DESIGN AND FABRICATION OF MULTIPURPOSE AGRO SYSTEM

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Abstract
This project strives to develop a robot capable of performing operations like automatic ploughing, seed dispensing and pesticide spraying. It also provides manual control when required and keeps tabs on the humidity with the help of humidity sensors. The main component here is the microcontroller that supervises the entire process. Initially the robot tills the entire field and proceeds to ploughing, simultaneously dispensing seeds side by side.
Keywords: Agriculture, microcontroller, Plough, Seeder.

I. INTRODUCTION

As one of the trends of development on automation and intelligence of agricultural machinery within the twenty first century, all types of agricultural robots are researched and developed to implement variety of agricultural production in several countries, like choosing, harvesting, weeding, pruning, planting, grafting, agricultural classification, etc. and that they step by step seem benefits in agricultural production to extend productivity.

Indian economics base on agriculture field development in agriculture lead to raise to economic status of country. In India farmer are facing problem due to unavailability of labor. Also traditional way of farming equipment which takes lots of time and it also increases labor cost.

The idea of applying robotic technology in agriculture is very new. In agriculture the opportunities for robot enhanced productivity are immense and the robot is appearing on the farm in increasing number. We can expect the robot performing agriculture operation autonomously such as mechanical weed control, digging, weeding, seed sowing, and spraying.

Why to use agro-bots?

Autonomous agricultural robots are an alternative to the tractors found on fields today. Cultivation tasks like seeding, spraying, fertilizing and harvesting may be performed by fleets of autonomous agricultural robots in the future. Independent of the actual design a serious agricultural robot will be a complex and expensive vehicle – the challenge is therefore to prove that it is competitive to traditional technology and may even bring a decisive lead.

1.1 Problem statement

- Design and develop an agricultural robot which can be able to seeding and digging carried out in agricultural field. The control of this agri-system should be wireless and can be able to show above operations.
- Fabricate the model of same operated by wireless control which able to show above mentioned operations like seeding and digging.
- Also design and analyze a prototype model for this robot to give a solution and propose a model which can be used in real time field.

1.2 Objectives

1. To Design and develop an agricultural robot which can be able to digging and seeds like operations carried out in agricultural field.
2. To control of this prototype should be wireless and can be able to show above operations.
3. To propose a low cost but effective agro system.
4. Wirless controlling system will help the farmers to have proper control over operation like sowing, seeding , digging and fertilizing

which will indirectly reduce the process cost in agriculture feild.

2. LITERTURE REVIEW

Amrita Sneha. A, Abirami. E [1]:
This paper strives to develop a robot capable of performing operations like automatic ploughing, seed dispensing, fruit picking and pesticide spraying. It also provides manual control when required and keeps tabs on the humidity with the help of humidity sensors .The main component here is the AVR At mega microcontroller that supervises the entire process. Initially the robot tills the entire field and proceeds to ploughing, simultaneously dispensing seeds side by side. The device used for navigation is an ultrasonic sensor which continuously sends data to the microcontroller. On the field the robot operates on automated mode, but outside the field is strictly operated in manual mode. For manual control the robot uses the Bluetooth pairing app as control device and helps in the navigation of the robot outside the field.

Vijaykumar N Chalwa, Shilpa S Gundagi [2]:
In this project work an engineering solution to the current human health hazards involved in spraying potentially toxic chemicals in the confined space of a hot and steamy glasshouse or agricultural field is achieved by the design and construction of an autonomous mobile robot for use in pest control and disease prevention applications in commercial greenhouses. For this a mechanical robot is designed.

Shivaprasad B. et al [3] In modern globalization, many technologists are trying to update a new development based on automation which works very rigidly, high effectively and within short time period. The progressive invention in agriculture system is becoming an important task especially because of rising demand on quality of agriculture products and declining labor availability in rural farming areas. The designed system is seeding and fertilizing agriculture robot using microcontroller. The aim of the designed system is to seeding, fertilizing and soil ph, temperature, moisture, humidity checking. The robot is controlled by remote. The designed system involves navigation of robot to the destination successfully and does the above functions. The direction of the robot is controlled via remote. The robot and the remote system are connected through internet system. 6 DC motors are used for navigation of the robot. The speed of the DC motors is controlled using controller. The solenoid is used to control seeding and fertilizing.The measurement of the moisture of soil, temperature of soil and ph value of soil, performing of the seeding and fertilizing in agriculture field is designed in the agriculture Robot.

