

DESIGN AND FABRICATION OF SOLAR POWERED MULTI-TASKING MACHINE

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Abstract- The main objective is to achieve more profit and making the manpower consumption level. Low in the Agricultural field. At current situation agricultural sector is one of the main things to Be developed and its very important, useful to our mankind. Our idea is to save the time and Energy wasted in the repetitive farming tasks. Importing of these machinery into the Agricultural sectors are quite helpful. The working of the current model is based on the field Parameters. A prototype of this machine is used for multitasking such as pesticide spraying, Sprinkler irrigation, ploughing, seed sieving process, etc.... The vehicle with roller chain Mechanism and it is controlled by a master controller, power supply is provided by a solar Panel which is eco-friendly to the environment. The solar panel which consists of Photovoltaic (PV) cell, that absorbs the sunlight to generate the power which is used to run The vehicle. The battery can also be recharged through regular electricity. The main Advantages of the model is its low cost, better results than manual system, it also helps us in Decreasing the use of nonrenewable resources which are pollutant to our environment. The Approach is now to develop smarter machines that are intelligent enough to work in a Unmodified or semi natural environment.

Key words- Solar Panel, Battery, Agriculture, Cost, Model, Automatic, sprayer, cutter.

1. INTRODUCTION

Indian modern agriculture development does not have sufficient skilled labor to trade off new technology. A Phenomenon common in the developed world. The Reasons are the need for improved food quality. The problem focused here is working with huge hours or manpower. Many of problems faced by the Indian farmers are lack of availability of skilled persons, lack of resources, wastage of money in terms of wastage of pesticides and fertilizers. So, its mandatory to automate this sector and a progressive innovation becomes necessity for raising the demand on agro product quality. To give a solution of these problems, the rover's navigation is performed by remote guiding devices fortified with the positioning system by solar called automated. Indian economics base on agriculture field development in agriculture lead to raise to economic

status of country. In India farmer are facing the major problem due to unavailability of labour. This motivated us to design and fabricate a model that utilizes solar energy for spraying pesticides. Solar pesticide sprayer which consists of solar panel, a battery, motor, pump, container and microcontroller. It is a 4 wheeled vehicle which is operated by a wireless remote which runs on power source as a battery. But all these functions are not yet being performed using a single model. Thus, we have tried to fabricate a single machine which can perform multiple task.

1.1 OBJECTIVES

- ECO friendly (Because we are using solar power and charged battery for operation)
- Easy of construction.
- More economical.
- Its works on renewable energy source.
- It does not create air pollution & noise.
- Easy to handle.
- Does not require fuel for working hence operation is cost reduced.

2. LITERATURE SURVEY

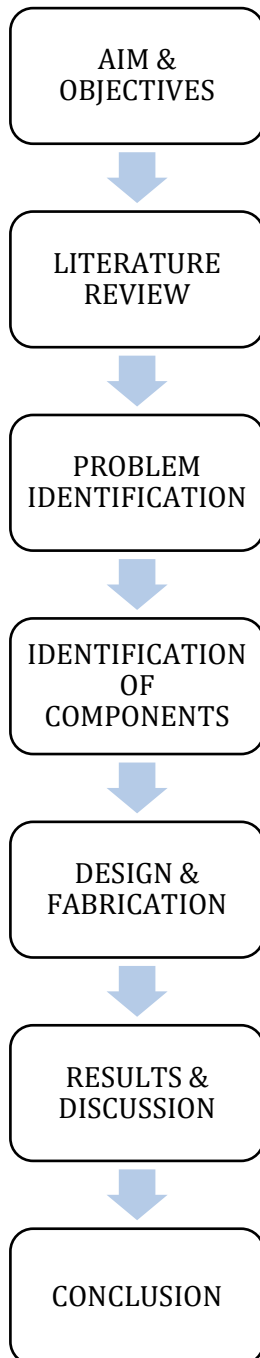
- **R. Joshua Says in the paper [1] "SOLAR SPRAYER -AN AGRICULTURE IMPLEMENT" that "ENERGY - DEMAND" is One the major thread for our country. Finding solutions, to meet the "Energy-demand" is the great challenge for Social Scientist, Engineers, Entrepreneurs and Industrialist of our Country. According to them, Applications of Non-conventional energy is the only Alternate solution for conventional energy demand.**
- **Philip J. Sammons Says in the paper [2] "AUTONOMOUS PESTICIDE SPRAYING ROBOT FOR USE IN A GREENHOUSE" that an engineering Solution to the current human health hazards involved in Spraying potentially toxic chemicals in the confined Space of a hot and steamy glasshouse.**
- **Mahesh M. Bhalerao. Says in the paper [3] "DEVELOPMENT AND FABRICATION OF SMART SPRAY PUMP" that in order to meet the food Requirements of the growing population**

and rapid Industrialization, modernization development of Agriculture is inescapable.

