

Design & Development of Automatic Seed Sowing Machine by Utilizing Solar Energy

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Abstract— In the current scenario, most of the countries do not have sufficient skilled man power in the agriculture sector and it affects the growth of developing countries. So it's a time to automate the agricultural sector to overcome this problem by using upgraded technology for cultivation activity. 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 a solar operated seed sowing machine.

Index Terms—Seed sowing machine, Solar energy, Automatic process, Automation, Agriculture,

1 INTRODUCTION

Agriculture is the backbone of the Indian economy and it will continue to remain so for a long time. The basic objective of seed sowing operation is to put the seed and fertiliser in rows at desired depth and spacing, cover the seeds with soil and provide proper compaction over the seed. The recommended row to row spacing, seed rate, seed to seed spacing and depth of seed placing vary from crop to crop and for different agricultural and climatic conditions. In order to achieve optimum yields and an efficient sowing machine, there should be an attempt to fulfil above requirements. In addition to that, effect of saving in cost of operation time, labor and energy are other advantages to be derived from use of improved machinery for such operations.

For a long time, it has been thought that atomic energy would be a solution for the growing energy problem, but in recent times solar energy has proved to be an efficient, more secure and safe way of providing energy. Concepts related to the solar energy have constantly been under heavy research and development. The basic objective is to optimize the energy produced from photovoltaic cells, by making the overall systems be more efficient and cost effective. Most solar panels are statistically aligned; they have a fixed position at a certain angle towards the sky. Therefore, the time and intensity of direct sunlight falling upon the solar panel is greatly reduced, resulting in low power output from the photovoltaic (PV) cells.

In traditional methods seed sowing is done by broadcasting manually, opening furrows by a plough and dropping seeds by hand. A traditional method of seed sowing has many disadvantages. This project is about the different types of methods of seed sowing and fertilizer settlement in the soil and developing a multifunctional seed sowing machine which can perform simultaneous operations.

Seed sowing machine is a device which helps in the sowing of seeds in a desired position, hence assisting the farmers in saving time and money. This project discusses different aspects of seed sowing machine which will be helpful for the agriculture industry to move towards mechanization. Mechanization of the agricultural industry in India is still in a stage of infancy due to the lack of knowledge and the unavailability of advanced tools and machinery

2 LITERATURE REVIEW

Klocke (1979) described the building of two experimental planters, one using a smooth coulter and the other a ripple edged coulter. Both types of coulters were followed by openers. The performance of the drills was satisfactory as long as the seed was placed into adequate soil moisture. Kumar et, at. (1986) developed a manually operated seeding attachment for an animal drawn cultivator. The seed rate was 43.2 kg/hr while the field capacity was 0.282 ha/hr. Tests

showed minimal seed damage with good performance for wheat and barley. Adisa and Braide (2012) developed template row crop planter.

Bamgboye and Mofolasayo (2006) developed a manually operated two-row Okra planter. The field efficiency and field capacity were 71.75% and 0.36 ha/hr. while seed rate was 0.36kg/hr with low average seed damage of 3.51%. Gupta and Herwanto (1992) designed and fabricate a direct paddy seederto match a two-wheel tractor. The machine had a field capacity of about 0.5 ha/hr at a forward speed of 0.81mls, and there was no damage caused by the metering mechanism for soaked seeds; though 3% damage was recorded for pre-germinated seeds.

LadeindeandVerma (1994) *Hand-pushed and Transnational Journal of Science and Technology August 2012 edition volume2, No.728* compared the performance of three different models of planters with the traditional method of planting. In terms of field capacity and labour requirement, there was not much difference between the traditional planting method and the Jab planters. However, backache and fatigue were substantially reduced while using the planters. tractor mounted row seeders (usually single and multiple row). Normally requires a well prepared seed-bed which may be ridged or flat bed. The single and double row planters developed at the University of Southern Mindanao Agricultural Research Centre (USMARC) can plant a hectare within 6-8 hours for single-row and half so much time for double-row. A disc type maize seeder developed which is simple in design and can be handily operated with ease and comfort. This is a labor intensive and time-consuming process. Lara-Lopez developed a singlerow direct planter for maize. The planter may be attached to a walking or riding type two-wheel tractor. Singh designed and developed a two-row tractor drawn ridge planter for winter maize.

Bamgboye and Mofolasayo tested a manually operated two row okra planter developed from locally available materials. The planter had a field capacity of 0.36 ha/h with a field efficiency close to 72%. In this paper we are designing of an advanced manual operated multi-crop seed planters, their utilization methods advantages, disadvantages and the process involving to design and fabrication of these planters for the purpose of utilization of poor farmers.

