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Design Of Solar Based High SpeedPesticide Sprinkler

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Abstract: We're using Non renewable sources of energy in excess mount for our needs. As this type of minerals like coal etc. are exhausting so we have to depend on the renewable sources of energy like solar, wind, etc. For smaller application it is better to use renewable energy. As this projects based on water pump and required AC supply. So for this particular application we are using solar panels to charge the DC battery and the power from the battery can be used for this application. This project is an innovative solution to operate a machine / motor / liquid pumps fora small duration. If a machine is to be operated for ten minutes, and should be switched off after the duration, it is too difficult and many times we forget to switch it off the system after the prescribed time. In order to protect food and fiber crops against insects, disease and weed pests used agricultural chemicals such as insecticides, fungicides herbicides. With classical methods more chemical than theoretically needed is often applied due to the variability in field conditions and the need to ensure complete. In this case, 95% of the chemical applied can be wasted to the ground, for soil pollution, or at most 50% of mass transfer onto the desired plant. The project shows that electrostatic spraying can offers a possible solution to those environmental problems by reducing spray drift and improving coverage of chemical to target plant .In this project are presented principle of Electrostatic Spraying, the equipments, technological aspects and application. This system is available in large scale but we can implement in small scale also

Keywords: Solar Power, Agricultural, Sprayers.

I. Introduction

Throughout the years, research has shown that pesticides drift causes damage to non-target organism. Sometimes drift from certain chemicals can be detected on susceptible plants and animals miles away. As farmers begin to realize the environmental impacts of some of the older practices in agriculture, they are demanding spray equipmentthat is more efficient and safer for the environment.

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The first step in reducing spray drift in timing. The applicator must look at the temperature, humidity, and wind speed to see how these factors would affect the spread of the pesticides. Most agriculture chemicals are volatile at higher temperature. After consulting the pesticides label; this must be taken into account. Higher humidity is good to reduce the chances of small droplet evaporating and not hitting their target. Thirdly, wind can cause problems by blowing the droplets away from target and increase the chances of non-target organisms being damaged. Technology can also play a part I reducing spray drift. A relatively new product that has made its way to the forefront in recent years are electrostatic spray technology .Along with reducing spray drift, this type of application equipment can improve canopy penetration ,increase the under leaf coverage, and decrease the total volume per acre applied.

In the sprinkler method of irrigation, water is sprayed into the air and allowed to fall on the ground surface somewhat resembling rainfall. The spray is developed by the flow of water under pressure through small orifices or nozzles. The pressure is usually obtained by pumping. With careful selection of nozzle sizes, operating pressure and sprinkler spacing the amount of irrigation water required to refill the crop root zone can be applied nearly uniform at the rate to suit the infiltration rate of soil.

The heart of the air –assisted electrostatic sprayer is the “air atomizing –induction charging” nozzle which was invented at the university of Georgia. Air and liquid enter the rear of the nozzle separately. The air moves through the nozzle under pressure and meets the liquid at the nozzle tip, causing the formation of spray droplets that are 30-60 microns in diameter. The charge on droplets, through small pulls the spray towards the target at 75 times the force of gravity. The spray droplet can reverse direction, moves again gravity, tocoat all sides of an object.

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figure1: Base diagram of solar based sprinkler

This paper is structured as follows. Section 1. provides an introduction of Solar Power Pesticide Sprayer. Section 2. describes the Literature Survey. Section 3 and 4 briefly introduces about System Development and Design Of Prototype .Section 5 about result and discussion

II. Literature Survey

Even though good quality pesticide is used and optimum timing for the application of pesticide is also adopted; unless the pesticide is applied properly it will not yield good results. Therefore, the quality of application of pesticides is very important in pest control operations.

