

Design and Development of Multipurpose Agriculture Solar Machine

Prof. D. B. Dukale¹ Pratik Shinde² Shubham Shinde³ Hitesh Shedulkar⁴ Akshay Shirsat⁵

¹Assistant Professor ^{2,3,4,5}Student

^{1,2,3,4,5}Department of Mechanical Engineering

^{1,2,3,4,5}TAE, Pune, India

Abstract— Agricultural machines deployed for agriculture purposes. In this regard here is a demo model of such equipment, which performs the operation very effectively. Such types of machines which are used in the agricultural fields, are called as agribots. Here in this module we have designed a machine which can be a semi-automatic or fully automatic which can run on solar system to perform plugging digging, seeding and mulching in the field or greenhouse. By the development of these bot lots of manual labor will also be decreased. The development and the fabrication of the robot which can dig the soil, put the seeds, leveler to close the mud and these whole systems of the robot work with the battery and the solar power. More than 40% of the population in the world chooses agriculture as the primary occupation, in recent years the development of the autonomous vehicles in the agriculture has experienced increased interest. In the field of agricultural autonomous vehicle, a concept is been developed to investigate if multiple small autonomous machine could be more efficient than traditional large tractors and human forces. Keeping the above ideology in mind, a unit with the following feature is designed: Ploughing is one of the first steps in farming. During this process we till the land and make it ready for the seed sowing. By tilling we mean that a plough will be used which will have teeth's like structure at the end and will be able to turn the top layer of soil down and vice-versa. Seed sowing comes next where the seeds need to be put in ground at regular intervals and these needs to be controlled automatically. Limiting the flow of seeds from the seeds chamber is typically doing this.

Keywords: Machines, Seeding, Digging Mechanism, Battery, Solar Power

I. INTRODUCTION

Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. This project work described here is quite useful in the agricultural fields. The project aims on the design Agricultural Robot for Spraying water, seeding, Mulching and cutting operation". More than 42% of the total population in the world has chosen agriculture as their primary occupation. In recent years, the development of autonomous vehicles in agriculture has experienced increased interest. This development has led many researchers to start developing more rational and adaptable vehicles. In the field of agricultural autonomous vehicles, a concept is being developed to investigate if multiple small autonomous machines would be more efficient than traditional large tractors and human force. These vehicles should be capable of working 24 hours a day all year round, in most weather conditions and have the intelligence embedded within them to behave sensibly in a semi-natural environment over long periods of time, unattended, while carrying out a useful task. There are a number of field operations that can be executed

by autonomous vehicles, giving more benefits than conventional machines.

II. PROBLEM STATEMENT

In farming there is lack of mechanization so for that it required excessive efforts to do different farming process. Through this it consumes time and more man power as well. Excessive time consumption for performing individual process for limited cultivable area.

III. OBJECTIVE

- The seeds and fertilizers can be placed at proper depth.
- The loss and damage of seeds is controlled by this machines
- To perform spraying digging, ploughing, seeding operations
- To increase productivity.
- Reduce man power

IV. LITERATURE REVIEW

1) Nithin P V1, Shivaprakash S2 UG Student, Mechanical Engineering, NHCE, Bengaluru, Karnataka, India

– A Review on Multipurpose agricultural robot [1]

The paper aims on the design, development and the fabrication of the robot which can dig the soil, put the seeds, leveller to close the mud and sprayer to spray water, these whole systems of the robot works with the battery and the solar power. The development of the autonomous vehicles in the agriculture has experienced increased interest. The vehicle is controlled by Relay switch through IR sensor input. The language input allows a user to interact with the robot which is familiar to most of the people.

2) Gholap Dipak , More Vaibhav Prof. Joshi S.G BE[E&TC], Vishwa Bharati Academy's College of Engineering, Pune university, Ahmednagar, Maharashtra

– A Review Is On Robotics Of Agriculture Machine &Advanced Process Based On Robotics Platform. [2]

This paper presents a system with high speed of operation for an advanced agriculture process which includes cultivation based on robotic platform. The robotic system is an electromechanical (conveys a sense that it has agency of its own) and artificial agent which is steered by DC motor which has four wheels. The farm is cultivated by the machine, depending on the crop considering particular rows & specific columns. The infrared sensor detects the obstacles in the path and it also senses turning position of vehicle at end of land. The seed block can be detected and solved using water pressure. The machine can be controlled remotely and solar panel is used to charge DC battery. Assembly language is used in programming the microcontrollers. The microcontroller is used to control and

monitor the process of system motion of vehicle with the help of DC motor. The result of implemented unit is also presented.