- **M. Kamaraj Says in the paper [4] "MULTIPURPOSE FARMING TOOLS EQUIPPED MOBILITY CYCLE"** This Paper basically focuses on the problem and solution for existing design of agricultural based mobility cycle.

3. METHODOLOGY

Design and Fabrication of solar powered multi-tasking machine has the following steps,



4. DESIGN CONCEPT

4.1 SELECTION OF COMPONENTS

Majorly used components are mentioned below,

SOLAR PANEL

- Power: 10 watts
- Voltage: 12 v
- Cells: 32 cells
- Material: Silicon (Si)

BATTERY

- Current: 7ah
- Brand: Exide (safe chloride)
- Type: Dry Battery
- Voltage: 12v
- Material: Lead acid

D.C MOTOR

- Power: 90watts
- Type: Permanent Magnet type
- Voltage: 12v
- Material: Aluminium (Al)

BLADES

- No of blades: 2
- RPM: 3000
- Motor: DC motor (gearless)
- Material: stainless steel (SS)
- Connecting method- shaft

CONTROLLER SETUP

- Model: Manually-Assembled
- Input Voltage: 5V
- Recommended Voltage: 7-12V
- Limits of Input Voltage: 6-20V
- Clock Speed: 16MHz
- Schematic: Arduino reference design uses Atmega 8

WHEELS

- Diameter: 1.5 inches
- Material: nylon

STORAGE TANK

- Material: Plastic (or) PVC
- Volume: 2.5 L

4.2 DESIGN OF THE MODEL

Creo Elements/Pro offers a range of tools to enable the generation of a complete digital representation of the product being designed. A number of concept design tools that provide up-front Industrial design concepts can then be used in the downstream process of engineering the product. These range from conceptual Industrial design sketches, reverse engineering with point cloud data and comprehensive free-form surface tools.

We created 3D model of this project frame by using CREO software. The model is shown below,



Fig 4.1: 3D MODEL OF THE FRAME

4.3 SELECTION OF MATERIAL

We selected a basic material as M.S because of some of its basic factors like easily availability, easily machining, easily weld-able. Even in M.S. basic grade is selected for frame, mounting supports and several other things but for shafts and axle we selected Bright Mild Steel just to provide it additional strength against several possible failures.

4.4 MACHINING PROCESS (ACCORDING TO DESIGN AND CALCULATION)

Several machining processes were done like cutting of square tubular M.S. pipe, cutting of L-angled frame, turning of axle shaft, turning of sieving shaft, PCB designing, PCB Assembling, grinding of metal, soldering of wire, welding of joints, welding of frame, controller setup with relay board, machining of universal joint several and drilling processes also.

4.5 DIMENSIONS OF THE MODEL

The dimensions of the model is determined by the field parameters and it can be fixed according to the field circumstances. This project's parameters are basically fixed by the standard order. The basic dimensions of the model is mentioned below,

- Length - 37.5 inches
- Width - 20 inches
- Height - 38 inches
- Weight - 30 kilograms (Approx)
- Radius of the wheel - 1.5 inch

4.6 CALCULATIONS AND MEASUREMENTS

• Solar panel

Material: silicon
Semiconductor Type: dark blue
Panel size: 30x20mm
Maximum power: 10W

• DC Battery

Weight of the battery: 2 kg
Operating voltage: 12V
Rated current: 7.5 Ah
Type: lead acid battery

• DC motor

Operating voltage: 12V

Current: 2.1 amps

Speed: 80 rpm

Torque: 100 N- m

• DC pump

Operating voltage: 12V

Operating Current: 0.5A

Liquid discharge: 1.5 lpm

• Time Required for Charging (manually measured)

Also Consider,

Battery 12V, 7.5Ah current.

Power = $V \times I = 12 \times 7.5 = 90$ watts

Below mentioned values are measured manually, calculations are subjected to field parameters and load acting on the motor,

TEMPERATURE (C)	TIME TAKEN (min)	CHARGED LEVEL (%)
28	45	25
28	90	50
28	135	75
28	180	100

Table 4.1: CHARGING TIME

- Time taken for charging the battery is 3 hours at nominal temperature of 28 degree celcius.
- The backup time of the battery (approx.) is 1.5 hour for all the operation.