Laukik P. Raut studied to meet the food requirements of the *growing population and rapid industrialisation*, modernisation of agriculture is inescapable. Mechanisation enables the conservation of inputs through precision in metering ensuring better distribution, reducing quantity needed for better response and prevention of losses or wastage of inputs applied. Mechanisation reduces the unit cost of production through higher productivity and input conservation.

D. Ramesh and H. P. Girish Kumar presented review provide brief information about the various types of innovations done in seed sowing equipment. The basic objective of sowing operation is to put the seed and seed in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. The recommended row to row spacing, seed rate, seed to seed spacing and depth of seed placement vary from crop to crop and for different agro-climatic conditions to achieve optimum yields. Seed sowing devices play a wide role in the agriculture field.

Mahesh R. Pundkar and A. K. Mahalle" *A seed sowing machine: A review' journal of engineering and social science. (IJESS) volume 3, Issue 3. ISSN: 2249-9482*, states that high precision pneumatic planters have been developed for many varieties of crops for a wide range of seed sizes, resulting to uniform seeds distribution along the travel path, in seed spacing. The

basic function of sowing operation is to sow the seed and fertiliser in rows at required depth and to maintain the distance between the seeds and provide proper compaction over the seed. Also provides brief information about the various types of innovations done in seed sowing machine available for plantation. The performance of seed sowing device has a remarkable influence on the cost and yield of agriculture products. Presently there are many approaches to detect the performance of seed-sowing device

N.Iqbal et al" *Effect of seed rate and Row spacing on yield and yield components of Wheat "Journal of Agricultural Research, 48(2)*.studied the effect of seed rate and row spacing on yield and yield components of wheat and concluded that seed rate of 150 kg/ha performed better for late sowing of wheat up to 28 November. Among row spacing 22.5 cm row spacing produced higher grain yield as compared to 11.25 and 15 cm row spacing.

P.P. Shelke et al, "*Frontline demonstration on bullock-drawn planter enhances yield of soya bean crop" International journal of farm science 1(2):123-128, 2011*. Planting distance and plant population are crucial factors in maximising the yields of crops. He concludes that bullock drawn planters are becoming necessity for sowing as the skilled workers for sowing are almost diminishing. Planting distance and plant population are crucial factors in maximising the yields of crops. Singh revealed that by using a seed drill for wheat crop there was an increase in yield by 13.025 percent when compared with the conventional method, it also revealed that by using a seed drill for wheat crop, a saving of 69.96 per cent in man-hours and 55.17 percent in bullock hours was achieved when compared, with the conventional method.

Mohammed Jamil rajput et al," *Effect of Row and Plant spacing on yield and yield components in soya bean", Journal*

Of agriculture Research, volume 5, No. 2. Studied the effect of row and plant spacing on yield and yield components in soya bean and concluded that the combination of 45 cm row spacing and 20 cm plant spacing gave the best results.

Singh et al "*Automatic Seed Planter Punching Type" International Journal of Emerging Technology & Research Volume 1, Issue 3, 2014* ISSN (E): 2347-5900 ISSN(P): 2347-6079 , revealed that by using a seed drill machine for wheat crop there was an increase in yield by 13.025 percent when compared with the conventional method, it also revealed that by using a seed drill for wheat crop, a saving of 69.96 per cent in man-hours and 55.17 percent in bullock was achieved when compared, with the conventional method.

Pranil V. Sawalakhe investigated the today's 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. This Paper deals with the various sowing methods used in India for seed sowing and seed placement.

Umed Ali Soomro et al, "*Effects of sowing Method and Seed rate on Growth and yield of wheat" World Journal of Agricultural Sciences 5(2):159- 162*. has evaluated three sowing methods and seed rate in a four replicated RCBD method and concluded that drilling method of sowing at seed rate is optimal for yield and quality of wheat grains, because the said sowing method and seed rate distribute seed uniformly and desired depth which provide appropriate depth for seed germination and crop establishment.

Swetha.S et al "*Solar Operated Automatic Seed Sowing Machine", International Journal of Advanced Agricultural Sciences and Technology 2015, Volume 4, Issue 1, pp. 67-71,*

In this machine solar panel is used to capture solar energy and then it is converted into electrical energy which in turn is used to charge battery, which then gives the necessary power to a motor. This power is then transmitted to the motor to drive the wheels. And to further reduction of labor dependency, IR sensors are used to manoeuvre robot in the field. Here 4 post sensors are used to define the territory and robot senses the track length and pitch for movement from line to line.

2.2 Summary of literature

Mahesh R. Pundkar stated that the seed sowing machine is a key component of agriculture field. high precision pneumatic planters have been developed for many varieties of crops, for a wide range of seed sizes, resulting to uniform seeds distribution along the travel path, in seed spacing.

