawatt facility covering a 60-hectare south-facing hillside in the southern [Alentejo](#) region and it will produce electricity for 21,000 households.

#### SOLAR PANEL CALCUALTION:

$$\text{VOLT} = 12 \text{ V}$$

$$\text{WATT} = 5 \text{ W}$$

$$W = V \times I$$

$$5 = 12 \times I$$

$$I = 5/12$$

$$I = 420\text{MA}$$

## X. BATTERY

A battery is a device in which chemical energy is directly converted to electrical energy. It consists of one or more voltaic cells, each of which is composed of two half cells connected in series by the conductive electrolyte. consists of one or more voltaic cells in series.

Each cell has a positive terminal, shown by a long horizontal line, and a negative terminal, shown by the shorter horizontal line. These do not touch each other but are immersed in a solid or liquid electrolyte. The electrolyte is a conductor which connects the half-cells together. It also contains ions which can react with chemicals of the electrodes. Chemical energy is converted into electrical energy by chemical reactions that transfer charge between the electrode and the electrolyte at their interface. Such reactions are called *faradaic*, and are responsible for current flow through the cell. Ordinary, non-charge-transferring (*non-faradaic*) reactions also occur at the electrode-electrolyte interfaces. Non-faradaic reactions are one reason that voltaic cells (particularly the lead-acid cell of ordinary car batteries) "run down" when sitting unused.

#### BATTERY CALCULATION:

$$B_{AH}/C_I = 8 \text{ ah}/420\text{ma}$$

$$= 19 \text{ hrs}$$

To find the Current

$$\text{Watt} = 18 \text{ w}$$

$$\text{Volt} = 12\text{v}$$

$$\text{Current} = ?$$

$$P = V \times I$$

$$18 = 12 \times I$$

$$I = 18/12$$

$$= 1.5 \text{ AMPS}$$

#### BATTERY USAGE WITH 1.5 AMPS

$$B_{AH}/I$$

$$8/1.5 = 5.3 \text{ hrs}$$

Total weight of the model = 15 kg

#### ESP-32 MICROCONTROLLER

With the NodeMCU-ESP32, comfortable prototyping is possible with simple programming via Luascript or the Arduino IDE and the breadboard-compatible design. This board has 2.4 GHz dual-mode Wifi and a BT wireless connection.

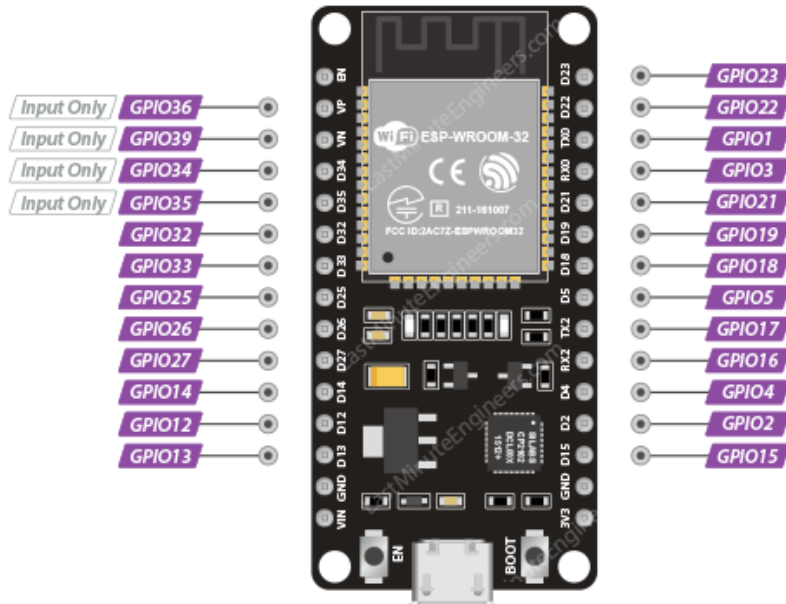
In addition, a 512 KB SRAM and a 4MB flash memory are integrated into the microcontroller development board. The board has 21 pins for interface connection, including I2C, SPI, UART, DAC, and ADC.



The major operational blocks of any IoT device are sensing, processing, storage, and transmitting. Therefore, to begin with, the  $\mu\text{C}$  should be able to interface with a variety of sensors. It should support all the common communication protocols required for sensor interface: UART, I2C, SPI. It should have ADC and pulse counting capabilities. ESP32 fulfills all of these requirements. On top of that, it also can interface with capacitive touch sensors. Therefore, most common sensors can interface seamlessly with ESP32.

