



## Design And Fabrication Of Automatic Seed Sowing Robot For Agricultural Field

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### Abstract

In Today era is marching towards the rapid growth of all sectors including the agricultural sector. To meet the future food demands, the farmers have to implement the new techniques which will not affect the soil texture but will increase the overall crop production. The aim of this project is to design and develop an Automatic seed sowing robot for Chickpeas Seed. The Chickpeas Seed sowing machine is a key component of agricultural field. The various technique used in India for seed sowing and fertilizer placement are manual, ox and tractor operator. The manual and ox operator technique are time consuming and productivity is low. Tractor is running on fossil fuel which emits carbon dioxide

and other pollution every second. This evident has led to widespread air, water and noise pollution and most importantly has led to a realistic energy crisis in the near future, in order to make the development of our farmer as well as nation sustainable and cause less harm to our environment. Now, the approach of this project is to develop the automatic Chickpeas Seed sowing robot which is to minimize the working cost and the time for digging as well as operate on clean energy. In this robot proximity sensor is used to convert rotations to distance with a 12V battery, which then gives the necessary power to a DC wiper motor. This power is then transmitted to the shaft to drive the wheels. And to further reduction of labor dependency, IR sensors are used to maneuver robot in the field. Seed sowing and digging robot will move on different ground contours and performs digging and sowing the seed.

**Key Words::** Low Cost Automation, Seed Sowing Machine, Chickpeas Seed

## 1 Introduction

The major occupation of the Indian rural people is agriculture and both men and women are equally involved in the process. Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. It has to support almost 17% of world population from 2.3% of world geographical area and 4.2% of world water resources. The Seed Planter was an invention thought out in 1699 Proposed by the author [1]. It was later built and used by author [2]. He started off in law school and then later in his life studied agriculture. Jethro inherited land in Europe where he practiced his agricultural study. His seed planter successfully planted seeds in uniform although this was improved in 1782, Jethro Tull still takes credit for his extremely helpful invention. The present cropping intensity of 137% has registered an increase of only 26% since 1950-51. The net sown area is 142 Mha. The basic objective of sowing operation is to put the seed and fertilizer in rows at desired depth and spacing, cover the seeds with soil and provide proper compaction over the seed. A traditional method of seed sowing has many disadvantages. Different types of methods of seed sowing and

fertilizer placement in the soil and developing a multifunctional seed sowing machine which can perform simultaneous operations. In order to save the farmer's effort and his valuable time, it is important to develop the method which not only saves the time but also saves his efforts. Farmers face the problem of non-availability of bullocks as well as tractors during the peak period of sowing. Hence, they are tempted to hire them at an increased cost. By making use of an automatic operated seed planter, the yield loss can be substantially decreased. The most important advantage of automatic operated seed planter is that - it can be easily driven by a single person as well as it can be driven manually. Currently, maximum process is done manually which is too much time consuming and requires more manpower for large farm areas and the automatic machines available have too much cost. For reducing manpower, safety and most importantly cost in working automatic seed planter following practices are adopted: Simplicity of process. Reduce human efforts. Eliminate steps. Improved accuracy. Researcher conducted [3-8] A punch planter for corn was designed, prototyped, and evaluated for no-till conditions using a commercial seed metering unit. The seed meter was evaluated for seed spacing performance at the vertical position with 2.5 kPa of vacuum, as specified by the manufacturer, and at a 22 degrees incline with 4.0 kPa of vacuum. The prototype punch planter was evaluated at a 22 degrees incline with 4.0 kPa of vacuum. Only small changes occurred in the seed meter performance when speed varied from 1 to 3 m/s. The precision of seed spacing decreased approximately 6.0% when compared with the seed meter results. Author studied [5-10] High precision pneumatic planters have been developed for many varieties of crops, for a wide range of seed sizes, resulting to uniform seed distribution along the travel path, in predefined spacing. The objective of the present work was to develop a high-resolution optical system for evaluation of performance parameters of pneumatic planters. This paper describes the design, construction and evaluation of the optical system. Researcher studied [9-12] Developed 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. Precision Farming has shown benefits of this approach but we can now move towards a new Generation of equipment. Author