P.P. Shelke concludes that bullock drawn planters are becoming necessity for sowing as the skilled workers for sowing are almost diminishing. Planting distance and plant population are crucial factors in maximising the yields of crops.

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Umed Ali Soomro et al. in Pakistan has evaluated three sowing methods and seed rate in a four replicated RCBD method and concluded that drilling method of sowing at seed rate 125 kg/ha is optimal for yield and quality of wheat grains, because the seed sowing method and seed rate distribute seed uniformly and desired depth which provide appropriate depth for seed germination and crop establishment.

3. TRADITIONAL METHODS OF SEED SOWING

3.1.1. Broadcasting: - A field is initially prepared with a plough to a series of linear cuts known as furrows. The field is then seeded by throwing the seeds over the field, a method known as manual broadcasting. The result was a field planted roughly in rows, but having a large number of plants. When the seeds are scattered randomly with the help of hand on the soil, the method is called broadcasting.

3.1.2. Dribbling: - Drill sowing and dribbling (making small holes in the ground for seeds) are better method of sowing the seeds. Once the seeds are put in the holes, they are then covered with the soil. This saves time and labor and prevents the damage of seeds by birds.

3.1.3. Another method of sowing the seeds is with the help of a simple device consisting of bamboo tube with a funnel on it attached to a plough. As the plough moves over the field the tube attached to it leaves the seeds kept in the funnel at proper spacing and depth. The plough keeps making furrows in the soil in which the seeds are dropped by the seed drill.

3.2. LIMITATIONS IN SOWING METHODS

1. No control over the depth of seed placement.
2. No uniformity in the distribution of seed placement.
3. Loss of seeds.
4. No proper germination of seeds.
5. During sowing, Placement of seeds at uneven depth may result in poor emergence because subsequent rains bring additional soil cover over the seed and affect plant emergence.
6. More labor requirement.
7. Time required for sowing is more.

4. TRADITIONAL SEED SOWING MACHINE

Another method of sowing the seeds is with the help of a simple device consisting of bamboo tube. This bamboo tube with a funnel on it is attached to a plough. When the plough moves over the field, the tube attached to it leaves the seeds and kept in the funnel at proper depth as well as spacing. The plough keeps making furrows in the soil in which the seeds are dropped by the seed drill.

4.1. LIMITATIONS OF THE SEED SOWING MACHINE

1. The Weight of the Machine is more.
2. Available for Tractors drive.
3. No Arrangement for depth control.
4. No Arrangement for seed bed preparation.
5. Improper compaction of soil over furrows.
6. Adjustment of row spacing is improper.
7. The cost of machine is more.

5. PROBLEM DEFINITION

Growing the crop means ploughing the field and sowing the seeds into it. Three steps are mainly taken to sow the seed; spreading the seeds over the soil, separate germination of seeds, and sowing the seeds into the soil.

The two latter processes take more time consuming and need more labor force to complete the work, even though some machines have poor accuracy and efficiency. It being the area of concern needs to be looked upon. The two latter processes take more time and labour to complete the work. It being the area of concern needs to be looked upon. Hence, an idea to implement the automation in the process of seed sowing raised. Therefore the aim was to design and develop a less expensive, distinct attachment to the machine

so that it can be used in a easy way.

For the fabrication, components were decided based on the material, factor of safety and the calculations were done to find out the speed of the machine at various output of the motor to be used to match the requirements. The design parts were modeled using solidworks software and the assembly was done to finalize the best position of the components. At the manufacturing end, the chassis was fabricated to form the skeleton for the hardware. The belt and pulley drive was installed with the wiper motor for proper functioning of the prototype. For better transmission, the angle of contact of belt and pulley is kept near 60 degrees. The automation part was done after the fabrication was completed. The code was generated and the connections were made and testing performed successfully for the finally manufactured prototype.

6. NEED OF PROJECT

An idea to implement the automation in the process of seed sowing raised. Therefore the aim was to design and develop a less expensive, distinct attachment to the machine so that it can be used in a easy way. For the fabrication, components were decided based on the material, factor of safety and the calculations were done to find out the speed of the machine at various output of the motor to be used to match the requirements. The design parts were modeled using CATIA software and the assembly was done to finalize the best position of the components.