Adherence to the following points can ensure it:

1. Proper dosage should be applied evenly
2. The toxicant should reach the target
3. Proper droplet size

The liquid formulations of pesticide either diluted (with water, oil) or directly are applied in small drops to the crop by different types of sprayers. Usually the EC formulations, wet powder formulations are diluted suitably with water which is a commoncarrier of pesticides. In some cases however, oil is used as diluent or carrier of pesticides. The important factors for spray volume consideration are:

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The volume of spray liquid required for certain area depends upon the spray type and coverage, total target area, size of spray droplet and number of spray droplets. It is obvious that if the spray droplets are coarse-size then the spray volume required will be larger than the small size spray droplets. Also if the thorough coverage (Eg. both the sides of leaves) is necessary then the spray volume requirement has to be more.

On the basis of volume of spray-mix the technique of spraying is classified as:

1. High volume spraying

2. Low volume spraying

Ultra low volume spraying The range of volume of spray mix in each of the above case is arbitrary. Usually forfield crop spraying the following spray volume ranges are take n as guide.

High Volume Spraying

300 - 500 L/haLow

Volume Spraying 50 - 150

L/ha Ultra Low Volume

Spraying < 5L/ha

There is distinct advantage in the case of lower volume of application over the high volume application. The higher the volume to be applied the more the time, the more the labor and the more the cost of application due to labor cost. However the lower volumeapplications are concentrated spraying of pesticide which should also be considered properly.

III. Components

The solar powered agricultural sprayer has following components:

Tank

Solar power unit

i. Solar panel

ii. Charge controller

iii. Battery

DC motor/pump

Spraying unit

Spray boom

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v. High pressure spray pipe

vi. Nozzles

The selection of the components can be done as per requirement. Tank is used to store the pesticide/insecticide chemical solution. It supplies chemical solution to nozzles on boom through dc motor/pump and pressure pipe.

The solar power unit is energy conversion unit. Solar energy obtained from sun is converted into electrical energy using solar panel by photovoltaic effect. The output of the energy conversion is given to charge a deep cycle lead acid battery through a charge controller.

The charge controller limits the rate at which electric current is added to the battery. Thereby, preventing overcharging and protecting against over voltage. It employs the Pulse Width Modulation (PWM) technique which gradually stops charging the battery, when it exceeds a set high voltage level and gradually re-enables the charging, when the battery voltage drops back below the safe level.

The main advantage of PWM is that the power loss in the switching device is very low. The output from the charge controller is given to the battery by a three pin socket through an electrical network. This circuit is designed to control the RPM of the motor by controlling the amount of resistance between the motor and the battery while simultaneously providing a charging supply for the battery. DC motor/pump lifts the pesticide from tank and delivers to nozzles with desired high pressure. Energy is supplied to DC motor/pump by the solar power unit for its running/operation. Nozzles on the boom atomize the spray liquid into fine droplets and sprayed on the crop canopy. The droplet size and spray pattern depends on pressure and type of nozzle used as per requirement.

Actuator Type	**Advantages**	**Disadvantages**
Mechanical	Cheap, Repeatable, No power source required, Self-contained, Identical behaviour extending or retracting	Manual operation only. No operation
Electro-Mechanical	Cheap, Repeatable, Operation can be automated. Self-contained,	Many moving parts prone to wear.

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	Identical behaviour extending or retracting. DC or stepping motors. Position feedback possible.	

Table 1: Comparison of electrical and mechanical actuators

The design was carried out in Fusion 360 3D Modeling software. This software is chosen for this project because it has user friendly interface and it is easy to use.

S.no	**Type of Material**	**Capacity**
1	Solar Panel	12 V
2	Batteries	12V
3.	sprayer	5 miters
4	Motor	12V
5	Current	8.0Amps
6	Tank	5 liters

Table 2: Mechanical properties

IV. Conceptual design and proposed system

Proposed system

This system is a designed for agricultural purpose.

This system is a robot designed for agricultural and sport fields maintenance purpose.

