

Design and Fabrication of Solar based Bluetooth Controlled Pesticide Sprayer

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Abstract: Agriculture is a profession of many tedious processes and practices, one of which is the spraying of insecticides in the vineyards. A typical vineyard requires extensive spraying every 4-5 days in the summer and every 3-4 days in the rainy season. The conventional methods are: a person carrying a sprayer and manually actuating a lever to generate pressure and pump the pesticide through a tube or a mobile vehicle carrying an inbuilt compressor and sprayer unit which has to be manually driven by a human operator. These methods are fuel consuming and susceptible to human errors. Another major drawback in human operated systems is that the operator is exposed to the harmful chemicals while spraying. Long term exposure, as in this case, can be extremely detrimental to the operator's health. This is a project which can be viewed as a viable alternate to these methods. The Automatic sprayer is a three wheeled vehicle which sprays pesticide in any given vineyard with almost nil human assistance. The vehicle is powered using an on board solar powered battery which brings down the running cost. The control of the vehicle is achieved using an inbuilt microcontroller unit which is programmed to respond to the wireless device.

Keywords – Microcontroller, Solar Panel, L293D Motors, Relays, Bluetooth device.

I. INTRODUCTION

Agriculture is a profession of many tedious processes and practices, one of which is spraying of insecticides in the farm fields. Sprayers are mechanical devices that are specifically designed to spray liquids quickly and easily. They come in a number of different varieties. In this paper a solar operated mechanical sprayer is presented. A sprayer of this type is a great way to use solar energy. Solar based automatic pesticide sprayer are the ultimate cost effective solution at the locations where spraying is difficult. This automatic solar based pesticide sprayer system uses solar energy as source. Solar energy is first used to charge a storage battery. The solar energy stored in the battery is utilized to operate motor which functions as pump. In this paper we are trying to make a prototype model for farmers and cultivators for whom spraying of insecticides is harmful and hazardous. The proposed system Automatic Pesticide Sprayer Robot which is expected to achieve better results compared to the previous methods without using human assistance. This would be an automatic mechanical model that would work automatically powered by solar energy and reduce drudgery and also protect the farmers and cultivators from harmful pesticides and chemicals. The main objective of this system is to implement smart robot pesticides spray motor & mix pesticides using Bluetooth through android mobile, A LDR is used for illumination during night times. Solar panel is used for battery charging.

II. LITERATURE REVIEW

[1] AbhishekJivrag et al,

Describes invention and operation of multiple granulated pesticides duster with the use of solar energy. The concoction is accomplished by the use of solar panel, impeller type centrifugal blower, gear reduction mechanism, dispensers, D.C motors and batteries. In addition, the duster has been equipped with a facility to operate on an electric supply, which serves beneficial in the absence of sunlight. The device essentially works for disbursing solid granulated (powder) form of pesticide. The operator controls the rate and discharge of different pesticides by means of push buttons and toggle switches. The technical specifications of the device are worked and examined in a way to minimize the weight of the device and deplete the feeder unit dispenser in a span of three hours.

[2] R.Joshua, V.Vasu et al,

“Energy demand” is one of the major problems 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 application non-conventional energy is the only alternate solution for conventional energy demand. Now-a- days the concept and technology employing this nonconventional energy became very popular for all kinds of development activities. Solar energy plays an important role in drying agriculture products and for irrigation purpose for pumping the well water in remote village without electricity.

[3] B. van Campen D et al,

Solar photovoltaic (PV) systems have shown their potential in rural electrification projects around the world, especially concerning Solar Home Systems. With continuing price decreases of PV systems, other applications are becoming economically attractive and experience is gained with the use of PV in such areas as social and communal services, agriculture and other productive activities, which can have a significant impact on rural development. There is still a lack of information, however, on the potential and limitations of such PV applications. The main aim of this study is, therefore, to contribute to a better understanding of the potential impact and of the limitations of PV systems on sustainable agriculture and rural development (SARD), especially concerning income-generating activities.