7. STUDY OF COMPONENTS

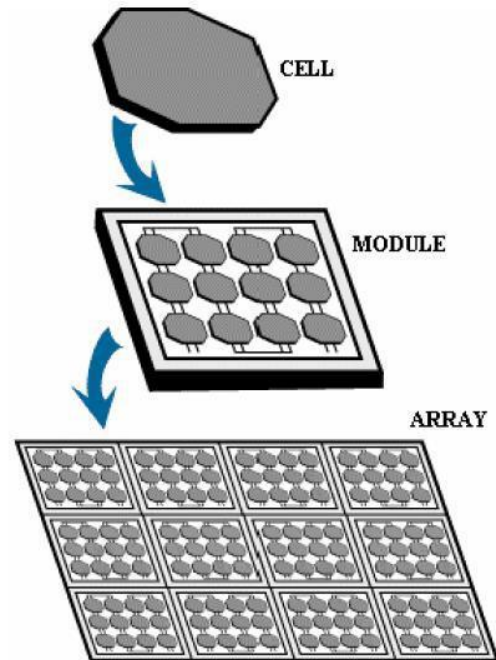
7.1. STUDY OF PHOTOVOLTAIC (PV) CELL

The photoelectric effect was first noted by a French physicist, Edmund Becquerel, in 1839, who found that certain materials would produce small amounts of electric current when exposed to light. In 1905, Albert Einstein described the nature

of light and the photoelectric effect on which photovoltaic technology is based, for which he later won a Nobel prize in physics. The first photovoltaic module was built by Bell Laboratories in 1954. It was billed as a solar battery and was mostly just a curiosity as it was too expensive to gain widespread use. In the 1960s, the space industry began to make the first serious use of the technology to provide power aboard spacecraft. Through the space programs, the technology advanced, its reliability was established, and the cost began to decline.

During the energy crisis in the 1970s, photovoltaic technology gained recognition as a source of power for non-space applications. The solar cells that you see on calculators and satellites are also called photovoltaic (PV) cells, which as the name implies (photo meaning "light" and voltaic meaning "electricity"), convert sunlight directly into electricity. A module is a group of cells connected electrically and packaged into a frame (more commonly known as a solar panel).

Solar panels are made of photovoltaic (PV) cells, which turn sunlight into electricity. This electricity can then be fed into your home's mains electricity supply. The technology behind solar is relatively old, despite their futuristic appeal, but while the basics are the same the efficiency of solar panels has improved greatly in recent years.



SOLAR PANEL:

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating. The primary component of a solar panel is the solar cells, or photovoltaic cell. This is the key component that converts sunlight into electricity. At the present time about 80% of all solar panels are made from crystalline silicon (i.e. monocrystalline, polycrystalline, amorphous silicon, or hybrids) solar cells.

Typically the solar cells are laid out in a grid pattern – with perhaps as many as 72 different solar cells.

The other 20% consist primarily of solar cells made mostly from Cadmium Telluride and a small but growing amount from CIGS. The appeal of these types of cells is their low cost resulting from the fact they can be made in large single sheets. Lots of small solar cells spread over a large area can work together to provide enough power to be useful. The more light that hits a cell, the more electricity it produces, so the machine is usually designed with solar panels that can always be pointed at the Sun even as the rest of the body of the machine moves around.

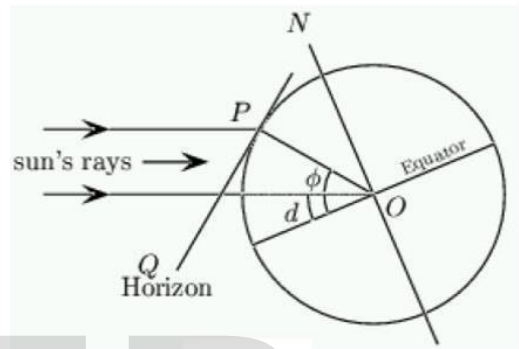


Declination

Declination may be defined as the angle between the line joining the centers of the sun and Earth and its projection on the equatorial plane. Declination varies from a max. value of 23.45° to the min. value of -23.45°. Mathematically it can be calculated by the following relation:

