Solar Operating Agriculture Three in One Machine

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***Abstract*— The machine is aimed for using in agriculture works for several operations like ploughing, seed sowing and water/pesticide spraying is needed. The main objectives of this machine are, to fabricate an economically efficient agricultural machine that reduces the man power, the time of work, a light weight and portable machine and low cost.**
The main aim of this equipment is to support small and medium scale farmers. In this project, human and animal efforts can be replaced by some advance mechanization which will be suitable for small scale farmer from economical and effort point of view.

Keywords—Solar Panel, Nozzle, Chassis, Hopper, Pump, Water Tank.

I. INTRODUCTION

India is agrarian economies and most of rural populations depend on agriculture to earn their livelihood. The farming methods at present are manual or semi-automatic with high involvement of laborers. In the recent years, the number of Labour availability is reducing continuously along with increase in their wages. There is a requirement of higher productivity. Hence the device is to be designed which helps farmers to overcome the stated problem. In our project, we are using solar cells for power generation. This energy can be utilized very effectively.

The most common difficulties observed in farming that the cost of equipment's likes dusting machine, cutting machine, and spraying machine. The convectional equipment's used, required the fuel for their working, this increases the maintenance of the equipment. The spraying machine is the most important due to which the price is, increasing, it is operated with the help of diesel machine means it will not be able to operate without the electricity or the diesel machine. The pollution is caused by the convectional equipment's is high. Cutting the grass in the farm field requires numbers of labors which are quite difficult, the charges to be pay are increasing day by day which cannot be affordable for the poor farmer and work are not done in time. The convectional dusting machine is very costly and it works on the tractor machine.

II. MATERIALS AND METHODS

The objective of this paper is to develop a multipurpose agricultural vehicle shown in figure 1 and figure 2, which can perform various agricultural operations such as ploughing and digging, seed sowing and water spraying. The vehicle is powered by solar energy, by collecting the energy from the sun and storing it in the battery. Thus, we can reduce the emissions caused by the usage of fossil fuels by utilizing solar energy. The various agricultural operations are controlled by electrical switches, each to drive the vehicle, to run the centrifugal pumps for water supply and to run the seed sowing mechanism.

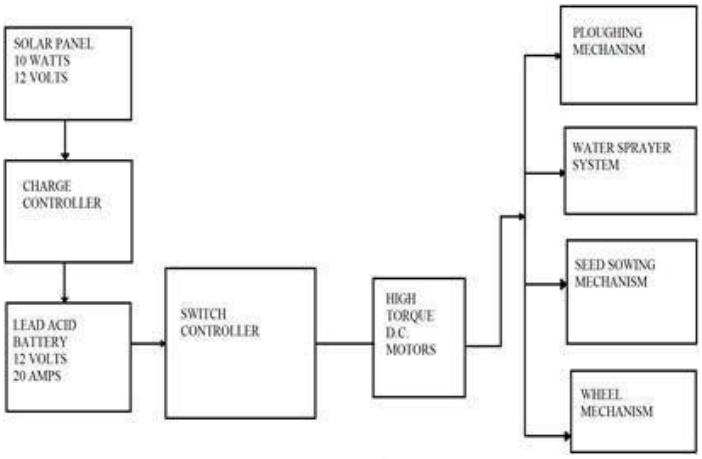


Figure.1 Flowchart of the system

A. Drive mechanism

Sometimes the power is output by simply rotating the chain, which can be used to lift or drag objects. In other situations, a second gear is placed and the power is recovered by attaching shafts or hubs to this gear. By varying the diameter of the input and output gears with respect to each other, the gear ratio can be altered. The agricultural vehicle is driven by a dc motor. Two sprockets are coupled together using a chain drive. The dc motor is coupled to a sprocket which is mounted on the rear axle. Due to the rotation of the motor the sprockets rotates and rotate the rear axle. The rotation of the rear axle rotates the wheels which drive the vehicle.

