Fabrication and Implementation of Agricultural Robot

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DEDICATION

This thesis is truly dedicated to the people responsible for our success in the educational fields and our lives. Our beloved parents and teachers who have provided a consistent a source of inspiration to us, and have encouraged and due to this encouragement support are able to undertake our higher education and face the tests of life with vigor, sincerity and fear of God.

Abstract

Agricultural Robot on tracks is made for the Agricultural and farming field. Due to the development of technical fields involving IT and Mechanics as well as electronics, the future of almost all departments is being automated based on the development in these fields. The result of these alterations in the status quo, help in the efficiency, cost and results of that particular function. Although the project itself is developed by our predecessors, our main objective is to induct tracks instead of wheels for better access on the various rough terrains where the AgriBot is used. The multi-tasking functions of the machine which consist of digging, seeding, watering and levelling the sand are done in one command and are all arraigned in a loop. This means that when the command is given all four functions automatically perform on after the other. The commands of controlling the locomotion of the chassis and the seed sowing function is done by the app. Which is designed and uses the Bluetooth module to interface the mobile with the machine. The power to operate the machine and perform the various functions is provided by an onboard battery which is a 12 volt 5 ampere SLA battery. This power is enough to run the machine for one hour. This is done to show the performance of the prototype. By the induction of this type of robot, which can be built on an economical cost the farming industry, especially in our country can have a revolutionary change for the better.

ACKNOWLEDGEMENT

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List of Abbreviations

Agri-bot	Agricultural Robot
DC	Direct Current
AI	Artificial Intelligence
RTK	Real Time Kinematics
HRI	Human Robotics Interaction
RPM	Revolution per Minute
mA	Milliampere
UART	Universal Asynchronous Receiver Transmitter
OS	Operating System
USB	Universal Serial Bus
MHz	Megahertz
UNO	Universal Network Objects
KB	Kilobytes
DHT	Device for Humidity and Temperature
Amps	Amperes
WH	Watt Hours
HSP	Hydraulic Submersible Pump
HSS	High Speed Steel
RHS	Rectangular Hollow Section
MG	Metal Gear
PA	Precision Agriculture

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Certificate

This is to certify that the work presented in this project report / thesis on "**Fabrication and Implementation of Agricultural Robot**" is entirely written by the following students / themselves / himself / herself under the supervision of **Engr. Waqar Hazoor**

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Chapter 1

Introduction

1.1 Introduction

The use of AI (Artificial Intelligence) isn't a replacement for thinking and analysis-reasoning work is still going on in the world to realize robotics used within the farming area. The purpose of deploying AI during this trade is the same as it was when robotics were introduced to other industry. That's the boost in output, labor dependence and precisely saved time earning more money. Now that farms are becoming larger and the scale of instrumentation on them is also growing, there's a need for ways of doing what was previously done by the farmer himself--for instance tackling pests with insecticial sprays. As autonomous robots generally need many repetitions over a long period of time and across a large area, tasks are fitted to them.

For typical farming jobs in performing arts, such as acquiring large quantities of water materials or seeds for planting into the bottom (or getting an outsized amount from that sector when collecting during harvest), a tiny low agricultural mechanism would be terrible effective. Furthermore if we compare it with the usual tractor used in farming, wastage even of minor seeds or a spray from an appropriately specific quantity of water all over where seed is sown would be enormous. So a smaller mechanism is often better because it's not only easier on the crops but also at tipping up. Much of this is due to lower weight compared with a tractor, causing only light soil compaction. The degree of soil compaction is something that needs to be thought about, not least on sowing seeds and watching the land soak up water inspecting its dryness and wetness. If this gets outta control a bunch 'o problems come along--American state nitrification being one such problem; with excessive amounts of Texas23 causing crop failure in some areas.

1.2 General Background

The use of AI for farming is by no means a new concept, and in the meantime still as sensible work goes on worldwide with regard to robotics used in agriculture. In this trade, the purpose of introducing AI is similar to that with robotics in other industries. That's the increase in production, potency and labor dependence, as well as accurately conserving time and earning more money. Since then as farms tend to become bigger, along with the dimensions of instruments used thereon cannot have that farm worker dominating fields for pests. These tasks are perfectly designed for autonomous robots, since they require a large number of repetitions over an extended period of time and across a broad area.

Most of the time a really low little agricultural instrument would be much more effective than pretending to do farming work, as every farm needs far too many seeds or water materials--to dump into it like seedlings and fertilizers; or else obtain from within the sphere during harvest. However, if we compare it to normal tractors farmers use in farming the wastage of even bitty seeds or a sprinkle of water on soil where the seed is sown is expensive. This is why mechanism works by often being easier on the crops as well. This is largely due to the low weight, and less soil compaction ensues. Regarding the level of soil compaction, this is something which needs to be thought about; after sowing seeds and watering (among other things) think once more at what times wetness or dry need redoubling your efforts. If you don't control land moisture it will cause such problems as poorer crop growth and nitrification.

1.3 Problem Statement

The current methodology of sowing seeds is connected largely to human effort. Inside this antique practice of sowing seed it is hard to understand uniform soil deepness for seed placing level and get unvarying distance amongst the placement of the seeds. There is also the fact that its seeds have a low rate of germination, and to achieve even coverage it's hard to get uniform distribution over soil. If the depth of placement is more, seeds will not germinate. Sprinkled in agricultural field Use water for irrigation purpose What is this typical method Couse of wasting water When only wet because The style and develop an agrarian mechanism which could be made ready to seeding or excavation at any time. Further innovation done from our side is the induction of tracks which replaces the wheels that were on the original chassis. This is done due to the problems faced by the wheels on uneven or rocky terrains. The farm land is not even, and for a very small size robotic trolley which is used to plough the field, it is very hard to maintain the motion in a line. But the tracks solve this problem by rolling over the uneven field obstructions and maintain their line. This Agri-robot's management should be wireless, and may follow on top of operations. This model, which is of same operated by wireless management that ready to show on top of mentioned operations like seeding and excavation. Also style this mechanism and make a true time system for offering an answer, then propose what could be used in real time field.

1.4 Aims and Objectives

The World population reaches 9 billion inhabitants by the year 2050. But to produce food for so large a population will intensify the pressure on agricultural environments and their inputs, especially land and water.

1.4.1 Aims

This work aims to build a mobile tracked autonomous robot with tracks in place of wheels. The designed robot is able to perform and monitor field operations such as spraying remedies for precision farming, fertilizing plants or simply analyzing yield per unit area, the soil's nutrient content or diagnosing diseases on affected crops. Here the big problems are reliability and durability against field conditions versus reducing robot unit cost for high-volume production. Domesticizing carrier platforms, circuit boards domestic resources is another design goal; integrating common production parts with designed or domestically available parts. The other aims of the work are that all devices on the network will be able to pass information over Environmental Agriculture Informatics Applied Research Center (TARBIL) cloud services, and applications software can deliver data from farmers' mobile phones, tractors or farming vehicles. Therefore, the aim is to make co-invested enterprises' costs as low as possible. There are two major stages to this work. This work is concerned with developing an autonomous mobile robot platform for agricultural applications. In this phase of work, a round autonomous mobile robot is designed and realized. part of an autonomous agricultural robot system in later stages, it is hoped to give a suited equipped Robot that can be used for precision farming such as monitoring crop status or weeding samples from the field. The ultimate state of the system will be a swarm of robots that can keep watch, plow and plant as well harvest grain from every corner of fields.

