A Mini Project Report on

Agricultural Robot

Submitted to the

DEPARTMENT OF
ELECTRONICS AND INSTRUMENTATION ENGINEERING

In partial fulfillment of the requirements of the course

Bachelor of Engineering in Electronics and Instrumentation Engineering

By

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CERTIFICATE

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ACKNOWLEDGEMENT

To keep the pace with today's modern world, the agricultural practices should be modernized with the help of technology. With technology we can save time and money of the farmer.

We take this golden opportunity to sincerely thank our HOD, Dr. M Jyothirmayi, Electronics and Instrumentation Engineering, MSRIT and project coordinator Dr. A Saravanan, Assistant Professor, Electronics and Instrumentation Engineering, MSRIT for letting us proceed the idea of agricultural robot using rf module. We are very thankful to our project guide Dr. A Saravanan for the constant support and guidance he has given throughout this process.

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ABSTRACT

Robotics is the branch of technology that deals with the design, construction, operation, structural depositions, manufacture and application of robots. Robotics brings together several very different engineering areas and skills. It is related to the science of electronics, Engineering, mechanics, mechatronics, and software. Robotics is playing a significant role in agricultural production and management. There is a need for autonomous and time saving technology in agriculture to have efficient farm management. The researchers are now focusing towards different farming operational parameters to design autonomous agricultural vehicles as the conventional farm machineries are crop and topological dependent. Till date the agricultural robots have been researched and developed principally for harvesting, chemical spraying, picking fruits and monitoring of crops. Robots like these are perfect substitute for manpower to a great extent as they deploy unmanned sensing and machinery systems. The prime benefits of development of autonomous and intelligent agricultural robots are to improve repeatable precision, efficacy, reliability and minimization of soil compaction and drudgery.

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CHAPTER 1: INTRODUCTION

INTRODUCTION

In India, there are 70% people dependent on agriculture. Robotics plays a major role in various fields such as industrial, medical, military applications etc., The robotics field are gradually increasing its productivity in agriculture field. Some of the major problems in the Indian agricultural are rising of input costs, availability of skilled labors, lack of water resources and crop monitoring. To overcome these problems, the automation technologies were used in agriculture. The automation in the agriculture could help farmers to reduce their efforts**.**By the development of these agrobots lot of manual labor will also be decreased.

The robot has been developed for the processes such as ploughing and seed sowing. The robot is developed to concentrate in an efficient manner and also it is expected to perform the operations autonomously. These functions can beintegrated into a single robot and then performed**.**In recent years, the development of autonomous vehicles in agriculture has experienced increased interest. This development has led many researchers to start developing more rational and adaptable vehicles. All the processes are advance to modifying the mechanism in farming which works automatically without the man power requirement.

1.1 LITERATURE SURVEY

Although the research developments are abundant, there are some shortcomings that are delaying the improvements required for commercialization of the guidance systems. The application of new popular robotic technologies for agricultural guidance systems will augment the realization of agricultural vehicle automation in the future[1]. Although existing manned operations can be efficient over large areas there is a potential for reducing the scale of treatments with autonomous machines that may result in even higher efficiencies[2].

In agriculture, the opportunities for robot-enhanced productivity are immense – and the robots are appearing on farms in various guises and in increasing numbers. The other problems associated with autonomous farm equipment can probably be overcome with technology. Crop production may be done better and cheaper with a swarm of small machines than with a few large ones. [3]. Primarily on demo basis it looks somewhat costly, but in future it may become more usable when produced on large scale[4].

The present commercial devices involve the working of all the three functions separately.It requires one day or more for loosening the soil and path forming for half acre land whereas the Multipurpose Farm Robot requires approximately 20 hours for completing the whole process which involves the three basic functions i.e. forming the path, sowing the seeds and back filling the soil in half acre land[5]. In conventional robotics, the controlling and operation of robots is usually done by using RF [Radio Frequency] circuits. These circuits are widely used for control and working applications and are also reliable over a small range. The RF circuits consist of transmitter and receiver which are independent of each other. All the control signals and commands are sent via wireless medium in between transmitter and receiver[6].

1.2 SCOPE OF THE WORK

The present project aims at designing an intelligent robotic vehicle which can be controlled wirelessly through RF communication. The objective is to develop a microcontroller-based system that helps in on farm activities like seeding, ploughing and closing the seed pit at designated the autonomous robot. The process of seeding is done by using the DC motor.

The aim is reducing the man power and increasing the productivity rates to a higher level. It is also efficient in terms of pollution because it does not run on fossil fuels, in turn reducing the consumption of ever depleting natural resources. This makes the robot a

non-polluting vehicle. One of the other aim is to reduce the running cost of digging or ploughing machines which makes it more suitable for farmers in India to afford it.

1.3 OBJECTIVES

Automation makes life easy. Automation is a key buzz word in industries. Each and every process demands automation in order to arrive at efficient, accurate and effective results.

Developing agriculture needs to find new ways to improve efficiency. One approach is to utilize available information technologies in the form of more intelligent machines to reduce and target energy inputs in more effective ways than in the past.