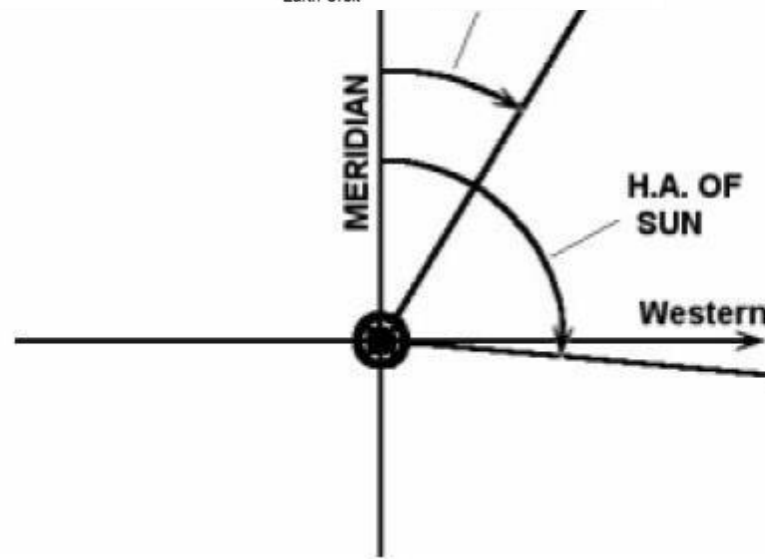
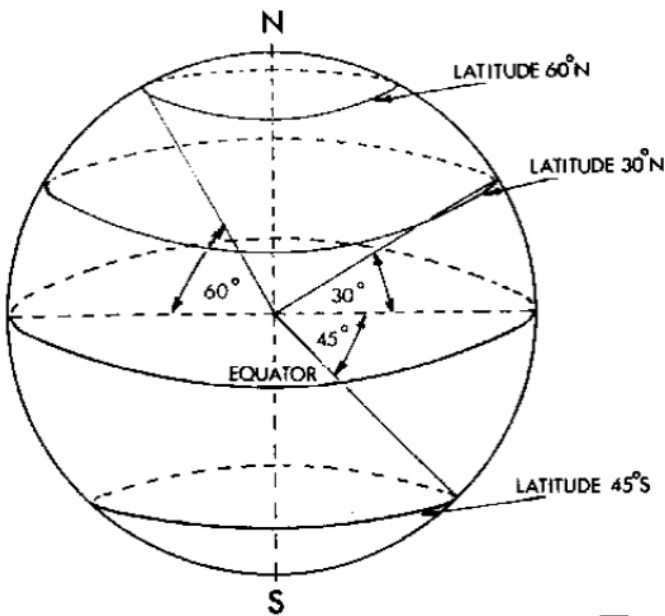
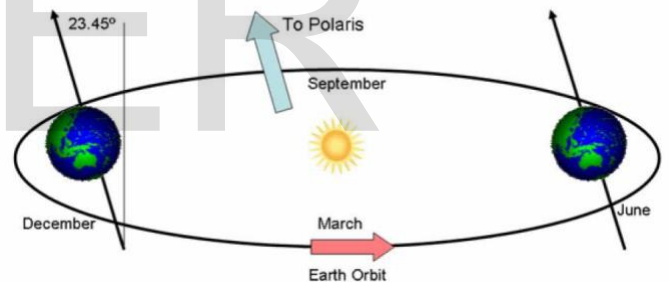
$$d = 23.45 \cdot \sin[(360/365) \cdot (284 + n)]$$

where n = day of the year.



7.2. STUDY OF ANGLES Latitude Angle (Φ)

The latitude of a location is the angle made by the radial line joining the given location to the center of the earth with its projection on the equatorial plane. The latitude is positive for the northern hemisphere and negative for southern hemisphere.



7.3. SPECIFICATIONS OF COMPONENTS

7.3.1. Chassis: chassis is a skeleton of the fabricated object, which supports the object in its construction and use. It is made up of C. I. angle bar of dimension 50mm x 50mm x 5 mm on which other components like hopper, disk, shaft etc are mounted.

Functions of chassis:

1. Supports or bears the load of the vehicle body.
2. Provide the space and mounting location for various aggregates of vehicle.
3. Supports the weight of various systems of the vehicle such as engine, transmission etc.
4. Supports a load of passengers as well as the luggage.
5. Withstands the stresses arising due to bad road conditions.
6. Withstands stresses during braking and acceleration of the vehicle.



7.3.2. Hopper: The Seed Hopper consists of a seed drum made up of two frustums. The small ends of frustums are connected with plastic cylinders. The large ends of frustums are connected to each other and three holes are created on the larger circumference of the hopper. Seeds are inserted in the frustums with the help of capped openings on the face of frustum.

Hopper will rotate about its central axis. Seed spacing will be maintained by the holes which are created on the circumference with equal distance. Hopper is made up of Sheet metal which contains Seed. A hopper can be used as a container & a crafting ingredient. A hopper has an output tube at its bottom that can face down or sideways and provides a visual indication of which block the hopper is setup to drop its items into, if the block has an inventory. To place a hopper, use the place block control while aiming at the surface to which its output should face. To place a hopper directly on the face of an already intractable block, the block instead faces downwards. A hopper does not change direction after placement, and it is not attached to the container it faces; the container can be removed or replaced, and the hopper remains unchanged.



7.3.3. Shaft Shaft form the important element of machines. They are element that support rotating parts like gears and pulleys and it turn are themselves supported by bearings resting in the rigid machine housing. The shafts perform the function of transmitting power from one rotating member to another supported by it or connected to it. Thus, they are subjected to torque due to power transmission and bending moment due to reactions on the members that are supported by them. Shafts are to be distinguished from axles which also support rotating members but do not transmit power.

