Multipurpose Agribot with Field Monitoring System Using IOT

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ABSTRACT

Plant and animal cultivation is the science and art of agriculture. More than 40% of people worldwide chose agriculture as their main line of work. The growing interest in the creation of autonomous vehicles, such as agricultural robots, has occurred in recent years. The suggested approach attempts to create autonomous multifunctional agriculture. A robot that drives a vehicle that waters crops, sows seeds, and plows the ground. This robotic vehicle is a powerful agricultural machine with excellent dirt-clearing capabilities. A network of interconnected computing devices known as the Internet of Things (IoT) enables data to be transferred over a network without human intervention. We have developed Agribot, a tool that uses this technology to monitor various agricultural operations. Agribot is a powerful robotic machine with excellent soil-clearing abilities. This versatile device aids in keeping an eye on soil moisture, temperature, humidity, and water content. Depending on the spacing between the crops, this equipment is utilized to cultivate the farm. Using an ESP8266 connection to an Android smartphone, the Agribot may be operated. Motors and other components are interfaced with a microcontroller in the design of the entire calculation, processing, and monitoring process.

I. INTRODUCTION

The majority of the rural populace in several Asian nations, including India, is reliant on agriculture for a living. This robot is created to carry out the fundamental tasks necessary to be carried out on farms with the aim of enhancing productivity and decreasing the labor involved. The robot begins its work by plowing the field, then sows the seeds in the area that has been tilled, and finally covers the seeds with dirt. DC motors, stepper motors, relays, and PSOC serve as the system's primary contr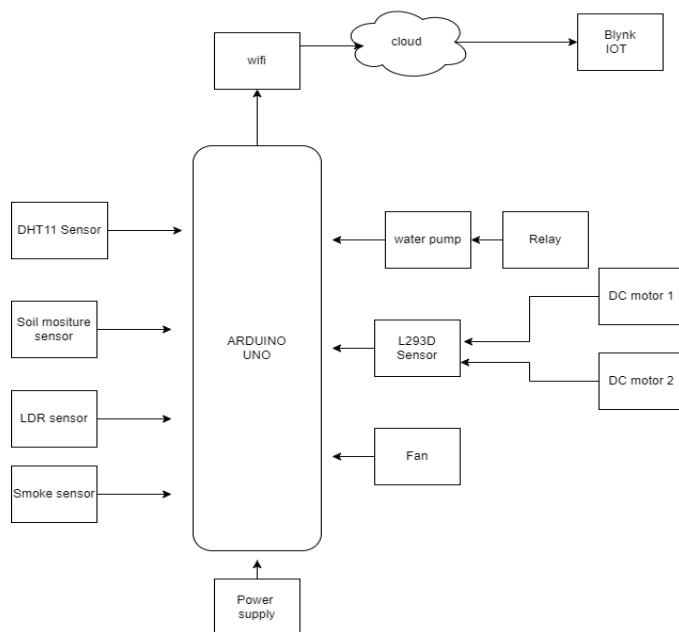ollers. The robot's mechanical layout is likewise straightforward. It is programmed to perform all of the aforementioned tasks at once. A container with seeds and a perforation in the bottom allows the robot to sow seeds, and its anterior end is equipped with spiked wheels to perform the function of plowing. The robot's posterior end has a sloping metal sheet that touches the ground, covering the sown seeds with soil as it moves forward. Agriculture robotics is not a novel idea; it has been used in greenhouses and other controlled environments for more than 20 years. Harvesters for cherry tomatoes, cucumbers, mushrooms, and other fruits have been developed via research. Robots have been used in horticulture to pick apples and oranges. In the Netherlands, milking robots are becoming prevalent in dairy production. The whole operation, from root cutting to planting seedlings, is managed by robots and computers.

The autonomous robot for agriculture (AgriBot) is a prototype that is used in this study to carry out different agricultural tasks including planting, weeding, spraying fertilizer, and applying pesticides. A Mega 2560 microprocessor on an Arduino Mega board is used to control the AgriBot. The robust Raspberry Pi minicomputer is utilized to operate and observe the robot's operation. All of the Arduino Mega's pins may be accessed for quick prototyping because it is placed on a robot. With the aid of an ultrasonic proximity sensor, its hexapod body can move autonomously in any direction. With the help of its walking algorithms, it can quickly alter its course and go in any new direction while remaining still. The robot can determine whether a seed has been put in the desired location at the right spacing and depth thanks to its underbody sensing array.

