

Design and Analysis of Multipurpose Agricultural Machine

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Abstract

It is a multipurpose farming mechanism that can aid in various farming processes. The processes involved in farming asks for tedious efforts and high manpower. Therefore, a machine that can streamline the entire process and significantly lower the demand for personnel is needed. The mechanisms of the machine peers over the traditional tools used as well as newer machines for individuals' processes and tries to be better. The potential for robot-enhanced productivity in agriculture is enormous, and farms are seeing an increase in the presence of robots in various forms. Technology can probably solve the other issues connected to autonomous farm equipment. A swarm of little machines may be more effective and less expensive at producing crops than a few giant ones. Along with the mechanism, various channels will be attached that can aid in different farming activities. Thus, a mechanism that can combine various activities of farming in an effective and productive manner is designed and analyzed.

Keywords: Backyard farming, feedback wheel, farming equipment, irrigation, leadscrew, module, multipurpose agricultural machine, ploughing, small-scale farming, sowing, spraying, track

INTRODUCTION

Agriculture is the primary source of livelihood in India. Agriculture is the backbone of our society. Indian farmers, however, are still using the same traditional methods and traditional equipment. Several equipment are used for operations like seed sowing, fertilizing, pesticide spraying, cultivation, etc. in order to cultivate different crops like vegetables, fruits, rice, wheat and other grains. Farmers have to use labor along with this agricultural equipment for carrying out the above said processes. The traditional ways are time consuming. Our goal is to merge all of the different tools into one piece of farming equipment that can be used by farmers for all types of seed cultivation at a low cost and implements all scientific farming procedures and standards. This one machine can carry out all of these tasks [1–5].

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This agricultural equipment is designed to be used for a variety of agricultural tasks, including tillage, seeding, pesticide application, and watering. The main objective of this project is to help the farmers by reducing their efforts and enhancing their operative speed. So, we designed a multipurpose agricultural machine which consists of a track, on which our machine moves forward and backward, with the help of leadscrew. The machine consists of various equipment for ploughing, seed sowing and fertilizing. So, we are aiming to replace human and animal efforts by some simple and advanced mechanization [6–10]. This machine will be suitable for small scale

farmers, from an economical point of view and it lowers the effort needed. Therefore, we are creating this machinery to meet all of these objectives and to address the labour issue. There are many manually operated equipment which are only suitable for gardening, seed sowing and fertilizing purpose, separately only. Our objective of making this multipurpose agricultural machine is to make it the best suitor for both economical and modern aspects, by using scientific and engineering methods, which reduces manual labor, increases productivity and increases the efficiency of the operations.

TYPES OF PLANTS

Cluster Beans

It also goes by the name "Guar". These fresh cluster beans feature a long, narrow body, and tiny pods. After germination, cluster beans should be harvested 60 to 70 days later. Growing season is from March to September (in case of heavy mansions March to June).

Eggplant

One of the most widely planted tropical vegetables in India is eggplant, often known as brinjal. Although it may be grown year-round, the ideal time is during the Rabi season. Rainy Months: June through July. Summer Season: February–March, Winter Season: October–November. A resilient crop, eggplant is grown on a variety of soil types. Eggplant takes around 70 to 80 days to reach maturity.

Green Peas

This pea is most commonly used in India. It judges the little spherical seeds within the pod fruit's seed pod. It is a winter-planted cool-season crop.

Carrots

Carrots are a type of root vegetable. With the exception of areas with extreme heat, carrots may be cultivated all year in India. It can take up to 14 to 21 days for carrot seeds to grow. After planting, carrots should really be ready for harvesting 70 to 80 days later.

PROBLEM DEFINITION

At present times, there are two main methods of farming i.e., using tractors for large fields and open lands and the other is by using hand operated tools/machines for small scale agriculture. The problem with hand tools is that for each farming process a different tool is required, and it is hand operated, so labor work is also included which makes the process very hectic and due to this reason, many small lands and congested areas are left out. These lands can easily be cultivated for a substantial aggregate of crop yield. Some more problems are faced while using hand tools like proper storage and usage to avoid its wearing and tearing. So, there is a need for such an alternative that can be used in small scale agriculture or congested areas. This project does the exact work by making most of the process hassle free and reducing the labor cost. With its compact structure it can be installed and used in congested areas which were unused for a long time. Apart from the design and research related problems, some other problems were also faced by us. Due to COVID-19 pandemic, our team could not meet anywhere physically, forcing us to use social media platforms and as our only options; but the problem with this was that most of the group members were at their native places where network connectivity was not good, due to which we had communication gap and also had many problems in conveying our thoughts to other teammates.

OBJECTIVES

- To design and analyze a machine which has the required tools for small scale agricultural activities and backyard farming.
- To design the mechanism by keeping in mind, the goal of making farming hassle free.
- To make portable and adjustable tool storage.
- To make the concept of farming in a congested area viable for everyone.

- Promote farming in urban cities and town.

METHODOLOGY

The very first step for making our project was to decide a common area of interest on which majority of group members were interested. This later came to be something related to agriculture as we all had a common goal of helping farmers and promoting agriculture in villages as well as cities and towns. It is seen that most of the lands in towns are barren or unused. These unused lands if used, can result in significant amounts of profit. After the selection of common area of interest, it was time to go through related research papers in order to search for an approach of a feasible methodology that would satisfy our project. It was really necessary to go through last 2 to 3 years of research papers related to agricultural machines. We searched and read several research papers that were available on various websites like Google Scholar, etc.

