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Design and Fabrication of Multipurpose Agricultural Machine

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ABSTRACT:

Bulls are now used by farms for levelling, sowing, and ploughing. It takes a long time for a farmer and his livestock to cultivate a crop. Tractors can be used as an additional method of land preparation. However, the vehicles are very pricey. A cultivator cannot expend that much money on labour. In order to solve this issue, we are developing a machine that can perform all farming tasks, including levelling, preparing the ground, and ploughing. Additionally, this equipment will be produced with less money. It will be offered at a cheap cost, making it accessible to all farmers.

Introduction:

In India, one of the key industries is agriculture. It is also India's support system, making significant economic contributions that will last for a very long time. India currently holds the second-place global position in agriculture. Agriculture is nothing more than the science and practise of farming, which includes tilling the soil and growing crops, among other things.

Using multipurpose machines will save time and money while increasing crop output, which must keep pace with the population growth. A special purpose machine must be used to surmount the lack of skilled labour, water resources, and crop monitoring that is affecting India's agricultural sector.

High investments, a lack of water resources and crop monitoring, land droughts, human and animal labour, and a low likelihood of profit are a few of the main issues in Indian agriculture.

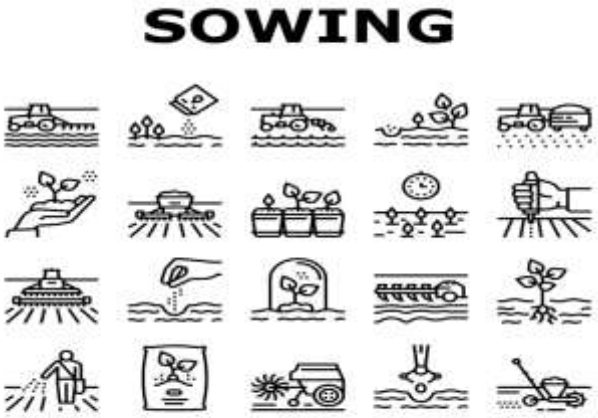
Fast crop cultivation is necessary to surmount such hardship. in order to increase the output. By using both human and animal power, it will take a long period. Machine use could facilitate farming more quickly and require less work from farmers. Vehicles are being developed for the ploughing, seeding, and levelling operations.

Traditionally, humans have carried out cultivation with the aid of bullock carts, tractors, tillers, and other tools. The main issues in contemporary agriculture are a lack of labour, a lack of understanding of soil testing, an increase in labour costs, seed and water waste, and an inability to test the soil. The development of the agricultural automaton aims to address all these drawbacks. Application of robotic technology in the agricultural sector is the primary goal of agricultural robots. Plowing, seeding, and mud levelling are all expertly handled by the farm robot on an automatic basis. The robot is a mechanical device that can carry out a variety of tasks without the assistance of a person.

Objective:

The primary goal of this project is to create a multifunctional agricultural machine that can level land, plough, and sow. This machine plants seeds at a specific depth and in the correct row relative to other planted seeds. The parameters such as the distance between two seeds, the depth of the seed, and the planting rate vary depending on the shape and size of various seeds.

The goal of this project is to provide farmers with multipurpose equipment that complies with all scientific farming requirements for optimum yield and high-quality crops while requiring less labour and expenditure. To create seed-sowing equipment that only requires a single person.



Constructional details:

Transmission:

This project's transmission is of the simple variety. Power is transferred from the motor shaft to the chain sprocket and then to the back axle of the agricultural machine using a chain mechanism. Rotational motion between the two axles is transmitted by the chain's mesh with the sprockets. Power can be transferred from the driven to the driving sprocket.

Chain and sprocket:

With the aid of a chain drive, a sprocket is used to transfer force to the intermediate shaft and axle. Chain drives are employed because they successfully transfer power from one shaft to another with extremely high efficiency and minimal power losses. The chain is greased to ensure seamless operation. Two sprockets are connected by a chain. A toothed wheel that attaches to an axle is called a sprocket. The driving sprocket is one of the sprockets. The moving sprocket is the other gear. The chain can be used to transmit energy and motion. From one shaft to another, as depicted in the figure 1 shown below, from one sprocket to another.