- 3) Wankhede, A. P. Rathod, A. V. Gorde, R. K. Gondane – A Design Modification Of Advance Seed Sowing Machine [3]

The purpose of developing this paper is to develop multipurpose machine to reduce cost and time required for seed sowing and fertilizer placement. By using advance seed sowing machine and advance techniques we can increase the production of crops in minimum cost and time

- 4) Mr. Muhammed Kashif R, Mr. Sharanabasappa Bola Shetty, Mr. Mohammed Yaseen A H, Ms. Bhargavi – A Design And Development Of Semi-Automated Multipurpose Agriculture Wheel Hoe [4]

The main objective of this project is to design and development of semi-automated multipurpose agricultural wheel hoe to use of weeding, ploughing and cultivating in single equipment. Their aim is to reduce the man power required for the operation of the wheel hoe. The only way is to automate it but we cannot fully automate it due to few constraints such as it will require electricity which will not be mostly available in villages, they will be requiring Microprocessor and sensors which will again increase the cost and might require skill to use it. They thought of solution being that instead of automating it fully they planned to semi automate it using engine, motors and power transmission equipment's. This might help us reaching their goal by reducing the man power as well as cost. In this design, fabricate and testing of semi-automated multipurpose agricultural wheel hoe to use of various agricultural operations. They designed and fabricate Wheel hoe and made semi-automated operative with the use of 2 stroke petrol engines to assist human to perform various agricultural operations like cultivating, ploughing, weeding and also other operations by attaching and detaching different tools for different agricultural operations.

V. CONSTRUCTION

The Construction Of The Solar Operated Multipurpose Agriculture Machine Consists Of Main Parts. They Are

A. Mobile Platform

- Frame stand
- Wheel
- DC motor
- Rocker Switch
- Battery
- Gear wheel
- Solar panel

1) Frame Stand & Wheels

The frame stand is the steel welded in such a way that it can carry the whole equipment. The steels are welded strongly in welding laboratory with an idea to carry the entire robot with the control unit, battery and DC motor in the mobile platform and the IR sensor, solenoid valve and spray gun in the roller shaft. Four wheels are attached to the frame stand in order to move the robot in the direction specified. The movement of these wheels are controlled by the DC motor

rotation which is controlled by the microcontroller. Since it is obvious that if either the movement of front or back wheels are controlled automatically the movement of the other one will be controlled. Therefore, in this robot the movement of the back wheels are controlled using the DC motor such that the movement of entire robot is controlled.

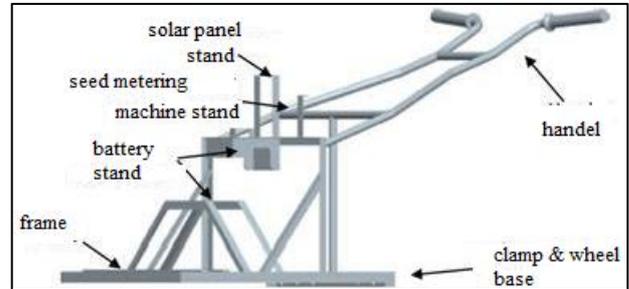


Fig. 1:

2) DC Motor

DC motors are part of the electric motors using DC power as energy source. These devices transform electrical energy into mechanical energy. The basic principle of DC motors is same as electric motors in general, the magnetic interaction between the rotor and the stator that will generate spin. DC motors are widely used in speed and direction control because control of these motors are easier than other motors. The motion of a DC motor is controlled using a DC drive. DC drive changes the speed and direction of motion of the motor. Some of the DC drives are just a rectifier with a series resistor that converts standard AC supply into DC and gives it to the motor through a switch and a series resistor to change the speed and direction of rotation of the motor. But many of the DC drives have an inbuilt microcontroller that provides programmable facilities, message display on LCD, precise control and also protection for motors.