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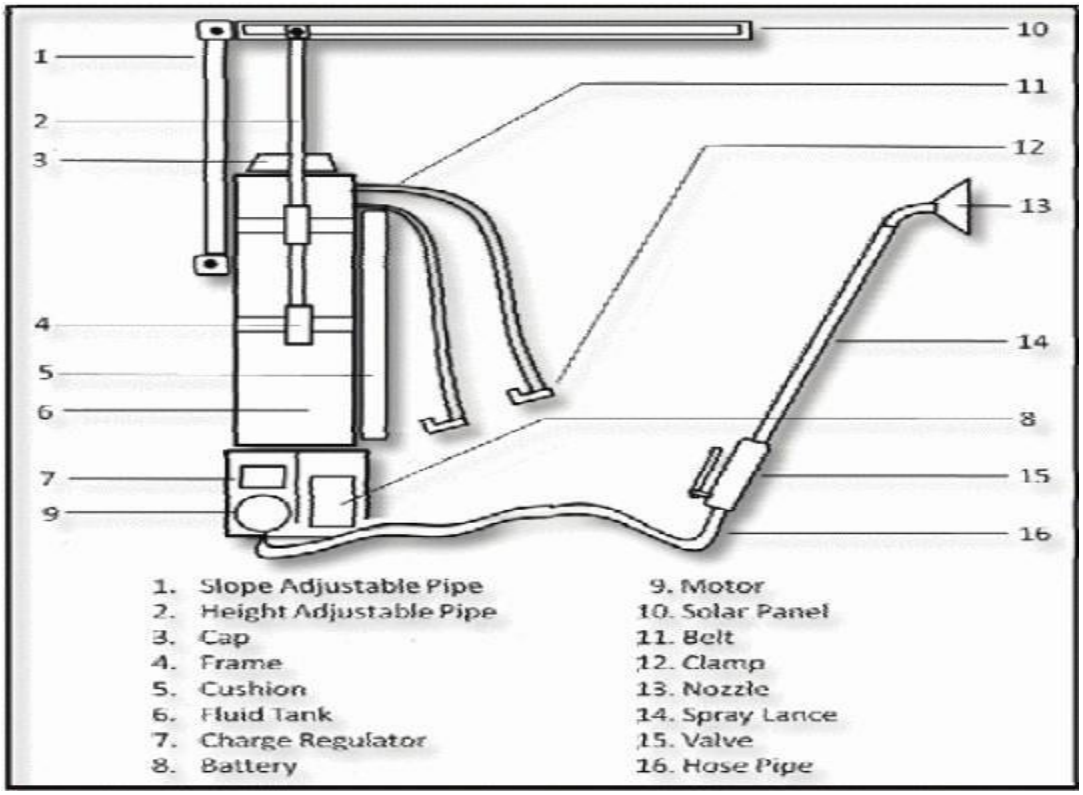

Figure 2: Block diagram of proposed system

Working

A concept was developed for the solar operated sprayer and it was fabricated in the Department of Farm Machinery and Power Engineering, University of Agricultural Sciences (UAS), Raichur, Kamataka, India. The solar sprayer uses solar energy as source of power in the form of a solar pv cell

This cell charges a 12 V DC battery which, in turn operates a DC motor. This motor activates a pump which further pumps pesticide, stored in the form of a solution / liquid, through a nozzle, thereby, creating a spray.Fig-4.1 and Fig-4.2 shows details construction of solar sprayer. It consists of a slope adjustable pipe to adjust the slope / angle of solar panel, height adjustable pipe to adjust the height of panel from the ground, a fluid tank with a cap to hold the pesticide in the form of liquid / solution a metallic frame enclosing the tank and to which height adjustable pipes are fixed, a 12 V battery and charge regulator compartment, fixed to the frame at the bottom of the tank, a 12 V DC motor-pump, a spray lance for spraying the pesticide. The spray lance, in

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turn consists of sufficiently long hose pipe, a spray nozzle, a valve for starting and stopping the spray and also to control the flow rate of spray. The spray unit is also provided with belt and a

set of clamps to fasten the entire unit to the back of the operator and also a cushion pad , glued on the tank, to provide cushioning effect when the entire unit is resting on the back of the operator. From above Fig which shows the cross section of the unit, provides a better and clear understanding of the construction of the unit.