B. Seed Sowing unit

The seed sowing unit is made of three different parts. The first part is the seed container in which all the seeds are

placed. The second part is a shaft upon which two spur gear like wheels is mounted containing a scoop like structure instead of the teeth. This scoop like structure ensures that each seed is scooped properly by the wheel and deposited to the deposition point marked by a funnel corresponding to each wheel. The seeds are directed through a pipe attached to the end of the funnel which directs the seeds to the soil at the end of the ploughing tool.

C. Water spraying unit

A centrifugal pump converts input power to kinetic energy by accelerating liquid in a revolving device - an impeller. The most common is the volute pump - where fluid enters the pump through the eye of the impeller which rotates a thigh speed. The fluid accelerates radially outward from the pump chasing and a vacuum is created at the impellers eye that continuously draws more fluid into the pump. The water in the supplying unit is impelled out of the tub to the required point of the crops through the rubber tubes provided at the end of the nozzles provided at the outlet of the centrifugal pump. Two centrifugal pumps are provided at either sides of the supply unit to supply water on the either sides of the vehicle when it is moved across the farms. The amount of water supplied is controlled by control switches which are made connected to the centrifugal pumps and the battery unit. The water supply unit used here is nearly 5 litres capacity which runs on the centrifugal pumps running at 12V and a speed of 500rpm.

D. Ploughing mechanism

The ploughing mechanism is mounted near the frontal part of the vehicle such that the seeds can be sowed into the ploughed path of the soil. The worm and spur gear mechanism is used to facilitate the movement of the jaws of the ploughing tool into the soil. The worm gear is turned using a D.C. motor which turns the spur gear or the worm wheel such a way that the small axel upon which the ploughing tool is mounted is moved up and down. The D.C. motor coupled to the worm gear is also connected to a switch controller mechanism, powered by the battery. This mechanism is used for power transmission in two perpendicular directions. The horizontal rotary motion of the shaft on which the ploughing tool is mounted can be converted in to the vertical motion of the tool.

E. Power supply unit

The power supply unit of this agricultural vehicle consists of a solar panel and a battery. The solar panel used is of 12V and provides a power of 10W. The solar panel is directly connected to the battery, charging it when it is left in the sun. The energy which is stored in the battery using the solar panel can be retrieved to run the vehicle and also the other auxiliaries in the absence of sun. To work, photovoltaic cells need to establish an electric field. Much like a magnetic field, which occurs due to opposite poles, an electric field occurs when opposite charges are separated. To get this field, manufacturers "dope" silicon with other materials, giving each slice of the sandwich a positive or negative electrical charge. In this vehicle the use of charge controller is eliminated as the power required to run the vehicle is low, which in turn decreases the current requirement from the battery. A couple of other components of the cell turn these electrons into usable power. Metal conductive plates on the sides of the cell collect the electrons and transfer them to wires. At that point, the electrons can flow like any other source of electricity.

F. DC Motor

An Electric DC motor is a machine which converts electric energy into mechanical energy. The working of DC motor is based on the principle that when a current carrying conductor is placed in a magnetic field, it experiences a mechanical force. The direction of mechanical force is given by Fleming's Left- hand Rule and its magnitude is given by F = BIL Newton. There is no basic difference in the construction of a DC generator and a DC motor. In fact, the same D.C. machine can be used interchangeably as a generator or as a motor. Like generators DC motors are also classified in to shunt wound, series-wound and compound-wounded motors are seldom used in ordinary applications because all electric supply companies furnish alternating current. However, for special applications such as in steel mills, mines and electric trains, it is advantageous to convert alternating current into direct current in order to use dc motors. The reason is that speed/torque characteristics of D.C. motors are much more superior to that of ac motors. Therefore, it is not surprising to note that for
Industrial drives, D.C. motors are as popular as 3-phase induction motors.

G. Chassis

The mechanical frame of the vehicle is made of mild steel rods of rectangular tube section. A chassis consists of an internal vehicle frame that supports an artificial object in its construction and use, can also provide protection for some internal parts. An example of a chassis is the underpart of a motor vehicle, consisting of the frame. If the running gear such as wheels and transmission, and sometimes even the driver's seat, are included, then the assembly is described as a rolling chassis. The mechanical frame has the length of 3feet, width of 2 feet and height of 15 feet. The complete chassis consists of four wheels, two mounted on each of the front and rear axles. The wheels are driven by the chain drive mechanism where the driving sprocket is rotated by a DC motor. The chassis is also customized in such a way that it can hold both water supplying unit and the seed carrying unit. The water supplying unit is placed at the bottom while the seed supplying unit is placed above it. The battery is placed near the rear axle of the vehicle. The solar panel is placed on the top of the vehicle to facilitate better exposure of the panel to the sun rays.

