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Solar Powered Pesticide Sprayer with Mobile Charger and LED Light

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Abstract: The need for energy is more significant in human lives.Different conventional and non-conventional energy resources are providing energy tothe world.Butthe major problem associated with conventional energy resources is that theyare exhaustible and pollute the environment seriously. Many researchers are focusing on non-conventional energy resources due to its availability and eco-friendliness. Radiation from solar is freely available in major parts of the world in the day time.By usingsolarpanels, light energycan easilybe converted into electrical energyanddoany mechanicalwork by using that electrical energy. Agriculture plays a vital role in the Indian economy; new innovations give full support to farmers as well. In this article, a farmer-friendly, cost effective solar-operatedpesticidesprayer with additional applications like LED andmobilechargersis developed. From this environment-friendly proposed system, the usage of fossil fuel is avoided with no operating cost, and it save the environment from pollution by notradiating the destructivesubstances like conventional systems. This proposed system can be remotely accessed in various places like farms, gardens, municipalities, etc.

Keywords:-*Solarenergy,solarpanel, solar powered pesticide sprayer, multipurposemachine.*

I. INTRODUCTION

The need for energy in the world is amajor threaddue to hikes in population and technological developments. Finding solutions to meet energy demand is t he greatest challenge for researchers. Many of the energy resources available to meet energy needs are divided into two categories: conventional and non-conventional (renewable energy). Conventional energy resources like petroleum, coal, natural gas, etc., have mostly fulfilled the world's energy requirements for many years. The major setbacks of using conventional energy resources like fossil fuels are their limited availability and the pollution they emit ino the environment by emitting harmful chemical components like CO2, No2, and SO2, which leads to smog and acid rain. Non-conventional energy resources like solar, wind, hydropower, biomass, etc., are environmentally friendly and widely available in most parts of the world. Many researches work in the field of renewable energy have been available in the literature for several decades [1–8].Among the different types of renewable energy sources, solar plays a major role in energy production as it simply converts light energy into heat or electrical energy [9] – [12]. Especially in electricity production, solar photovoltaic (PV) systems can produce electricity in the range of mW to GW by interconnecting the solar cells based on the energy requirement [13] – [16].Solar PV panels are integrated using multilevel inverters of emerging topologies with reduced total harmonic distortion[17] – [24].

In many countries, agriculture's contribution to economic growth is a major thing. In recent years, solar PV systems have started to play a major role in agriculture, like solar-powered power water pump sets, lights, etc, [25]. Power requirements of many agricultural types of equipment are fulfilled by solar PV systems. The pesticide sprayer is important machinery equipment in the agriculture field and used for so many years. In the earlier years, the pesticide sprayer was hand-operated and it was switched over to fuel operated. In the past few decades, pesticide sprayers have been powered by electrical batteries. The major drawbacks of hand-operated sprayer are a lot of hand pain in the operator [26] – [27], fuel operated sprayer is the emission of harmful gases, and fuel-cost, battery-operated sprayer has to charge the battery in a selectively fixed location. To overcome these issues solar-powered pesticide sprayers were proposed in the literature [28] – [29]. Here the author proposed solar-powered pesticide sprayers with LED light and mobile chargers. From this proposed system, farmers can utilize the sprayer for spraying pesticides, utilize the powered LED at night times, and can charge the mobile phones anywhere from the battery attached to the sprayer.

II. LITERATURE REVIEW

B. van Campen et al. [30] discussed solar photovoltaics and their applications in sustainable agricultural and rural development. Bibhu Santosh Behera et al. [31] discussed applications of solar systems in the agricultural field like electricity production, heating, water pumps etc., Mandar et al. [32] suggested solar operated sprayers overcome the drawbacks of hand-operated and fuel operated sprayers. The suggested systems only focused on sprayer operations and not considered additional futures. Ritesh Chavan et al. [33] proposed the design and construction of a low price, less weight, user, and environmentally friendly solar operated pesticide sprayer for agricultural applications. A solar sprayer is implemented for agricultural applications and

discussed its benefits over other methods like hand-operated and fuel operated pesticide sprayers [34-36].

III. EXISTING SYSTEM

Different kinds of pesticide sprayers are available in the literature and listed in table 1 with merits demerits.

S. No.	Type of sprayer	Merits	De-merits	Reference
1	Hand - operated	Low cost, portable, easy maintenance	Air pumping through the hand leads to pain, Not suitable for large forms	[26]
2	Fuel - operated	Medium cost, easy to operate, suitable for small to large farms	Fuel cost emits harmful gases, maintenance is not easy	[27]
3	Battery-Operated	Easy to operate, Environment friendly, suitable for small to large forms	High cost, need to charge in a fixed place	[28]
4	Solar-powered	Environment friendly, automatic charging during the working, , suitable for small to large forms	High cost	[29]

Table 1: Different types of sprayers with merits and demerits

From the existing systems, solar power sprayers are effective and user-friendly. Now researchers look forward to additional applications along with solar-powered sprayers. Here, the authors propose some additional features like mobile chargers and LED light glowing from the solar-powered sprayer.

IV. EXPERIMENTAL SETUP

Different types of sprayers are available in the literature. In this article, the solar-powered sprayer is considered with some additional applications. Solar-based pesticide sprayer is one of the most improved and modern versions. This type of sprayer is mostly used in different types of applications like farms, gardens, and pastoral areas. It is found more reliable to use. It uses solar power to run so it is a maintenance-free and pollution-free pesticide pump as compared to two-stroke engine pumps. Figure 1 depicts the solar-powered pesticide sprayer LED light and mobile charger block diagram. It consists of a tank, 12V lead-acid battery, pipe,spray gun with on-off switch, solar panel, two adapters; one for the mobile charger and another LED bulb. The sprayer is a mechanical device that is specifically designed to spray liquid quickly and easily based on applied pressure. Solar energy received from sunlight is directly converted into electrical energy using solar panels. The converted electrical energy is given to the battery through a voltage adaptor. The lead-acid battery is used as a storage device to store the converted DC electrical energy from the solar panel. This DC power is used to operate the DC motor to pump the water from the tank to the nozzle with controlled pressure. Figure 1 shows the block diagram of the proposed system.