Shafts are always made to circular cross-section and could be either solid or hollow. The shafts are classified as straight, cranked, flexible or articulated. Straight shafts are commonest to be used for power transmission. Such shafts are commonly designed as stepped cylindrical bars, that is, they have various diameters along their length, although constant diameter shafts would be easy to produce. The stepped shafts correspond to magnitude of stress which varies along the length. Moreover, the uniform diameter shafts are not compatible with assembly, disassembly and maintenance such

shafts would complicate the fastening of the parts fitted to them, particularly the bearings, which have restricted against sliding in axial direction. While determining the form of stepped shaft it is borne in mind that the diameter of each cross-section should be such that each part fitted on to the shaft has convenient access to its seat.

7.3.4. Plougher. A plougher is a farm tool for loosening or turning the soil before sowing seed or planting. Ploughs were traditionally drawn by oxen and horses, but in modern farms are drawn by tractors. A plough may have a wooden, iron or steel frame, with a blade attached to cut and loosen the soil. It has been fundamental to farming for most of history. The earliest ploughs had no wheels, such a plough being known to the Romans as an *erratum*. Celtic peoples first came to use wheeled ploughs in the Roman era.

The primary purpose of ploughing is to turn over the uppermost layer of soil, so bringing fresh nutrients to the surface, while burying weeds and crop remains to decay. The trenches cut by the plough are called furrows. In modern use, a ploughed field is normally left to dry out and then harrowed before planting. Ploughing and cultivating soil homogenizes and modifies the upper 12 to 25 centimeters (5 to 10 in) layer of soil, where most plant feeder roots grow. Ploughs were initially powered by humans, but the use of farm animals was considerably more efficient. The earliest animals used were oxen. Later horses and mules were used in many areas. With the industrial revolution came the possibility of steam engines to pull ploughs. These in turn were superseded by internal-combustion-powered tractors in the early twentieth century.

Use of the traditional plough has decreased in some areas threatened by soil damage and erosion. Used instead is shallower ploughing or other less-invasive conservation tillage.

7.3.5. Wheel: A circular plate is mounted on the bush with the help of C. I. Strip and spikes of certain measurements

(according soil condition) on the surface of circular plate.



7.3.6. Battery. -A battery is a device consisting of one or more electrochemical cells with external connections for powering electrical devices such as flashlights, mobile phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower-energy products, and the free-energy difference is delivered to the external circuit as electrical energy. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved to include devices composed of a single cell.

Primary (single-use or "disposable") batteries are used once and discarded, as the electrode materials are irreversibly changed during discharge; a common example is the alkaline battery used for flashlights and a multitude of portable

electronic devices.

Secondary (rechargeable) batteries can be discharged and recharged multiple times using an applied electric current; the original composition of the electrodes can be restored by reverse current. Examples include the lead-acid batteries used in vehicles and lithium-ion batteries used for portable electronics such as laptops.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to small, thin cells used in smartphones, to large lead acid batteries or lithium-ion batteries in vehicles, and at the largest extreme, huge battery banks the size of rooms that provide standby or emergency power for telephone exchanges and computer data centers.

Batteries have much lower specific energy (energy per unit mass) than common fuels such as gasoline. In automobiles, this is somewhat offset by the higher efficiency of electric motors in converting chemical energy to mechanical work, compared to combustion engines.



7.3.7. Electric Motor:-

An electric motor is a device used to convert electricity into mechanical energy— opposite to an electric generator. They operate using principles of electromagnetism, which shows that a force is applied when an electric current is present in a magnetic field. This force creates a torque on a loop of wire

present in the magnetic field, which causes the motor to spin and perform useful work. Motors are used in a wide range of applications, such as fans, power tools, appliances, electric vehicles, and hybrid cars. According to Ampere's Law, a wire which carries an electric current produces a magnetic field around it. Following this law, an electric motor is a device used to convert electrical energy to mechanical energy. Electric motors are extremely important in modern-day life. The basic principle on which motors operate is Ampere's law. This law states that a wire carrying an electric current produces a magnetic field around itself.



7.3.8. Piston:-A piston is a component of reciprocating engines, reciprocating pumps, gas compressors and pneumatic cylinders, among other similar mechanisms. It is the moving component that is contained by a cylinder and is made gas-tight by piston rings. In an engine, its purpose is to transfer force from expanding gas in the cylinder to the

crankshaft via a piston rod and/or connecting rod. In a pump, the function is reversed and force is transferred from the crankshaft to the piston for the purpose of compressing or ejecting the fluid in the cylinder. In some engines, the piston also acts as a valve by covering and uncovering ports in the cylinder.