[4] R. Rajesh et al,

Energy demand is one of the major threads for our country. Finding solution to meet the energy demand is great challenge for Scientist, Engineers. Now a day pesticide sprayer is operated based on fuel engine. This operation is more economical. In order to overcome this we found the new concept known as “Solar Pesticide Sprayer”. In this pesticide sprayer is operated mainly based on solar energy and hence there is no need of any kind of alternative source. It has many advantages such as cost of spraying and also saving on Fuel/Petrol. There is less vibration as compared to the petrol sprayer. Hence the system can be easily operated there is no need of labours which increases the efficiency of farmers. Solar based pesticide sprayer is one of the improved model of pesticide sprayer pumps. Sun is the source of all energy on the earth. It is most abundant, inexhaustible and universal source of energy. All other sources of energy draw their strength from the sun. India is blessed with plenty of solar energy because most parts of the country receive bright sunshine throughout the year except a brief monsoon period

[5] J. V. Bhanutej et al,

In India, agriculture has a predominant role in our day to day life. The crops that come as yield decides the total production, adds to the economy of our country. The yield decreases due to the presence of pests, insects in the farms. To kill the pests, insect's 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. These sprayers consist of different mechanisms and the cost of equipment is generally high. We developed a mechanism in which we tried to minimize the equipment cost by removing the pump to spray. This Sprayer works on Bernoulli's principle, in which the spraying action of the sprayer is due to the head developed and mechanical linkage. The model is developed mathematically for the major components like tank, required head and the spring mechanism 3. Working principle and fabrication details.

III. METHODOLOGY

Explanation of Flow Chart

- The first step involved the selection of the project. After weighing in various factors like feasibility, cost, usefulness and challenges involved we settled on this project. This was done after extensive discussions with our guide.
- After selection of project we went on to select the various general elements required for the project. This involved sourcing a welder and getting a quote on the steel pipes used.
- We next designed the chassis of the sprayer unit. We based this on an guided vehicle structure and made the necessary modifications.
- The electrical components were selected to best suit the project requirements. The circuit diagram was used as a basis for selection of components.
- The next step involved two steps carried out almost simultaneously – the fabrication of the model according to the design and putting together the electrical circuits, calibrating the sensors and the micro-controller.
- After the fabrication of the model and the completion of the electrical circuits, we integrate the mechanical and electronic parts into one unit for further testing.
- We test the integrated unit on accuracy and robustness.

If any changes or additions are required, we implement them and re-test them until satisfactory results are obtained. Manual operated sprayers are dangerous to the human's life and fuel consuming. With the help of the above proposed system we can overcome above said problems. The solar plates convert solar energy into electrical energy and electrical energy is stored in battery. Using Bluetooth application instructions are sent to the receiver side, with the help of the above system we can overcome the problems faced by farmers previously and it has greater advantage.

The main components used to fabricate the model are:

- Solar panel
- Pump
- DC motor
- Battery
- Tank
- Nozzle

Solar Panel:

A solar panel (also solar module, photovoltaic module or photovoltaic panel) is a packaged, connected assembly of photovoltaic cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Each panel is rated by its DC output power under standard test conditions, and typically ranges from 100 to 320 watts. The efficiency of a panel determines the area of a panel given the same rated output - an 8% efficient 230 watt panel will have twice the area of a 16% efficient 230 watt panel. Because a single solar panel can produce only a limited amount of power, most installations contain multiple panels. A photovoltaic system typically includes an array of solar panels, an inverter, and sometimes a battery and or solar tracker and interconnection wiring.

Pump:

For people living in remote areas, solar water pumps are usually the only solution as there is no access to diesel. If there is diesel, Solar Water Pumps are the only solution or an excellent alternative for diesel as the cost of running power lines or diesel pumping may be too great. A solar powered water pump differs from a regular water pump only in that it uses the sun's energy to supply electricity for the pump. The solar panels absorb the sun's energy and convert it to electrical energy for the pump to operate. All the pumped water is stored in a water tank so that there is constant supply even in bad weather conditions and during night time where there is insufficient power to generate the solar water pumps. Solar powered water pumps represent a higher initial investment, however, over a period of 5 years they represent a cost benefit due to minimal maintenance costs compared to AC pumps run with a generator.

DC motor:

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor. DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills.

Battery:

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smart 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 when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work.

Tank:

Storage tanks are containers that hold liquids, compressed gases or mediums used for the short or long term storage of fluids or gases. The term can be used for reservoirs. Storage tanks are available in many shapes: vertical and horizontal cylindrical open top and closed top flat bottom, cone bottom, slope bottom and dish bottom. Large tanks tend to be vertical cylindrical, or to have rounded corners transition from vertical side wall to bottom profile, to easier withstand hydraulic hydrostatically induced pressure of contained liquid. Most container tanks for handling liquids during transportation are designed to handle varying degrees of pressure.