II. PROPOSED SYSTEM

For effective farming with seed sowing, plowing, grass cutting, and other conditions, the Agri-bot and field monitoring system

platform architecture has been proposed to collect, transmit, and process the physical parameters such as soil moisture, LDR, IR sensor, temperature, humidity, and to detect smoke or gas. The Arduino is the device that initially controls all of the sensors, including the temperature and humidity sensor, which gauges the temperature of the immediate area, and the soil moisture sensor, which detects the amount of moisture in the soil. The Wi-Fi module receives the data from the Arduino and sends it to the cloud, where it is stored for later access through a mobile application. In this case, the relay will function as a switch to turn on the water pump if the soil moisture level is low. A relay & IR sensor are used to activate water pumps when there is insufficient water present, and the moisture sensor measures the moisture level in the soil to warn the user. Robotic farming assists and lessens the workload of farmers by keeping an eye on all field conditions, such as tillage, seeding, crop harvesting, leveling, etc. An android application that uses IOT to monitor all agricultural field metrics and farming conditions.

MODULES INVOLVED:

HARDWARE MODULES:
1. Arduino UNO
2. L293D motor Driver
3. DC motors
4. Soil moisture sensor

5. IR sensor
6. Smoke sensor
7. DHT11 sensor
8. Relay
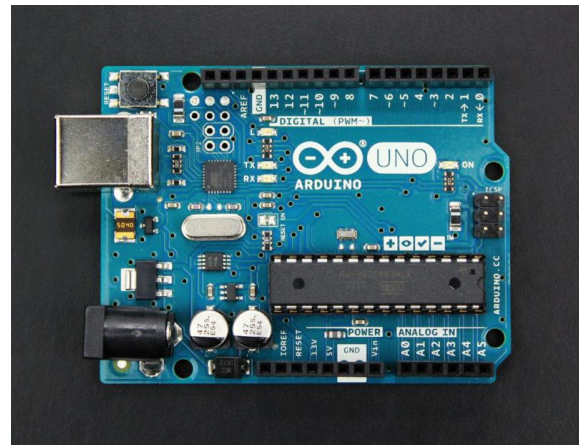9. Water pump
10. Wifi module

SOFTWARE MODULES:
1. Arduino IDE software
2. Embedded C Programming/Arduino C
3. Android Application(BLYNK IOT)

HARDWARE MODULES:
Arduino UNO
An Arduino is essentially a microcontroller-based kit that, thanks to its open-source hardware feature, may either be produced at home using the components or purchased straight from the seller and used right away. It is mostly used for communications and for running a variety of devices. Massimo Banzi and David Cuartielles started it in 2005.

Arduino Architecture:
The Harvard design, which has separate memory for the program code and program data, is essentially what the Arduino processor employs. There are two memories in it: a program memory and a data memory. The data is kept in the data memory, but the code is kept in the flash program memory. The Atmega328 runs at a clock speed of 16MHz and features 32 KB of flash memory for code storage (of which 0.5 KB is needed for the bootloader), 2 KB of SRAM, and 1 KB of EEPROM.

Arduino Pin Diagram

Arduino Uno is a popular illustration of an Arduino board. It an ATmega328 microprocessor with 28 pins.