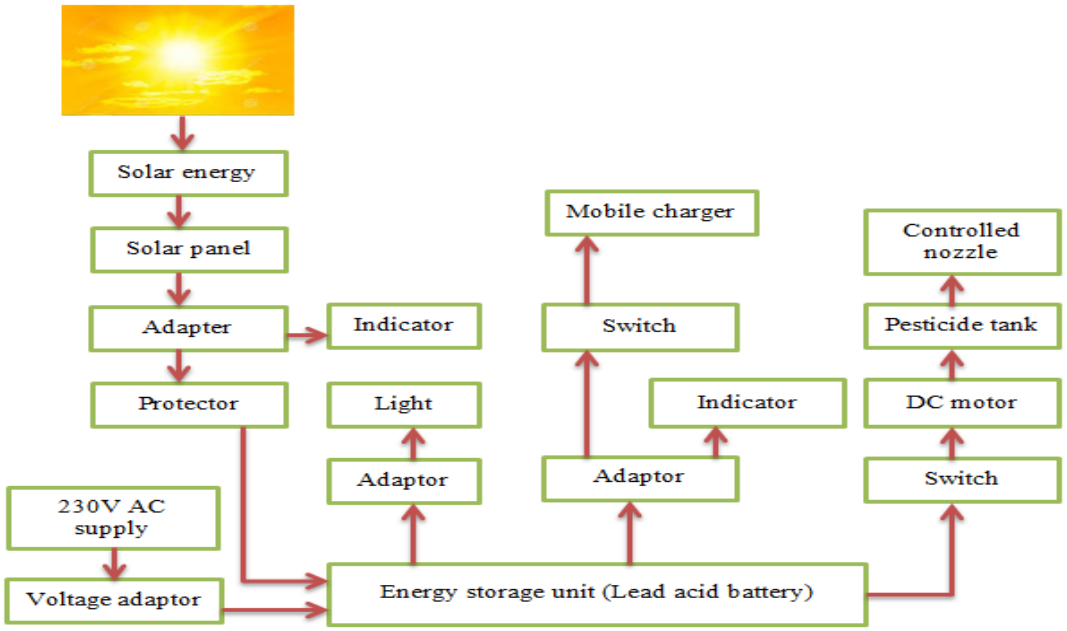

Fig. 1.Block diagram of the proposed system

A. Working:

Here three major parts are presented. First, one is the conversion of sunlight into electrical energy and stored in the battery. The second part is mobile charging from stored power and the third is pesticide sprayer operation using converted energy. The battery uses this electricity to charge itself. From the stored power from the battery, LED light and mobile charger get operated. Three separate switches were used to ON/OFF the pesticide sprayer, mobile charger, and LED light. For proper operation of the sprayer, a gun trigger is used to control the speed of liquid flow through the nozzle. Indicators are used to display the status of the working pesticide sprayer, LED light, and mobile charger. In this proposed system, the battery is charging continuously from sunlight with the help of a solar panel placed on top of the tank. Another major benefit of the proposed system is it can get charged from an AC source also if needed. Table 2 gives the specifications of different components used in the proposed system.

S. No.	Component	Specification
Solar panel		
1	Output power	10 watts
2	Size	297mm*300mm
3	Weight	1.6 Kg
Battery		
4	Operating voltage	12 V
5	Operating current	1.7 A
6	Output power	20 watts
7	Weight	1.6 Kg
DC motor		
8	Volt	12 V
9	Ampere	1 A
10	Flow	2.7 LPM
11	Pressure	80 PSI (5.5 bar)
DC mobile charger		
12	Input	12 V
13	Output	3 to 4 V
14	Output	640 mA
15	Connectivity's	5 plugin system

Table 2: Specifications of components:

V. RESULTS ANDDISCUSSIONS

The proposed system provides better performance. The systems get continuous power from sunlight in the daytime and store excess energy in the battery. The stored energy can be utilized at night time for glowing LEDs and charging the mobile phones. Maintenance of the systems is very less since it uses solar panels for energy production. The proposed system saves the former costs by not using the fuels for operation and helps the environment from harmful gases. Figure 2 displays the battery, pump, and interconnections used in the proposed system. Figure 3 depicts the overall proposed system. Table 3 gives the cost of different components used in the proposed system.

(a) (b) (c)

Fig.2: (a) Battery, (b) Pump, (c) Interconnections

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(a) (b) (c)

Fig. 3: .(a) Mobile charger, (b) LED light, (c) Overall system

S. No	Component	Amount
1	Solar panel	1200/-
2	12V Leadacid battery	800/-
3	DC motor	450/-
4	DC charger	200/-
5	Tank	500/-
6	Micro control sensor	400/-
7	Spray gun	400/-
8	LED	120/-
Total		4070/-

Table3: Components cost

VI. CONCLUSIONS AND FUTURE WORK

In this article, an environment-friendly solar-powered pesticide sprayer is proposed as a cost-effective method. The proposed system consists of a mobile charger and LED light along with the main system. The performance of the proposed system is better than other conventional methods and maintenance is too low. The proposed system contributes to the major role of farmer societies, rural, and municipal corporations. In the proposed system, a solar panel placed on the tank top is fixed. Due to this efficiency is low for movements in different directions. In the future, work may be carried out to rotate the solar panel in accordance with solar irradiations.

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