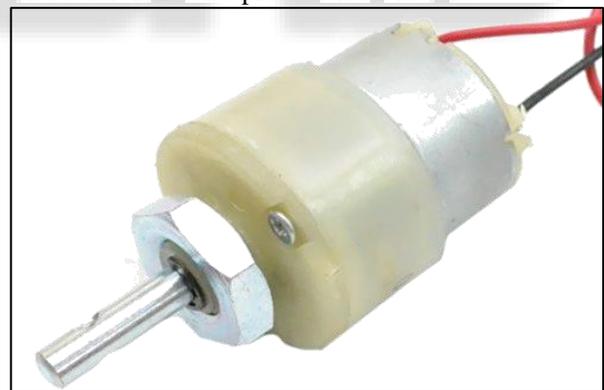


Fig. 2:

3) Controlling of DC motor using Rocker Switch

- 1) Rocker Switch provides us only digital logic (1 or 0)
 - 2) The polarity can't be provided from Rocker switch
 - 3) The motors can't be connected to Controller as mostly motors run on voltage higher than +5V, and motors demands high current (depends), this can be removing by use of a "H Bridge here four transistors are used to change polarity.
- a) Specification of DC motor: The specification the DC motor used in this project is mentioned as follows:
- Voltage -12V
 - No load speed -45rpm

- Load speed -40rpm
- No load current -75mA
- Load current -1400mA
- Power -17W

4) Rocker Switch

A rocker switch is an on/off switch that rocks (rather than trips) when pressed, which means one side of the switch is raised while the other side is depressed much like a rocking horse rocks back and forth. A rocker switch may have a circle (for "on") on one end and a horizontal dash or line (for "off") on the other to let the user know if the device is on or off. Rocker switches are used in surge protector display monitors, computer power supplies, and many other devices and applications. A rocker switch with independent circuitry can have a light activated on the face of the switch in both the on and off positions, which allows the switch to be found easily in the dark. With dependent circuitry, the light is activated only when the switch is on.

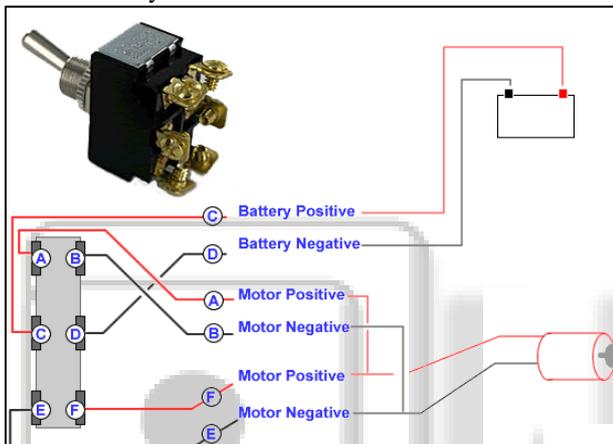


Fig. 3: Rocker Switch

5) Battery

In order to provide supply to the controller unit battery is used. Lead acid battery is used in this project. The lead-acid battery is a rechargeable battery. Despite having a very low energy-to-weight ratio and a low energy-to volume ratio, their ability to supply high surge currents means that the cells maintain a relatively large power-to-weight ratio. These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by automobile starter motors.



Fig. 4: 12 V DC Battery

6) Gear Wheel Mechanism

The spur gears, which are designed to transmit motion and power between parallel shafts, are the most economical gears in the power transmission industry. The spur gear arrangement is used to move the conveyor in forward and direction.

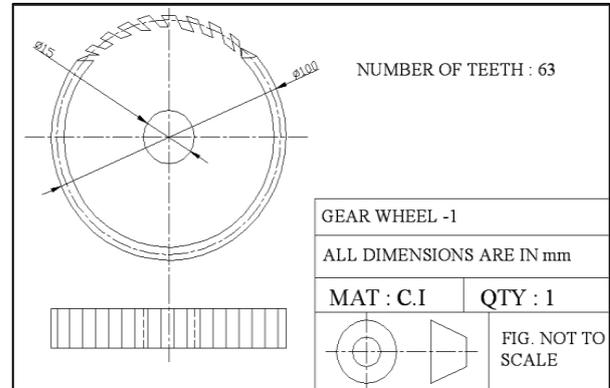


Fig. 5:

7) Solar Panel

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).