The Arduino Uno has 6 analog inputs, a 16 MHz crystal oscillator, 14 digital input/output pins, 6 of which may be used as PWM outputs, a USB port, a power connector, an ICSP header, and a reset button.
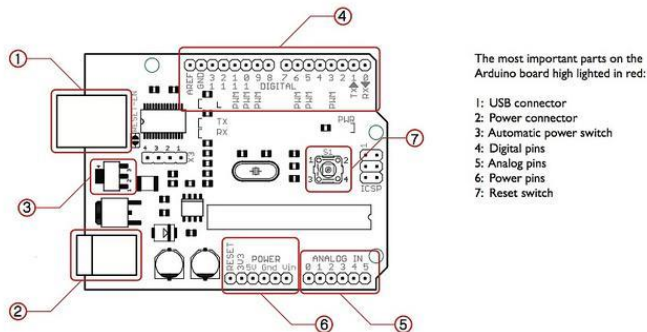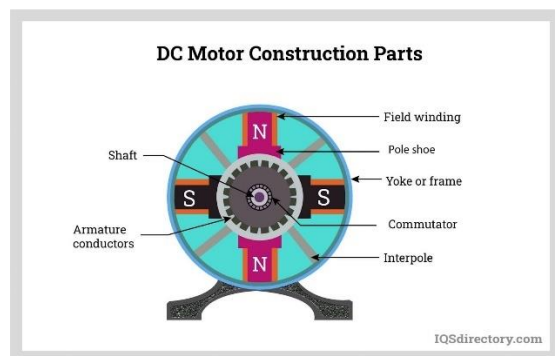

The most important parts on the Arduino board high lighted in red:

1: USB connector
2: Power connector
3: Automatic power switch
4: Digital pins
5: Analog pins
6: Power pins
7: Reset switch

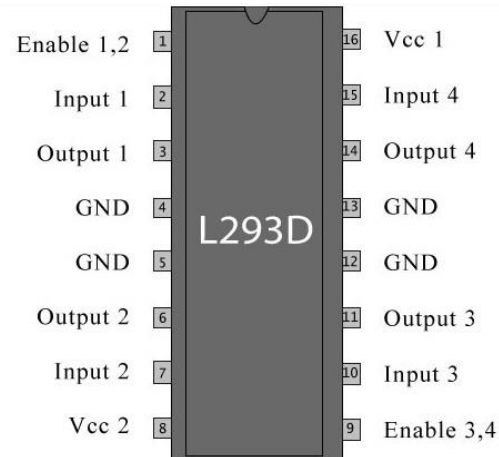**Figure: Arduino Pin Diagram**

DC MOTOR:

An electric motor that uses direct current is known as a DC motor. The operation of an electric motor is based on straightforward electromagnetism. A conductor that is carrying current produces a magnetic field; when this field is subsequently exposed to an external magnetic field, it experiences a force that is inversely proportional to the conductor's current and the intensity of the external magnetic field. This gadget transforms electrical energy into mechanical energy. It is based on the idea that a current-carrying conductor in a magnetic field would rotate relative to its initial location due to a force applied to it. Field windings produce the magnetic flux, while the armature serves as the conductor in a practical DC motor.

- Frame sizes from 8 to 35 mm.
- Speeds from 5,000 to 14,000 rpm.
- Continuous motor torque - 0.36 to 160 mNm.
- Coreless rotor design.
- Low rotor inertia.

III. L293D Motor Driver :

An integrated circuit chip known as a motor driver IC is typically used to operate motors in autonomous robots. Robotic motors and microprocessors are connected via motor driver integrated circuits (ICs). The L293 series, including the L293D, L293NE, etc., has motor driver ICs that are used the most frequently. These ICs are made to manage two DC motors at once. Two H-bridges make up L293D. The simplest circuit for managing a motor with a low current rating is an H-bridge.

Features

- Can be used to run Two DC motors with the same IC.
- Speed and Direction control are possible
- Motor voltage Vcc2 (Vs): 4.5V to 36V
- Maximum Peak motor current: 1.2A
- Maximum Continuous Motor Current: 600mA
- Supply Voltage to Vcc1(vss): 4.5V to 7V
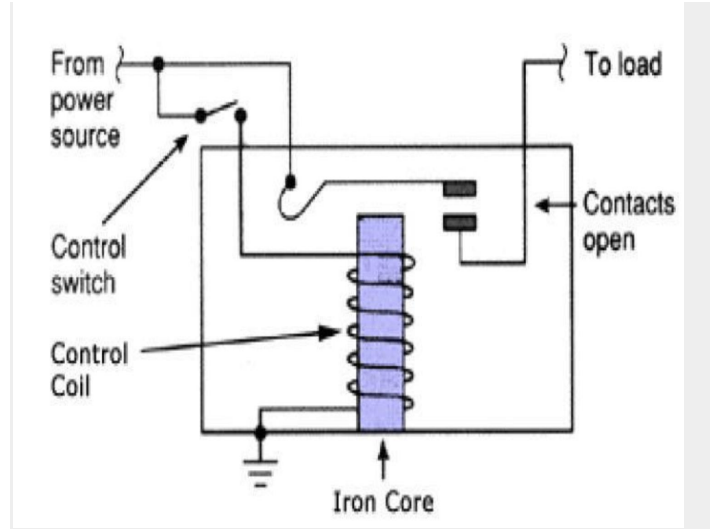
Spe0cifications:

IV.RELAY:

Relays are switches that work both electromechanically and electronically to close and open circuits. It regulates how an electrical circuit's circuit connections open and close. The relay is not powered while the contact on the relay is open (NO). The relay is not powered up, though, if the contact is closed (NC). The states are, nevertheless, susceptible to change when energy (electricity or charge) is given. Relays are typically used in control panels, factory automation, and building automation to switch smaller current levels in control circuits and control electricity. Yet, because a big voltage may be switched by the contacts when a low voltage is given to the relay coil, the provision of amplifying effect can assist manage the huge amperes and voltages. In order to protect electronic equipment, preventative relays may detect overcurrent, overload, undercurrent, and reverse current. It is used to heat the elements, turn on audible alerts, switch the starting coils, and pilot the lights, among other things.

Relay Types:

There are several other relays with various operating, polarity, and governing principles in addition to electromechanical and electromagnetic relays. Relays are typically used in control panels, factory automation, and building automation to switch smaller current levels in control circuits and control electricity. Yet, because a big voltage may be switched by the contacts when a low voltage is given to the relay coil, the provision of amplifying effect can assist manage the huge amperes and voltages. In order to protect electronic equipment, preventative relays may detect overcurrent, overload, undercurrent, and reverse current. It is used to heat the elements, turn on audible alerts, switch the starting coils, and pilot the lights, among other things.

Relay Function

In order to provide a thorough knowledge of relay wiring and relay circuits, as well as how they function, we have included a relay diagram in the section below.

The internal portion of the relay in the circuit is highlighted in the diagram. The control coin is separated by an iron core. Via load connections and a control switch, the power supply is connected to the electromagnet. Magnetic fields increase when energizing begins in the circuit when energy is supplied through the control coil. In this manner, the lower fixed arm attracts the higher contact arms, closing the connections and causing a short circuit. On the other hand, if the relay was de-energized, the contact would go the other way, resulting in an open circuit. A moveable armature is forced back to its starting position once the coil current stops flowing, and this force is equal to half of the magnetic force and electric strength. Gravity and spring are the major causes of this force. The relays carry out two fundamental tasks, including high-voltage and low-voltage applications.

Features

- The coil of a relay passes a relatively large current, typically 30mA for a 12V relay,

- It can be as much as 100mA for relays designed to operate from lower voltages.

- The maximum output current for the popular 555 timers IC is 200mA so these devices can supply relay coils directly without amplification.
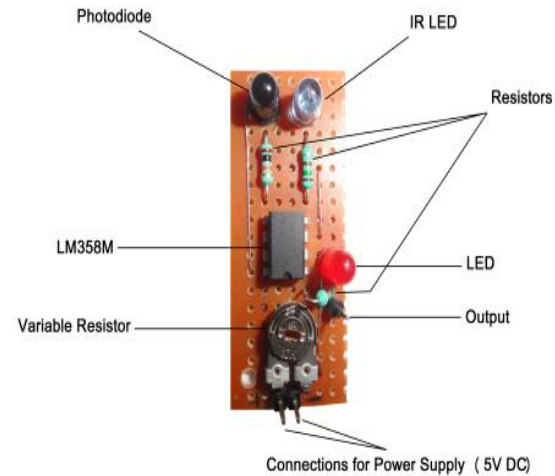
COMPLETED CIRCUIT BOARD

Advantages of relays:

- Relays can switch AC and DC, transistors can only switch DC.