1.4.2 Objectives

The first objective is to develop the AGRI BOT into a strong platform. The main route of achieving this is to develop a complete research and studies and references on practical personals with reference to the faults which occur in wheel actuators and sensors. The seeding watering plaguing and planning mechanisms will be activated by examining the methods for programming codes.

This is archived though the following:

1. To completely overhaul the robot on tracks, and take off the wheels.

2. To test the detection of major faults, and to execute a seeding and watering mechanisms.

3. To construct and develop an encoder to take right left and front back readings with the dc gear motors.

1.5Scope of Project

Our “Agri Bot” is designed to be smart with an optional digital plant moisture sensor/water pump controller. This device sends the notification that when it's time to water a potted plant, or turn on a water Pump for thirsty plants as well. This is an agricultural tool for those who manage mid-size or large operations. Each field on the farm It collects measured data from every one of them And gives you real-time visibility to Soil conditions On your computer or smartphone. Smart moisture sensor for regulating the soil's moisturizer. Preventing your plants from drying out and cutting down on the amount of time spent watering. Self-watering system is the best thing for those people who are often away on vacation, taking all guesswork out of watering. Likewise, plants suck up moisture when they need to. For agricultural applications, measuring soil moisture is important so that farmers can manage their irrigation system more effectively. Farmers can not only use less water to grow a crop, they are better able to increase yields and the quality of the particular cash crops cultivated. This is due in part because having accurate information enables farmers for example at critical plant growth stages of judiciously increasing soil moisture after reducing planned irrigations by half or more.

Table 1 Comparison between old age and modern time

Sr.No	Parameter	Traditional	Tractor	Robotic
1	Speed	Slow	High	Very high
2	Man power	More	Moderate	Less
3	Time required	More	Less	Less
4	Sowing Techniques	Manually	Manually	Automatically
5	Required energy	high	Very high	Less
6	Yelled of crop	Low	Moderate	High

Chapter 2

Literature review

2.1 Literature

The cost of real time kinematics Global Positioning System (RTK GPS) and the low efficiency of vehicles are factors that determine the value of systems as mentioned in [1]. In today's scenario many urban areas, in Pakistan no longer have workers in the agricultural sector, which affects the progress of agriculture in developing countries as discussed in [2]. To address this a self-sufficient robot has been developed specifically for farming tasks like seeding. This agribot is designed to sow four types of crops; cotton, maize, soybean and wheat. The system models the row and column distances required for each crop type. Discusses this in [3]. It ensures seed placement depths and consistent distances between seeds. The developed robot is capable of performing its operations without any effort. Significantly reduces the need for human intervention as explained in [4]. The rapid growth of industries is causing laborers who used to reside in villages to migrate to cities. This migration poses a labor challenge, for agriculture, which is discussed further in [5]. Additionally of wheels the robot can be equipped with a chain roller design [6]. Agricultural robots require support infrastructure that includes connectivity, for the robots in the field effective communication tools between robots and humans and a framework for sharing and reusing robotic software as discussed in [7]. The agricultural industry is currently witnessing a trend towards the development of robots and autonomous vehicles. These advanced machines, built with technologies to those used in agricultural machinery can perform specific tasks more efficiently than large tractors. In fact they can achieve even greater output than conventional systems as highlighted in [8]. The manual method of seed sowing faces challenges such as seeds being eaten by rats, birds and snails. Therefore automating the process of seed sowing has become essential. This innovation plays a role in meeting the increasing demand, for quality agricultural products. To address these challenges effectively a microcontroller guided rover has been developed to dig trenches sow seeds accurately and efficiently. The robot is powered by a high torque DC geared motor equipped with a rotating shaft. It also incorporates pesticide application capabilities that contribute to enhancing Indias sector as mentioned in [9]. Currently the agricultural industry is encountering challenges such, as a decline in labor and a shift towards more corporate farming practices. These factors necessitate the need to enhance efficiency and productivity in farming methods.

This paper explores a not future where self-sufficient farming becomes a reality enabling farming communities to not only survive but also thrive in the global market. The focus is on viewing farms as systems that seamlessly integrate different requirements. This integration encompasses the fields of robotics for self-agriculture and Precision Agriculture (PA) which addresses issues discussed in [10]. In situations where crops are cultivated intensively timeliness of operations holds importance, which can only be achieved through utilization of agricultural machinery. The manual approach to seed planting results in challenges such as seed placement, inefficiencies in spacing and significant difficulties for farmers ultimately limiting the area that can be planted. To achieve performance, from a seed planter it is vital to optimize these limitations using a plan and determine computer based elements that suit crop requirements as discussed in [11]. Nowadays the field of agriculture is experiencing a decline due, to a shortage of workers and inadequate investments. Besides the implementation of crops there haven't been any advancements, in agriculture. The tools used to limit human labor in agriculture can be expensive or have high maintenance costs. As a result, it takes a long time for these machines to reach the farmers. However, the AGROBOT is a simple device with multiple components that are controlled by computers, as mentioned in [12]. Agricultural robots have the potential to speed up plant breeding and improve precision farming through data driven approaches while reducing the need for manual labor. Most agricultural robots are designed for crop production and specifically for tasks ranging from plant breeding to cultivation and harvesting in open fields. In recent years, there has been an increasing integration of mechatronics and robotics into postharvest processing and food manufacturing systems, as discussed in [13]. With technological advancements and the need for cost effective solutions that address environmental concerns, farmers are encouraged to reconsider their practices and embrace better automation strategies. We need to incorporate new technologies that can improve the efficiency of machines while also optimizing the use of limited resources and minimizing environmental impact. One promising application of automation based technologies is the use of area robots, which was mentioned in [14]. These robots are equipped with more gears for seeding, allowing them to cover more rows easily. In the next version, we plan to implement a dedicated processor for image detection and seed sowing mechanism. Additionally, we will switch from lead acid batteries to high power batteries as discussed in [15]. The project called "AGRICULTURAL ROBOT" utilizes discrete electronic components around an advanced microcontroller 8051. The system is operated by DC motors and performs various agricultural operations. The Arduino microcontroller is utilized to sense and automate the above mentioned parameters, as discussed in [16]. Field operations for agricultural robots require them to perform with the same level of quality achieved by current methods and techniques in unstructured agricultural environments. To achieve this, we must develop technologies that can adapt to continuously changing conditions and variations in produce and environments. Intelligent systems are necessary for successful task performance in such challenging environments.