Nozzle:

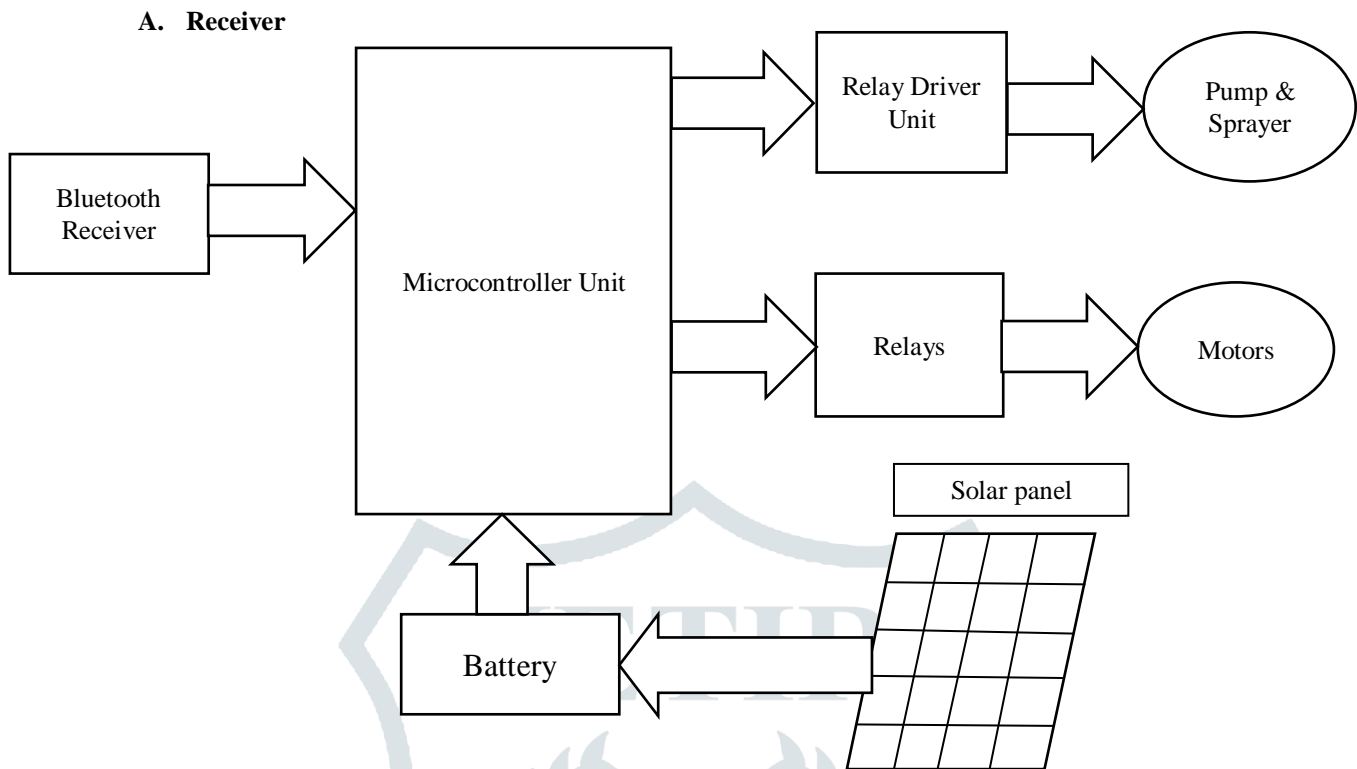
A nozzle is a device designed to control the direction or characteristics of a fluid flow (especially to increase velocity) as it exits (or enters) an enclosed chamber or pipe. A nozzle is often a pipe or tube of varying cross sectional area and it can be used to direct or modify the flow of a fluid (liquid or gas). Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape, and/or the pressure of the stream that emerges from them. In a nozzle, the velocity of fluid increases at the expense of its pressure energy.

IV. WORKING

Microcontroller is the mother unit of the complete system. It consists of two parts one is transmitter and another is receiver. In transmitter part it consists of Bluetooth device. The Solar panel, Bluetooth and Storage battery make the input of the system. The receiver part consists of Microcontroller, Relays, Light, L293D Motors, Sprinkler motor. The sun rays are collected by the solar plates, where it converts solar energy into electrical energy and it is stored in the battery. We can also use direct electrical energy for spraying whereas battery can be used as backup for night time's usage. Bluetooth is used to send instructions to the microcontroller unit.