- Relays can switch high voltages, transistors cannot.

- Relays are a better choice for switching large currents (> 5A).

- Relays can switch many contacts at once.

ESP WIFI MODULE

A self-contained SOC with an integrated TCP/IP protocol stack, the ESP8266 Wi-Fi Module allows any microcontroller to access your Wi-Fi network. The ESP8266 is capable of offloading all Wi-Fi networking tasks from another application processor or hosting an application. Each ESP8266 module has an AT command set firmware that has been pre-programmed, so all you have to do is connect it to your Arduino device to get nearly the same amount of Wi-Fi functionality as a Wi-Fi Shield (and that's right out of the box)! The ESP8266 module is a very affordable board with a sizable and expanding community.
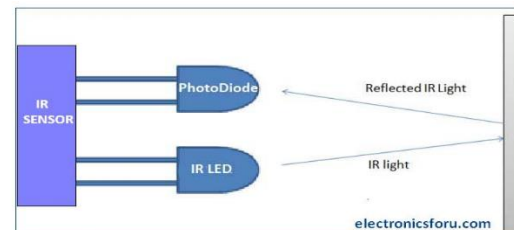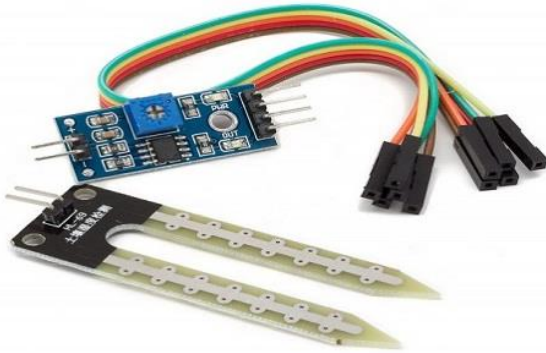
IR SENSOR:

IR SENSOR

Soil Moisture Sensor:

The soil moisture sensor is one type of sensor used to calculate the volumetric quantity of water in the soil. Straight gravimetric dimensions need to be removed, dried, and sample weighted because of the moisture in the soil. These sensors determine the volumetric water content indirectly by replacing the moisture content with electrical resistance, neutron interaction, dielectric constant, and other soil principles.

replacement and text searching. While saving and exporting, the message section provides feedback and shows errors. The console shows text generated by the Arduino Software (IDE), including error messages in their entirety and other data. The configured board and serial port are visible in the window's bottom right corner. You may create, save, and save drawings, validate and upload programs, view the serial monitor, and more using the toolbar buttons.

Verify
Checks your code for errors compiling it.

Upload
Compiles your code and uploads it to the configured board. See uploading below for details.

Note: If you are using an external programmer with your board, you can hold down the "shift" key on your computer when using this icon. The text will change to "Upload using Programmer"

New
Creates a new sketch.

Open
Presents a menu of all the sketches in your sketchbook. Clicking one will open it within the current window overwriting its content..

Save
Saves your sketch.

Serial Monitor
Opens the serial monitor.

Specifications:

- The required voltage for working is 5V
- The required current for working is <20mA
- Type of interface is analog
- The required working temperature of this sensor is 10°C~30°C

SOFTWARE MODULES:

Software requirements are concerned with specifying the software resources and prerequisites that must be installed on a computer to provide the best possible performance of a program. The majority of the time, these conditions or prerequisites must be installed individually before the program can be installed because they are typically not part of the software installation package.

- **IDE:** Arduino IDE
- **Language:** Embedded C
- **Blynk App**

Arduino IDE

In addition to a text editor for writing code, a message area, a text terminal, a toolbar with buttons for frequently used operations, and a number of menus, the Arduino Integrated Development Environment, sometimes known as the Arduino Software (IDE), is also available. To upload programs and communicate with the Arduino and Genuino hardware, a connection is made.

