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Design and Development of Agricultural Bot - AGRIBOT

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Abstract – *This dissertation concentrates on introducing a robot which will help the farmers for farming the field. The most important parameter which no one can buy in this world is Time and we are introducing an Agribot that will do all the work that farmers do on their fields for production of crops which will definitely contribute in saving their time. The focus of designing this robot is to reduce the entire farmer's efforts, increase the speed of work, helping the environment causing no pollution which will reduce the global warming. The operating of this robot is very simple and it can be completely automated by introducing artificial intelligence. Number of operations such as ploughing the field, sowing of seeds and covering the seeds with soil can be performed by using the Agribot with flexible options of with or without human interference. The fact as introducing autonomous machinery for carrying agricultural activities is essential to improve the quantity and quality of the agricultural products.*

Key Words: Robot, farmers, Agribot, crops, speed, global warming, artificial intelligence, agricultural products etc.

1. INTRODUCTION

Agriculture is an important fields in which there needs an automation to fulfil the need of more enhancement in each field of technology. Food is one of the three basic needs for human survival; Food – Shelter – Clothes. For automation in this field the system purposes a robot that can work in co-ordination with the farmers. Agribot is a robot that can perform all the tasks as per the instructions given by farmers.

The selection of which seed should be sown in the particular season is also done by the robot with the introduction of artificial intelligence to the respective system. A LCD display is put on for the easy processing and understanding of the things to be executed. A manually operated set of sharp blades is also included in the system so that the grown crops can be cut down. Spraying the fertilizers or water to the crops is carried out by the water pump mounted on the robot assembly.

An android mobile application is used to give the commands and complete the desired work. Movement of the robot in any required direction is achieved using the same application. Two separate modes as Automatic and Manual will be given so that desired objective can be achieved easily.

In this daily rush and fast life, we observe that due to less profit issues from the sown grains or harvested plants farmers are committing suicides. The government is trying its best to provide them the facilities but the farmer's occupied are in large number.

As in all the field's there is automation from smallest pens nip to largest vehicles like trucks. There should be automation in this field as well. We have come up till the tractors and now it is the time to upgrade from tractors to robots.

Number of tasks such as spraying water, fertilizers, cutting the crops is performed by farmers with the conventional methods since hundreds of years. While performing these tasks, there are chances of accidents and these chances can be reduce or completely eliminated by introducing the Agribot.

The main objective of the robot is to reduce the work done by farmers. As the farmers may get hurt while cutting the weeds, all this cutting is done by the robot with reduction in time and increased production. To avoid the problems due to load shedding in urban areas, solar operated battery power source is used for the operation of this robot.

2. WORKING

2.1 Principle of operation

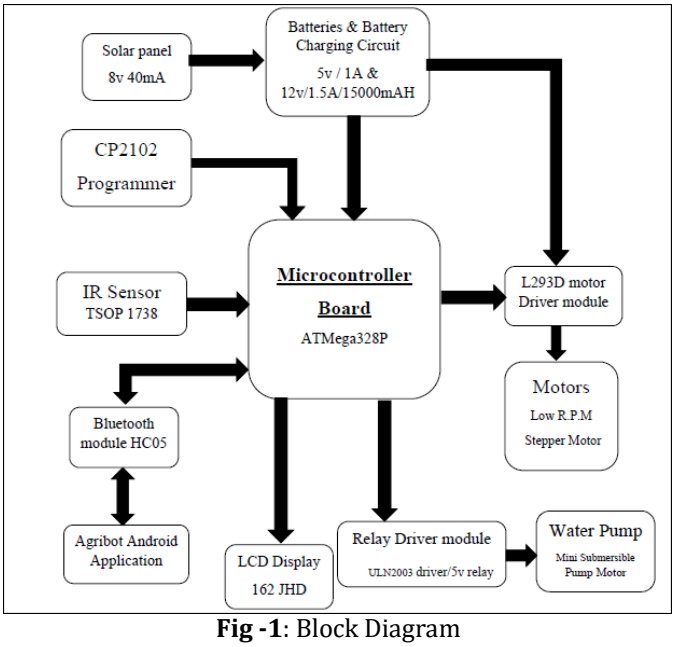

Fig -1: Block Diagram

This robot is operated using the android mobile phone with an application that comes with two dedicated modes as Manual and Automatic Mode.

In the automatic mode, user will have to select the operation that is to be carried out, eg. Spraying water or sowing the crops etc. forward or reverse direction according to the field is placed. If there is an obstacle in the path of the robot it will change its path or stop working and the error will be showed on LCD and on the mobile screen.