Circuit Board Of Solar Operated Sprayer:

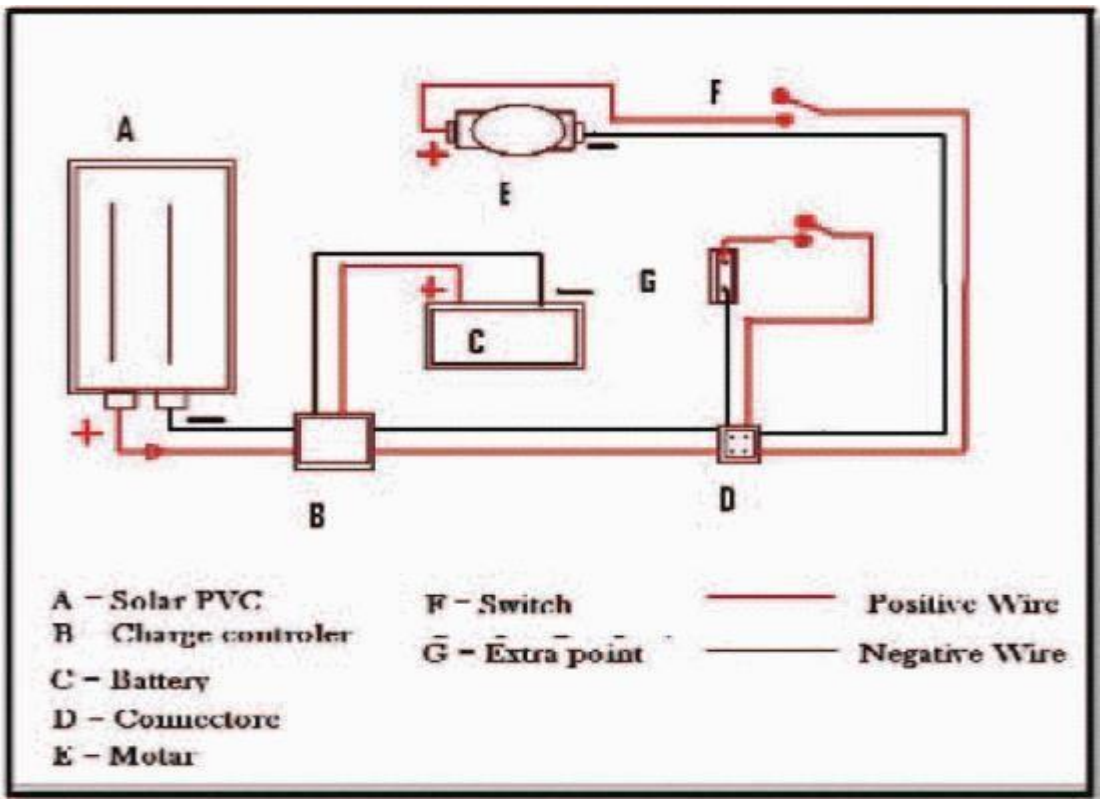

Fig:3 side view of solar operated sprayer

Fig: 4 Power transmission system

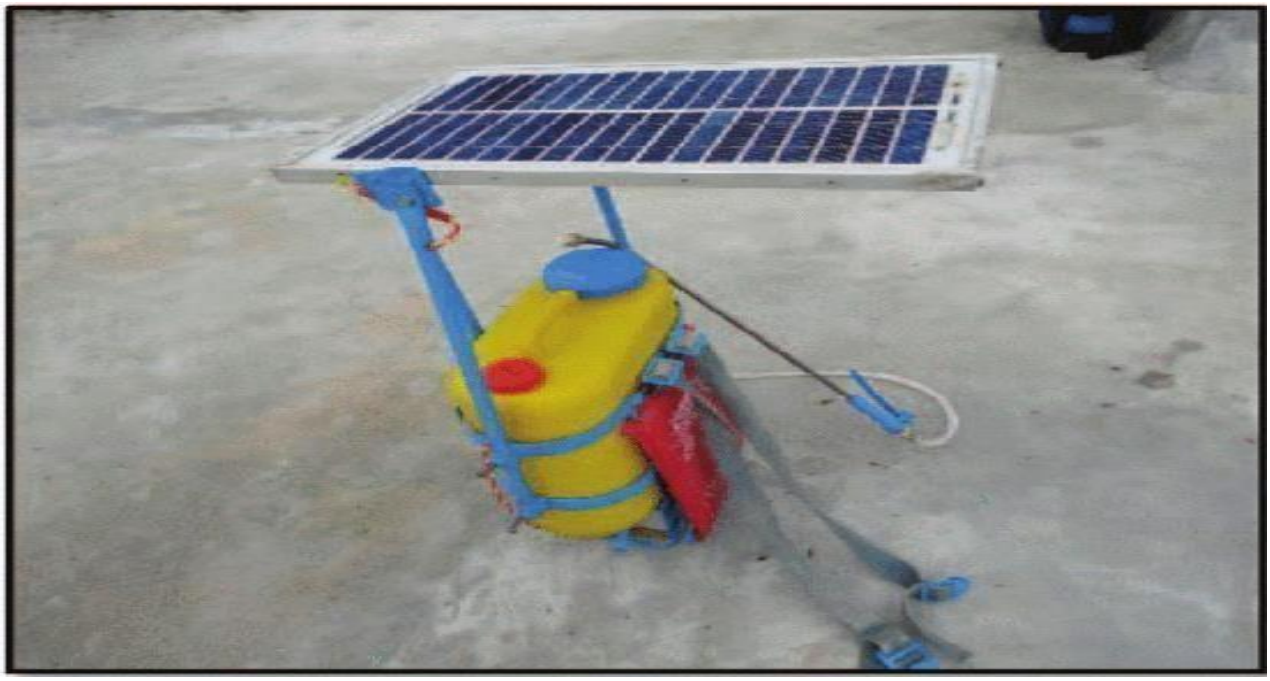

Fig5:Top view of solar operated sprayer:

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Fig6:field evaluation of solar operated sprayer:

IV. Experimental Analysis

In order to evaluate the performance of the system, several trials were performed on the robot. We have evaluated different functions that are to be performed by the robot. The functions are listed below.

1) For Long Distance Sprinkler Sprayer
2) For medium Distance Sprinkler Sprayer
3) For short Distance Sprinkler Sprayer

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For Long Distance Sprinkler Sprayer

For Medium Distance Sprinkler Sprayer

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For Low Distance Sprinkler Sprayer

V. FUTURE SCOPE

Battery capacity can be increased in the future depending upon the requirements.

VI. CONCLUSION

A solar operated sprayer was developed for spraying which uses solar energy as source of power. It consists of a solar panel of 20 W capacity, a 12V DC battery, a DC motor, operated by the battery a pump, to spray the pesticide and a tank to hold the pesticide. The performance evaluation of the sprayer, the effective field capacity of the sprayer was observed to be 0.14 ha/h which corresponds to an average coverage of 1 ha/day of 8 hours operation. As the equipment does not use any other external source of power and that it is operated by the user himself, it reduces drudgery, is quite economical and eco-friendly as it uses solar energy which can be easily affordable by small and marginal farmers. Further, its power can also be used for multi-purpose applications such as charging the battery of mobile, operating the radio and lighting the domestic light etc., which makes it more economically viable technology.

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