Asian Journal of Applied Science and Technology (AJAST)
(Open Access Quarterly International Journal) Volume 2, Issue 2, Pages 730-736, April-June 2018

Precision Agriculture Using Agribot for the Welfare of Farmers

P. Prakash[1], B. Priyadharshini[2], G.Thiriveni[3] and Mr.V.Gowrishankar[4]

[1,2,3]*UG Students, Department of ECE, Velalar College of Engineering and Technology, India.*
[4]*Assistant Professor, Department of ECE, Velalar College of Engineering and Technology, India.*

Article Received: 01 March 2018 *Article Accepted: 09 April 2018* *Article Published: 28 April 2018*

ABSTRACT

More than 40 percent of the population in the world chooses agriculture as the primary occupation. In recent years, increased interest has grown for the development of the autonomous vehicles like robots in the agriculture. Agribot is a robot designed for agricultural purposes. It is designed to minimize the labor of farmers in addition to increasing the speed and accuracy of the work. It performs the elementary functions involved in farming i.e. spraying of pesticide, sowing of seeds, and so on. The existing agricultural robot performs basic elementary functions like harvesting, planting and spreading the pesticides. The Proposed system aims at designing multipurpose autonomous agricultural robotic vehicle which can be controlled through Bluetooth for seeding and spraying of pesticides. This is especially important for the workers in the area of potentially harmful for the safety and health of the workers. These robots are used to reduce human intervention, ensuring proper irrigation and efficient utilization of resources.

1. INTRODUCTION

Many countries in Asia including India are agrarian economies and most of their rural populations depend on agriculture to earn their livelihood. Aimed at increasing the productivity and reducing the labor involved, this robot is designed to execute the basic functions required to be carried out in farms. All kinds of agricultural robots have been researched and developed to implement a number of agricultural products in many countries. This Agribot can performs basic elementary functions like ploughing, planting and spray the pesticides. The application of agricultural machinery in precision agriculture has experienced an increase in investment. The robot starts its function by ploughing of soil followed by sowing of seeds and ends the process by spraying of pesticides. It uses basic components like DC motors, servo motor, relay, solenoid valve and Arduino as the main controller. The mechanical design of the robot is also simple. It is programmed to carry out the above functions simultaneously. To perform the function of ploughing it is equipped with spiked wheels which are fixed in the anterior end of the robot, to sow seeds it has a container with seeds and its bottom contains a perforation to drop the seed and finally the posterior end of the robot has a sprayer equipped with solenoid valve which is controlled by a relay. Precision autonomous farming is the operation, guidance, and control of autonomous machines to carry out agricultural tasks. It motivates agricultural robotics. The goal of agricultural robotics is more than just the application of robotics technologies to agriculture

2. PROCEDURE

The robot is placed in the field and is switched on. This enables the movement of its wheels. This starts the rotation of spiked wheels and thus starts ploughing which is done simultaneously as the robot moves forward. As the spiked wheels are in the front, a container is used for holding the seeds. A hole is drilled in the bottom of this container and that is covered with a small sheet. This sheet acts as a flip-flop and caters to the dropping of seeds at periodic intervals. The control of the flip-flop can be done using servo motor. The final step is spraying of pesticides which can be done with the help of solenoid valve and is periodically sprayed whenever the relay switch is closed.

3. PROPOSED SYSTEM

The proposed system focused on the design, development and the fabrication of the multipurpose agricultural robot with pesticide spraying system in addition to ploughing and seeding. The multipurpose agricultural Robot is used to control the three functions like ploughing the soil, seed sowing, and pesticide/ water spraying with least changes in accessories through Bluetooth without affecting cost. The block diagram of the proposed model is shown in Figure1.