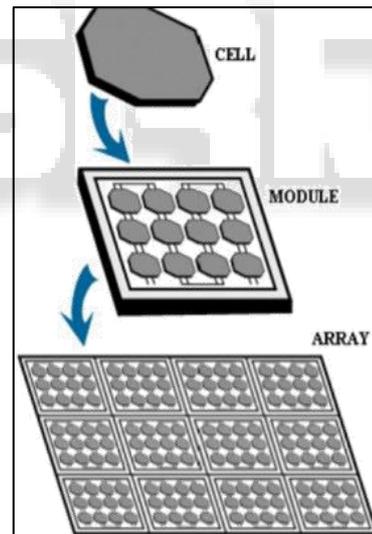


Fig. 6: Internal Structure of Solar Panel

Solar panels are a great way of cutting your electricity we all want to live self-sustainably, or at least reduce the carbon footprint of our home, and solar panels make that dream possible. 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 SEED SOWING MACHINE solar panels has improved greatly in recent years. Rated power 15W Frame Heavy duty aluminum Kind of connection waterproof junction box, can be customized Guarantee of power 90% within 10 years 80 within 25 years, Kind of glass and its thickness Low Iron, high transparency

tempered glass of 3.2mm SLA Battery Voltage 12V 12 inch x 18 inch.

VI. METHODOLOGY

The basic aim of this project is to develop a multipurpose machine, which is used for digging the soil, seed sowing, and leveller to close the mud and water sprayer to spray water with least changes in accessories with minimum cost. This whole system of the robot works with the battery and the solar power.

The base frame is made for the robot with 4 wheels connected and driven the rear wheel is dc motor. One end of the frame, cultivator is fitted which is also driven by dc motor and design is made to dig the soil. Funnel is made by the sheet metal, to store the seeds and the seeds flow through the funnel through the drilled hole on the shaft to the digger soil. On the end leveller is fitted to close the seeds to the soil, and water pump sprayer to spray the water. Solar is placed on top of the robot and is connected to the battery for charging the battery. Thus, the max efficiency is utilized from the sun by the solar panel and to the battery

VII. DESIGN CALCULATION

Superimposing of applied moment and torque for design of machine elements. It is assumed that machine would at times be required to test some mild steel and medium strength steel at the stress level in the neighbor of the yield stress. The shear stress theory is reasonably good agreement, it is often used by engineer to obtain quick estimates.

Mechanical properties of Steel,
Ultimate strength = 400 Mpa,
Yield strength = 240 Mpa,
Shear Strength= 200Mpa

A. Torque & Speed Required

1) Torque

In the case of our Gear, the force exerted is due to the mass being accelerated by gravity:

$$T = (\text{Mass}[\text{kg}] \times g) \times \text{Radius}[\text{m}]$$

Where $g = 9.81 \text{ms}^2$

We want to lift a 0.63 kg mass using a 0.05 m diameter pulley. We can find the torque load created by the mass using equation $T [\text{Nm}] = \text{Mass} [\text{kg}] \times g \times \text{Radius} = 0.04 \times 9.81 \times 0.18 \text{ T} = 0.08 \text{ Nm}$

2) Speed of the Threaded Screw

No. of teeth on DRIVEN Gear (T2) = 75

No. of teeth on DRIVER Gear (T1) = 21

Smaller driver gear must turn three times to get the larger driven gear to make one complete turn Gear ratio= $T2/T1=75/21=3.57$ or 1:3.5

Motor Speed= 30 RPM

Therefore,

No. of teeth on Driven Gear = Speed of Motor No. of teeth on Driver Gear

$$75/21=30/X$$

$$X= 8.5 \text{ rpm}$$

Speed of thread Conveyor =8.5 RPM

3) Gear Sprocket



Fig. 7:

Driven (75-tooth) and driver (21-tooth) sprocket gear ratio 1:3.5 which controls the speed of the thread rod lead to uniform extrusion of Chakli.

Gears are made of hardened carbon steel to avoid greasing to ensure quality of the nutrients.

B. Design of Torque Transmitting Of Conveyer Shafts (D)

Design of Power transmission shaft considering fatigue load. Shaft material selected as C30 steel, diameter 10.80 mm, subjected to rotating bending fatigue loading, fatigue factor=1.612 [43].