The robotic system needs to be both affordable and prioritize the safety of humans, as well as the protection of the environment, crops and machinery. Although there have been advancements in recent years, in many instances, this technology is still not readily accessible for commercial use. In order to adapt to the ever changing conditions of unstructured agricultural environments, it is important to fine tune information acquisition systems such as sensors, fusion algorithms and data analysis. A significant area of research focuses on integrating human operators into the control loop of these systems to improve their performance and reliability. Efforts should be made to reduce the size of these systems while enhancing the integration of all their components, as mentioned in [17]. By using manually operated seed cum fertilizer soybean planters, crop cultivation costs can be reduced by approximately 93.47% for planting purposes. The overall performance of these planters has been found satisfactory, as discussed in [18]. Agricultural robots today can be categorized into various groups including harvesting or picking, planting, pest control and maintenance. Unlike factory robots used for car manufacturing purposes, farm robots need to operate in accordance with natural conditions. They must handle uneven environmental conditions and changes that occur within those environments, unlike factory robots which do not face such challenges (as explained in [19]). The research projects mentioned have relevance across multiple fields including Agricultural Engineering, Electrical Engineering, Electronics Engineering, Telecommunication Engineering, and Mechatronics Engineering Environmental Engineering Biomedical Engineering Mechanical Engineering etc (as discussed in [20]. Each specific farming operation requires auxiliary devices and sensors with distinct functions. This article explores the recent developments in employing mobile robots for open arable farming and offers an overview of the systems and methodologies utilized. Additionally, it addresses the future challenges associated with enhancing the use of dependable mobile robots in arable farming, as discussed in [21]. The seeding mechanism concept of the Equipped Mobility Cycle was chosen in a way that allows gravity to collect seeds near the lower part of the tilted seeder. The rotating circular acrylic sheets have holes that pick up the collected seeds from the lower level of the box and transport them to the topmost level of the seeder box. From there, the seeds are dropped towards a drilled wooden wedge, which acts as a passage from the seeder box to a seeding pipe and finally into the soil through a plastic pipe [22]. In today's agricultural practices, instrumentation and control systems play a crucial role. To address this, we have developed an economical and beneficial system for a "seed plantation robot" using a microcontroller. This system consists of a four tire vehicle powered by a geared DC motor. According to the program on the microcontroller, after traveling for some distance or at specific time intervals, seeds are released through a nozzle controlled by a relay. The size of the nozzle depends on the diameter of the seed. This process is repeated after certain time delays, reducing labor intensive work [23]. This system proves advantageous for operations in agricultural fields. Blackmore and colleagues (2004b) developed an automated steering system for a customized tractor, equipped with an initially predetermined route plan. These compact robots encompass modified tractors or entirely novel robotic designs. Ground based small robots have the capability to assist humans in various tasks. These robots have the ability to transport strawberries, from workers to an unloading station. It has been noted in [24] that workers can spend an amount of time up to 20% simply walking back and forth between the strawberry field and the unloading station. This is why automating this task is highly beneficial. In the mid-1980s researchers at Michigan State University and Texas A&M University were studying machine vision guidance while during that decade the University of Florida successfully conducted a program on orange harvesting [25]. Currently many countries face a shortage of labor in the sector, which hampers their growth. As a result farmers are compelled to adopt technology for activities like digging, seed sowing, fertilizing and spraying. Henceforth it becomes necessary to automate this sector in order to address this problem effectively. By doing not will it eliminate the need for manual labor but also prevent seed wastage [26]. The rise in wages coincided with increased protectionism during the late 1980s and 1990s in our country. This resulted in food costs. Additionally impacting the manufacturing sector was a decrease in industrial protection measures along, with an appreciation of the peso. Consequently numerous manufacturing plants went out of business. However the Philippine manufacturing sector has experienced growth, in industries such, as machinery and automobile parts that require semi-skilled labor and are less sensitive to wage fluctuations as mentioned in reference [27]. The main objective of plowing is to turn the layer of soil bringing nutrients to the surface while also burying weeds and remnants of previous crops to aid in their decomposition. When a plow is pulled through the soil it creates furrows filled with soil. In agriculture after plowing fields are usually left to dry out before being harrowed and prepared for planting. Plowing helps mix and modify the 12 to 25 cm of soil to create a layer, for farming. In soils the majority of plant roots responsible for nutrient absorption can be found in this topsoil or plow layer [28]. There has been interest in exploring the use of robots in farming, for purposes [29]. For instance a robotic arm can be used to dig holes at distances to sow seeds and remove excess plants from farms. Researchers have also discussed controlling these robots using an application on a device [30].

Research Gap

If you take into consideration on the research gap of our project we find out that we have innovations on the programing side as well as on mechanical side. First of all taking into consideration the programing side we have developed our agri bot which can be controlled by Bluetooth module. We have on our project are controlling our whole system by android app it is performing four different function first of all ploughed or the digger comes down and dig the sand after the sand is dig the ploughed is raised up again automatically and then the next face which is the seeding face starts. After the seed is placed in the soil at the point where the ground is dig the plainer is the third part which plains the land and which plains the soil and levels the soil. After leaving the soil the moisture sensor which we have added on the digging bite will sense if the soil is wet enough or dry enough for it to be watered. If the soil is dry then only the pump will watered that part of the soil which has been seeded .However if rain has taken place for the pump will sense that the soil is wet and they will be no water given to the land.

Basically these all these four functions can be performed either individually or simultaneously in a loop.

Chapter 3

Methodology

The final assembly of the seeding robot is as shown in the Fig -. The fabricated robot is capable of performing the seeding operation. The process involved in the operation of the robot can be divided into four categories, first one is the drilling process, second one is the seed feeding process, third one is planning the soil and fourth one is watering the seeded place.

3.1 Design & Concept

The design concept for our Robotic Vehicle is based on the Functions performed by our robot. These function are basically divided into two parts, which is the locomotion of the vehicle itself and the other function include the Ploughing (Digging), Seeding, Planning and Watering Function.

First of all the chassis of the robotic trolley has to bear the mechanism for the plough which dig the surface of the field then comes the seeding mechanism which placed the seeds inside the dig area. The placement of the device is on top of the water tank, thirdly when the seed is placed in the hole the plainer plains the dig land and finally the land is water by the sprayer which used the submersible pump inside the water tank.

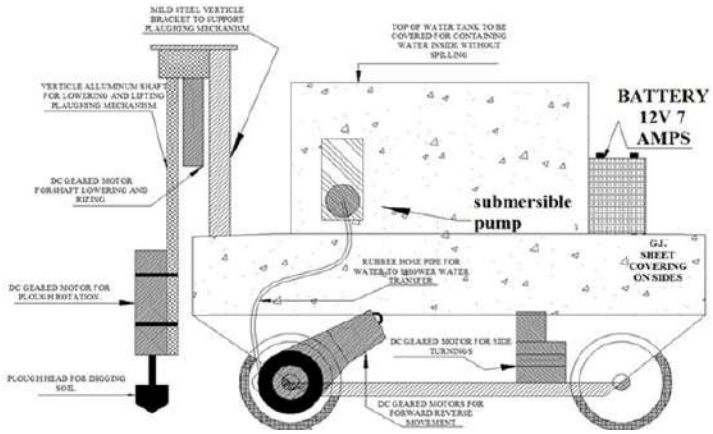

Fig 3-1 Auto Cad Drawing of Agribot (Side View)