A.O. Hannure et al [4] In the above paper author has briefly discussed about the phenomenon of automatic seed feeder mechanism. Their objective was to reduce seed plantation time, increase productivity etc. the mechanism used in automatic seed feeder is reduce manual effort and also reduces the time required for the seed feeding. In this modern era research in the agricultural field is going on. Plant nursery is important part of agriculture field and facing many problems. The problems are availability of labours, low productivity rate and more manual efforts required for seed feeding. In plant nursery more time is required for plantation which is due to seed feeding process. For reducing these problems of plant nursery research of automatic seed feeder mechanism is used. The mechanism consists of frame, hopper, belt drive, sewing motor, conveyor etc. Hopper consists of seeds are fall down on belt. This customised belt transfer seeds from one end to other end. The customised belt contains conical shaped holes on sheet metal which mounted on cloth material. While movement of belt excess amount of seeds are minimised by stripper plate. Those seeds are passed through stripper plat and present in holes are fall down in the tray.

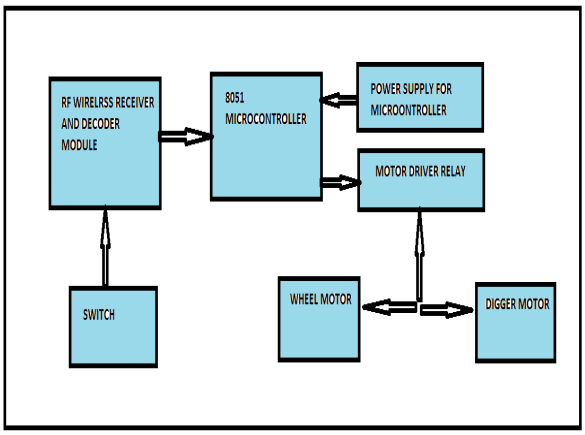
Nagesh B. Adalinge et al [5] In this paper the purpose of author was to design and manufacturing seed sowing machine which can be operated by the single operator. The basic objective of sowing operation is to put the seed and fertilizers in rows at desired path and seed to feed spacing, cover the seeds with soil and provide proper compaction over the seed. They have also make a comparison between the traditional sowing method and new purposed machine which can perform a number of simultaneously operation and has a number of advantages.

Swati D.Sambare et al [6] In this paper author discussed about current problem in agriculture field like seed sowing, weeding, cutting, fertilizers spraying etc. very basic and significant operation is seed sowing. But the present methods of seed sowing are problematic. The

author has also state a control mechanism which aims to drop seeds at particular position with specified distance between two seeds and lines while sowing. The system is beneficial to the farmers for the basic seed sowing operation. The mode of operation of this machine is very simple even to the lay man. Low germination percentage leading to wastage of seeds can be reduced by the use of this system. Creation of gap due to non-germination of seeds can be avoided. Total yield percentage can be increased effectively. Labor problem can be reduced. As compared to the manual and tractor based sowing time, energy required for this robot machine is less. Also wastage of seed is less. So this system will be a better option for the farmers who want to perform the seed sowing operation in a well-organized manner.

3. SYSTEM DESCRIPTION

3.1 BLOCK DIAGRAM



3.2 WORKING OPERATION

- The assembly of the robotic system is built using high torque DC motor, RF module (transmitter receiver) for wireless communication , relay driver circuit, Battery package and microcontroller module which is shown in block diagram above.
- When DC motor is started, the vehicle moves along the particular columns of ploughed land for digging and sowing the seeds and its movement is controlled by remote guiding device.
- LCD module is used to display the condition of the battery level. The remote control transmitter and receiver is shown in block diagram.
- This system has two main sections, robot end and control section, which are intercommunicated.

3.3 COMPONENTS DESCRIPTION

1. FRAME:

- Size: (450×300×50)mm
- Material: wooden

2. SEEDER:

Length: 235mm
Diameter: 50mm

3. TANK:

- Length = 305 mm
- Breath = 534 mm
- Height = 381 mm
- Area = 305×534×381
  $= 62.05\times10^6$ mm^3

4. DIGGER

- Height: 650mm
- Width: 165mm

5. WHEEL:

- Diameter: 65mm
- Material: Fiber

6. MOTOR: (Total four motors are connected and two motor are dummy motors which is connected to wheel)

- One motor is submersible connected to water tank.
- Two motor (12v dc motor) connected to wheel.
- One is connected to seeder.
- And remaining one is connected plaw.

10RPM 12V DC geared motors for robotics applications.Very easy to use and available in standard size. Nut and threads on shaft to easily connect and internal threaded shaft for easily connecting it to wheel.

Features

- 10RPM 12V DC motors with Gearbox
- 3000RPM base motor
- 6mm shaft diameter with internal hole
- 125gm weight
- Same size motor available in various rpm
- 12kgcm torque
- No-load current = 60 mA(Max), Load current = 300 mA(Max)

Fig No 5.1 DC Motor.