Secondly, the  $\mu\text{C}$  should be able to perform basic processing of the incoming sensor data, sometimes at high speeds, and have sufficient memory to store the data. ESP32 has a max operating frequency of 40 MHz, which is sufficiently high. It has two cores, allowing parallel processing, which is a further add-on. Finally, its 520 KB SRAM is sufficiently large for processing a large array of data onboard. Many popular processes and transforms, like FFT, peak detection, RMS calculation, etc. can be performed onboard ESP32. On the storage front, ESP32 goes a step ahead of the conventional microcontrollers and provides a file system within the flash. Out of the 4 MB of onboard flash, by default, 1.5 MB is reserved as SPIFFS (SPI Flash File System). Think of it as a mini-SD Card that lies within the chip itself. You can not only store data, but also text files, images, HTML and CSS files, and a lot more within SPIFFS. People have displayed beautiful Webpages on WiFi servers created using ESP32, by storing HTML files within SPIFFS.

Finally, for transmitting data, ESP32 has integrated WiFi and Bluetooth stacks, which have proven to be a game-changer. No need to connect a separate module (like a GSM module or an LTE module) for testing cloud communication. Just have the ESP32 board and a running WiFi, and you can get started. ESP32 allows you to use WiFi in Access Point as well as Station Mode. While it supports TCP/IP, HTTP, MQTT, and other traditional communication protocols, it also supports HTTPS. Yep, you heard that right. It has a crypto-core or a crypto-accelerator, a dedicated piece of hardware whose job is to accelerate the encryption process. So you cannot only communicate with your web server, you can do so securely. BLE support is also critical for several applications. Of course, you can interface LTE or GSM or LoRa modules with ESP32. Therefore, on the 'transmitting data' front as well, ESP32 exceeds expectations.



**PIN CONFIGURATION**

**Power & Control Pins**

Pin Name	Pin No	Description
VIN	1	External power input (5 V)
3V3	2	Regulated 3.3 V output
GND	3	Ground
EN	4	Enable pin (Reset – Active HIGH)



- **GPIO (General Purpose Input/Output) Pins**
  - GPIO 0 – GPIO 39 available (not all usable).
  - Used for digital input/output, sensor interfacing, LEDs, relays, etc.
  - Some pins have special functions (boot, flash, touch).
- **Input-Only Pins**
  - GPIO 34, 35, 36 (VP), 39 (VN)
  - Input only (no output).
  - Mostly used for ADC (Analog input).
- **ADC (Analog-to-Digital Converter) Pins**
  - ADC1 Pins: GPIO 32–39
  - Safe to use even when Wi-Fi is ON.
  - ADC2 Pins: GPIO 0, 2, 4, 12–15, 25–27
  - Not reliable when Wi-Fi is active.
  - Resolution up to 12-bit (0–4095).
- **DAC (Digital-to-Analog Converter) Pins**
  - GPIO 25 – DAC1
  - GPIO 26 – DAC2
  - Used to generate analog voltage signals.
- **UART (Serial Communication) Pins**
  - UART0
  - TX: GPIO 1
  - RX: GPIO 3
  - Used for programming and debugging.
  - UART1 / UART2
  - Configurable pins for GPS, GSM, Bluetooth modules.
- **SPI Pins**
  - MOSI – GPIO 23
  - MISO – GPIO 19
  - SCK – GPIO 18
  - CS – GPIO 5
  - Used for SD card, TFT display, sensors.
- **I2C Pins**
  - SDA – GPIO 21
  - SCL – GPIO 22
  - Used for OLED displays, RTC, sensors.
- **PWM (Pulse Width Modulation) Pins**
  - Almost all GPIO pins support PWM.
  - Used for motor speed control, LED brightness, servo motors.
- **Touch Sensor Pins**
  - GPIO 0, 2, 4, 12–15, 27, 32, 33
  - Used for capacitive touch applications.
- **Boot & Special Function Pins**
  - GPIO 0 – Boot mode selection.
  - GPIO 2 – Must be LOW during boot in some boards.
  - GPIO 15 – Boot configuration.
  - EN (Enable) – Reset pin (LOW = reset).