Fig 3-2 Previous Model

Fig 3-3 Present Model

3.2 Android Application Interface

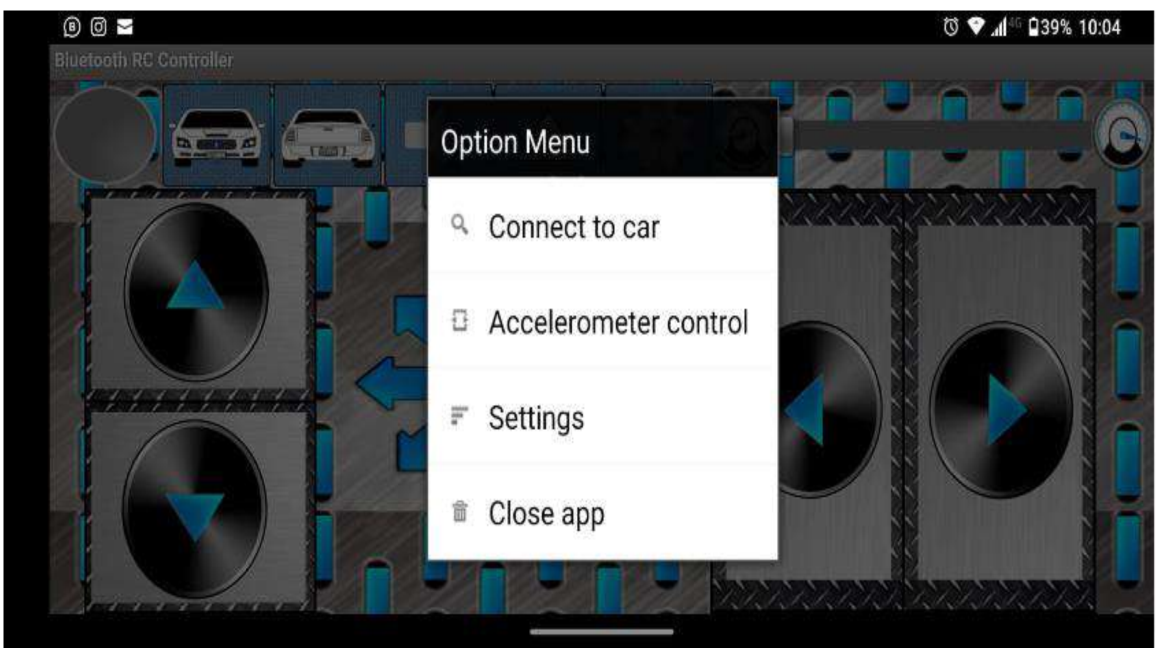

Fig 3-4 Application Interface (Manual Mode)

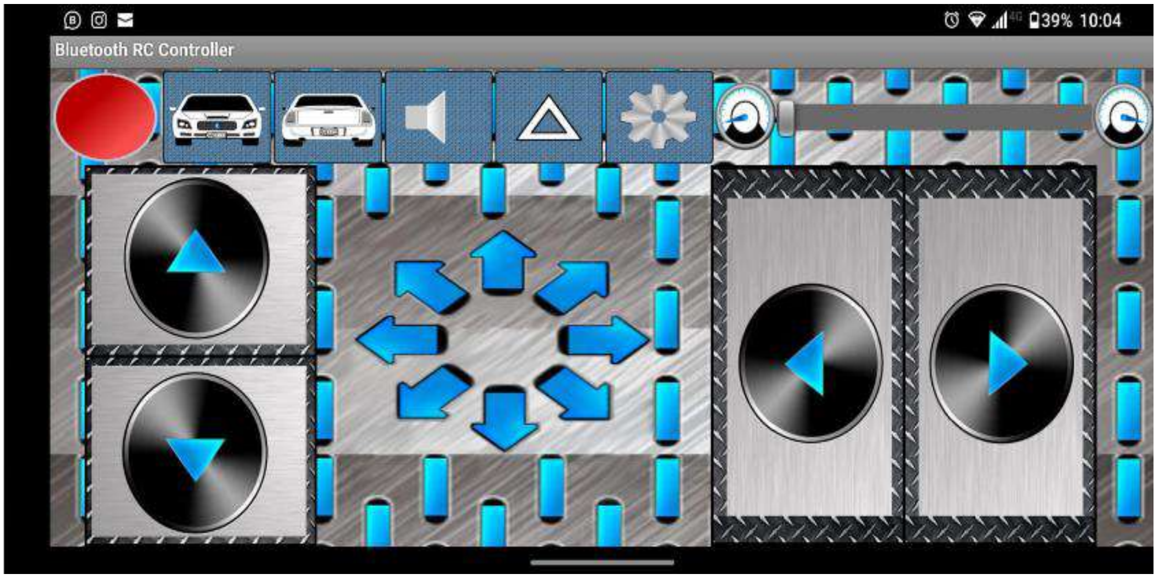

Fig 3-5 Application Interface (Auto Mode)

3.3 Agribot Programming

```
#include <Servo.h>

int M1A = 26, M1B = 27, M2A = 24, M2B = 25, pump = 30, Drill = 28, Linear1 = 22,
Linear2 = 23, Seeder = 31; // Motor pins

int enc = 2;

//SoftwareSerial Serial(A4, A5);// RX, TX Bluetooth module pins

Servo S;

int pos = 0;    // variable to store the servo position


int pulse1 = 0;

int z1 = 0;

int limit1 = 10, limit2 = 11;


String rec = "";
```

```
String PointA = "", PointB = "", PointC = "", PointD = "";

int Dista = 0, Dira = 0, Distb = 0, Dirb = 0, Distc = 0, Dirc = 0, Distd = 0, Dird = 0;

String DistA = "", DirA = "", DistB = "", DirB = "", DistC = "", DirC = "", DistD = "",
DirD = "";

int seedA = 0, seedB = 0, seedC = 0, seedD = 0;

int ppm = 1;


int in = 0;

int p = 0;

int i = 0;

int Point = 0, pnt = 0;

int q = 0;

char c = ' ';

int prev = 0;

void setup()

{

  Serial.begin(9600);

  Serial3.begin(9600);

  //Assign pin modes

  S.attach(4);

  S.write(90);

  pinMode(M1A, OUTPUT);

  pinMode(M1B, OUTPUT);

  pinMode(M2A, OUTPUT);

  pinMode(M2B, OUTPUT);
```

```
  pinMode(pump, OUTPUT);
  pinMode(Drill, OUTPUT);
  pinMode(Linear1, OUTPUT);
  pinMode(Linear2, OUTPUT);
  pinMode(Seeder, OUTPUT);
  pinMode(limit1, INPUT);
  pinMode(limit2, INPUT);
  //  initialize output as off state
  digitalWrite(M1A, HIGH);
  digitalWrite(M1B, HIGH);
  digitalWrite(M2A, HIGH);
  digitalWrite(M2B, HIGH);
  digitalWrite(pump, HIGH);
  digitalWrite(Drill, HIGH);
  digitalWrite(Linear1, HIGH);
  digitalWrite(Linear2, HIGH);
  digitalWrite(Seeder, HIGH);
  digitalWrite(limit1, HIGH);
  digitalWrite(limit2, HIGH);

}

void loop()
{
  in = digitalRead(enc);
```

```
if (in == 1 && z1 == 0)
{
  pulse1++;
  z1 = 1;
  //    Serial.print(z1);
}
else if (in == 0) z1 = 0;
//  Serial.println(pulse1);
while (Serial3.available())//Runs when received request from App
{
  c = Serial3.read();
  Serial.println(c);


if (c == 'f')
{
  //    Serial.println("Forward");
  digitalWrite(M1A, HIGH);
  digitalWrite(M1B, LOW);
  digitalWrite(M2A, HIGH);
  digitalWrite(M2B, HIGH);
}
else if (c == 'b')
{
  //    Serial.println("Backward");
```

```
  digitalWrite(M1A, LOW);
  digitalWrite(M1B, HIGH);
  digitalWrite(M2A, HIGH);
  digitalWrite(M2B, HIGH);
}
else if (c == 'l')
{
  //    Serial.println("Left");
  digitalWrite(M1A, HIGH);
  digitalWrite(M1B, HIGH);
  digitalWrite(M2A, LOW);
  digitalWrite(M2B, HIGH);
}
else if (c == 'r')
{
  //    Serial.println("Right");
  digitalWrite(M1A, HIGH);
  digitalWrite(M1B, HIGH);
  digitalWrite(M2A, HIGH);
  digitalWrite(M2B, LOW);
}
else if (c == 's')
{
  //    Serial.println("Stop!");
  digitalWrite(M1A, HIGH);
```

```
  digitalWrite(M1B, HIGH);
  digitalWrite(M2B, HIGH);
  digitalWrite(M2A, HIGH);
  digitalWrite(Linear1, HIGH);
  digitalWrite(Linear2, HIGH);
}
else if (c == 'q')
{
  digitalWrite(Linear1, LOW);
  digitalWrite(Linear2, HIGH);
}
else if (c == 'w')
{
  digitalWrite(Linear1, HIGH);
  digitalWrite(Linear2, LOW);
}
else if (c == 'o')
{
  digitalWrite(pump, LOW);
  Serial.println("dasd");
  c = ' ';
}
else if (c == 'p')
{
  digitalWrite(pump, HIGH);
```

```
  c = ' ';
}
else if (c == 'k')
{
  digitalWrite(Drill, LOW);
  c = ' ';
}
else if (c == 'u')
{
  digitalWrite(Drill, HIGH);
  c = ' ';
}
else if (c == 'n')
{
  digitalWrite(Seeder, LOW);
  c = ' ';
}
else if (c == 'm')
{
  digitalWrite(Seeder, HIGH);
  c = ' ';
}
else if (c == '<')
{
  Left();
```

```
    c = ' ';
  }
  else if (c == '>')
  {
    Right();
    c = ' ';
  }
  else if (c == 'c')
  {
    for (pos = 90; pos <= 30; pos -= 1) { // goes from 0 degrees to 180 degrees

      // in steps of 1 degree
      S.write(pos);              // tell servo to go to position in variable 'pos'
      delay(15);                       // waits 15ms for the servo to reach the position
    }
    for (pos = 30; pos >= 90; pos += 1) { // goes from 180 degrees to 0 degrees
      S.write(pos);              // tell servo to go to position in variable 'pos'
      delay(15);                       // waits 15ms for the servo to reach the position
    }
    c = ' ';
  }
}


void seed()
```

```
{
  digitalWrite(M1A, HIGH);
  digitalWrite(M1B, HIGH);
  digitalWrite(Drill, LOW);
  digitalWrite(Linear1, HIGH);
  digitalWrite(Linear2, LOW);
  delay(6000);
  digitalWrite(Linear1, LOW);
  digitalWrite(Linear2, HIGH);
  delay(6000);
  digitalWrite(Linear1, HIGH);
  digitalWrite(Linear2, HIGH);
  digitalWrite(Drill, HIGH);
  digitalWrite(Seeder, LOW);
  delay(1500);
  digitalWrite(Seeder, HIGH);
  delay(500);
  for (pos = 60; pos <= 100; pos += 1)
  {
    S.write(pos);
    delay(15);
  }
  for (pos = 100; pos >= 60; pos -= 1)
  {
    S.write(pos);
```

```
    delay(15);
  }
  delay(500);
  digitalWrite(pump, LOW);
  delay(1000);
  digitalWrite(pump, HIGH);
  digitalWrite(M1A, HIGH);
  digitalWrite(M1B, LOW);
}
```