7. Hose pipe:

Fig No 5.2 Hose Pipe

Color: White
Length: 820mm
Diameter: 10mm
Material: plastic

8. Submersible water pump

DC Voltage: 12V
Maximum lift: 40-110cm / 15.75"-43.4"
Flow rate: 80-120L/H
Outside diameter of water outlet: 7.5mm / 0.3"
Inside diameter of water outlet: 5mm / 0.2"

Specification

Diameter: Approx. 24mm / 0.95"
Length: Approx. 45mm / 1.8"
Height: Approx. 30mm / 1.2"
Material: engineering plastic
Driving mode: brush-less dc design, magnetic driving
Package Contents: 1 x Mini Submersible Water Pump,12v 1amp. adapter + 1m pipe

9. Battery:

Fig 5.3 : Battery

- Product Name : 12v / 1.3 Ah Recharge
- Description
- Output Voltage: 12v.
- Current Output: 1.3ah.
- Application of 12v/1.3 Ah Rechargeable Battery

Fig.2: 10 rpm dc motor

4. CALCULATION AND CAD MODEL

1. **Motor selection for wheels**

Given Given
Diameter for wheels=60mm
Weight of assembly with frame is=5.72kg+1=6.72kg
Torque required for motor
Torque=force×radius of wheel
=6.72×9.81×30
=19.77 Nmm
=1.9778 Nm
=19.778 kgcm
Here we are using two motors for 4 wheels
So torque required for one motor is half of total torque=4.95 kgcm
Therefore we are selecting motor with 5kgcm torque.
Power output of DC motor is =voltage ×current
=12×0.3
=3.6 watt
Power=2× π ×N×torque/60
3.6=2× π ×N×4.95/60
N=6.95
We are selecting motor with 10rpm

2 Motor selection for seeder

Given
Diameter for seeder=40mm
Weight of seeder is=1.42kg
Torque required for motor
Torque=force×radius of seeder pipe
=1.42×9.81×30
=417.9 Nmm
=0.4179 Nm
=4.179 kgcm

So torque required for seeder motor is =4.179 kgcm

Therefore we are selecting motor with 5kgcm torque.

Power output of DC motor is =voltage ×current

=12×0.3

=3.6 watt

$$\text{Power}=\frac{2\times pi\times N\times torque}{60}\quad\frac{2\times pi\times N\times torque}{60}$$

$$3.6=\frac{2\times pi\times N\times 4.179}{60}\quad\frac{2\times pi\times N\times 4.179}{60}$$

N=8.23 rpm

We are selecting motor with 10rpm

Design of seeder

•We are going to use hollow pipe as a seeder.

•According to dimension of our prototype model the length of the seeder should be approximately 250mm

•Hole will be made on the pipe for seeding purpose.

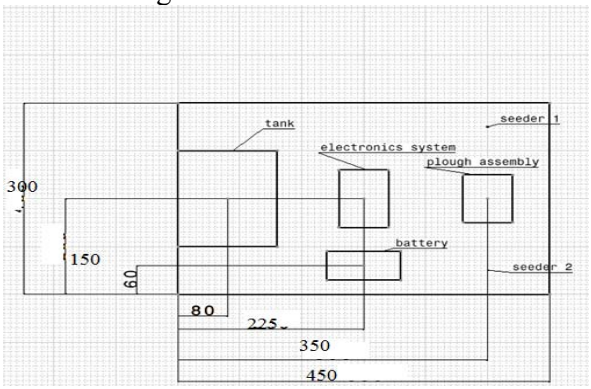
•The diameter of the seeder is approximately 50mm

•According to our requirement the no of holes formed are 6 at 50mm distance.

•Cap will be provided to the seeder for inserting or removing seeds from seeder.

3. Centre of mass for system

In order to find the center of gravity we have to consider weight and coordinate of the mass



8.1 Centre of mass of system

Weight will be consider as given in the table of weight of component

Total weight of plough assembly =wt .of motor + wt. of plough + wt. of gear assembly

=120+3000+130

=550gm=0.55kg

Total weight of seeder assembly=wt. of motor +wt. of seeder +wt. of aluminum strip

=120+1000+300=1420gm =1.42 kg

Centre of gravity along x axis is=m1×x1+ m2×x2+m3×x3+…..m6×x6/(m1+m2+m3+….. m6)

=3×80+0.15×225+0.6×225+0.55×350+0.71×350+0.71×350/(3+0.15+0.6+0.55+0.71+0.71)

=178.28 mm

Centre of gravity along y axis is=m1×y1+ m2×y2+ m3×y3+….. m6×y6/(m1+m2+m3+…..m6)