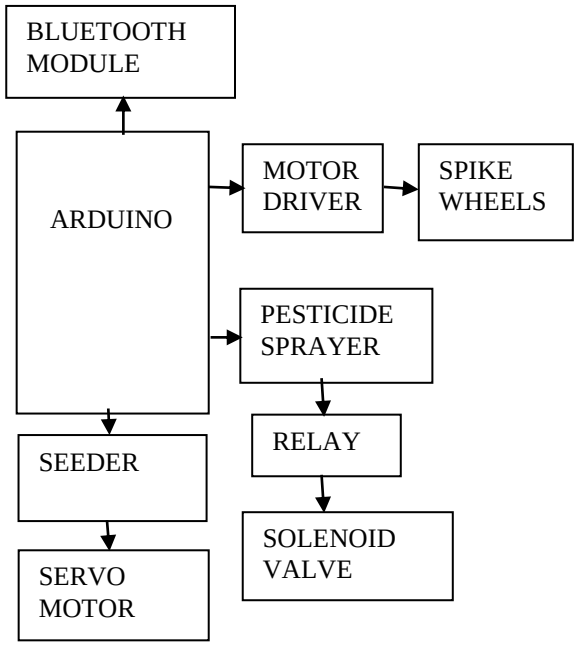


Fig:1 Block Diagram of AGRIBOT

3.1. Hardware Mode

The whole system of the robot works with 5V supply. The base frame consists of 4 wheels connected to four arms and both rear and front wheel is driven by dc motor. The seeds are sowed through drilled hole on the shaft. A solenoid valve equipped pump sprayer is used to spray the pesticide. Bluetooth technology through smart phone is used to control the entire operation of robot for ploughing, seeding and pesticide spraying. The Heart of the proposed system is Microcontroller. Bluetooth module, DC motors, relays are interfaced to the Microcontroller to provide various operations like Ploughing, seeding and pesticide spraying.

The entire mechanism of the system is controlled by Bluetooth module from Android smart phone. The wireless communication of Bluetooth technology enables the robot to move in four directions as front, back, right and left. Various commands can be used to move robot into forward, reverse, stop, left, and right. The microcontroller in the proposed model enables various functions in the field according to the commands received from smart phone.

The various operations of the prototype model is demonstrated below

3.1.1. Ploughing function

The primary purpose of ploughing is to turn over the upper layer of the soil, bringing fresh nutrients to the surface, while burying weeds and the remains of previous crops and allowing them to break down. In the prototype model shown above, a DC Motor coupled with the screw rod is used for ploughing the farm. As the screw rod rotates, the nut welded to the cultivator slides between the screws of the rod. Then the cultivator is lowered down and the soil is dug up to 1.5 inches. The direction of the cultivator can be controlled by the Bluetooth app in the smart phone.

3.1.2. Seed sowing function

Seeding is planting seeds in a place or on an object. In this prototype model, a box is used for Seed storage and is arranged to sow the seeds when wheels are rotated. The movement of wheels of the robot causes the shaft to throw the seeds to the field.

3.1.3. Pesticide spraying function

The pesticides are used to increase the crop yield. Spraying of some pesticides causes health issues to the humans when some chemicals in, it come into contact with the skin of the farmers. Thus, the agribot equipped with pesticide sprayer i.e., relay controlled solenoid valve is used to spray harmful pesticide/ fertilizer.

4. CONSTRUCTION

The various components used for performing the above mentioned functions are DC motor, servo motor, solenoid valve, L239D driver, relay and Bluetooth module. These are interfaced with Arduino.

Fig: Servo motor

4.1. Brushless DC motor

Basic principle operation of BLDC motor is similar to a DC motor instead in DC motor, feedback is implemented using a mechanical commutator and brushes while in BLDC motor feedback is achieved using multiple feedback sensor. A BLDC has a rotor with permanent magnets and stator with windings.

4.2. Servo motor

A Servo motor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of suitable couple to a sensor for position feedback. Servo motor is 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. Modern servo motor are designed and supplied around a dedicated controller module from the same manufacturer. Controllers may also be developed around microcontrollers in order to reduce the cost for large volume applications.

4.3. Solenoid valve

A Solenoid valve is an electromechanically operated valve. The valve is controlled by an electric circuit through a solenoid: in the case of a two-port valve the flow is switched on or off. Multiple solenoid valves can be placed together on a manifold. Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose or mix fluids. They found in applications like long service life, low control power and compact design. Besides the plunger-type actuator which is used most frequently, pivoted-armature actuators and rockers actuators are also used.