3.4 Flow Chart of Agribot

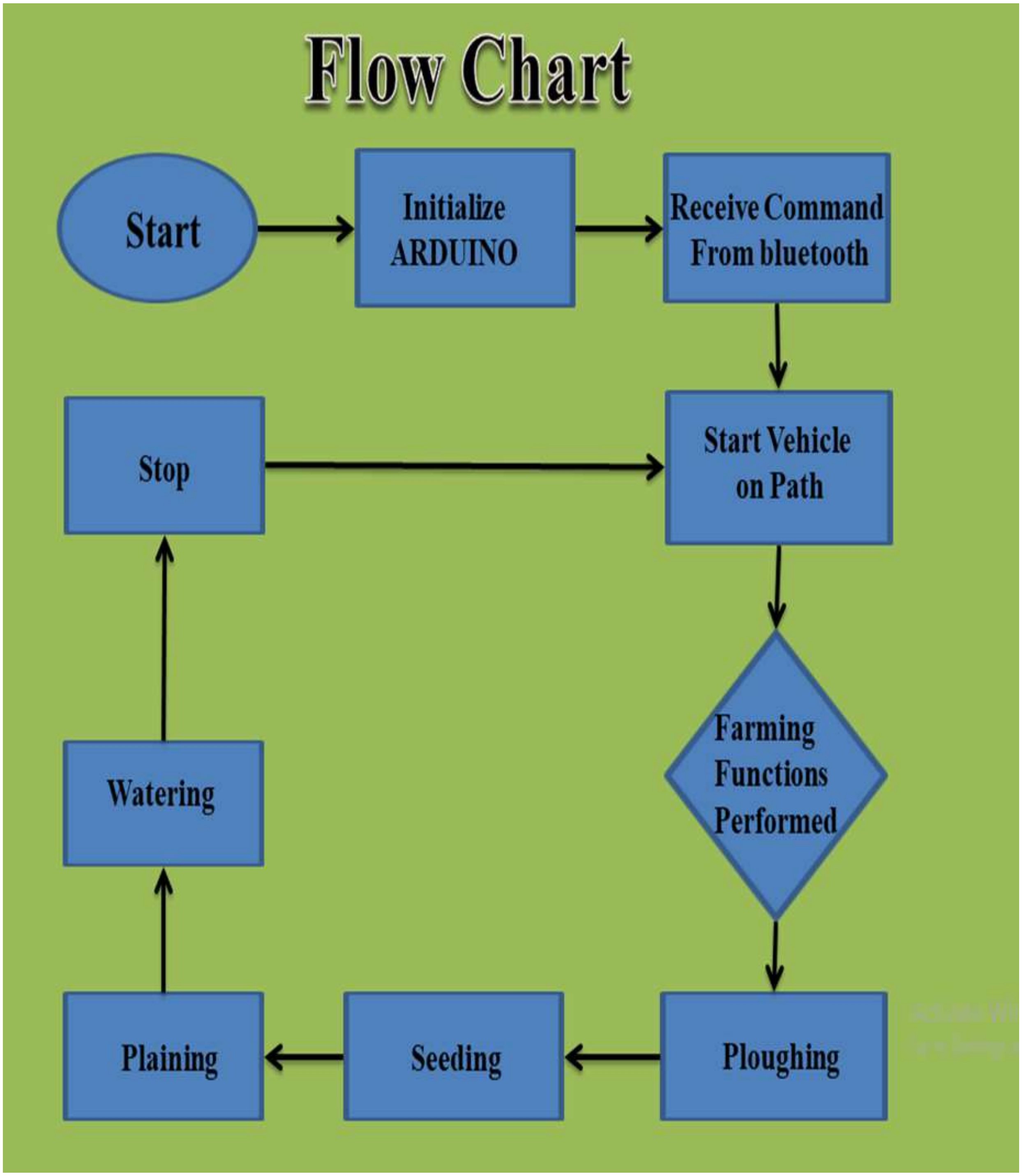

Fig 3-6 Flow Chart

Individual Farming & Mechanism Description

3.5.1 Ploughing or Digging Mechanism

In this Mechanism we have a linear motor which lowers and lifts the drilling motor for digging the land. The linear motor is 24 volt and uses tempere for operation. Where is the drill motor is a 24 volt 500mA for operation. The drill speed is 120 RPM spinning.