=3×150+0.15×50+0.6×150+0.55×150+0.71×50+0.71×250/(3+0.15+0.6+0.55+0.71+0.71)

=147.38mm

Therefore centre of gravity is =(178.28,147.38)

4. Worm and worm gear calculations

Given data:

Values for worm

D1=15mm

Z1=3

Vulues for worm gear

D2=40mm

Z2=26

1.to find the module of gear

d2 = m Z2

40= m×26

m = 1.54≈2

Centre distance C= 0.5(d1+ d2) = 0.5(15+40) =27.5mm

Axial pitch: p = πm = 3.14×2 = 6.28 mm

Lead: L = p Z1 = 6.28 x 3 = 18.84 mm

$V_1 = V_m = (\pi d_1 n_1/60000) = \pi\times15\times10 / 60000 = 7.85\times10^{-3}$ m/s

$n_2 = n_1/ i = \{n_1 (Z_2/Z_1)\} = 10/ (26/3) = 1.15$ rpm= 2rpm

$V_2 = (\pi d_2 n_2/60000) = \pi\times40\times2/60000 = 4.188\times10^{-3}$

Answer

$V_1 = 7.85\times10^{-3}$ m/s

$V_2 = 4.188\times10^{-3}$

n_2 = 2rpm

5. ADVANTGES AND APPLICATION

ADVANTGES

1- It is one of the latest and sophisticated system

2- It control whole system automatically.

3- It is reliable and requires less maintenance.

4- It is Affordable.

5-The system working is simple and easy to use.

APPLICATION

1-The system or robot can be mainly use in agricultural field.

2-It is used in home gardening.

3-It is used in sports ground

4-It is used in fruit gardens

6. CONCLUSION

In this project we made an effort to overcome some problems in agriculture. The rapid growth

in the industries is influencing the labors who are situating in the villages to migrate to the cities. This creating the labor problem for the agriculture. The wages for the labor is also more. By using this robot in the field of agriculture we can help the farmers in the initial stage of agriculture i.e. during the seeding and fertilizing. This robot can be a better substitute for the human who performs the seeding and fertilizing. This robot is very useful for the farmers who are interested to do agriculture activity but facing the labour problem.

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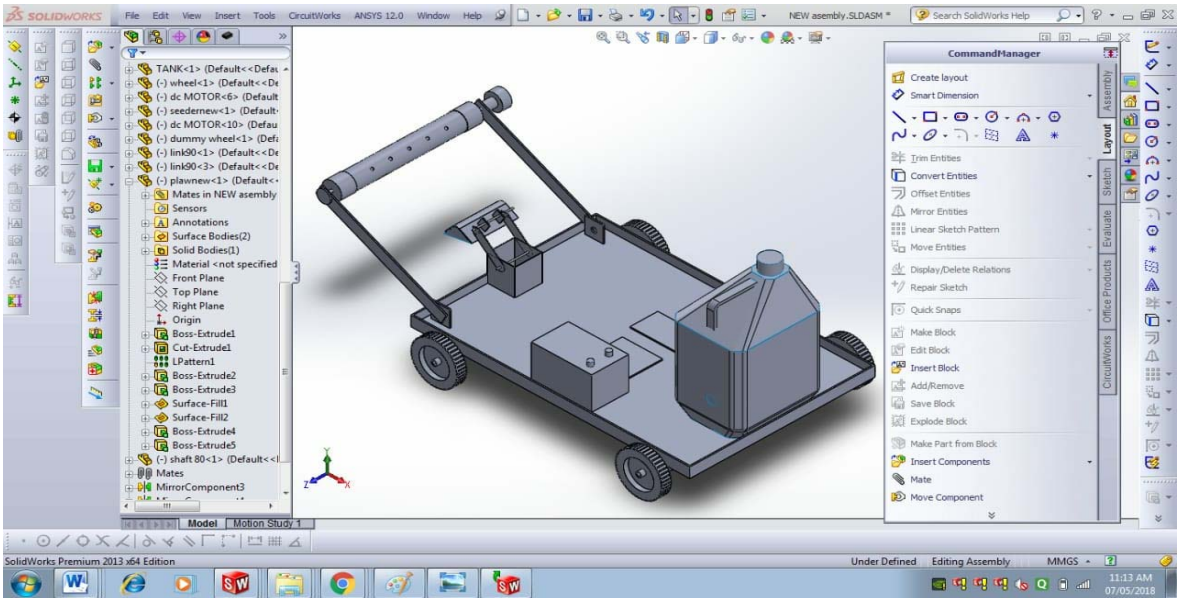
10. CAD Model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