studied [8-15] Sowing is prime operation in cultivation practice of any crop which directly affects production. Therefore, timely sowing is necessary with available sources of power. To achieve these a prototype consisting of seed hopper, metering mechanism, power transmission unit, frame, furrow opener and beam for hitching arrangement was developed. The seed planter was tested for its performance of sowing groundnut variety SB-XI. Author proposed [12-15] the study method by dynamic modeling of the technical system tractor - sowing machine, using the specialized software Inventor. The achievement of the dynamic system model assumed in advance the design and the simulation of three different models namely: the dynamic model of working sections of the sowing machine, dynamic model of mechanical transmission of the sowing machine and the tractor dynamic model. Researcher conducted [11-15] The critical parameters for plant population with desired planting geometry include uniform distribution and precision placement of seeds. RD efforts in metering of single seeds at predetermined intervals are carried in this paper. Proximity sensor technique-based seed spacing evaluation system that measure time intervals between seeds and transmission ratio between two velocities is used to determine planter seed spacing uniformity. researcher used [12-15] The basic requirements for small scale cropping machines are, they should be suitable for small farms, simple in design and technology and versatile for use in different farm operations. A manually operated template row planter was designed and developed to improve planting efficiency and reduce drudgery involved in manual planting method. Seed planting is also possible for different size of seed at variable depth and space between two seeds. Discussing the current scenarios of agricultural practices, we found that there is tremendous scope in this field to develop as lack of development is there. By taking this point the machines available in the market are very costly and most of them are manually operated. So, we decided to make an agricultural seed planter in minimum cost as well as automatically operated that it reduces farmers effort and time. Hence, we decided to do effort and use our engineering knowledge for the development of a planter which must be having low cost, simple in construction with greater accuracy.

## 2 DESIGN AND FABRICATION OF ROBOT

### 2.1 Mechanical components and description

#### **Selection of motor.**

As our main principle is to reduce the speed and increased torque hence we require a high rpm as well as less costly dc motor. So, we decided to go with this dc wiper motor as it satisfy our design as well as easily available in the market. In which calculated the Power and torque as per our requirement.

#### **Spur gear design and selection.**

Calculate forces on teeth of helical gears, including impact forces associated with velocity and clearances.

Step 1. Determine allowable force on gear teeth, including the factors necessary due to angle of involute of tooth shape and materials selected for gears.

Step 2. Design actual gear systems, including specifying materials, manufacturing accuracy, and other factors necessary for complete helical gear design.

Step 3. Understand and determine necessary surface hardness of gears to minimize or prevent surface wear.

Step 4. Understand how lubrication can cushion the impact on gearing systems and cool them.

Step 5. Select standard gears available from stocking manufacturers or distributors.

Step 6. In which calculated the Diametric Pitch (P) - Pitch circle Diameter (PCD) and the Number of Teeth (N).

#### **Seed sowing disc and Seed bucket.**

The main purpose of this disc is to dropping the seeds into the field. Description- From the surveys to calculate the distance between two seeds, we have make conclusion that the approximate distance between two seeds is normally 2.5 to 3 inches. So, we decided to make the distance according to that calculation as follows-



Figure 1: Seed sowing disc and hopper

**Chickpeas Seed hopper.**

Storage device is one of the important devices of the system. And is designed according to weight sustained by the robot as well as the required capacity for planting. This component is stationary. To the bottom of this tank seed sowing disc is arranged. This disc serves the function of distribution of the seeds, as for each complete rotation of the rotating wheel, only one seed falls from the tank. Number of seeds falling from tank is varied according to requirements. This disc evenly opens the way to seed hence planting is done smoothly and accurately.

**Ploughing arrangement**

Digging plates are used to dig the land and to spray the seeds. There are four holes in the plate. It is used to mount with rod. Digging plates are made of mild steel. These plates are mounted in front of the seed container and coupled in the rod with particular distance using bolts and nuts. By adjusting the bolts and nuts we can vary the position of plates. Rod is mounted with the bearing mounting plate using bolts and nuts. It can be easily dismantled and assembled.



Figure 2: Ploughing arrangement

**Frame**

Frame is back bone of the equipment. It is made of mild steel.

All the sub-parts in the equipment are mounted in the shaft. It is the rigid structure that forms a skeleton to hold all the major parts together. At the bottom end of the frame wheel with seed container assembly is mounted.

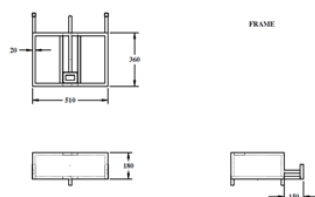


Figure 3: Design of frame

### Bearing with cap

The main purpose to use the bearings is rolling bearings use rolling elements to maintain the separation between moving parts to reduce rotational friction and support radial and axial loads. The shield protects the working parts of the bearing from environmental debris that may be introduced and could reduce the ball bearing speed and lifespan. Rolling bearings are used in a range of applications from agricultural machinery to conveying equipment, robotics, dental equipment, elevators, rolling mills, ship ruddershafts, and aggregate crushers, among others.