H. Solar Panel

The term solar panel is used colloquially for a photo-voltaic (PV) module. A PV module is an assembly of photo-voltaic cells mounted in a frame work for installation. Photo-voltaic cells use sunlight as a source of energy and generate direct current electricity. A collection of PV modules is called a PV Panel, and a system of Panels is an Array. Arrays of a photovoltaic system supply solar electricity to electrical equipment. The most common application of solar energy collection outside agriculture is solar water heating systems. Most solar modules are currently produced from crystalline silicon (c-Si) solar cells made of multi crystalline and monocrystalline silicon. In 2013, crystalline silicon accounted for more than 90 percent of worldwide PV production, while the rest of the overall market is made up of thin-film

technologies using cadmium telluride, CIGS and amorphous silicon.

I. 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.

J. Pump

A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action, typically converted from electrical energy into hydraulic energy. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps. Pump operate by some mechanism (typically reciprocating or rotary), and consume energy to perform mechanical work moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, and come in many sizes, from microscopic for use in medical applications, to large industrial pumps.

Mechanical pumps serve in a wide range of applications such as pumping water from wells, aquarium filtering, pond filtering and aeration, in the car industry for watercooling and fuel injection, in the energy industry for pumping oil and natural gas or for operating cooling towers and other components of heating, ventilation and air conditioning systems. In the medical industry, pumps are used for biochemical processes in developing and manufacturing medicine, and as artificial replacements for body parts, in particular the artificial heart and penile prosthesis. When a casing contains only one revolving impeller, it is called a single-stage pump. When a casing contains two or more revolving impellers, it is called a double- or multi-stage pump.

K. Nozzle

A spray nozzle is a precision device that facilitates dispersion of liquid into a spray. Nozzles are used for three purposes: to distribute a liquid over an area, to increase liquid surface area, and create impact force on a solid surface. A wide variety of spray nozzle applications use a number of spray characteristics to describe the spray

L. Frame

The L angle frame is used in this project. It is made up of mild steel. It is the main structure of the project. All the parts are mounted in the frame. Box type frame is used as a handle.

III. SPECIFICATION

3.1 Water Tank

Material : MS
Size : 20 X 20 cm

It is made up of steel sheet. It is used to carry the seed. It is in rectangle shape. It is fabricated by means of ARC welding. In the bottom of the box seed sowing mechanism is attached.

Figure.2 WATER TANK

3.2 WHEEL

Figure.3 WHEEL

Material : Rubber. It is a circular component, Which is fixed in the axle with bearing. It is made up of rubber. Used for transporting purpose. I t is primary function to transfer the load.

3.3 Hopper:

Material : MS
Size : 20 X 20 cm

It is made up of steel sheet. It is used to carry the seed. It is in rectangle shape. It is fabricated by means of ARC welding. In the bottom of the box seed sowing mechanism is attached.