4.7 COST ANALYSIS

- Material cost = 17700
- Labour cost = 3200

TOTAL COST

Total cost = Material Cost + Labour cost
= 17700 + 3200 = 20900/-

- TOTAL COST OF THIS PROJECT IS Rs.20900/-

5. WORKING PRINCIPLE AND ASSEMBLY

5.1 GRASS CUTTER

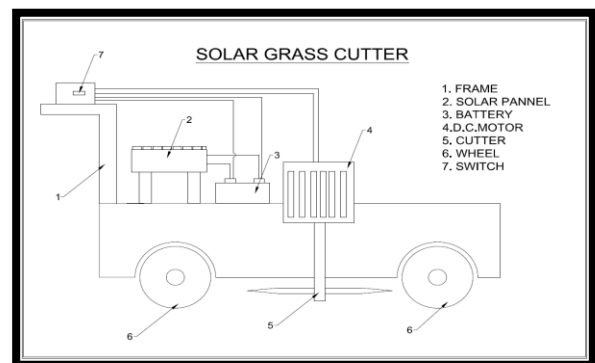


Fig 5.1: GRASS CUTTER

The experimental setup of our project consists of a frame in which the battery is mounted and a solar panel is placed upon the frame. Also the cutter blades are present in the front of the machine which is operated by a motor as shown in Fig:4.1. Solar panel converts the sunrays falling on the panel directly into the electrical energy and

is used to charge the battery. The power from the battery is transferred to the DC motor. Also the frame consists of a wheel and a handle which is used to guide the vehicle in the desired path as per the wish of the operator. The battery is charged by the solar panel continuously during the day time. When the machine is switched on, the battery supplies power to the motor which operates the cutter blades. Now the blades rotate at high speeds, so that the grass is being cut by the machine continuously.

5.2 SEED SIEVING PROCESS

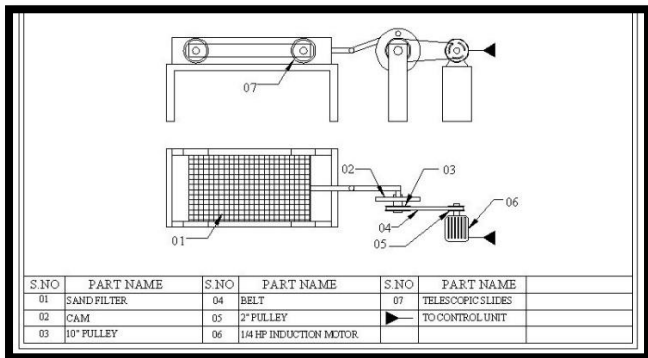


Fig 5.2: SEED SIEVING

Solar panel is used to charge the battery. DC motor fixed at the shaft of SOLAR SEED SIEVING MACHINE seed filter as shown in Fig:4.2. The supply of the current is given by the 230 volts main supply provided. This is converted to 230 volts ac to 12 volt dc by using power supply. This machine combines the principles of reciprocating machine and sieving machine. The rotary motion converted to reciprocating by using cam and cam shaft mechanism. DC motor is coupled to main shaft by spur gear mechanism which is made up of cast iron. This will be used to increase the torque of the machine.

5.3 PESTICIDE SPRAYER

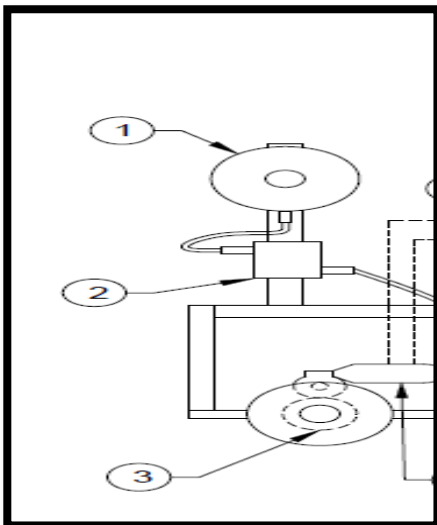


Fig 5.3: PESTICIDE SPRAYER

Near the handle of the machine is provided with the tank which is connected to the sprayer. This setup (as shown in Fig:4.3) is used to spray the water or the fertilizer that is stored in the tank automatically. Thus when the machine is started, the pesticide sprayer is turned on manually. Also the frame consists of a motor which is used to guide the vehicle in the desired path as per the wish of the operator. The battery is charged by the solar panel continuously during the day time. When the machine is switched on, the battery supplies power to the motor which operates the sprayer.

5.4 PLOUGHING

The ploughing tool is attached to the machine which is made up of cast iron. The tool is operated by pressing it into the soil and the movement of the machine which controls the torque and capacity of the ploughing tool. It is majorly used in the black and red soil. The ploughing tool can be used in any type of land. Whereas it should be cleaned immediately after the use and it should be handled with care due to the sharp edges and heavy weight.