Figure 4: Bearing

### PIC Microcontroller (16F877A)

The PIC microcontroller PIC16F877A is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it uses FLASH memory technology. It

has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A is used in many PIC microcontroller projects. PIC16F877A also has many applications in digital electronics circuits. PIC16F877A finds its applications in a huge number of devices. It is used in remote sensors, security and safety devices, home automation and in many industrial instruments. An EPROM is also featured in it which makes it possible to store some of the information permanently like transmitter codes and receiver frequencies and some other related data. The cost of this controller is low and its handling is also easy. It is flexible and can be used in areas where microcontrollers have never been used before as in coprocessor applications and timer functions etc.

Assembly.

The assembly process is elaborated in the following steps -

Step 1. All the components such as gear is oiled so as to remove the metallic chips, dust

Step 2. and other foreign particles.

Step 3. Firstly, attach the front wheels (diameter = 2000mm) to the fabricated frame.

Step 4. Now insert shaft to the frame.

Step 5. Mount the smaller wheels to the back side and front side of the frame for balancing

Step 6. purpose.

Step 7. Now mount the bearing (i.e. 6202) to the shaft and for reducing the friction and

Step 8. stress.

Step 9. After that mount two motors on both side of the frame (i.e. front and back).

Step 10. After mounting the motors mesh the bigger spur gear with the smaller gear which

Step 11. already attach with the motor.

Step 12. Mount the hopper and seed dropping disc to the middle shaft.

Step 13. Now fix and attach the ploughing arrangement.

Step 14. Mount microcontroller circuit to the frame.

Step 15. Connect the motor connection to the microcontroller with the help of wires.



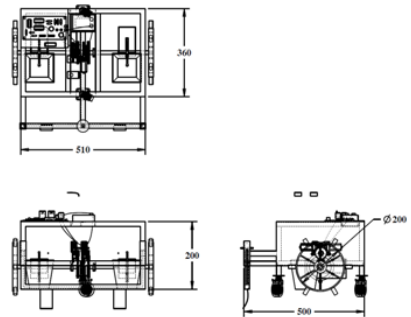


Figure 5 :2D diagram of the final assembly

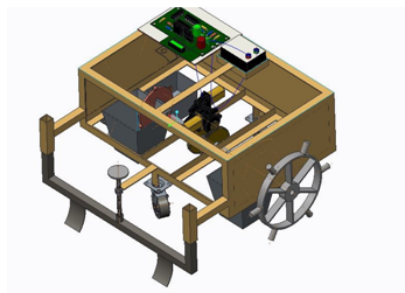


Figure 6 :3D diagram of final assembly

### 3 METHODOLOGY.

This study begins by studying the requirements and the existing method of agricultural seed planter. This study will include overview of the current manual as well as automatic seed planting process and formulation of initial design proposal for the proposed new method of seed planting.

Step 1. The next step to follow will be to carry out extensive literature review to find out about the seed planting process, automation in seed planting and recent developments in seed planting applications. This task is accomplished through accessing the internet, reference books, research papers, technical magazines and others related source of information.

Step 2. After gathering and collecting all relevant information and knowledge about the seed planting processes and automation, the

proposal for design of a seed planting machine will be prepared. It will include proposed schematic layout of seed planting machine considering all the requirements of the seed and the planting process.

Step 3. The schematic layout of seed planting machine will be followed by detailed design of various assemblies and sub-assemblies required for manufacturing and fabricating the seed planting machine. After ensuring the functional requirements from the assembly, the material specifications for individual components and the technical specifications of the standard bought out parts will be finalized. Then the design will be evaluated for safety and functionality.

Step 4. The next step after the design is finalized will be to manufacture the components and fabricate the different sub-assemblies considering their manufacturing suitability and requirements such as operations and machines required, selection of microcontroller, receiver and transmitter and the inspection of the parts.

Step 5. The next step will be to assemble the sub-assemblies and join the sub-assemblies on a single platform to assemble the complete seed planting machine.

Step 6. The microcontroller is programmed and tested.

#### **Autonomous control algorithm**

The basic set of instructions that are followed by the Automatic seed sowing robot during operation are as follows-

Step 1. The LCD panel is initialised and programmed to ask for the input values.

Step 2. Now, the inductive proximity sensor is called to check and complete the provided instruction.

Step 3. The relays are controlled and hence the dc wiper motors for displacement of the robot.