We scrutinized many research papers related to our project, the same are mentioned in literature review so that we can get an idea. This gave us an opportunity to explore an undiscovered way leading to raw idea of our project with some problems which became our next step towards making of this project. After reading the research papers we got a raw idea of making a machine which can be installed on a land and can be made automatic to perform certain tasks involved in farming. Next, every project member was assigned to find a logical structure that would be the base of our design and further planning. After some days of brainstorming, we finally had a structure to get going. Assuming it in practical conditions we started getting problems to be solved which were divided among the team members according to their specializations without limiting them to a boundary of certain part. Some problems were easy to find where else some were hard which are included with their solutions in the next step. The fourth step was solving those big problems we got through literature review. Some problems were solved on individual basis leaving some harder ones. These were the ones which needed the whole team to work on diligently.

DESIGN

Material Selection

Galvanized Steel

- Yield Strength: 600 MPa
- Tensile strength: 640 MPa
- Elongation Percentage: 4%
- Hardness Value Rockwell Scale: 77 HR30T
 - It is less expensive when compared with most of the treated steel.
 - Compared to other coated metals, lower maintenance costs mean faster repairs and replacements.
 - It is extremely resilient, resistant to damage, and weatherproof.
 - It has self-healing properties which provides automatic protection for the areas that are damaged.

Mechanism Design

While designing the components of our machine, we had to keep in mind that:

- The assembly should be as simple and compact as possible.
- After installation, it ought to be able to cover the majority of the farm field.
- It should be able to carry out various operations like ploughing, seeding, fertilization and irrigation.
- It should generate enough power for easy movement of the indwelling mechanisms.
- Vibration should be reduced for ensuring stability and long life.

The following parts with their basic expectations of functionality are discussed herewith briefly. Figure 1 shows the CAD model of full assembly.

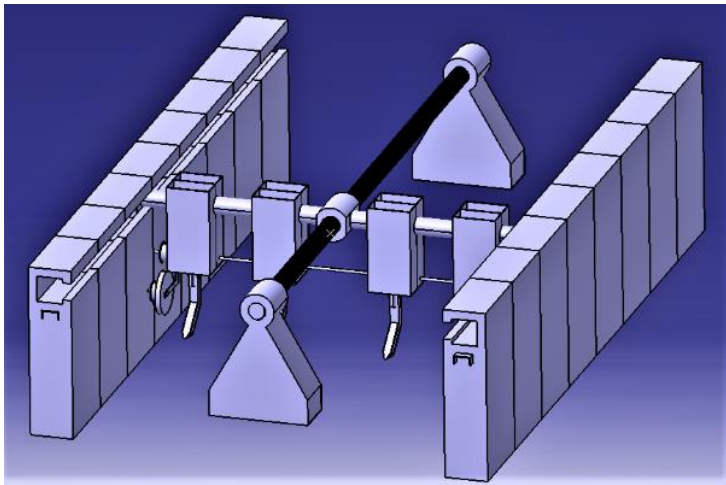


Figure 1. CAD model of full assembly.

Track

The track is a rather static part in itself but is of immense important for the dynamic features of the overall mechanism. The basic function of the 'track' is to provide guiding pathway for the 'module', so that it can move in its described motion with ease and stability.

Module

This is the most crucial component of our machine. It performs the main functions of ploughing, seeding, irrigation and fertilizing. Thus, it dwells the mechanisms necessary for successful working of the above functions:

- It will house the fluid channels and storages, required for the irrigation and fertilization.
- It will house the motor and pumps required for the movement of fluids and various parts.
- It will house a long arm like arrangement for ploughing.
- It will house the seed storage and planter mechanism.

Lead Screw

This part is very crucial for the dynamics of our overall mechanism. The movement of the module will be facilitated by the lead screw arrangement itself. The lead screw will go through the female part of the arrangement installed at the middle of the module. Lead screw arrangements are great at transmitting power. The rotational motion of the lead screw will be converted into translation motion of the module. The lead screw will control the to-and-fro motion of the module as well as the speed of the module. This will ensure greater control and flexibility to the farmer or the general operator. The length of the lead screw has to be equal to the length of the field desired to be farmed and the track assembly length, with feasible proportions. The lead screw will be square threaded for good load handling and low friction.

Lead Screw Stand

Lead screw stands are wide triangular solid bodies with bearing at the top corner. The widened feature will help in better stationing over the surface of farm field. The triangular shape will bear the weight efficiently and distribute the load equally towards its base. The bearing will help in smooth revolutionary motion of the lead screw. Two such stands will be assembled, one each on the extreme ends of the lead screw placement.

CONCLUSION

After observing various existing farming equipment and studying the exact needs of the different processes involved in farming, a mechanism that can perform multiples farming activities as needed is designed. The designing is performed by keeping in mind, not only the nuances of farming but also

the features of small-scale or constrained space farming by including modularity to an extent. This mechanism can perform spraying, seeding as well as ploughing. Thus, this mechanism reduces labor requirement, reduces the need to purchase various equipment and makes farming activities simple and time efficient.

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