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Solar Agro Sprayer

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Abstract*: In the agriculture segment, splashing pesticides is a significant undertaking to shield the harvests from creepy crawlies for getting a high return. However, farmers have been mainly using traditional conventional techniques like hand operated and fuel operated sprayer system for spraying pesticides. Fuel is expensive and in some places fuel may not be available. If hand operated spraying systems are used, the labour productivity decreases and the efficiency will be low. The use of a solar energy system is an alternate solution for these limitations. A sun powered worked pesticide sprayer is a siphon running on power created by the photovoltaic boards or the warm vitality accessible from gathered daylight. The task of sun powered controlled siphons are progressively affordable for the most part because of the lower activity and support costs and has the less ecological effect than siphons fueled by an internal combustion engine. In this, charged battery can in like manner be used for home machines like sparkling CFL bulbs, compact charging, etc. In this paper, a detailed design calculation of an agro sprayer is presented by using reliably available solar energy which makes our device eco-friendly.

***Index Terms*: Batteries, Charge Controller, DC pump, Photo Voltaic Cells, Spray Pump, Sun Energy System**

I. INTRODUCTION

India is overwhelmingly a horticultural based nation with roughly 75% of populace of India is especially subject to cultivating either legitimately or by implication. The ranchers have been utilizing similar strategies and hardware for a very long time for instance the seed planting, showering, weeding and so on activities are completed by same methods. There is requirement for advancement of a powerful splashing machine for expanding efficiency levels. The vast majority of the late creating nations of Asia have the issue of higher populace and low degrees of land profitability as of contrasted with the created countries. One the principle purposes behind lower profitability is inadequate power accessibility for the ranches and low degrees of homestead automation. This is particularly valid for India [1-2].

Creepy crawlies are to a great extent in charge of the yield obliteration. Bug sprays or pesticides, a man made or normal arrangement are utilized to execute bugs or generally control their multiplication. These herbicides, pesticides, and composts are connected to agrarian yields with the assistance of an extraordinary gadget known as a "Sprayer". A sprayer is a mechanical gadget used to shower the fluid like herbicides, pesticides, fungicides and manures to the yields so as to keep away from any irritation and control the undesirable plant species [3-4]. Sprayer gives ideal usage of pesticides or any fluid with least endeavors. In Indian homesteads commonly two sorts of splash siphons are utilized for showering, they are hand worked splash siphon and fuel worked splash siphon, out of which hand worked splash siphons are generally mainstream. To kill the pests and insects pesticides, fertilizers are sprayed either manually or by using sprayers. Earlier, the pesticides and fertilizers were sprinkled manually, but they will result in harmful effects on farmers. In order to overcome this problem, different spraying techniques have been developed [5-7]. These sprayers consist of different mechanisms and the cost of equipment is generally high.

Sustainable power source is commonly characterized as vitality that originates from durable assets. The sun is the most abundant and unlimited source of energy. As solar energy is one of the most important non-conventional sources of energy. This energy is environmental friendly, which is mainly free from pollution. Solar energy get from the sun is harvested on the solar panel the panel is made up of photovoltaic cells, which converts energy from photon to electric. And these cells are made up of silicon semiconductor. Sun powered board is utilized to store electric vitality or charge the battery from the sunlight based vitality and the battery charged is utilized to work DC siphon for showering the pesticides. A solar operated sprayer is easy to handle and maintenance free, hence is affordable to the farmers [8-10]. The objectives of proposed work are to design an agro sprayer that exhibits following characteristics. (i) ECO friendly (Because we are using solar power and charged battery for operation) (ii) Easy to construction (iii) More economical (iv) Easy to clean and maintain (v) Its works on renewable energy source called solar energy (vi) It does not create air pollution & noise (vii) Easy to handle (viii) Does not required fuel for working hence cost reduce for operation.

II. PROPOSED METHODOLOGY

The structure involves sun oriented board, charging unit, battery, siphon and sprayer as appeared in Fig.1. The sun situated board passes on a yield in the request of 12 volts and 20 Watts ability to the charging unit. The charging unit is used to sustain the sign from the sun based board. The charging unit conveys the sign which charges the battery. According to the charged unit, the siphon works, with the ultimate objective that the sprayer works. Here excrement can be secured in tank. Exactly when the sun shafts are falling on the daylight based board power will be made through the sun situated cells and set away in the battery [15]. By the electric power in the battery the siphon works and along these lines manures from the tank is sprinkled out through the sprayers. There is no upkeep cost and working cost as it is using sun based essentialness and no defilement issue.

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Its working standard is especially basic and it is moderate for the farmers, which has one more piece of room that it can similarly make control that power is saved in the battery and it might be used for both showering and well as to light in the houses when there is no power supply.