## XI. PIN DESCRIPTION:

**GPIO:** Total 32 Multifunctional GPIOs are available on the ESP-Wroom-32 development board which can be used for input/output devices. Every GPIO pin can be configured as an internal pull-up, pull-down, or set to high impedance. The input can also be set to edge-trigger or level-trigger to generate CPU interrupts.

**Note:** GPIO34, GPIO35, GPIO36, and GPIO39 are the only input pins

**ADC:** On-chip 12-bit SAR (Successive Approximation Registers) ADCs (Analog to Digital Converter) which supports measurements on 16 channels of ESP32.



**DAC:** On-chip two 8-bit DAC (Digital to Analog) channels to produce digital signals into analog voltage signal outputs. Both DAC channels can also support independent conversions.

**PWM:** ESP32 development board has support 8-bit 32 channels PWM. The pins with the symbol ‘~’ represent that it has PWM support. It can be used for dimming LEDs or controlling motors etc.

**TOUCH Pad:** ESP32 has 10 capacitive sensing GPIOs, that detect physical touch by the human body. This technique can replace mechanical buttons and switches to eliminate mechanical wear and tear.

**I2C:** The ESP32 development board has only one I2C bus interface (Supported in Arduino IDE). which can serve as an I2C master or slave, depending on the user’s configuration.

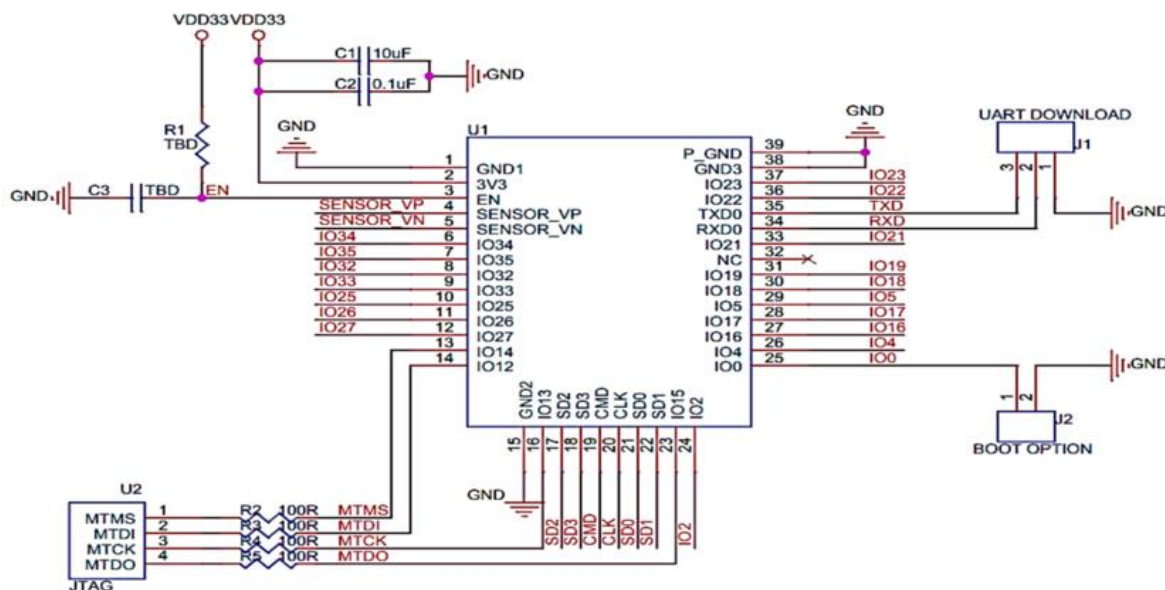
The I2C interfaces support:

- Standard mode Support (100 Kbit/s)
- Fast mode Support (400 Kbit/s)
- Support both 7-bit and 10-bit addressing modes
- Dual addressing mode

**SPI:** ESP32 has three SPIs which are SPI, HSPI, and VSPI. These SPIs also support the following general-purpose SPI features:

- Four modes of SPI transfer format (depend on the polarity and the phase of the SPI clock)
- Speed Up to 80 MHz
- up to 64-byte FIFO

**UART:** ESP32 development board has two UART interfaces UART0 and UART1. Both provide asynchronous communication and support to RS232, RS485, and IrDA too.



### Way of Programming for ESP32

The ESP32 supports both C/C++ and MicroPython programming languages that you can use to program your ESP32. Now, let’s check the supported ide for both types of languages.

Here’s a list of IDEs that supports to program the ESP32 series boards with C/C++.