The objective of our project is to operate and control the robot for agricultural purposes. The project is designed with microcontroller P89V51RD2, servo and stepper motors, mechanical arrangements etc. The robot can be operated in forward direction, left and right side.

The main purpose of the agricultural robot is to accomplish 3 main tasks involved in Agricultural process. The tasks are listed below:

- Ploughing
- Seed Sowing
- Leveling
- Sprinkling water for irrigation

The main advantages of the agricultural robot include:

- Portable
- Cost effective
- Consumes less power
- Eco friendly
- Less man-power
- Accurate
- Less wastage
- Can protect farmers from harmful effects of pesticides

1.4 ORGANISATION OF THE REPORT

This report gives a basic description about how we are going to implement our project and the literature survey included here gives us an idea on how to implement various innovations and overcome the problems that are faced in the development process.

In order to provide an easier understanding of the following project it has been organized into the particular categories. Following are the categories:

- Chapter 1: It includes the basic idea behind selecting the project, literature survey, objectives and scope of work.
- Chapter 2: It consists of basic introduction to the project and the basic block diagram of the overall system.
- Chapter 3: It explains the hardware and software sections with implementation details.
- Chapter 4: It explains about the results obtained from the existing model of the project.
- Chapter 5: This chapter has the conclusion of the project.

CHAPTER 2: METHODOLOGY

METHODOLOGY

2.1 INTRODUCTION

In earlier days farmers were using conventional methods of Agriculture for example Bullocks for ploughing the soil, seed sowing, levelling the ground, etc. These methods are time consuming and require more man power and are less accurate. In order to overcome these parameters, these conventional methods were replaced by tractors. But the tractors are huge in size, costly and consume a lot of energy. Most of the farmers in the rural areas cannot afford this.

Facts and Figures of INDIAN Agriculture-

- India has worlds highest percentage of arable land to the total geographical area, in the world.
- About 50% of India's geographical area is used for Agricultural activity.
- India has the worlds largest cattle and buffalo population.
- Agriculture provides livelihood to about 65% of India's GDP.
- Agriculture accounts for India's 10% of India's exports.
- Agriculture sector is changing the socio-economic environments of the population due to liberalization and globalization.

Most of the activities involved in agriculture are carried out manually. Due to manual or improper methods or employments cultivated to achieve the above processes, Indian agriculture is yet to get the desired results. Providing technical solutions by the use of modern and advanced technologies in this particular field is very important. Sustainability of resources is the need of the hour, and hence alternative and renewable sources of energy, coupled with mechanization of time consuming activities will ensure better output. This is known as precise agriculture.

2.2 SOFTWARE PART

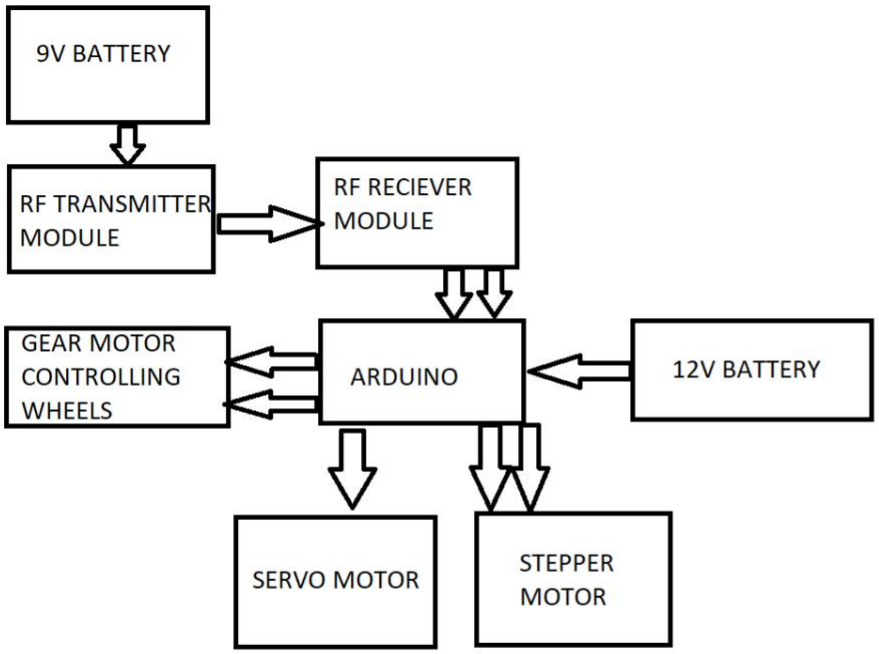


Fig2.1: Proposed Block Diagram for Agricultural Robot

2.3 HARDWARE PART

Block diagram:

1) RF TRANSMITTER AND RECEIVER PAIR

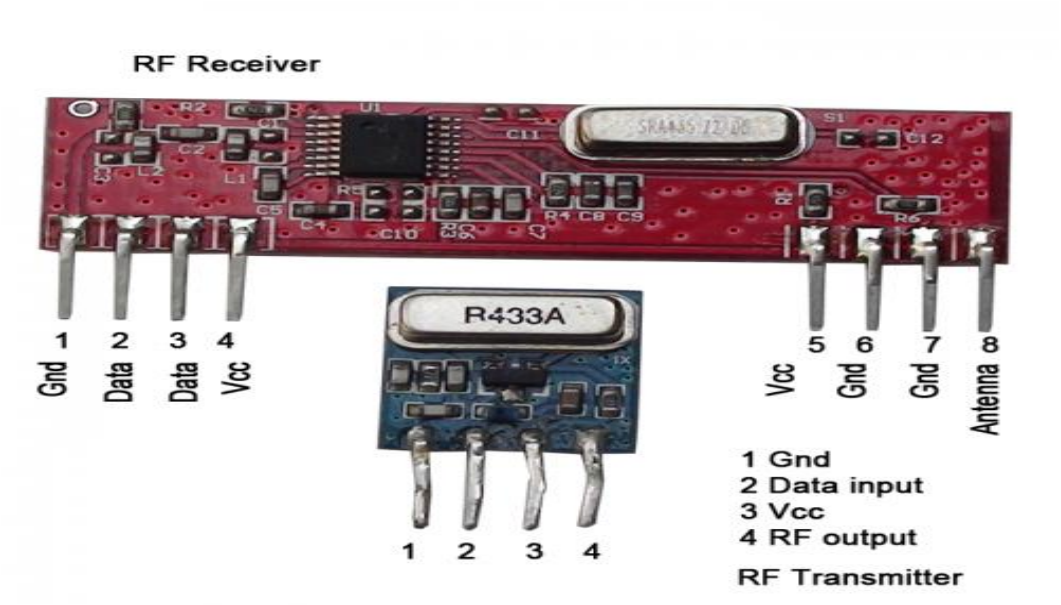


Fig2.2: transmitter/receiver pair

The transmitter/receiver pair operates at a frequency of **434 MHz**.

RF Transmitter Features:

- Frequency Range: 433 Mhz
- Output Power: 4-16dBm
- Input supply: 3 to 12 volt dc

RF Receiver Features:

- Sensitivity: -105dBm
- IF Frequency : 1MHz
- Low Power Consumption
- Current 3.5 mA
- Supply voltage: 5 volt

An RF transmitter module is a small PCB sub-assembly capable of transmitting a radio wave and modulating that wave to carry data. Transmitter modules are usually implemented alongside a micro controller which will provide data to the module which

can be transmitted. RF transmitters are usually subject to requirements which dictate the maximum allowable transmitter power output, harmonics, and band edge requirements.

An RF receiver module receives the modulated RF signal, and demodulates it. There are two types of RF receiver modules: superheterodyne receivers and super-regenerative receivers. Super-regenerative modules are usually low cost and low power designs using a series of amplifiers to extract modulated data from a carrier wave. Super-regenerative modules are generally imprecise as their frequency of operation varies considerably with temperature and power supply voltage.Superheterodyne receivers have a performance advantage over super-regenerative; they offer increased accuracy and stability over a large voltage and temperature range. This stability comes from a fixed crystal design which in the past tended to mean a comparatively more expensive product. However, advances in receiver chip design now mean that currently there is little price difference between superheterodyne and super-regenerative receiver modules.

HT12E

Fig2.3: HT12E

HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits.

HT12E has a transmission enable pin which is active low. When a trigger signal is received on TE pin, the programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium. HT12E begins a 4-word transmission cycle upon receipt of a transmission enable. This cycle is repeated as long as TE is kept low. As soon as TE returns to high, the encoder output completes its final cycle and then stops.

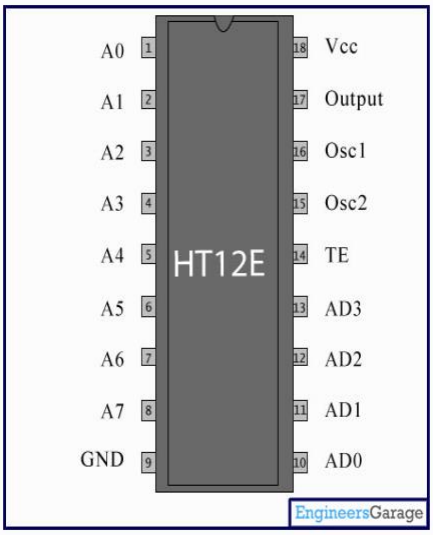


Fig2.4: HT12E Pin diagram

Pin No	Function	Name
1	8 bit Address pins for input	A0
2		A1
3		A2
4		A3
5		A4
6		A5
7		A6
8		A7
9	Ground (0V)	Ground
10	4 bit Data/Address pins for input	AD0
11		AD1
12		AD2
13		AD3
14	Transmission enable; active low	TE
15	Oscillator input	Osc2
16	Oscillator output	Osc1
17	Serial data output	Output
18	Supply voltage; 5V (2.4V-12V)	Vcc

Table2.1: HT12E Pin description

HT12D

HT12D converts the serial input into parallel outputs. It decodes the serial addresses and data received by, say, an RF receiver, into parallel data and sends them to output data pins. The serial input data is compared with the local addresses three times continuously. The input data code is decoded when no error or unmatched codes are found. A valid transmission in indicated by a high signal at VT pin.