In the manual mode, first the user will select the application for the robot to work i.e. user will select the button of spraying water/fertilizers or sowing the grains. When the user will select the button of spraying water the signal will be transmitted to the Bluetooth module of robot via Bluetooth of mobile and when the signal will be reaching the Bluetooth module of robot, the signal will be transferred to the microcontroller which will then execute the further process according to the c program written by the manufacturer.

Then the signals i.e. high low pulses will send to the relay driver which is connected to the Submersible Pump Motor which will spray the water or fertilizers to the field and similarly all other operations will take place. In this mode there are dedicated buttons for controlling the robot in forward, backward, left side, right side directions by the process as; module will receive the signals and transfer it to AT-Mega 328p microcontroller.

2.2 Atmel AT-Mega 328P (Microcontroller)

A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM.

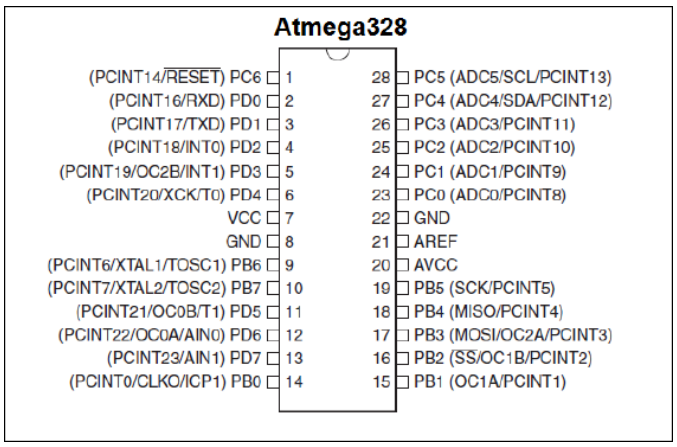

Fig -2: Atmega328

The ATmega328 is a single-chip microcontroller created by Atmel in the Mega AVR family. AVR is a family of microcontrollers developed by Atmel beginning in 1996. AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to one-time programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time.

ATmega328P is used for Arduino Uno. Arduino Uno board is based on the ATmega328P microcontroller. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

2.3 CP2102 (Programmer)

The CP2102 is a highly-integrated USB-to-UART Bridge Controller providing a simple solution for updating RS-232 designs to USB using a minimum of components and PCB space. The CP2102 includes a USB 2.0 full-speed function controller, USB transceiver, oscillator, EEPROM, and asynchronous serial data bus (UART) with full modem control signals in a compact 5 x 5 mm MLP-28 package. No other external USB components are required. The on-chip EEPROM may be used to customize the USB Vendor ID, Product ID, Product Description String, Power Descriptor, Device Release Number, and Device Serial Number as desired for OEM applications.

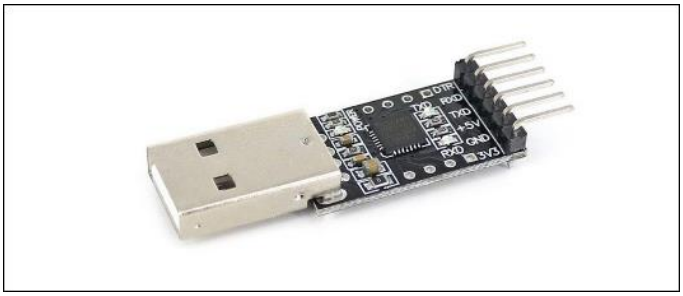

Fig -3: CP2102

The EEPROM is programmed on-board via the USB allowing the programming step to be easily integrated into the product manufacturing and testing process. Royalty-free Virtual COM Port (VCP) device drivers provided by Silicon Laboratories allow a CP2102-based product to appear as a COM port to PC applications. The CP2102 UART interface implements all RS-232 signals, including control and handshaking signals, so existing system firmware does not need to be modified. In many existing RS-232 designs, all that is required to update the design from RS-232 to USB is to replace the RS-232 level-translator with the CP2102.

2.4 L293D (Motor Driver)

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC).

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.

L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop

the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

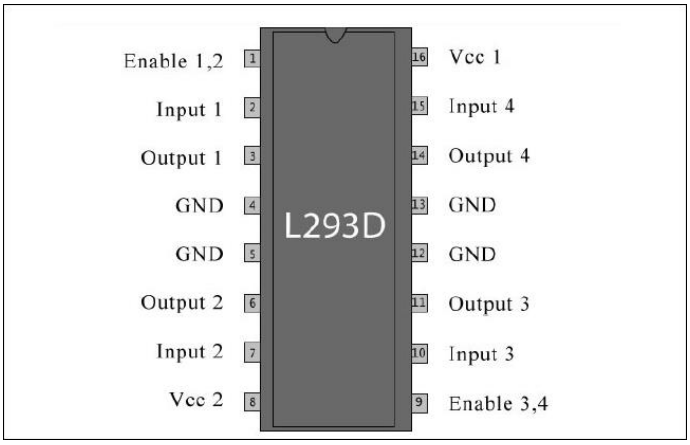

Fig -4: L293D.

Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

2.5 TSOP 1738 IR Sensor (IR Sensor)

The TSOP 1738 is a member of IR remote control receiver series. This IR sensor module consists of a PIN diode and a pre-amplifier which are embedded into a single package.

TSOP1738 is a very commonly used IR receiver for PCM remote control systems. It has only 3 pins, Vcc, GND and Output. It can be powered using a 5V power supply and its active low output can be directly connected to a microcontroller or microprocessor.

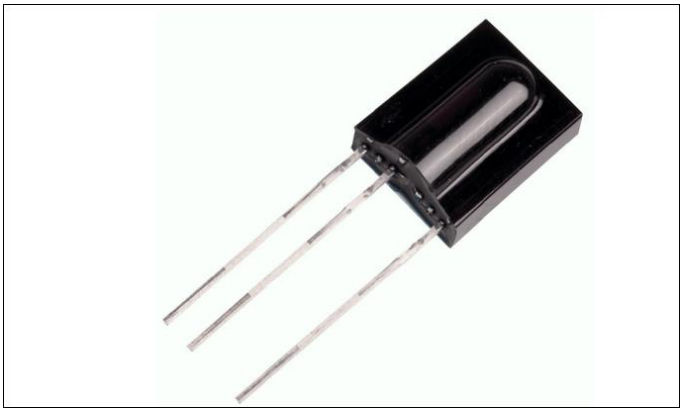

Fig -5: TSOP 1738 IR Sensor

The TSOP 1738 is a member of IR remote control receiver series. This IR sensor module consists of a PIN diode and a pre-amplifier which are embedded into a single package. The output of TSOP is active low and it gives +5V in off state. When IR waves, from a source, with a center frequency of 38 kHz incident on it, its output goes low.

Lights coming from sunlight, fluorescent lamps etc. may cause disturbance to it and result in undesirable output even when the source is not transmitting IR signals. A bandpass filter, an integrator stage and an automatic gain control are used to suppress such disturbances.

TSOP module has an inbuilt control circuit for amplifying the coded pulses from the IR transmitter. A signal is generated when PIN photodiode receives the signals. This input signal is received by an automatic gain control (AGC). For a range of inputs, the output is fed back to AGC in order to adjust the gain to a suitable level. The signal from AGC is passed to a band pass filter to filter undesired frequencies. After this, the signal goes to a demodulator and this demodulated output drives an NPN transistor. The collector output of the transistor is obtained at pin 3 of TSOP module.

2.6 SRD-12V-DC-SL-C Relay Driver

A Relay driver IC is an electro-magnetic switch that will be used whenever we want to use a low voltage circuit to switch a light bulb ON and OFF which is connected to 220V mains supply. There are various ways to drive relays.

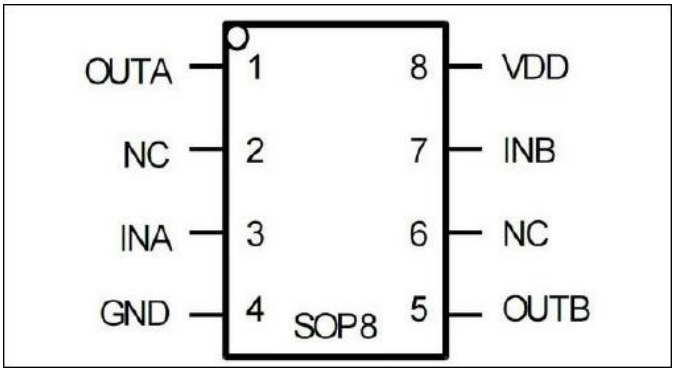

Fig -6: SRD-12V-DC-SL-C Relay Driver

The required current to run the relay coil is more than can be supplied by various integrated circuits like Op-Amp, etc. Relay have unique properties and are replaced with solid state switches that are strong than solid-state devices. High current capacities, capability to stand ESD and drive circuit isolation are the unique properties of Relays.

2.7 HC-05/06 Bluetooth Modules

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.