Fig.1: Framework Components

This framework can be worked utilizing sun powered vitality or electrical vitality. The sun based vitality is changed over into electrical vitality and is put away in a capacity battery. The primary focal points of the present framework are the running expense decreases to least and devour less time. Sun powered vitality from the sun is collected on the sunlight based board. The board is comprised of photovoltaic cells, which changes over photon vitality to electric vitality. These cells are made up of silicon semiconductor. Solar panel is used to generate electric energy and charge the battery. The charged battery is used to operate a DC pump for spraying the pesticides. So with this foundation, we are attempting to plan and develop a sun based controlled splash siphon framework. The main occupation of villagers of our country is agriculture. Farmers are using hand-sprayers, IC engine sprayers. Hand operated sprayer needs more manpower, IC engine needs fossil-fuels and emits flue gases. Instead of using IC engine sprayer or hand driven sprayer farmers can use solar powered agro sprayer for spraying the pesticides. Solar powered agro sprayer simply consists of a battery and electric motor which are powered by photovoltaic cells. Solar operated pesticide sprayer is to meet the demands of farmers such as reduced maintenance cost, shortage of electricity and fuel. The main parts of solar operated pesticide sprayer consist of Solar panel, Charge controller, DC Pump, Battery, liquid storage tank, Nozzle etc.

A. Solar panel

When Photons in daylight hit the sun based board and are consumed by semi-conducting materials. Electrons (adversely charged) are thumped free from their iotas as they are energized. Because of their exceptional structure and the materials in sun oriented cells, the electrons are just permitted to move in a solitary course. The electronic structure of the materials is significant for the procedure to work, and frequently silicon consolidating limited quantities of boron or phosphorus is utilized in various layers. An array of sun powered cells changes over sunlight based vitality into a usable measure of direct flow (DC) power [11].

B. Charge controller

A charge controller is basically a voltage & current controller to shield batteries from over charging. It controls the voltage and current starting from the sun controlled sheets taking off to the battery. Most "12 volt" sheets put out around 16 to 20 volts, so if there is no guideline the batteries will be hurt from over charging. Most batteries need around 14 to 14.5 volts to get totally stimulated. In a large portion of the cases, solar boards will give more than the appraised voltage. Actually, solar boards are simply made to put out more than appraised voltage. The reason is that in the event that they made for appraised voltage, the boards will give control just when cool, under flawless conditions and full sun. This isn't something you can rely on in many spots. The boards need to give some additional voltage with the goal that when the sun is low in the sky, or you have substantial dimness, overcast spread, or high temperatures, despite everything you get some yield from the board [12].

C. DC Pump

On a fundamental level, a wide range of sorts of siphons can be utilized to siphon water. The most widely recognized kind, notwithstanding, is the radiating siphon. A radiating siphon is fueled by a gadget called an impeller. The impeller is somewhat similar to a turbine. It has many bended cutting edges, which channel the water through the siphon. The impeller turns extremely quick. The bended edges channel water into the eye, or focal point of the impeller, however that water streams along to the outside of the sharp edges. Since the impeller moves quick, the radial power packs the water against the outside of the cutting edge. This pressure makes the water rocket forward in a fast stream out of the impeller. This speed makes pressure on the outlet side of the siphon, pushing the water through the pipe [13].

D. Battery

An electric battery is a contraption including at any rate one electrochemical cell that changes over put away compound essentialness into electrical imperativeness. Each cell contains a positive terminal, or cathode, and a negative terminal, or anode. Electrolytes empower particles to move between the anodes and terminals, which empowers current to stream out of the battery to perform work. At the point when the battery is associated with the outer burden, the chemical changes happen in backward direction, during which the assimilated vitality is discharged as electrical vitality and provided to the load.

E. Liquid Storage Tank

Tank is used to store liquid like pesticides, insecticides and fungicides. Capacity of liquid storage tank used here is 16litres. Filter is placed near the lid of the storage tank in order to avoid entering of leaves and mud into liquid stored.

F. Nozzle

A spout/gush is a contraption planned to control the bearing or characteristics of a fluid stream (especially to grow speed) as it exits (or enters) an encased chamber or pipe. A gush is consistently a pipe or holder of fluctuating a cross sectional area and it might be used to organize or change the movement of a fluid (liquid or gas).

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Spouts are from time to time used to control the rate of stream, speed, course, mass, shape, just as the heaviness of the stream that ascents up out of them [14]. In a gush, the speed of fluid augmentations to the weakness of its weight vitality.

Kinds of spouts:

1. Sectorial fog spout
2. Conical fog spout
3. Four-opening customizable spout.

III. BLOCK DIAGRAM

The square graph of sun powered shower framework is appeared in Fig.2. It comprises of five units specifically: sunlight based board, charge controller, battery, DC motor, siphon, spout release. We designed an agro sprayer with a capacity of 16 litres. According to that we require a Poly Vinyl Chloride tank which is filled with prepared liquid. A casing is provided below the tank for inserting the components with the proper connections. The casing is fixed to the bottom of tank with the help of screws for proper fitting. The supporting stand is connected to the handle of tank and the solar panel is attached to it, which gives shade from the sunlight. The sunlight based charge controller is fixed to the supporting stand. Also, the charge controller is associated between the sun oriented board and a battery to make constant charging while in utilization of retaining heat from the daylight. Now the hose (pipe) is connected to the bottom of the casing for spraying chemical to the pesticides. A suitable nozzle arrangement is provided at the end of hose for proper discharge of the liquid.