HT12D is capable of decoding 12 bits, of which 8 are address bits and 4 are data bits. The data on 4 bit latch type output pins remain unchanged until new is received.

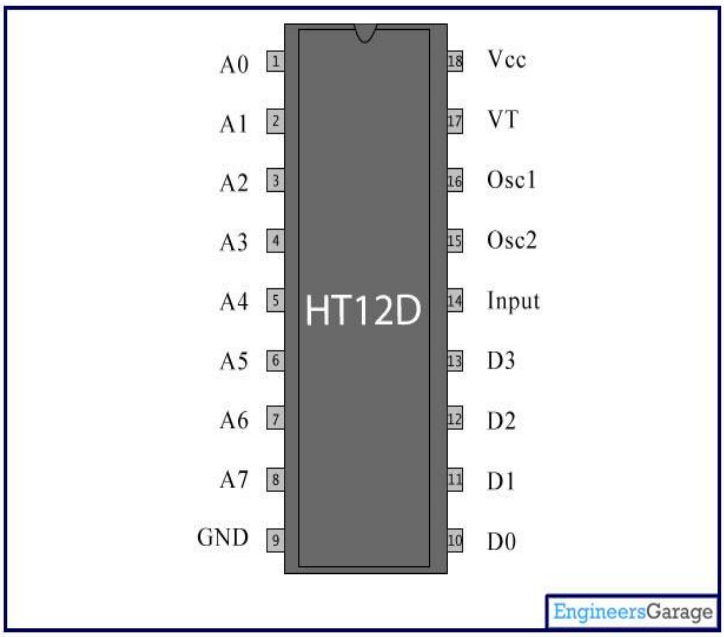


Fig2.5: HT12D Pin diagram

Pin No	Function	Name
1	8 bit Address pins for input	A0
2		A1
3		A2
4		A3
5		A4
6		A5
7		A6
8		A7
9	Ground (0V)	Ground
10	4 bit Data/Address pins for output	D0
11		D1
12		D2
13		D3
14	Serial data input	Input
15	Oscillator output	Osc2
16	Oscillator input	Osc1
17	Valid transmission; active high	VT
18	Supply voltage; 5V (2.4V-12V)	Vcc

Table2.2: HT12D Pin description

L293D MOTOR DRIVER

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.

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.

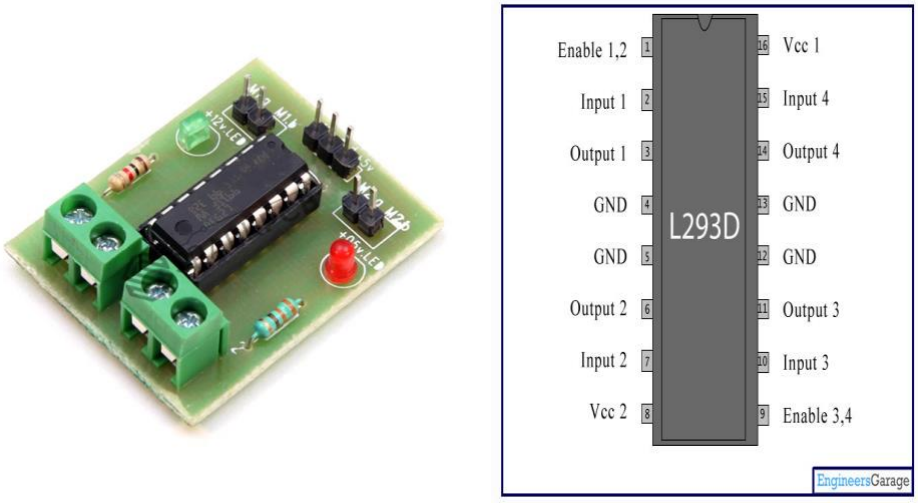


Fig2.6: L293D Motor driver

Specifications

- Supply Voltage Range 4.5V to 36V
- 600-mA Output current capability per driver
- Separate Input-logic supply
- It can drive small DC-geared motors, bipolar stepper motor.
- Pulsed Current 1.2-A Per Driver
- Thermal Shutdown
- Internal ESD Protection
- High-Noise-Immunity Inputs

Pin No	Function	Name
1	Enable pin for Motor 1; active high	Enable 1,2
2	Input 1 for Motor 1	Input 1
3	Output 1 for Motor 1	Output 1
4	Ground (0V)	Ground
5	Ground (0V)	Ground
6	Output 2 for Motor 1	Output 2
7	Input 2 for Motor 1	Input 2
8	Supply voltage for Motors; 9-12V (up to 36V)	Vcc_2
9	Enable pin for Motor 2; active high	Enable 3,4
10	Input 1 for Motor 1	Input 3
11	Output 1 for Motor 1	Output 3
12	Ground (0V)	Ground
13	Ground (0V)	Ground
14	Output 2 for Motor 1	Output 4
15	Input2 for Motor 1	Input 4
16	Supply voltage; 5V (up to 36V)	Vcc_1

Table2.3: L293D Motor driver pin description

2) ARDUINO HARDWARE

Arduino board includes a microcontroller, and this microcontroller is what executes the instructions in your program. The ATmega328 microcontroller is the MCU used in Arduino UNO R3 as a main controller. ATmega328 is an MCU from the AVR family; it is an 8-bit device, which means that its data-bus architecture and internal registers are designed to handle 8 parallel data signals.