5.5 ASSEMBLING PROCEDURE

- The frame is welded according to the designed model with the square tubular and L-angled frame.
- The DC motor is fixed at the both the rear wheel where, the power is transmitted with the help of the spur gear.
- The tank is kept on the side where it has a DC pump which sprays the pesticide into the field.
- The DC brushless motor is fixed at the other end where the grass cutter blades is fixed to it using a shaft.
- The other motor connects the sieving slide with the help of the mild steel shaft, it works under the principle of cam shaft mechanism.
- The solar panel is placed on the top of the machine and it is tilt-able.
- The battery is kept at the bottom safely.
- The ploughing tool is fixed at the back side of the machine and it is in lifted position.
- Every component are using the wire which connects directly to the battery terminal via a two-way operating switch.
- Finally, the controller setup is coupled with the battery setup and it is operated by a remote control.

6. RESULTS AND DISCUSSION

Final Check-up & Testing of Prototype: - Here any type of software testing is not required but check the wear out of components we need its manual testing on field. Even though software oriented testing is available in the industrial platform but due to lack of that platform in surroundings we have to skip it. But manual testing on field also gives enough idea about the myths.

- Maximum achieved depth is 10 cm using plougher.

- The level of covering mechanism should be rigidly fixed 0.5cm deep inside the soil.
- Height leveller mechanism of ploughing tool, seating and covering mechanism is achieved.
- Seed sieving can be done in 20 minutes for 1 kg seed.
- Maximum bearable weight of machine is 65 Kg.
- Time taken for charging the battery is 3 hours.
- The backup time of the battery (approx.) is 1.5 hour for all the operation.
- The sprayer sprays the pesticide of 2.5 litres in less than 5 minutes.

For final check-up & testing of prototype, any type of software testing is not required but to check the wear out of components we need its manual testing on field. Even though software oriented testing is available in the industrial platform but due to lack of that platform in surroundings we have to skip it. But manual testing on field also gives enough idea about the myths. As we checked our system is performing 90% correctly as per our calculations and expectations. There is a lag of 10 % of working. Some of the real time analyzing software are available to observe the chassis response but those are possible only with some sensors oriented testing consultancies, which is not possible for us.

6.1 DEVELOPMENT OF THE MODEL

A Picture of overall developed model is given below,



Fig 6.1: DEVELOPED MODEL

7. MERITS AND LIMITATIONS

7.1 MERITS

- Simple in construction.
- Maintenance cost is low.

- It does not create any type of pollution such as noise, air and so on.
- It does not require fuel to energize.
- Solar power is economical. It involves high initial expenses like installation of both the solar Panels and the complete system, but this cost is soon offset by savings on energy bills.
- This complete system can be manually operated but can be used as automatic machine. Both the units (water-sprinkler and Pesticide sprayer) work independently.

7.2 LIMITATIONS

- Initially the cost required to purchase is a bit high.
- The efficiency of the system decreases during cloudy and rainy seasons
- Must be handles carefully because of more number of moving parts.
- Suitable only for particular crops.
- Large time required to remove the grass.

7.3 ADDITIONAL DETAILS

- All the process can be run at a same time.
- It can also be used for single and two purpose at a single time. where, the each operation has a separate switch.
- The left over grass should be cleaned manually after the cutting operation.
- The seed must be poured inside the sieving slide manually.

8. CONCLUSION

Multipurpose agricultural machine has been designed and fabricated for various functions like ploughing, sewing, grass cutting and pesticide spraying. The advantages of multipurpose machine are reducing human intervention, ensuring proper fertilization and efficient utilization of resources. The proposed system is mainly used for crop establishment, plant care and selective harvesting. The initial cost of the proposed system is little more but it can be balanced in by the running cost of the system which costs was very less. We are Sure that once this concept is presented in a manner suitable to Indian market, it will definitely help in Bringing down the 15% modality rate found in the Indian formers associated with the agricultural spraying operation.

8.1 FUTURE SCOPE

This model would be very useful in near future as far as increasing rate of pollution is concern. At the same time following modifications can be done to make this machine more convenient.

- This can be made fully automated with the Use of sensors and micro controller which are Able to detect obstacles, crops and weeds.
- As our proposed system is a semi-automatic type, we can completely Transform it into an automatic system.

- With some modifications robot can perform Few more operations like seed sowing, digging, fruit picking, can also be Performed
- The propose system can be modified for future application. In advancement of weed detection process we can make use of the concept of digital image processer. Instead of spraying pesticide on the weeds we can use robotic arm to pluck from the roots.
- By adopting new Advanced Computer Technology, we can make fully automatic spraying.
- Implementing the Telescopic Nozzle, we can adjust the length of the spray required.
- Using the Hydraulics System to the wheel, helps in varying the ground clearance.
- IOT devices also can be used for maintaining these process.

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