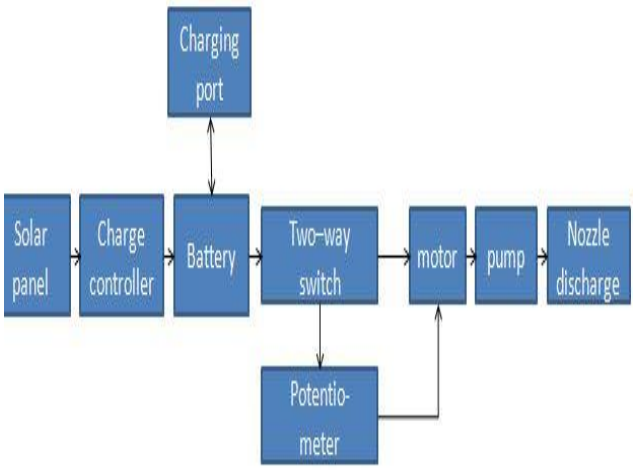

Fig.2 Block diagram of solar agro sprayer

IV. RESULT ANALYSIS & DISCUSSION ON WORKING MODEL DEVELOPED

A working model was developed as per the block diagram given in Fig.2. The developed model was working as per specified requirements and the results reported were quite satisfactory. The solar panel is able to provide required power to the spray pump and excess amount of power produced by the solar panel was stored in the associated battery. Centrifugal pump was injecting the pesticide present in the storage tank to the nozzle, the spraying capacity of the nozzle was found satisfactory.

Results obtained by using the developed model were listed in Table.1

S.No.	Type of unit	
	Name of unit	*Obtained Performance Value*
1	Amount of Power developed by solar panel per hour	0.02 units
2	Operating voltage of Battery	11.6V
3	Discharge	

A. Spray Pump

As indicated by splashing limit, the shower siphon is chosen as follows.

Type: Centrifugal Pump (Diaphragm sprayer pump)
Liquid Discharge = 4.5 lit/min (0.8 GPM)
Pressure = 110 PSI (6.9 Bar) (maintained up to 1.5m head from motor)
Speed at no-load = 6000 rpm.
Power = 60 W
Current = 3 A
Voltage = 12 V

B. Battery

As indicated by splashing limit, the battery is chosen

Type: Lead acid battery

Voltage	=12 V
Required motor current	= 3 A
Required lamp current	= 1 A
Required other equipment current	= 2 A
Total current required	= 6 A
Voltage	=12 V

The battery capacity should be enough such that the motor should run for at least 4 hours even the solar energy is not available to charge. So the capacity required for the battery is Battery Amp-hour = current required for motor * Running time = 3*4 = 12 AH. If all the equipment is used at time then the battery can supply power for 2hrs.

Time taken for total discharge of battery = Battery Amp-hour / Total current = 12 / 6 = 2 hrs.

Voltage regulation of battery = 13.5-13.8 (Stand-By use)
= 14.5-14.7 (Cyclic use)

Initial current = 2.40 A max to spraying capacity, the spray pump is selected as follows.

C. Solar Panel

As per battery yield control, sunlight based board is chosen as

Dimensions: 500 mm * 22 mm * 340 mm

Weight	= 2.0 kg
Power	= 20 W
Open Circuit Voltage	= 21.0 V
Short Circuit Current	= 1.19 A
Voltage at Maximum Power	= 17.0 V

Current at Maximum Power = Power rating / Voltage rating at Pmax = 20 / 17 = 1.18 A

D. Solar Charge Controller

The voltage rating of the solar charge controller is selected based on the solar panel voltage rating. So,

Operating voltage = 12 V

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A sun powered charge controller must deal with the greatest yield current of the sunlight based board (or sun based cluster). The most extreme conceivable current that a PV board can create is the short circuit current (Isc = 1.19 A). Here, other equipment with 3A loading are also used.

Required current rating = 6 A

The standard designs for the sunlight based charge controller are 12, 24, and 48 volts. So, based on the above requirements the solar charge controller rating is selected as 12 V, 10 A.

Time required for charging battery from solar panel or charger:

i) From solar panel:

The current created by the sun oriented board is determined by knowing the greatest power (P) of the sun oriented board and its voltage rating (V).

Current (I) = P/V = 20 / 17 = 1.18 A

Charging time (T) = Battery amp-hour rating / current (I)

= 12 /1.18 = ~10 hrs.

ii) From charger:

The ratings of the charger are 12 V, 2 A DC.

So the time (T) taken for full charge = Battery amp-hour rating / current (I) = 12 / 2 = 6 hrs.

E. Liquid Storage Tank

Tank capacity =16 ltrs.

Material = PVC

Finished model of Solar Agro Sprayer is shown in Fig.3

Fig.3 Solar Agro Sprayer

V. CONCLUSION

The proposed system is very efficient and can be used in agricultural field very effectively. This technology is most suitable for Energy Alternate Device for power sprayers. This system is user friendly and also environment friendly as it doesn't produce any pollution. Also this sprayer can be used at very remote place where fuel and power are not available. This sprayer is economical than that of the conventional engine operated sprayers. In addition a similar procedure and innovation can likewise be reached out for a wide range of power sprayers.

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