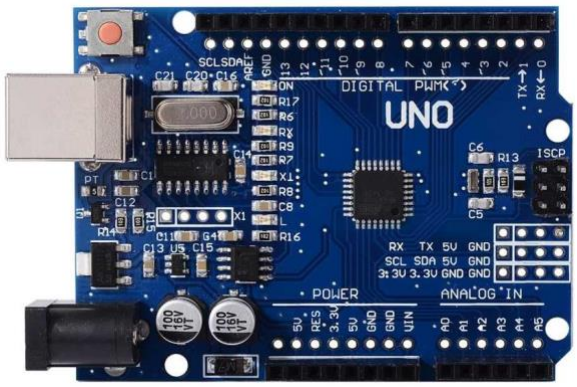


Fig2.7: ARDUINO hardware

Power:

The MCU accepts supply voltages from 1.8 to 5.5 V. However, there are restrictions on the operating frequency; for example, if you want to use the maximum clock frequency (20 MHz), you need a supply voltage of at least 4.5 V.

Digital I/O:

This MCU has three ports: PORTC, PORTB, and PORTD. All pins of these ports can be used for general-purpose digital I/O or for the alternate functions.

ADC Inputs:

This MCU has six channels—PORTC0 to PORTC5—with 10-bit resolution A/D converter. These pins are connected to the analog header on the Arduino board.

UART Peripheral:

A UART (Universal Asynchronous Receiver/Transmitter) is a serial interface. The ATmega328 has only one UART module.

SPI Peripheral:

The SPI (Serial Peripheral Interface) is another serial interface. The ATmega328 has only one SPI module.

TWI:

The I^2C or Two Wire Interface is an interface consisting of only two wires, serial data, and a serial clock: SDA, SCL.

3) IC7805

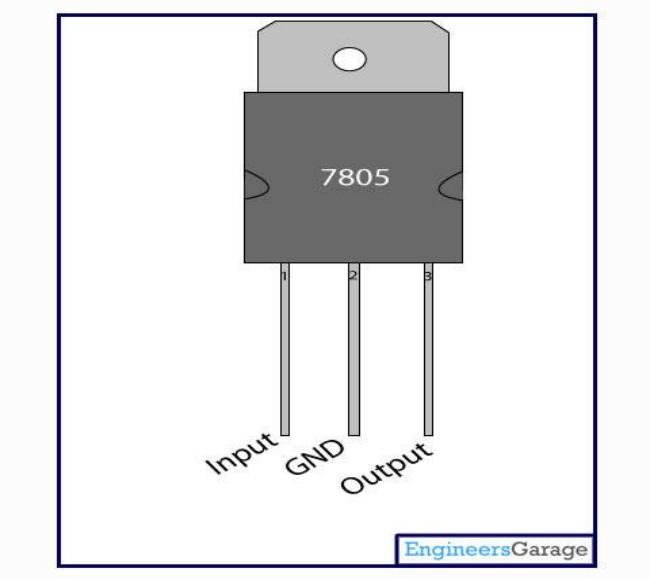


Fig2.8: IC7805

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

7805 IC Rating

- Input voltage range 7V- 35V
- Current rating Ic=1A
- Output voltage range Vmin= 4.8v, V*max=5.2v

4) STEPPER MOTOR:

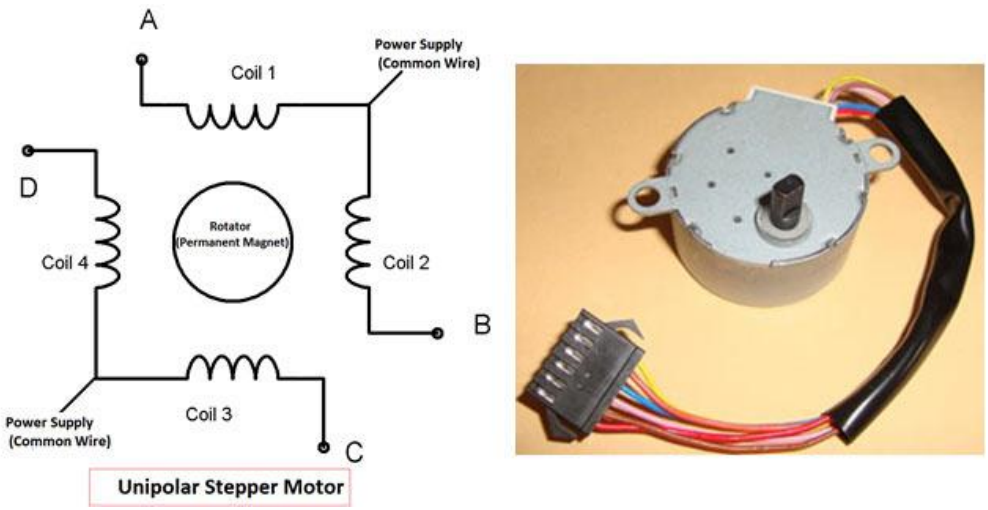


Fig2.9: Stepper motor

A stepper motor is an electromechanical device it converts electrical power into mechanical power. Also it is a brushless, synchronous electric motor that can divide a full rotation into an expansive number of steps. The motor's position can be controlled accurately without any feedback mechanism, as long as the motor is carefully sized to the application. Stepper motors are similar to switched reluctance motors.