Assuming

$$K_{\text{size}} = 0.85 K$$

$$K_{\text{surface}} = 0.83 K$$

$$K_{\text{reliability}} = 0.896$$

$$S_e' = 0.5 \sigma_{\text{ultimate}}$$

$$= 245 \text{ mpa}$$

$$s_e = k_{\text{size}} \times k_{\text{surface}} \times k_{\text{reliability}} \times 1/k_s \times s_e \quad (2)$$

This fatigue strength calculated is less than endurance strength of standard C 30 steel, shows that the design is safe. Power transmission consists of the following arrangements.

- Motor with Standard specification.
- Stepped pulley arrangement.
- Leather trapezoidal section V belt to connect motor driver shaft and driven shaft vertically for better stability.

Considering power transmission shaft as beam

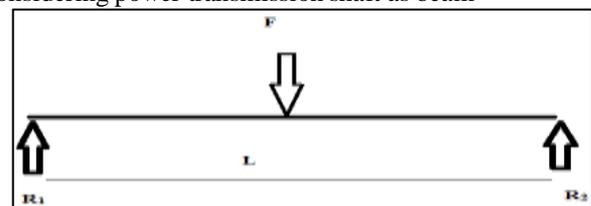


Fig. 8: Simply supported beam of shaft

$$Y_{\text{max}} = FL^3/48EI \quad (3)$$

$$= 0.00249 \text{ mm}$$

E= Young's Modulus N/mm^2 ,

L=40 mm assumed

$$\Sigma \text{ bending} = M/z \quad (4)$$

M= Moment, z= Section Modulus mm^3

$$\Sigma \text{ bending} = 79.66 \text{ N/mm}^2$$

Design of motor power required (P)

$$P = 2 \times \pi \times n \times t / 60 \text{ watts} \quad (5)$$

$$= (2 \times 3.14 \times 8.5 \times 79.66) / 60 \text{ watts}$$

$$= 70.28 \text{ watt}$$

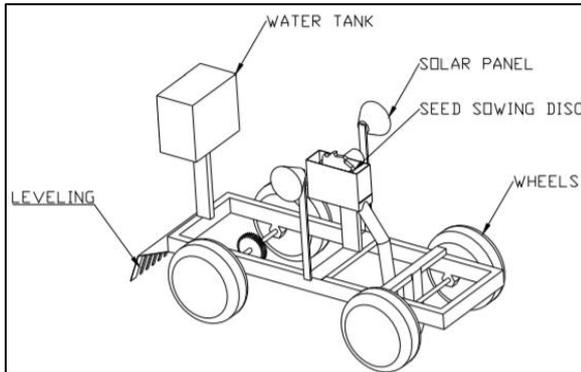


Fig. 9: CAD Model

VIII. MATERIAL SELECTION

Sr. No.	Components	Materials
1	Frame	Mild steel (MS)
2	4 wheels	Rubber
3	Wiper motor	6.5A & 12 P
4	DC motor	45RPM
5	DC Battery	12V
6	Bearing	White metal alloy
7	Solar panel	10 To 12 V

Table 1:

IX. ADVANTAGES

- It saves labor cost.
- It saves operating time and saving on cost of operation as compared – to conventional method of behind country plough.
- Operational cost is less.
- It is light in weight as compared to present devices.
- It reduced the use of man power up to 50 %.
- It can be used also for various seed.
- It is cheaper so poorer farmer can also afford this modern device.

X. FUTURE SCOPE

- Introduction of Cutter in place of drill can be used as grass cutter equipment.
- Using remote control machine can be made automatic.
- Addition of multi-hopper can be attached side by side for sowing of large farm.
- Water dripping unit could be included in seed sowing machine.

XI. CONCLUSION

By using this innovative project of solar operated seed sowing machine, we can save more time required for sowing process and also it reduces lot of laborer cost. It is very helpful for small scale formers. After comparing the different method of seed sowing and limitations of the

existing machine, it is concluded that this solar powered seed sowing machine can

- Maintain row spacing and controls seed rate.
- Control the seed depth and proper utilization of seeds can be done with less loss.
- Perform the various simultaneous operations and hence saves labor requirement so as labor cost, labor time and also save lots of energy.

Hence it is easily affordable by farmers. So, we feel that this project serves something good to this world and we would like to present it before this prosperous world

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