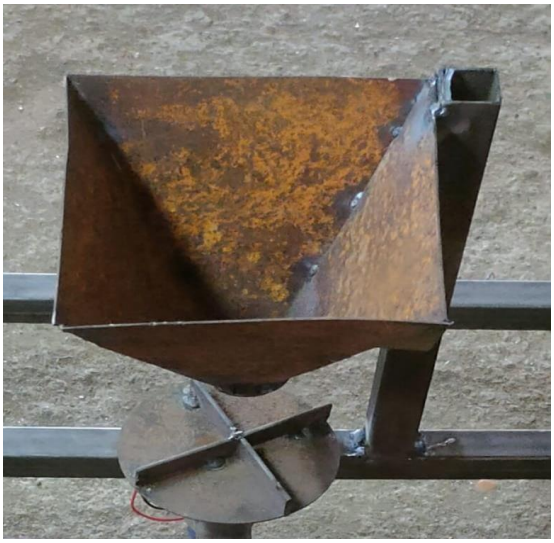


Figure.4 HOPPER

Design of Hopper

In this project have a following data width(b) = 20 mm
Length (L) = 20 mm
To find the diameter, area and volume of the nozzle
Circumference(C) = 3.14*D
60 = 3.14*D
Diameter (D) = 19.09 mm
Area (A) = 3.14/4*D2
=3.14/4*19.092
=286.22 mm^2.
Volume (V) =A*L
=286.22*20
=5.72×103 mm3
Assume 20% air gap inside the nozzle
Volume (V) = 4575 mm^3
The standard size object has a following data
Circumference(c) = 380 mm
Length (L) = 160 mm
To find the diameter, area and volume of the standard size object: Circumference(C) = 3.14*D

380= 3.14*D
Diameter (D) =121.01mm
Area (A) = 3.14/4 * D2
= 3.14/4*121.012
=11.5×103mm^3
Volume (V) =A*L
=11.5×103*160
=1.84×106mm^3

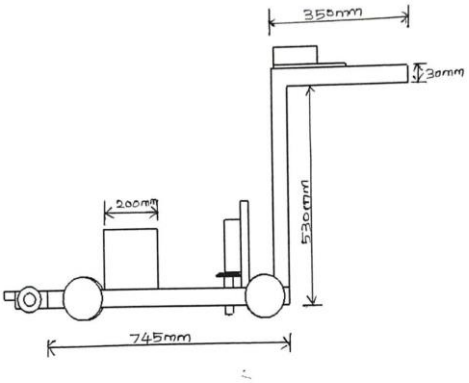
Assume 20% air gap inside the standard size object
So, Volume (V) =1.472×103mm3
1.472×103 = 1015grms
4575 = x
1.472×103*x = 1015×4575
Mass flow rate (m) X=3.152 grams/sec
Where, m = x

Speed of the fan (N) = 3000rpm

Circumference(C) = 870mm
Circumference(C) = 3.14*D
Diameter (D) = 277mm
Velocity (V) = ((3.14*D*N)/60)
= 14.5 m/s

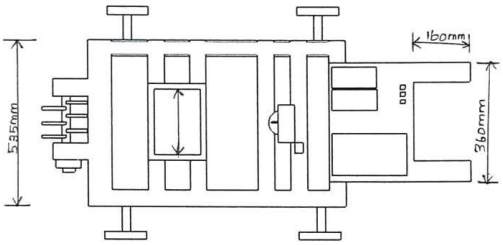
We know that
Air flow rate (Q) = V*A*60
= 43.51*0.060*60
= 157.32 m^3/s
(Mass flow rate(m) = (3.152/157.32)
=50m3/gram.

IV. CONSTRUCTION & WORKING



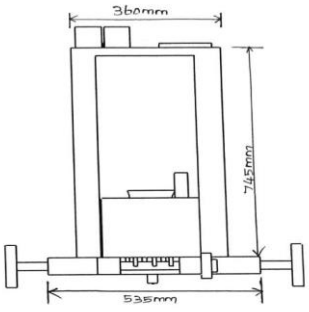
Front view

Figure.5 FRONT VIEW



Top view

Figure.6 TOP VIEW



Left side view

Figure.7 LEFT SIDE VIEW

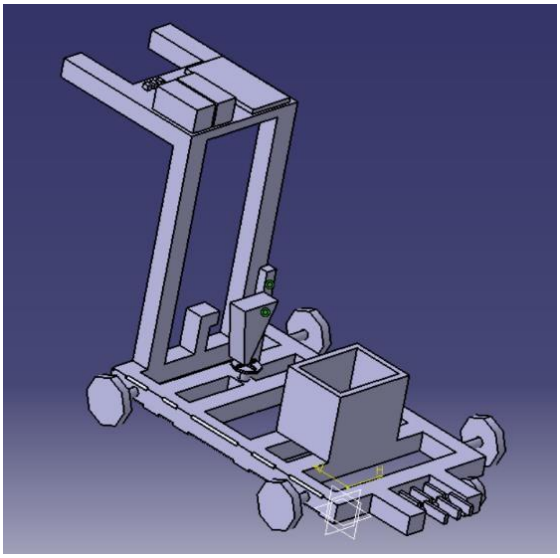


Figure.8 3-D VIEW OF THE SYSTEM

WORKING

The solar operating agriculture three in on machine consists of a frame, DC motor, battery, plastic wheels, DC pump, solar panel, water storing tank and nozzle. In our project all the components are placed on the basic frame. There are four wheels to move the machine.