Fig : Solenoid valve

4.4. L293D Driver

L293D is a typical motor driver or Motor Driver IC which allows DC to drive on either direction. Dual H-Bridge Motor Driver for DC or Steppers - 600mA - L293D. This is a very useful chip. It can actually control one motor independently. We will use in its entirety the chip in this tutorial. Pins on the right hand side of the chip are for controlling a one motor. Pins on the left hand side of the chip are for controlling second motor. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor.

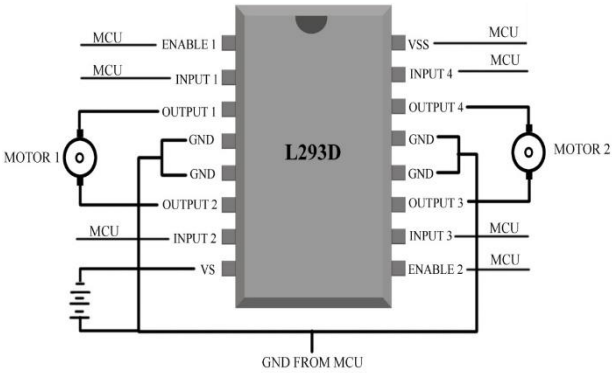


Fig: L293D Pin diagram

4.5. Relay

A relay is an electromagnetic switch operated by a relatively small electric current that can turn ON or OFF a much larger electric circuit.

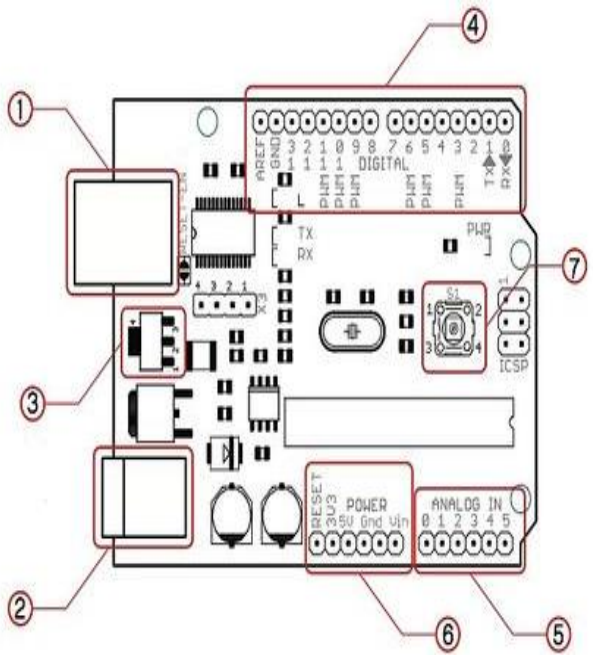
5. METHODOLOGY

Arduino microcontroller is used to control various operations of proposed system. Arduino microcontroller are used to control ploughing, seeding and pesticide spraying through motor drivers of robot. L293D is the motor driver for controlling DC motor operations for ploughing. DC Motor used for rear wheels is connected to another L293D driver for proper movement of wheels. Similarly, for seeding and pesticide spraying functions, servo motor and solenoid valves are used respectively.

Fig : A sample of field ploughed with agribot.

6. CONTROL OF THE ROBOT

The robot is controlled using Arduino. It is programmed to perform the above mentioned functions along with motor drivers, servo motor, DC motors, solenoid valve and relay. The overview diagram of the Arduino is shown in the figure.



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

6.1. The code to execute above mentioned function is given below:

```
#include<servo.h>
int motor 2H=7;
int motor 2L=6;
int motor 1H=5;
int motor 1L=4;
Servo myservo;
int pos = 0;
void setup() {
  myservo.attach(9);
  void loop() {
analogWrite(motor2H,0);
analogWrite(motor2L,255);
analogWrite(motor1H,0);
analogWrite(motor1L,255);
  for (pos = 0; pos <= 180; pos += 1) {
       myservo.write(pos);
    delay(10);
    }
delay(1000);
  for (pos = 180; pos >= 0; pos -= 1)
  {
    myservo.write(pos);
    delay(10);
  }
delay(15);
}
```

7. CONCLUSION

In this work a robot, named, AGRIBOT has been designed, built and demonstrated to carry out ploughing in an agriculture field. It is expected the robot will assist the farmers in improving the efficiency of operations in their farms. This work has been carried out as our undergraduate research project

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