Figure 1 Chain and sprocket

Plough:

The frame is joined to the plough on the lower side, which is used to remove the top soil layer. After the seed germinates, weeds are also used in the field as shown in figure 2. When the seed is sown at a specified depth, a seed covering device covers soil over the seed. We can use the same frame setup for weeding by swapping out the seed drill for weeding tools.

Figure 2 Plough tool

Hopper and seeding:

It is a seed storage structure. Because the hopper is shaped like a round hopper, seed waste is prevented. It is constructed of timber. The first seed is stored in the receptacle after it has been drilled. Because the hopper and the earth are close together, drilling in the soil is simple. It's close to the handle so you can see if it's correctly drilled or not. Figure 3 shows below hopper which depicts the process of seeding, which involves ploughing seeds into the earth. For ideal seeding, uniform spacing (column by row), depth, and seed count per unit area must be planned. There are three steps are involved in the seeding seed sowing, mud piercing and mud levelling. Holes or space is created to plant the seeds in land by piercing then it covered by mud.

Figure 3 Hopper and seeding

Seeding mechanism:

This mechanism comprises of a hopper containing the seeds, which is connected to a pipe that drops to the ground as shown in figure 4. The hopper is made up of holes through which only a few seeds descend. As shown in Figure below, the storage device is an essential component of the system and is designed to accommodate the weight of the robot as well as the necessary capacity for planting. This component is fixed. A seed sowing disc is positioned at the bottom of this tank. This disc is responsible for seed distribution, as seeds descend from the tank with each full rotation of the rotating wheel. The quantity of seeds that fall from the tank is also adjusted to meet the needs. This disc evenly opens the way to seed hence planting is done smoothly and accurately.

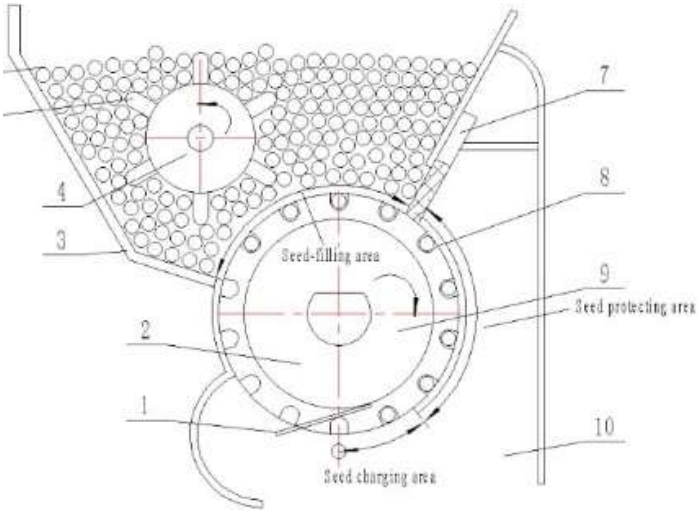


Figure 4 Seeding mechanism

Working principle:

The equipment will operate using a Chain Drive Mechanism. A chain connects two sprockets. A sprocket is a toothed wheel that is connected to an axle. The driving sprocket is one of two. The moving sprocket is the other. Motion and power can be transmitted from one Sprocket to another and thus from one shaft to another via the chain. The seeds are sown with some space between them, which is accomplished by a wheel with notches around its perimeter. The vehicle's top has a hopper for transporting seeds. According to the movement of the vehicle the sowing operation is carried. The front portion of the vehicle is provided with the plough tool to plough the operation. The sowing operation is done then the levelling tool levels the soil to a level that is provided on the back side of the vehicle. The working of the machine is operated by motors and the motors are controlled automatically by connecting with the Arduino and motor drivers and for power purpose the machine is provided with the solar panels. The working model is shown in figure 5.

Figure 5 agricultural machine

Calculations:

Thrust and Speed Calculation:

Total weight of machine m = 20 kg

Load applied on machine =F=m g=20 9.81 F=196 N

Diameter of sprocket = D =80mm

Sprocket radius = r = 40mm

The torque needed to drive the machine T= F r =196 0.040 T= 7.84 N-m

The rated power source = P = 250 watts.