The stepper motor uses the theory of operation for magnets to make the motor shaft turn a precise distance when a pulse of electricity is provided. The stator has eight poles, and the rotor has six poles. The rotor will require 24 pulses of electricity to move the 24 steps to make one complete revolution. Another way to say this is that the rotor will move precisely 15° for each pulse of electricity that the motor receives

.

5) ULN2003A MOTOR DRIVER

Fig2.10: ULN2003A motor driver

The **ULN2003A** is an array of seven NPN Darlington transistors capable of 500 mA, 50 V output. It features common-cathode flyback diodes for switching inductive loads. It can come in PDIP, SOIC, SOP or TSSOP packaging. In the same family are ULN2002A, ULN2004A, as well as ULQ2003A and ULQ2004A, designed for different logic input levels.

The UNL2003A is also similar to the ULN2001A (4 inputs) and the ULN2801A, ULN2802A, ULN2803A, ULN2804A and ULN2805A, only differing in logic input levels (TTL, CMOS, PMOS) and number of in/outputs (4/7/8).

Features:

The ULN2003 is known for its high-current, high-voltage capacity. The drivers can be paralleled for even higher current output. Even further, stacking one chip on top of another, both electrically and physically, has been done. Generally it can also be used for interfacing with a stepper motor, where the motor requires high ratings which cannot be provided by other interfacing devices.

Main specifications:

- 500 mA rated collector current (single output)
- 50 V output (there is a version that supports 100 V output)
- Includes output flyback diodes
- Inputs compatible with TTL and 5-V CMOS logic

6) 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.
- 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 controlsystem.
- Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing.

Fig2.11: servo motor

- A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft.
- The motor is paired with some type of encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops.

7) LITHIUM ION BATTERY

A lithium-ion battery or Li-ion battery is a type of rechargeable battery in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging.

Fig2.12: lithium ion battery

2.4 SOFTWARE USED

ARDUINO IDE

The software consists of a standard programming language compiler and a boot loader that executes on the microcontroller. Arduino coding has two major blocks. One of them is called void setup and the other one is void loop. In void setup, we define that which pin should be input and output. It is used to initialize variables and start using libraries.

Second block of the code is void loop. It contains all the code and logics placed within the brackets (it will repeat endlessly).