- ESP-IDF
- Arduino IDE
- VS Code

Here’s a list of IDEs that supports to program the ESP32 series boards with

## XII. DESCRIPTION OF EQUIPMENTS

### 12.1. WHEEL

A wheel is a circular device that is capable of rotating on its axis, facilitating movement or transportation or performing labor in machines. A wheel together with an axle overcomes friction by facilitating motion by rolling. In order for



wheels to rotate a moment needs to be applied to the wheel about its axis, either by way of gravity or by application of another external force. Common examples are found in transport applications. More generally the term is also used for other circular objects that rotate or turn, such as a Ship's wheel and flywheel.

## 12.2. STORAGE TANK

Storage tank is used to store the seed on it. The inside of the storage tank have a seed stopper. The storage tank has a large open on its top side. And the bottom side have a correct size of open same as seed stopper dimension

## 12.3. SEED STOPPER

The seed stopper is used to stop the seed in correct time on seed sowing the seed stopper is connected to the flat face follower and it is guided to the help of guide way. The cam is used to control the up and down movement of the seed stopper in this equipment.

## SOWING

Sowing is the process of planting seeds. However, before sowing, good quality seeds (clean and healthy seeds) should be selected to produce a high yield.

## PLANTS WHICH ARE USUALLY SOWN

Among the major field crops, oats, wheat, and rye are sowed, grasses and legumes are seeded, and maize and soybeans are planted. In planting, wider rows (generally 75 cm (30 in) or more) are used, and the intent is to have precise, even spacing between individual seeds in the row; various mechanisms have been devised to count out individual seeds at exact intervals.

## TYPES OF SOWING

### HAND SOWING

Hand sowing is the process of casting handfuls of seed over prepared ground: broadcasting. Usually, a drag or harrow is employed to incorporate the seed into the soil. Though labor intensive for any but small areas, this method is still used in some situations. Practice is required to sow evenly and at the desired rate. A hand seeder can be used for sowing, though it is less of a help than it is for the smaller seeds of grasses and legumes.

A tray used in horticulture (for sowing and taking plant cuttings)

Hand sowing may be combined with pre-sowing in seed trays. This allows the plants to come to strength indoors during cold periods (eg spring in temperate countries).

In agriculture, most seed is now sown using a seed drill, which offers greater precision; seed is sown evenly and at the desired rate. The drill also places the seed at a measured distance below the soil, so that less seed is required. The standard design uses a fluted feed metering system, which is volumetric in nature; individual seeds are not counted. Rows are typically about 10-30 cm apart, depending on the crop species and growing conditions. Several row opener types are used depending on soil type and local tradition. Grain drills are most often drawn by tractors, but can also be pulled by horses. Pickup trucks are sometimes used, since little draft is required.

A seed rate of about 100 kg of seed per hectare (2 bushels per acre) is typical, though rates vary considerably depending on crop species, soil conditions, and farmer's preference. Excessive rates can cause the crop to lodge, while too thin a rate will result in poor utilization of the land, competition with weeds and a reduction in the yield.

## OPEN FIELD

Open-field refers to the form of sowing used historically in the agricultural context whereby fields are prepared generically and left open, as the name suggests, before being sown directly with seed. The seed is frequently left uncovered at the surface of the soil before germinating and therefore exposed to the prevailing climate and conditions. This is in contrast to the seedbed method used more commonly in domestic gardening or more specific (modern) agricultural scenarios where the seed is applied beneath the soil surface and monitored and manually tended frequently to ensure more successful growth rates and better yields.

Klocke (1979) described the building of two experimental planters, one using a smooth coulter and the other a ripple edged coulter. Both types of coulters were followed by hoe openers. The performance of the drills was satisfactory as long as the seed was placed into adequate soil moisture. Kumar et, at. (1986) developed a manually operated seeding attachment for an animal drawn cultivator. The seed rate was 43.2 kg/hr while the field capacity was 0.282 ha/hr

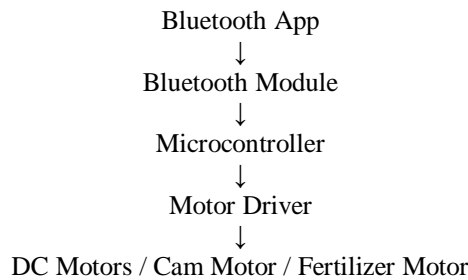


Bangboye and Mofolasayo (2006) developed a manually operated two-row Okra planter. The field efficiency and field capacity were 71.75% and 0.36 ha/hr while seed rate was 0.36kg/hr with low average seed damage of 3.51%. Gupta and Herwanto (1992) designed and fabricate a direct paddy seeder to match a two-wheel tractor. The machine had a field capacity of about 0.5 ha/hr at a forward speed of 0.81mls, and there was no damage caused by the metering mechanism for soaked seeds; though 3% damage was recorded for pre- germinated seeds.