We already know that P= 2NT/60 250=2 3.142 N 7.84 60 N= 300 rpm.

The required speed =N=300 rpm.

Design for number of notches provided on circular plate:

The seed metering plate Is used for seed sowing purpose the seed metering plate is run by motor Material of circular plate = wood Diameter of circular plate = 80 mm

Circumference of circular plate = π D = $\pi \times 80$ =251.32 mm

Distance between of two sowing seed is 65mm

Distance between of sowing seed= Circumference of circular plate/distance between two seeds=251.32/65=3.86

No of ring produce to circular plate = 4

Methodology:

In this assignment, we created a multipurpose agricultural machine and designed it using Iron Cad work simulation shown in figure 6. The length of the back shaft and front axle shaft is 12 cm, with a seeding sowing shaft diameter of 3cm and a front axle diameter of 3cm. The shaft support is 10 centimetres long. In cad model design, we used various kinds of blocks, cylinders, and hollow shafts. We used a variety of materials in the development and fabrication of agriculture machines, including wooden shaped cylinders, steel pipes, ply wood material for the basement motor and seed hopper unit, and the battery, which was put on the plywood piece. Axle axles were rotated using rolling type bearings.

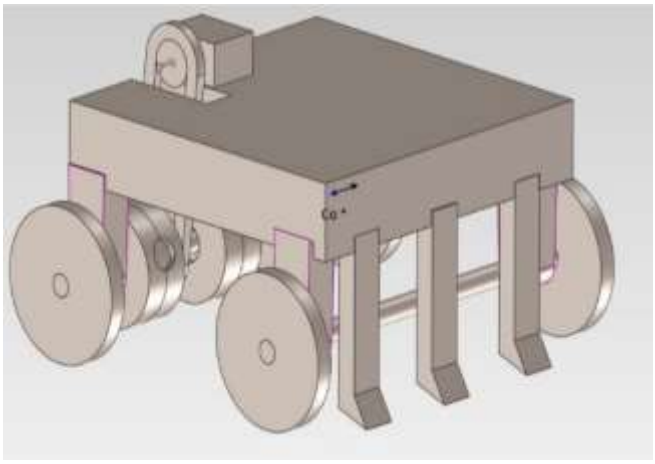


Figure 6 front view of iron CAD design

The bearings are made of alloy steel, and the supports are made of timber. The mechanical structures and devices used in farming or other agriculture are referred to as agricultural equipment. The seeding mechanism is made of wood, and the circular wheels for seeding are produced on a lathe machine. The sowing support wheels are also dined using a lathe. After making the seeding mechanism, the axle supports are made with a basic cutting operation, and the holes for the axles and bearings are made with a radial drilling machine.

The supports have been finished, and the assembly of the supports with the axle has been completed. The entire assembly portion is then nailed to the frame. After securing the frame, the motor is secured to the frame in order to move the back axle via the drive mechanism. On front part of the frame is provided with the ploughs. The automation link is provided by the node MCU, and the connection is powered by a lead acid battery. The MCU is then linked to the mobile, and the hopper is affixed to the top rear axle. Seeds are then loaded into the hopper, and the machine is ready for agricultural use.

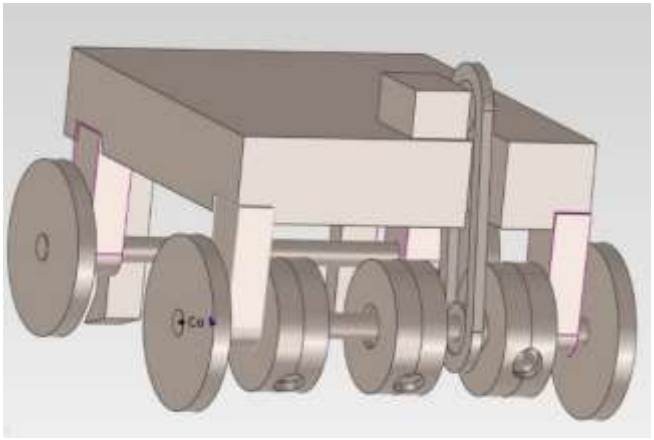


Figure 7 rear view of iron CAD design

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