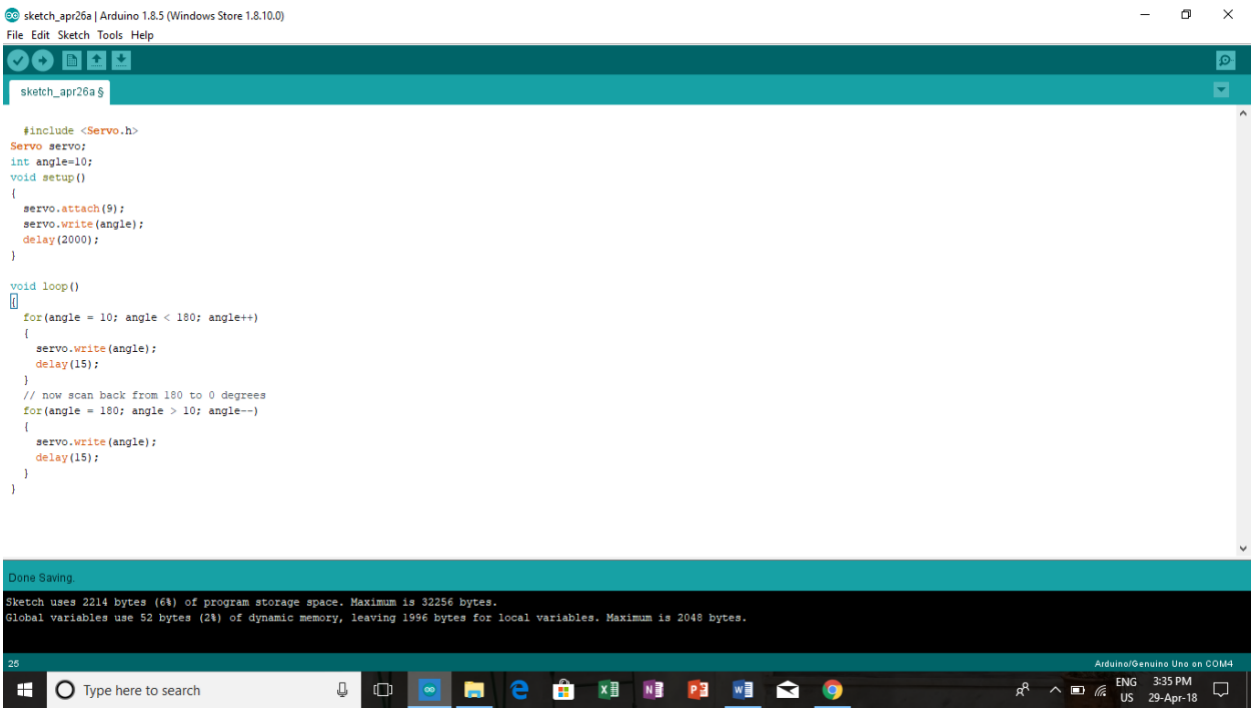


Fig2.13: ARDUINO IDE

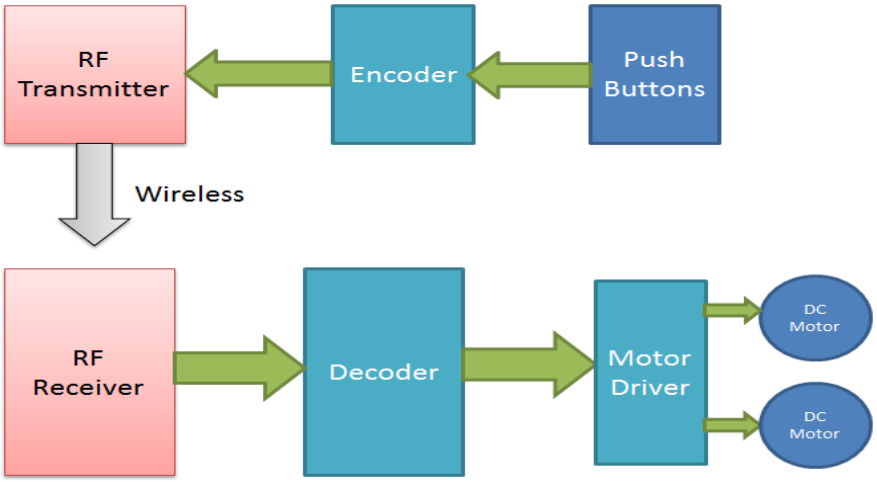
CHAPTER 3:IMPLEMENTATION

IMPLEMENTATION

3.1. INTRODUCTION

Mechanism of the movement of the robot:

- In transmitter part a data Encoder and a RF transmitter is used. The four push buttons are connected with Encoder with respect to ground. When we will press any button encoder will get a digital LOW signal and then applied this signal serially to RF transmitter. The Encoder IC HT12E encodes data or signal or converting it into serial form and then sends this signal by using RF transmitter into the environment.
- At the receiver end we have used RF receiver to receive data or signal and then applied to HT12D decoder. This decoder IC converts the received serial data to parallel and then send this decoded signal to L293D Motor driver IC. According to the received data robot runs by using two dc motor in forward, reverse, left, right and stop direction.



:

Button 1	**Button 2**	**Button 3**	**Button 4**	**functionality**
1	**0**	**0**	**0**	**Stepper motor starts**
0	**1**	**0**	**0**	**forward**
0	**0**	**1**	**0**	**reverse**
0	**0**	**0**	**1**	**Servo motor starts**
1	**0**	**0**	**1**	**Left**
1	**0**	**1**	**0**	**right**

Table 3.1: function of each push buttons

Ploughing mechanism:

- As the robot moves forward the digging of the ground is done by using a structure made using sheet metal and connected to a stepper motor which starts as soon as it gets commands from the arduino module.

Seed sowing mechanism:

- The seed container is spaced at equal and calculated distance from these structures and is held using a rod holder. The seeds are sown in the digged hole by using a thermocol having a hole and rotating using a servo motor. A container is used for holding the seeds. A hole is drilled in the bottom of the container so that the seeds can fall through it.