Step 4. In each above step the IR sensor function is called and checked for any interruption.

Step 5. If found anything it instructs the robot to stop until the interruption is cleared.

Step 6. Finally, the robot stops after completion of the task.

#### **Working.**

Step 1. The LCD display asks for number of rotations the wheel should move in straight and right path simultaneously.

Step 2. As the data is provided, the rotations of the wheels is sensed

by inductive proximity sensor.

Step 3. The main drive is given through 12v dc wiper motor which is having low torque and higher RPM.

Step 4. The two spur gears rotates speed decreases and torque increases.

Step 5. Then the motion is transferred to shaft and finally wheels.

Step 6. As the wheels rotates the seed dropping disc also rotates as it is attached with the shaft

Step 7. The plough are make furrows in the soil at the same time the seeds are placed in the field.

Step 8. The distance between two seeds is calculated.

Step 9. In case any obstacle is detected in the defined path of the robot IR sensor senses it and the robot pauses until path is cleared.



Figure 7: Chickpeas SeedRobot

## 4 RESULT AND DISCUSSION

Testing of the Automatic seed sowing robot.

Trail 1-

The power supply was not properly give so it burnt the relay driver circuit. Thebalancing 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.

Difficulties faced while testing the robot

Level 1. Straight Line Sowing: It is very necessary for sowing to sow in a straight line. During trials it is not exactly possible to sow in straight line.

Level 2. Uneven Distribution of Seeds Fertilizer: There is uneven distribution of seeds and fertilizer where the land is not properly levelled (at some ups and downs) or due to big stones in the way.

Level 3. Speed of Operation: For uniform sowing the speed of operation is of prime importance. More uniform the speed of operation, more uniform will be the sowing resulting in higher yield. The speed of operation varies in some scale during sowing.

Level 4. Opening of Seeds Fertilizers: At some places the seeds and fertilizers had remained open to atmosphere which is very bad for the germination of the seed. It is due to the improper levelled land or improper functioning of chain employed for covering the seeds.

Level 5. Non-Uniform depth of seeds sown: The depth of the seeds sown is varied at some places. For uniform depth of the seeds the effort applied to the machine should be nearly constant as possible.

## 5 Confirmation experiment

The confirmation experiment is conducted

- It reduces the time and effort.
- A machine makes work of many workers.
- Mechanism makes process easier/faster.
- Use of seed planter machine increase efficiency.

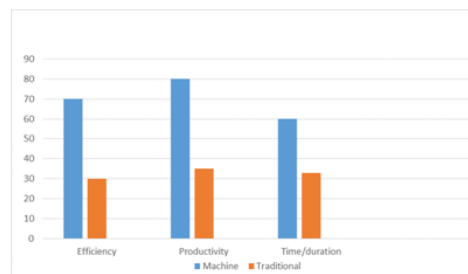


Figure 8: Comparison of machine and traditional methods

The economy is the most highlighting feature of this machine as it does not require any electric power is independent of tractor or bullocks which are not affordable to poor farmers. Farmers face the problem of non-availability of bullocks as well as tractors during the peak period of sowing. Hence, they are tempted to hire them at an increased cost. By making use of manually operated seed cum fertilizer planter, the yield loss can be substantially decreased. The most important advantage of manually operated seed cum fertilizer planter is that - it can be easily driven by a single person. There is hardly any problem of manpower in rural areas where the average size of the family is large. Thus, if 2 to 3 people are employed for the sowing operations, the area coverage can be increased. As far as most of the farmers requirements are considered, this seed and fertilizer planter is able to satisfy most of them effectively during the peak season. The low cost of the machine as well as its ability to carry out sowing fertilizing simultaneously, is certainly a boon to the farmers thereby saving much of their time. It results in almost 60 % saving in operational cost and 15% saving in seed requirements. If the machine is commercially exploited, it can be proved to be beneficial to poor farmers.

#### **Future Scope:**

After carrying out the field trials and observing the results, the scope for the further work is- For better and strong germination of the seeds, the required depth of the seeds to be sown is to be increased about 8 cm. Thus by employing a different type of furrow opener having more width can be used for obtaining the proper seed depth which ultimately increases the yield. As far as ergonomic considerations are concerned, instead of using relays we can use two different kinds of RF module. Also, an acre meter can be placed on the top of machine so that area coverage can be known. For more range of remote control, we can use higher capacity RF module to operate the machine at higher range. For water distribution we can add a small water tank near the back fabrication to supply the water to the seeds or the fertilizers.

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