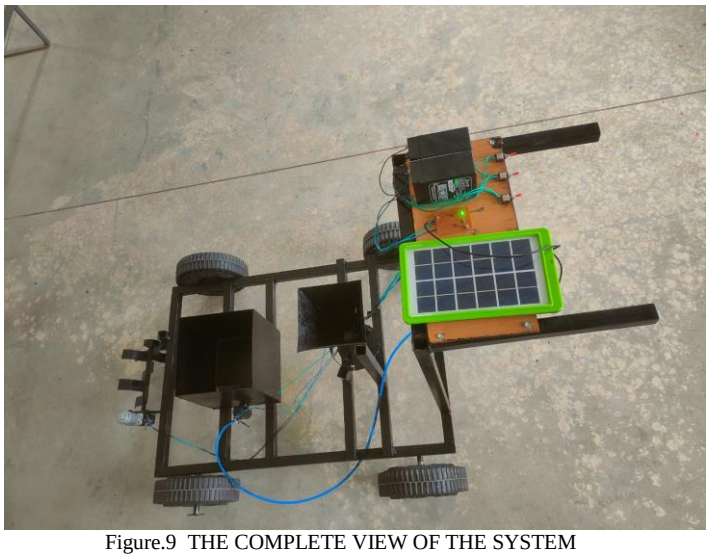


Figure.9 THE COMPLETE VIEW OF THE SYSTEM

The spraying nozzle is coupled with the motor to spray and for moving the nozzle. Then the water is pumped from the water tank to the sprayer nozzle. The plougher is fixed in front of the machine and it is rotating with the help of the dc motor. The hopper and the motor setup is used for sowing the seeds. Seed sprayer setup consists of four pipes around the main in right angle to each other. The seed sprayer is used for spraying the seeds over the land.

All motors are taken the energy from the storage battery. The battery is charged by the sunlight by using the solar panel which is attached in this vehicle. After all the motors are switched ON, then the vehicle can be moved manually over the agriculture field. When the vehicle is started to move, at first the plouger will plough the field and the water is sprayed over it.

Then seed is sprayed after that to the plowed field. This process will be continuously done. Then vehicle can be moved wherever we want in the field.

V. ADVANTAGES, DISADVANTAGES AND APPLICATION

Applications

- It can be used by all farmers such that they avoid diesel sprayers and without any maintenance cost they can use it.
- It can be used by small and medium scale farmers.

SI.NO	COMPONENTS	MATERIALS	QUANTITY	COST (in Rupees)
1	DC Motor	-	2	1600
2	Battery	-	2	1000
3	Dc Pump	-	1	500
4	Solar Panel	-	1	2000
5	Plougher	MS	1	1600
6	Sprayer tank	MS	1	200
7	Frame	MS	1	1200
			TOTAL	8100

Advantages

- Low cost
- Easy to operate
- Usage of solar energy
- Low power consumption
- Reduced man power.

Disadvantage

- Solar power is not available at night time and also during rainy times.

VI. FUTURE SCOPE

By increasing the equipment strength and quality to its peak, we can have multipurpose agricultural equipment for life time usage. By providing hydraulics, gear arrangements and some minor adjustments the equipment can also be made as tractor powered equipment.

VII. MATERIALS AND COST ESTIMATION

VII. CONCLUSION

The project carried out by us made an impressing task in the field of agricultural sector. The multi utility agricultural machine is very usefully for the workers to carry out a number of operations in a single machine. Practically our multi utility agricultural machine can be used for seed sowing, ploughing, and also used for water spraying. All the parts are arranged in such a way that in every stage of agriculture, the equipment can be rearranged to perform the specified action.

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