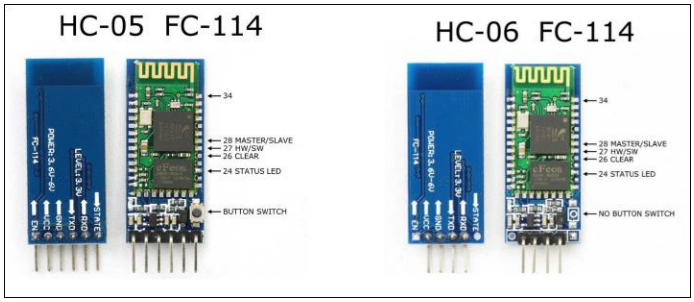

Fig -7: HC-05/06 Bluetooth Modules

2.8 Motors

DC Motors:

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor.

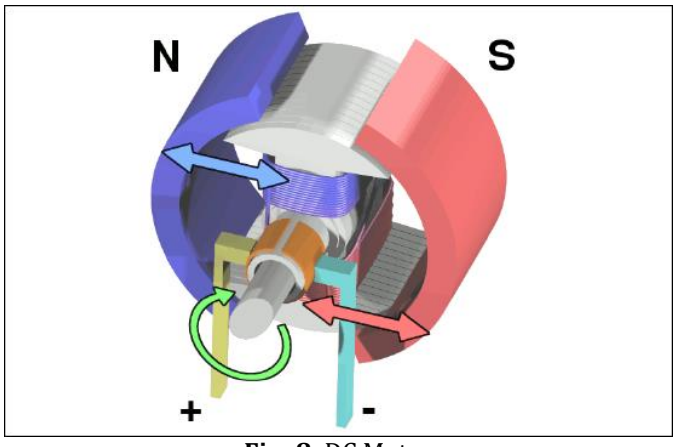

Fig -8: DC Motor

DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

In a brushed electric motor with a two-pole rotor (armature) and permanent magnet stator, "N" and "S" designate polarities on the inside axis faces of the magnets; the outside faces have opposite polarities. The + and - signs show where the DC current is applied to the commutator which supplies current to the armature coils.

Servo Motor:

A servomotor is a rotary actuator 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 servomotors.

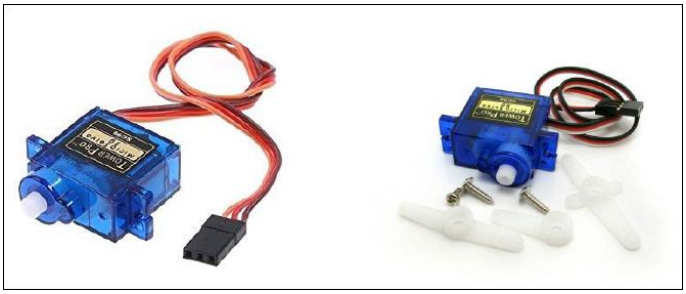

Fig -9: Servo Motor

Servomotors are not a specific class of motor although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing.

More sophisticated servomotors use optical rotary encoders to measure the speed of the output shaft and a variable-speed drive to control the motor speed.

Bo Motors:

DC motor (BO) Battery Operation. Dc motor converts electrical energy into mechanical energy. Why DC gear motor used in robot Motor control circuit. ... Speed of motor is counted in terms of rotations of the soft per minute is called RPM. RPM means Revolution per Minute.

Gear Reduction: The rotary machine's output torque is increased by multiplying the torque by the gear ratio, less some efficiency losses. While in many applications gear reduction reduces speed and increases torque, in other applications gear reduction is used to increase speed and reduce torque.

Fig -10: Bo Motor

A gear motor is a specific type of electrical motor that is designed to produce high torque while maintaining a low

horsepower, or low speed, motor output. Gear motors can be found in many different applications, and are probably used in many devices in your home.

2.9 Mini Submersible pump motor

A submersible pump (or sub pump, electric submersible pump (ESP)) 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. Submersible pumps push fluid to the surface as opposed to jet pumps having to pull fluids.

The motor is hermetically sealed and close-coupled to the body of the pump. A submersible pump pushes water to the surface by converting rotary energy into kinetic energy into pressure energy. The major advantage to a submersible pump is that it never has to be primed, because it is already submerged in the fluid.

2.10 16*2 LCD (JHD 162A LCD)

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals.

Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome.

LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

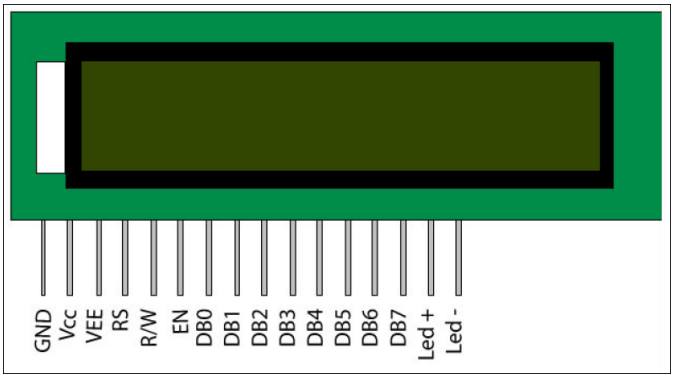

Fig -11: 16*2 LCD

2.11 Robot Wheels

There are many types of robots of which wheeled robots are the most common ones. Here used is a 3 Inch robot wheel. The Wheel is plastic with rubber tires. This wheel is compatible with BO motors with slotted shaft.

Fig -12: Robot Wheels

Table -1: Hardware Description

Name	Details
Microcontroller	AT Mega 328P
Programmer	CP2102
Motor Driver	L293D
IR Sensor	TSOP 1738 IR Sensor (MH-Sensor-Series Flying Fish)
Relay Driver	SRD-12V DC-SL-C Relay Driver
Bluetooth Module	HC-05/06 Bluetooth Module
Motor	DC Motors, Servo Motor, Bo Motor
Water Pump	Mini Submersible pump motor
Liquid Crystal Display	16*2 LCD – JHD 162A LCD
Body Material	Acrylic
Wheels Material	Plastic
Battery/Power Supply	12v / 1 A
Lithium Battery	9v / 1 or 1.5 A
Solar Panel	8v / 40mA

3. SOFTWARE REQUIREMENTS

Table -2: Software Requirements

Name	Details
Eagle	PCB Layout design, Circuit Diagram
Programming Language (C language)	Arduino (Programming)
MIT App Invertor (website)	For developing android application (using c and interface)

4. RESULTS

We tested the board after printing it all the test point were correct and were working properly. Connectivity between all the connection and tracks were good. After mounting the components we again tested the board all the components were working properly and finally we connected the PCB with other external components.

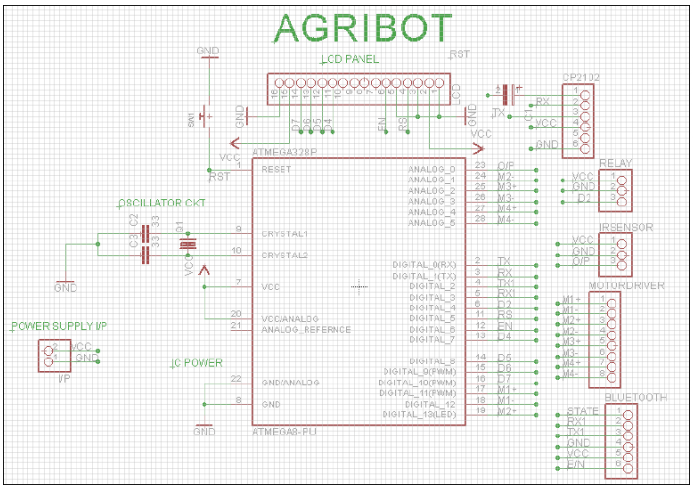

Fig -13: Circuit Diagram

5. ADVANTAGES

1. The robots do not get sick or tired and they do not need the time off, they can operate with closer tolerance, they offer fewer errors and at higher speeds, and the higher quality products can be sensed by the machine accurately.
2. As the machines can be made lighter and cheaper if the driver's seat controls and cab can be eliminated, the robots can be used in various fields in the agriculture, the robots can easily work around the trees, the rocks, the ponds and the other obstacles.
3. The robots can reduce up to 80% of farm's use of pesticide, the robots may perform more or different tasks in the future, the robots can create the jobs for the people who have to make the robots and who have to fix the robot.

6. DISADVANTAGES

1. The robot can change the culture and emotional appeal of the agriculture as well as the energy issues are costly.
2. The robots may be more acceptable to the non-form community.
3. The jobs in the agriculture require intelligence and quick, and the robots can be substituted with the human operator.

7. CONCLUSIONS

1. The project agribot is one of the greatest ideas which will help farmers throughout the working period due to its easy user interface and flawless operation.
2. Soon the agribot will be used widely as the farmers become more aware of the same and would be seen in the Indian Farms.
3. It can be used from anywhere from the world for the scheduled harvesting and cutting of crops according to the requirements using artificial intelligence and internet services.
4. This project will dedicatedly work for the farmers and their welfare and will be productive in all the applications it performs.

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BIOGRAPHIES

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