The instructions used are:- A-for FORWARD MOVING, B-for BACKWARD MOVING, D-for TURN RIGHT, C-for TURN LEFT, E-for STOP, F-for SPRINKLER STOP, G-for SPRINKLER ON.

V. SYSTEM MODEL AND ASSUMPTIONS



B. Transmitter



VI. TECHNICAL SPECIFICATION:

Specifications of battery:

Weight of the battery	1/2kg
Output power	12 volts 7.5 amps
Operating voltage	12 volts 1 amps
Current	1-1.5 amps

Specification of motor:

Weight of motor	1kg
Operating power required	12 volts 1 amps
Operating voltage	12 volts
Operating current	1 amps
Motor speed	80rpm

Specification of solar panels:

Panel size	316*217 mm
Weight of the panel	500gms

VII. OBJECTIVES:

- Design and fabrication of solar pesticide sprayer.
- The pesticide sprayer operating with zero pollution.
- It does not require fuel for working hence cost reduced for operation.
- This method reduces the maintenance task.

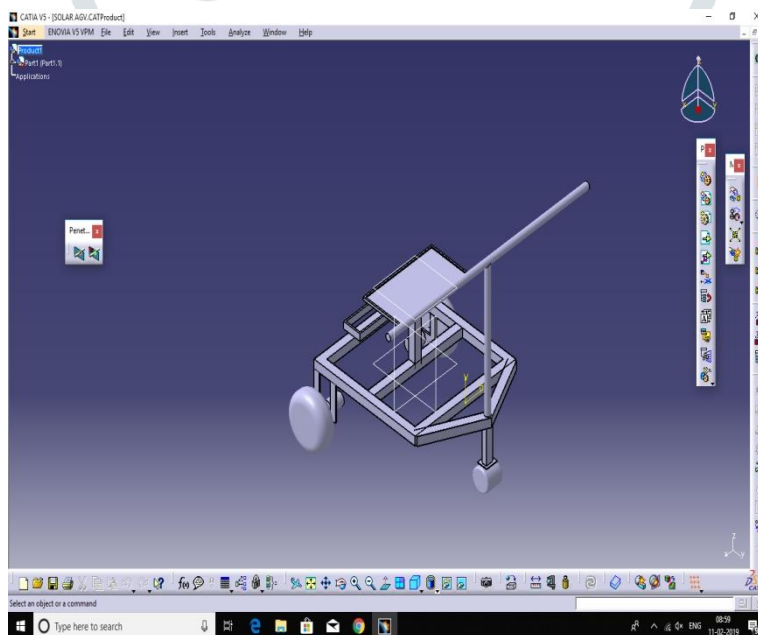
VIII. DESIGN:

Figure 1. 3D Model



Figure 2. Actual Model

IX. RESULTS

This Agriculture based vehicle proves to be an effective and efficient machine which can be easily navigated and controlled. The vehicle can move through different types of terrains and soil. Command for controlling the vehicle movement and spraying of pesticides is done by using an app called arduino Bluetooth controller which is available in play store. Hence control of vehicle is user friendly and it is not very complicated ; hence farmers can easily control the vehicle. Pesticide spraying is a tedious job in agriculture as it requires various protection equipment's to protect the farmers. This vehicle mainly emphasis on pesticide spraying by farmers from a remote location without directly coming in contact with it. This feature will encourage more people to take up agriculture as the complexity of the task is reduced and the manned task is converted to an unmanned task. The power supply required for the vehicle is obtained using batteries. The power is obtained from the renewable source, solar energy in the working model. Though pesticide spraying is important to increase the production yield, unregulated usage of pesticides will damage the soil and the crops.

X. CONCLUSION

This project demonstrates the implementation of robotics and mechatronics in the field of agriculture. This being a test model the robustness of the vehicle is not very high. The performance is satisfactory under laboratory condition. The model gave a fairly good rate of area coverage and the cost of operation as calculated was also reasonably low. In addition the safety and long term health of the farmers is ensured by eliminating human labour completely from this process. It does not compromise the performance of a petrol based pesticide sprayer.

XI. ACKNOWLEDGEMENT

The Existing system does not have minimum requirements for human needs such protection from pesticides regarding health issues, consumption of solar energy, no fuel consumption, does not create any pollution and so on. In this project the above requirements are fulfilled with the advanced technology by sending instructions with the Bluetooth device and this project provides greater advantage in future.

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