Writing Sketches

Sketches are computer programs created using Arduino Software (IDE). These drawings are created in a text editor and saved as files with the. In to extension. The editor offers functions for text

EMBEDDED C

The most common programming language for creating electrical devices is embedded C. Every electronic system's CPU is linked to embedded software. The performance of particular tasks by the CPU is greatly influenced by embedded C programming. We utilize a variety of technological equipment in our daily lives, including our mobile phones, washing machines, digital cameras, etc. The basis for all of these devices' operation is a microcontroller that is written in embedded C. The LED attached

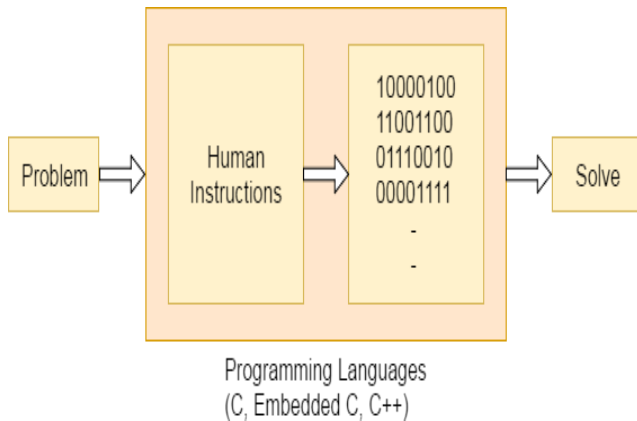to Port0 of the microcontroller is flashing thanks to the embedded C code shown in the block diagram above.

Programming in C is preferable over other languages for creating embedded systems. Because of the following factors :

- o Easy to understand
- o High Reliability
- o Portability
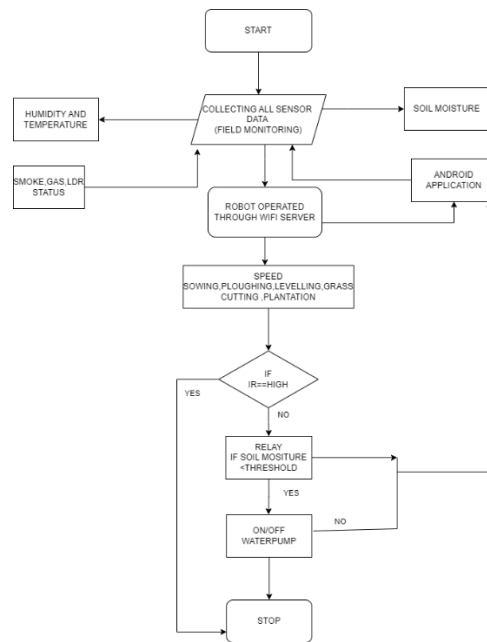- o Scalability

Embedded System Programming:

Basic Declaration

Let's look at the development block diagram for embedded C programming:

A function is a group of statements used to carry out a particular activity, and a programming language is a group of one or more functions. Each language is made up of fundamental components and grammatical rules. Writing a C program requires the use of variables, character sets, data types, keywords, expressions, and other programming constructs.

FLOW CHART:

V.OUTCOME

This technology is more adaptable than conventional technology. This method aids in minimizing human effort. As a result, it has enabled the automation of the most important working processes. It has been successfully installed and tested to perform a variety of tasks like plowing, sowing, leveling, and spraying water. With IOT and an Android application, all agricultural field metrics and farming conditions are tracked.

VI.CONCLUSION

For effective farming with seed sowing, plowing, grass cutting, and other conditions, the Proposed Agribot and field monitoring system architecture has been proposed to collect, transmit, and process the physical parameters such as Soil Moisture, LDR, Temperature, Humidity, IR obstacle detection, and to detect and avoid obstacles, smoke or gas. The Wi-Fi module receives the data from the Arduino and sends it to the cloud, where it is stored for later access through a mobile application. According to the soil's moisture content, the proposed system will check the soil, plow the seeds with a structure resembling teeth at the end to turn the top layer of soil downward, close the seeds and automatically level the ground, and provide irrigation by sprinkling water with a pump in the field. The Blynk software allows us to interface Node MCU with the cloud to operate the Agribot. By automating agricultural procedures, the robot module (AgriBot) can lessen the load on farmers and make their labor-intensive activities easier.

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