3.5.2 Seeding Mechanism

This mechanism consist of a circular Container in which the seeds are placed. There is an agitator attached with a DC geared motor working on 12 volt 500mA which rotates the agitator and allows a seed to fall from an aperture in the base of the seed container. The seed is then dropped from a tube which directs the seed to its proper position.

3.5.3 Plaining Mechanism

This mechanism consists of two MC 950 Servos placed at opposite sides which have 90 movement. These servos are attached with a rubber strip for plaining the soil. The rubber strip is a neoprene 3mm strip which has the capacity to plain soft soil perfectly.

3.5.4 Watering Mechanism

The watering mechanism consists of a tank placed on the chasis and has a capacity of 5 liters. There is a submersible pump placed inside the water tank which has a pipe attached to it. The free end of the pipe is attached on the seed flow pipe and when the ground is leveled the water is sprayed on top of that spot.

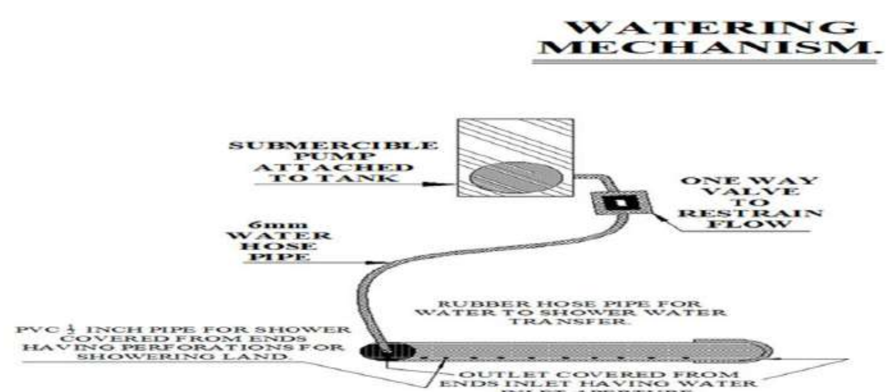

Fig 0-7 Agribot Dripping System Auto Cad Drawing

3.6 Material List

The materials used in our Agribot are given below:-

3.6.1 Arduino Mega Microcontroller

Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software on running on a computer. The Arduino Mega2560 has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega2560 provides four hardware UARTs for TTL (5V) serial communication. An ATmega8U2 on the board channels one of these over USB and provides a virtual com port to software on the computer (Windows machines will need a .inf file, but OSX and Linux machines will recognize the board as a COM port automatically.

Fig 3-8 Arduino Mega2560

Table 2 Specification of Micro Controller (AT Mega2560)

Microcontroller	ATmega2560
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	54 (of which 14 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz

3.6.2 Temperature Sensor

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal – acquisitio technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectivenes.

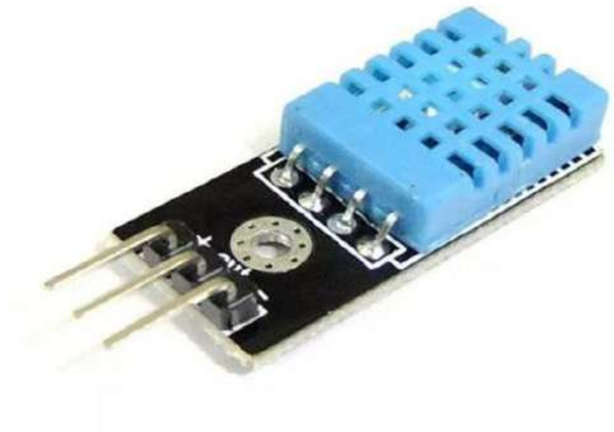

Fig 3-9 Temperature Sensor

Table 3 Specification of Temperature Sensor

Temperature Range	**0-50 C**
Humidity Range	**20 – 80%**
Sampling Rate	**1Hz (one reading every second)**
Body Size	**15.5mm x 12mm x 5.5mm**
Operating Voltage	**3-5 V**
Ma current during measuring	**2.5 mA**

3.6.3 Soil Moisture Sensor

The Moisture sensor is used to measure the water content(moisture) of soil.when the soil is having water shortage,the module output is at high level, else the output is at low level.This sensor reminds the user to water their plants and also monitors the moisture content of soil.It has been widely used in agriculture,land irrigation and botanical gardening.

The Soil Moisture Sensor uses capacitance to measure the water content of soil (by measuring the dielectric permittivity of the soil, which is a function of the water content).

Simply insert this rugged sensor into the soil to be tested, and the volumetric water content of the soil is reported in percent.

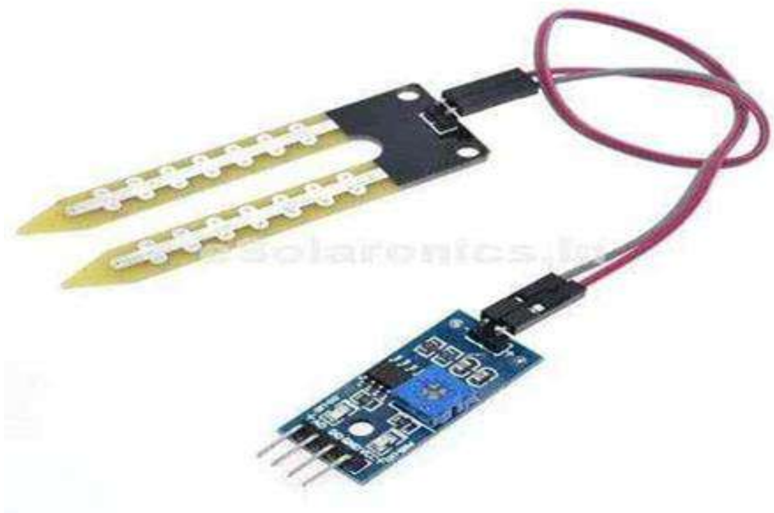

Fig 3-10 Soil Moisture Sensor

3.6.4 Bluetooth Module

HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with controller or PC. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data.

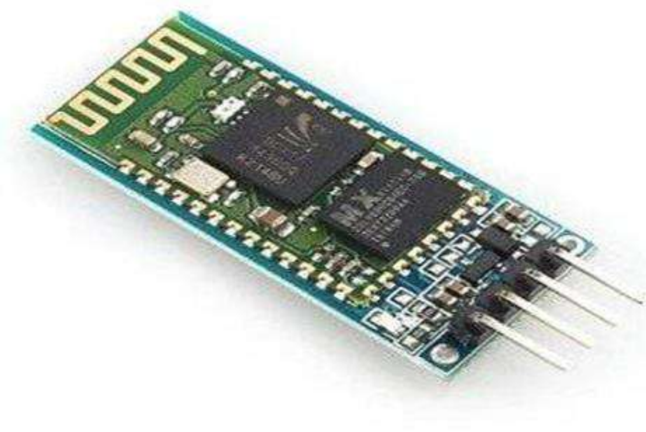

Fig 3-11 Bluetooth Module

3.6.5 Relay Array Modules

Relay breakout module is a smart choice for controlling higher current loads from your microcontroller development board, PC parallel port or your favourite Arduino. This board has sixteen on-board relays which can switch up to 10A. All relay terminals (C, NC, NO) are accessible through screw terminals which makes wiring up the board very easy. The relays are driven by popular darlington array ULN2803. Relay coil is rated for 12VDC.