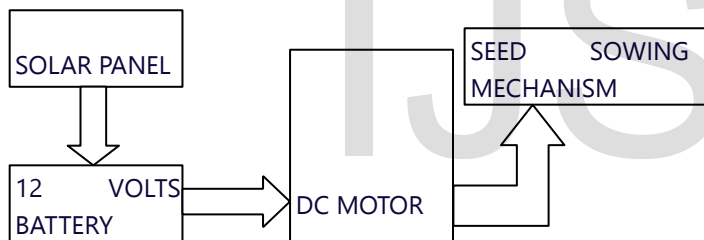


7.3.9. Connecting rod:-A connecting rod, also called a con rod, is the part of a piston engine which connects the piston to the crankshaft. Together with the crank, the connecting rod converts the reciprocating motion of the piston into the rotation of the crankshaft. The connecting rod is required to transmit the compressive and tensile forces from the piston, and rotate at both ends. The predecessor to the connecting rod is a mechanic linkage used by water mills to convert rotating motion of the water wheel into reciprocating motion. The most common usage of connecting rods is in internal combustion engines and steam engines.



1000 RPM and 7 kgcm torque. This is connected to 12 V and 1.3 A DC battery. This is directly connected to the solar panel through which it gets charged. With help of which it can be start and stop which rotates in clockwise motion of motor. For dropping seed we are using a hopper which is mounted at the top of the machine. The seed from the hopper goes down; the small hole in the bottom of the hopper is provided. The cross cut piston arrangement is made between the gap of the hollow mid of hopper and the bottom of the hole in the hopper. The piston is connected to the disc with the help of connecting rod; the whole system acts like a crankshaft mechanism. The vertical movement of the cross cut piston allows the appropriate amount of seeds to be placed in the field.

7. WORKING METHODOLOGY



This solar powered seed sowing machine basically works on "VERTICAL DISCONTINUOUS WORKING PRINCIPLE" Which refers to the vertical movement which can be followed by an individual body in an agricultural field and implements its discontinuous action in relation to the horizontal line of work. As per name indicate this machine is used for sowing seed. Which includes: -

1. Plough the ground.
2. Sow the seed inside the ploughed ground.
3. Cover that ploughed ground with the help of adjuster.

Wheels of the machine are rotated by the DC Motor which runs with the help of battery power. Firstly a hole is ploughed with the help of 4 inch ploughing rod and with a depth of cut- 6 cm The base is run with the help of motor

The basic objective of sowing operation is to put the seeds in rows at desired depth, to maintain seed to seed spacing and to cover the seeds with soil and provide proper compaction over the seed. The recommended row to row spacing, seed rate, seed to seed spacing and depth of seed placement can vary from crop to crop and for different agroclimatic conditions to achieve optimum yields.

8.1. SEED SOWING MACHINE MECHANISM

8.1.1. Seed meter mechanism

Rotary motion of wheels provided to the sowing shaft (which will placed in seed storage tank) by sprocket or belt drive. Due to this shaft will rotates and it drop the seed from hopper. The basic objective of sowing operation is to put theseed and fertilizer in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide concentrate on agriculture without the need to remember to charge this machine. The solar panel keeps on charging the battery online whenever the battery charge drops below a particular level. Thus this vehicle forms a complete automated

solution for the problems faced by the Indian farmers today.

8.1.2. Digger mechanism

Digger mechanism is used for digging and seeding. Digger itself is used as digging tool. Digger is connected to the frame by nut bolt. There are three adjustable digger. A digger has a flapper for opening into the cavity for seeding. Flapper is connected to the hopper with the help of hose.

8.1.3. Seed storage tank

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 as shown in figure 5. 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. Also 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.

8.1.4. Power Unit

The power unit consists of a rechargeable battery which supplies the power for all components of the robotic vehicle. There is also a provision for charging the battery when the battery is discharged. It also contains a solar PV panel and a charge controller. The solar energy is harnessed using the solar PV panels and stored into the battery using a charge controller. Thus this robot doesn't require charging and can be charged using solar energy. Thus by assembling all these components we can make a fully functional smart automated robotic vehicle for Indian farmers. Further the entire system is powered using solar energy which makes Indian farmers to worry less about charging of the robot and completely concentrate on their work.

9. DESIGN OF SEED SOWING MACHINE

9.1. Design Calculations

9.1.1. Calculation for rpm and shaft radius of the motor from motor power

Assuming the force required for ploughing of the field is around 200 N and $n=30$ rpm for motor with 8.4 watts power, the following calculations are made,

Power=Force \times Velocity

$$=200 \times r \times \omega$$

$$=200 \times 0.5 \times 2\pi \times 30/60$$

$$=314 \text{ watts}$$

Power Input, $P_{in} = 314$ Watts

Power output, $P_{out} = P_{in} \times \text{Efficiency}$

Efficiency of an electric motor to convert electrical energy to mechanical for the work to be done is assumed to be as 10%.