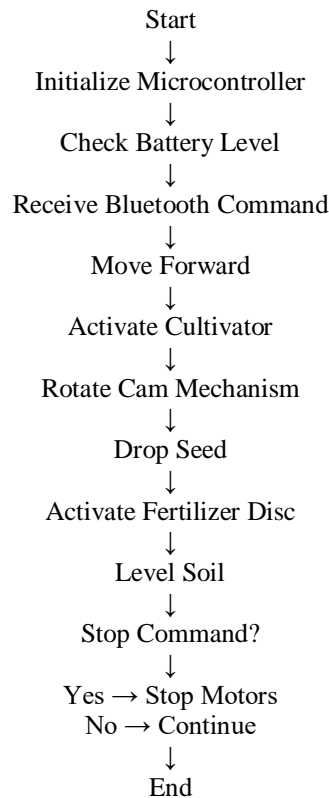
Molin and D' Agostin (1996) developed a rolling planter for stony conditions, using 12 spades radially arranged with cam activated doors and a plate seed meter. Performance evaluation showed important improvement in the planting operation with reduction in human effort, more accurate stands and high field capacity

Ladeinde and Verma (1994) compared the performance of three different models of Jab planters with the traditional method of planting. In terms of field capacity and labour requirement, there was not much difference between the traditional planting method and the Jab planters. However, backache and fatigue were substantially reduced while using the planters. Hand-pushed and Transnational Journal of Science and Technology August 2012 edition volume2, No.728 tractor mounted row seeders (usually single and multiple

**SIGNAL FLOW**



**METHODOLOGY (FLOW CHART FORMAT)**





## ALGORITHM

1. Begin
2. Initialize system
3. If Bluetooth command received
4. Start drive motor
5. Activate cam motor at fixed RPM
6. Activate fertilizer motor
7. Monitor speed
8. Maintain synchronization
9. Stop on command
10. End

## MATERIALS AND SPECIFICATIONS

Component	Specification
Solar Panel	12V, 10–20W
Battery	12V, 7Ah Lead Acid / Li-ion
Microcontroller	Arduino UNO / ESP32
Bluetooth Module	HC-05
Motor Driver	L298N
DC Motors	12V, 100–300 RPM
Cam Shaft	Mild Steel
Fertilizer Disc	Stainless Steel
Chassis	MS Frame
Wheels	Rubber 8–10 inch
Cultivator Blade	Hardened Steel V-Type
Leveler Plate	MS Flat Plate

## ADVANTAGES

- Multi-function in single pass
- Reduced labor cost
- Uniform seed spacing
- Controlled fertilizer distribution
- Eco-friendly (solar powered)
- Wireless operation
- Suitable for small farms

## XIII. RESULTS

- Uniform seed placement achieved
- Reduced seed wastage by ~20–30%
- Even fertilizer spreading
- Improved crop germination
- Reduced manual effort
- Battery backup supports 3–4 hours operation

## XIV. DISCUSSION

The cam mechanism ensures mechanical precision without requiring complex sensors. The integration of solar power reduces dependency on fossil fuels. Bluetooth control enhances ease of use. The combined cultivator and leveler ensure proper soil coverage, improving crop growth conditions. Future improvement can include GPS-based automation and IoT data monitoring.



## SCOPE

- Small-scale farmers
- Agricultural research farms
- Smart farming implementation
- Rural mechanization projects
- IoT-based agriculture upgrades

## XV. CONCLUSION

The proposed solar-battery powered Bluetooth-controlled multi-functional seed sowing machine offers a cost-effective, eco-friendly, and precise agricultural solution. By integrating cultivation, seed sowing, fertilizer distribution, and leveling into one system, it enhances efficiency and productivity.

This system supports sustainable agriculture and can significantly improve small-farm mechanization in rural areas.

## FUTURE WORK

- GPS-based auto navigation
- Soil moisture sensor integration
- IoT cloud monitoring
- Mobile app development
- AI-based crop recommendation system
- Automatic row alignment

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