Fig 3-12 Relay Array Modules

3.6.6 Buck Converters

This is an LM2596 DC-DC buck converter step-down power module with high-precision potentiometer, capable of driving a load up to 3A with high efficiency, which can work with UNO, other mainboards and basic modules. When the output current keeps greater than 2.5A (or output power greater than 10W), please add a heat sink on it.

Fig 3-13 Buck converter

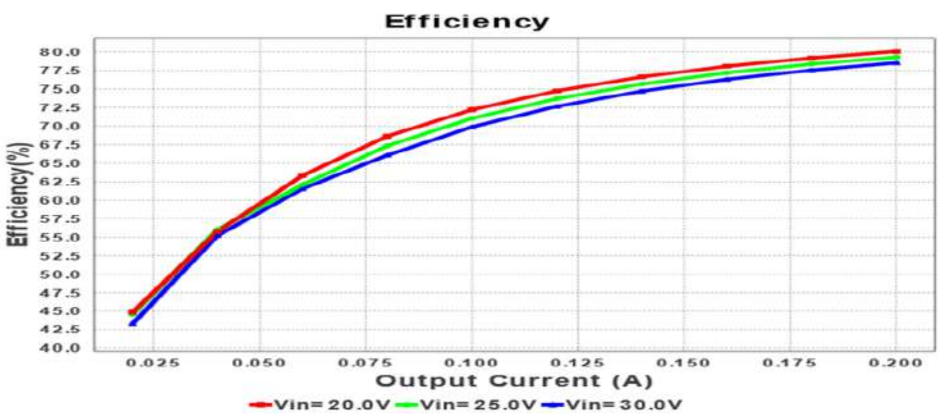

Fig 3-14 Buck Converter Efficiency

3.6.7 Battery

Sealed Lead Acid batteries are maintenance free and with non-spill able design. They are ideal for both cycle and standby use and can operate in any orientation. Rechargeable, recyclable, and no memory effect they are used in our Agri bot 12 Volt 7 Amp Sealed Lead Acid batteries.

In 1 hour = 0.52083Wh lost, as you multiply by one. Therefore, in 9.6 hours, it means 5 watts is lost. Practically about 4 - 5 hours. The battery energy capacity is 12 volts x 40 amp-hours, for a total of 480 watt-hours.

Fig 0-15 Dry Cell Battery

3.6.8 DC Gear Motors for Wheels

This would be a good motor for a low speed cart, like a golf buggy or even a moving trolley that you need to have powered.

Its obviously a copy of the XYD-18 design as it came out after the XYD did, but interestingly they chose to have a much lower speed with a higher torque. Attach abike wheel to this and you'll get a decent speed but attach a small wheel to this and you'll get a boatload of torque.

Fig 3-16 DC Gear Motors

3.6.9 DC Gear Motors for Seeder

The is a 12 volt gear motor, generating 20 Kg-cm of torque at 18 RPM. Since this motor has a lower power output for its size, you can expect it to have a longer lifespan than other motors. The planetary gearbox on this motor is more sophisticated than a typical spur gearbox and will provide greater efficiency, higher torque, and quieter motor operation.

Fig 3-17 Stepper DC Gear Motors

3.6.10 Linear DC Gear Motor for Plough Lowering and Raising

An electric linear actuator is a device that converts the rotational motion of a DC motor into linear motion – that is, it will provide both push and pull movements.

By pushing and pulling it is possible to lift, drop, slide, adjust, tilt, push or pull objects, simply by pushing a button. Additionally, Linear Actuators provide a safe and clean movement with accurate motion control that you, the operator have full control over. They are energy efficient and have a long lifetime with little or no maintenance. Installing an actuator is very easy compared to hydraulic or pneumatic systems and they take up much less space, as they have no pumps or hoses. They are also significantly cheaper than Hydraulic or Pneumatic Actuators for the same reason.

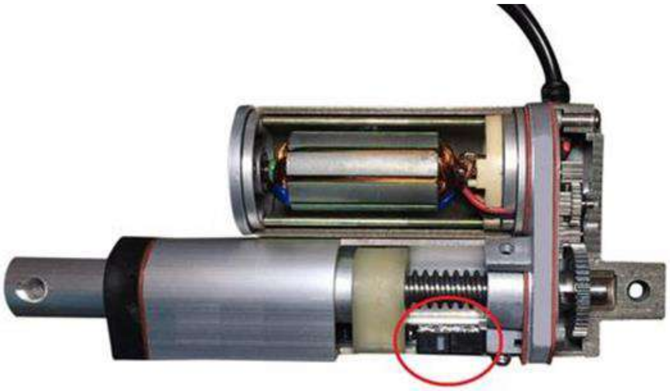

Fig 3-18 Linear DC Gear Motor

Table 4 Specification of Motors

Motor Name	RPM	Torque	Voltage
DC Gear Motor for wheel	180	20 kg/cm	24 volt
DC Gear Motor for Seeder	120	5 kg/cm	12 volt
Submersible Motor Pump	1.5 litter per minute	-----------	12 volt
Servo Motor for Plaining	0.25sec/120 degree	10 kg/cm	5 volt
Linear DC Gear Motor	1 cm/sec (in or out)	30kg/cm	24 volt

3.6.11 Servo Motor for Plaining Device

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. This is Tower Pro MG-945 Digital High Speed Servo.Its gear type is metal.It has a high quality and high speed.It comes with a 3-pin power and control cable, even a dozen of hardware as shown.

Fig 3-19 Servo Motor

3.6.12 Mini Submersible Pump for watering

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. The main advantage of this type of pump is that it prevents pump cavitation, a problem associated with a high elevation difference between pump and the fluid surface. Submersible pumps push fluid to the surface as opposed to jet pumps which create a vacuum and rely upon atmospheric pressure. Submersibles are more efficient than jet pumps. Hydraulic submersible pumps (HSP's) use pressurized fluid from the surface to drive a hydraulic motor downhole, rather than an electric motor, and are used in heavy oil applications with heated water as the motive fluid.

Fig 3-20 Centrifugal Pump

3.6.13 Galvanized Iron (G.I) Sheet for Chassis Cover

GI Roofing sheets full form is Galvanized Roofing Sheets, used to protect the buildings from the bad weather, and sunlight. GI stands for Galvanized Iron, Galvanization is the process of coating zinc in iron Sheets.

Fig 3-21 Galvanized Iron (G.I) Sheet

3.6.14 Rectangular Hollow Section Square iron Tube

HSS, especially rectangular sections, are commonly used in welded steel frames where members experience loading in multiple directions. Square and circular HSS have very efficient shapes for this multiple-axis loading as they have uniform geometry along two or more cross-sectional axes, and thus uniform strength characteristics. This makes them good choices for columns. They also have excellent resistance to torsion.

HSS can also be used as beams, although wide flange or I-beam shapes are in many cases a more efficient structural shape for this application. However, the HSS has superior resistance to lateral torsional buckling.

Fig 3-22 RHS Iron Tube

3.6.15 Bearings

A bearing is a machine element that constrains relative movement to the desired motion and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts. The Stainless steel bearing we use in the wheel for smooth and frictionlesw s motion it size is ½ inches and fitted inside the wheel.