At 10 % efficiency,

Power output, $P_{out} = 314 \times 0.1 = 31.4$ Watts

9.1.2. To determine the shaft radius,

Power = Torque \times angular velocity = $T \times \omega$

Power = Force \times shaft radius \times angular velocity

$$31.4 = 200 \times r \times \omega$$

$$r \times \omega = 0.157 \text{ m/sec} \dots\dots\dots (3) \quad \omega = 2 \times \pi \times n/60$$

Using above equation, equation (3) can be written as,

$$r \times n = (0.157 \times 60)/2 \times 3.141$$

$$r \times n = 1.499 \text{ m- rev per minute} \dots\dots(4) \text{ substitute in the above}$$

$$\text{equation (4) } r = 4.59 \text{ mm, } r = 5 \text{ mm (approx..)}$$

At $n = 60$ rpm

The moving speed of the vehicle at this rpm can be calculated as,

Velocity = angular velocity \times radius of the front wheel (5)

$$\text{Velocity} = 2 \times \pi \times 60 \times 0.072 / 60 = 0.4523 \text{ m/sec} = 1.628 \text{ km/hr.}$$

The velocity of the vehicle obtained at 60 rpm is 1.628 km/hr which is less than average walking speed of humans i.e.,

4km/hr.

At this speed, the area that can be covered is,

Area covered = vehicle speed x seed
space metering x 2 Area covered =
 $1.628 \times 0.02 \times 2 = 65.12 \text{ m}^2/\text{hr}$.

This means on 1 acre (4046.86 m²) land, the seeds can be sown in 60 hours 10 minutes.

At n =500 rpm
The moving speed of the vehicle at this rpm can be calculated as,

Velocity = angular velocity x radius of the front wheel

Velocity = $2 \times \pi \times 500 \times 0.072 / 60 = 3.769 \text{ m/sec} = 13.568 \text{ km/hr}$.

The velocity of the vehicle obtained at 500 rpm is 13.568 km/hr which is more than average walking speed of humans i.e., 4km/hr.

At this speed, the area that can be covered is,

Area covered = Speed of the vehicle x seed space
metering x 2 Area covered = $13.568 \times 0.02 \times 2 =$
 $542.72 \text{ m}^2/\text{hr}$.

This means on 1 acre (4046.86 m²) land, the seeds can be sown in 7 hours 45 minutes.

9.1.3. Calculation of distance between two seeds

As we have maintained the gear ratio as 1 between rear wheels and the seeder, one revolution of the rear wheel will transmit one revolution to seeder mechanism.

As the radius of the rear wheel is 0.072 m, for one revolution of the rear wheel the distance (D) travelled is given by,

$D = 2 \times \pi \times \text{radius of rear wheel}$

$D = 2 \times \pi \times 0.072$

$D = 450 \text{ mm}$ (approx.)

9.1.4. Calculation of Moment

During the sowing process the joint of cultivator and the machine will experience force. The moment acting on the joint of cultivator is,

Moment = Shear force x perpendicular distance

Moment = $200 \times 0.45 = 90 \text{ N-m}$

10. ADVANTAGES

1. Economical.
2. User friendly and can be easily operated by Indian farmers.
3. Solar powered, hence doesn't require charging.
4. Safe equipment.
5. Maintain row spacing.
6. Proper utilization of seeds can be done with less loss.
7. Perform the various simultaneous operations and hence saves labor requirement, labor cost, labor time, total cost of saving and can be affordable for the farmers.
8. Achieves automation in agricultural field.

11. LIMITATIONS

1. Machine requires more effort in hard soil.
2. Operating force varies from land to land.

12. FUTURE SCOPE

1. Introduction of Cutter in place of plougher can be used as grass cutter equipment.
2. Using arduino can control machine through the software application.
3. Addition of multi-sized toothed wheel can be attached for sowing of large farm.
4. Water dripping unit could be included in seed sowing machine.

13. CONCLUSION

This seed plantation machine has great potential for increasing the productivity of the planting. Till now tractor was the main traction unit for nourishment in farming. With the adaptation of this seed planting machine its purpose will be done. Hence there is need to promote this technology and

made available to even small scale farmers with affordable prices. This machine can be made by raw materials also which saves the cost of whole project and is easily manufactured in available workshops. Hence by using this machine we can achieve flexibility of distance and control depth variation for different seeds. Hence usable to all seeds.

By using this project of seed sowing equipment we can save more time required for sowing process and also it reduces lot of labor cost. It is very helpful for small scale farmers. After comparing the different method of seed sowing and limitations of the existing machine, it is concluded that the this solar powered seed sowing machine can

1. Maintain row spacing and controls seed rate.
2. Control the seed depth and proper utilization of seeds can be done with less loss.

3. Perform the various simultaneous operations and hence saves labour requirement so as labour cost, labour time and also save lots of energy.



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