3.2 FLOW DIAGRAM

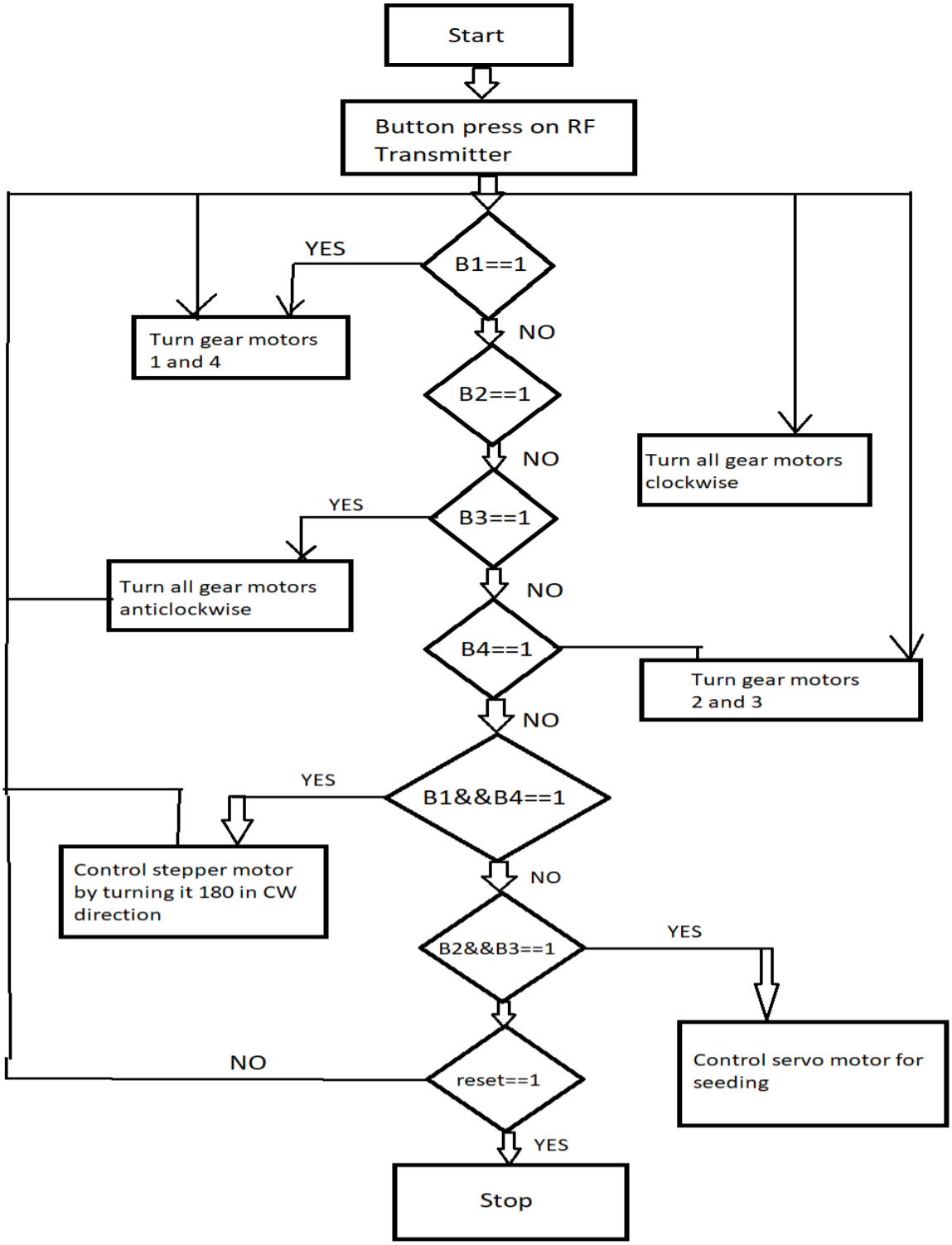


Fig 4.1 Flow chart

3.3 ROBOT CONTROL

The robot is prepared using rf module and arduino module with motors for forward ,reverse,left and right motion. To control the robot wirelessly an rf module is used with push buttons. The robot starts its function of ploughing and seed sowing once it has received commands from the rf module, arduino via stepper and servo motor.The power supply is given by lithium ion battery.

CHAPTER 4: RESULTS

RESULTS

In this work a robot, farm robot, has been designed, built and demonstrated to carry out ploughing in an agriculture field and sowing seeds. It is expected that robot will assist the farmers in improving the efficiency of operations in their farms. It is aimed at increasing the productivity and reducing the labour involved, this robot is designed to execute the basic functions required to be carried out in farms. The robot performs the tasks like digging the ground, sowing the seeds and backfilling the soil automatically in a sequence without human intervention. Thus an effort is made so that the robot becomes an aid to the farmers. The design is accepted and unique compared to the existing robots.

CHAPTER 5: CONCLUSION

CONCLUSION

Agricultural Robot accomplishes the task like:

- Ploughing(to make the soil loose for air circulation)

  About 0 to 3cm of the upper layer soil is removed by the plougher
- Sowing of seeds(at appropriate spacing)

  Seeds are sown at a depth upto 3cm with spacing which is set between the seeds. Sample seeds used in our project is pea.
  - If the seeds go below the given level, a signal is sent to the operator for refilling it
- Leveling of soil

  It closes the seed row to overcome the unevenness of fertile soil

  Better leveling of land results in benefits to the farmer in yield, weed control, farm operation, seeding practices and efficiency of water use

CHAPTER 6: FUTURE WORK

FUTURE WORK

Agricultural robot is a prototype with reduced scaling which ploughs a single row in dry land. It includes mechanically seed dropping assembly. It can be implemented in farms with some modifications given below:

- Operation can be extended to 4-5 rows by adding mechanical systems.
- Solar panel to get continuous charging of battery on field.
- High torque motors to withstand load.
- It can also be implemented on wet land by changing d wheels.
- Different types of seeds can be sown.
- Automatic obstracle detection and path correction system.

Because of ever our increasing population it is predicted to reach 8 billion by 2020. In this generation ,most of the people migrate for employment to cities. Hence, labour force is decreasing and demands for automated machines like agricultural robot.

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