/

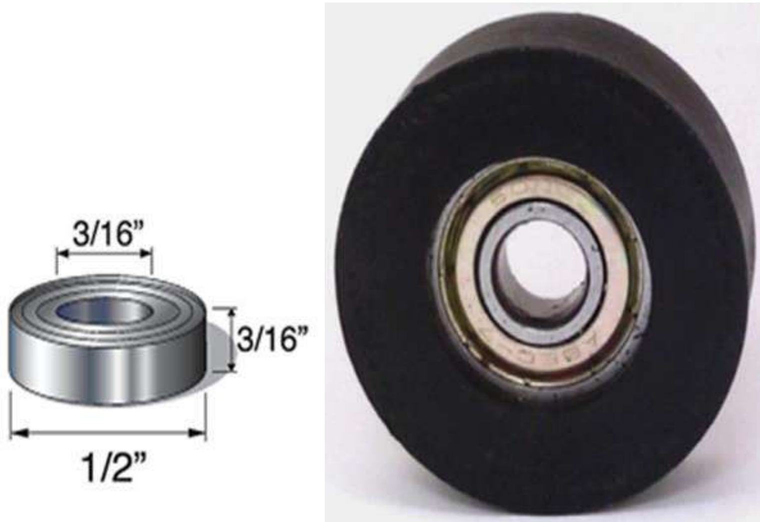

Fig 3-23 Bearings

3.6.16 Tracks and rollers.

The tracks which have been used are the rubber, special 3 ply material used in the timing chain of an industrial machine. These are very tough and have a teeth figure on the outside. They can endure tensions of 1000n and temperatures of 150 degree centigrade. The belt is 2 inch wide and has a length of 43 inches circumference. The rollers on the top are made of fiberglass resin materials strengthened with fiber glass re enforcement. The four rollers on the bottom side of the tracks are 1 inch pvc pipes which are on topo of bearings for easy rolling purpose and also for the stiffness of the belt at the bottom side. The whole assembly is set up on a steel sheet 3. Which has RHS stiffeners. These assemblies are 2 on either sides.

Figure 3.24 Roller Assembly

Chapter 4

Result and Discussion

After the agribot was made and all the interfacing of hardware mechanical and software was done It was now time to test the vehicle. For its operational outcomes the test and results done on the Vehicle are as under:-

4.1 Speed Test

The speed of the vehicle was kept 20 cm/sec this was basically due to the un even surface of the farming land. We don't need much speed as we saw the daily life if the speed is more it would takes some effect as a car passing over speed breaker. The speed of vehicle is basically kept such because after every 20 to 30 cm and other speed has to be sowed.

Results:- The result of this test after it was perform was perfect over robot trolley stop it any interval we desire to stop it.

4.2 Terrain Test

Although all the tests performed for various function by us were also performed by our predecessors, this test was especially new to the project which involved the use of tracks instead of wheels. We made observations on various surfaces, such as soft sand and hard sand as well as sand with gravels of various sizes. The max size was 40 mm gravel size.

Result: We found out that the speed of travel varied on each different terrain as per the smoothness of the terrain. But the machine maintained a better line and length as compared to the previous wheeled system.

4.3 Load test

The weight of the whole machine after it filled with water and seed comes to about 30 kg the main test here is to take this load on uneven land.

Result:- the vehicle was move fully loaded on uneven land with maximum crest and trough of 6 inches the vehicle moved without any hindrance.

4.4 Drilling test

The plough bit is 1.25 inch and it is poisoned 3 inch about the ground when the posion is 5 inch the surface of the soil is dogged 2 inch. We tested the digging mechanism on different surfaces and having different hardness. We found at that from very soft soil to compacted soil as used on verdant road the digger dig all these surfaces with perfection.

Result:- we found out that drill is working perfectly on all surfaces.

4.5 Electronic Test

The electronic circuitry and module implemented for the movement and the function of the Agribot where tested individually and the result was satisfactory. First of all the movement of the vehicle was tested for its straight path and turns on right and left side this has done by using Bluetooth module and from the app designed by us the result here satisfactory. The drilling , seeding, plaining and watering was set in loop. By programming on ARDUINO and when the test were carried out the timing for whole these

Result:- So Result was found after the test is that all four function run perfectly with the v help of ARDUINO. The electronically working is perfect.

4.6 Soil Moisture Test

After three step before watering the soil moisture sensor sense the moisture of soil. It working was perfectly we tested that if there soil is wet. The system will not work on watering command. Where is the soil is completely dry so the spray some water on the soil. It is also working perfectly.

Result:- we see that in this test the soil moisture sensor is work perfectly.

Trail 1- The power supply was not properly give so it burnt the relay driver circuit. The balancing problem existed while testing the robot in soil.

Trail 2-

Soil type- Medium soil

Soil depth- 40-45cm

Soil moisture- 20

Average depth of sowing obtained- 1-2cm

Row spacing obtained-25cm

Distance between each seed dropped- 2.5 to 3inch

The Automatic seed sowing robot was tested for 2 rotations i.e., 1m in a straight line and again 1m straight after taking a right turn. Expected number of seeds to be dropped in soil- 60.

Chapter 5

Conclusion and Future Suggestions

In agricultural terms, a robot vehicle designed for the sowing process and watering of seeds that uses tracks rather than wheels has many advantages. It's powered with a 12-volt 5-amp battery. Here are some of the key features and benefits:

1. Precision Farming:

• The use of a tracked robot with great navigating and driving accuracy ensures accurate seed placement as well as water distribution. This accuracy allows the optimum spacing of plants and a maximum yield per hectare.

2. Reduced Soil Compaction:

• This is more even weight distribution than traditional wheeled vehicles, and helps reduce soil compaction. This is important for maintaining soil structure and promoting good root growth.

3. Energy Efficiency:

• Because the robot is 12-volt on a 5-amp battery, it's more energy efficient and environmentally friendly than traditional agricultural machinery which burn fuel. It also lowers farmers 'operating expenses.

4. Mobile App Control:

• Adding a control mobile app also means that robot can be used to monitor and remotely manage the farm. This feature adds flexibility and convenience; farmers can monitor the planting process from anywhere.

5. Real-time Feedback:

• Water conditions and soil moisture levels can be reported in real time by the mobile app. With this kind of information, farmers can make decisions based on data rather than guessing. This not only ensures that crops receive ample water but also stops them from being over or underwatered. This feature is also conducive to water conservation.

6. Adaptability to Variable Conditions:

• Through the use of tracks, the robot is able to negotiate difficult terrains and adjusts itself according to changing field conditions (such as uneven surfaces or muddy areas). This adaptability increases the robot's efficiency in a variety of agricultural settings.
7 Time and Labor Savings:

• The automatic sowing and watering carried out by a robot saves time, effort, and labor costs for farmers. This efficiency is especially important during peak piercing seasons.

8. Consistent Performance:

• Automated planting and watering leaves no room for human error. This uniformity leads to even crop emergence and growth.

9. Data Logging and Analysis:

• The robot can record and store data on planting and watering activities. These data are therefore valuable resources which farmers can use to analyze the climate, detect trends, optimize resource efficiency and make informed planning for future planting cycles.

10. Environmental Sustainability:

• Combined with precision farming techniques, the electric-powered robot helps advance sustainable agriculture by reducing carbon emissions and lowering operating costs.

To summarize, the agricultural robot tractor has many advantages. It can work more precisely and efficiently; it makes environmentally sustainable operations possible for farmers to make informed decisions on improving production quality through data analysis by relying upon mobile app control in feeding water, fertilizer tablets or spraying pesticides uniformly across a designated area.

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