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Design and Implementation of Solar Based Pest Controller

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Abstract: *Agriculture is the principle occupation of the people in India. It serves as the main livelihood for farmers, but the damage caused by insects and pests ruins the crops and results in loss of production every year. One of the commonly used remedy for this is the use of pesticides. However, when pesticides are used in large quantity, they cause adverse impact on people, animals and the environment. To prevent this, solar based insect pest trap is used. In this model, an automatic control system is employed by which the insects can be captivated during night-time. The results of this model showed that this proposed solar energy based insect pest trap could get rid of several types of insect pest in an efficient manner. It is the most effective tool for monitoring of insect pest, providing no harm to nature and also has low cost involvement so that it can be utilized by most of the farmers.*

Key Words: *Agriculture, Solar Energy, Solar Panel, Pest, Pesticide.*

1. INTRODUCTION:

Majority of land mass in India is used for agricultural purpose. It account for about for about 60.43 per cent of the land area in India. Majority of the population in India is dependent on agriculture for their living. Agriculture also plays the chief role of revenue earning in the Indian economy. The fertile lands and presence of plenty of rainfall makes it ideal for cropping. This has led to the flourishing growth in food crops and vegetation in the country. Rice is the main food crop in the state of Assam as it is the main diet in the state too. The people in the state under the agricultural department fully focus themselves in the cultivation of this crop. Other than rice, various other crops like jute, sugarcane, fruits, tea, pulses, coconut, potatoes, cotton, and areca nuts are also cultivated. More than 50 percent of the total population of the state engage themselves in agricultural activities of Assam. However, every year farmers face the problems caused by insects and pests which seriously destroy the crops. There are many prevention methods to control the growth of pests like physical method, mechanical method, biological method, and chemical method. The chemicals called pesticides are designed to kill or control insects, weeds, microbes or rodents. Pesticides are widely used in agriculture and forestry and also some other sectors which include industries, trade, storage and other sectors of economic and household activity. With the requisite use of these pesticides, the crops and other products can be protected efficiently. However, pesticides tend to cause adverse affects on the environment and also on human and animal health. Pesticides can contaminate soil, water and other vegetation. Besides being efficient in killing insects and weeds, it causes great harm to nature like the soil, water, fish, birds, other useful plants and beneficial insects. As pesticides are applied in a wide variety of sectors like agriculture, forestry etc, they may put workers in different occupations at risk of acute poisoning or occupational diseases. Thus, the application of pesticides causes adverse impact on agriculturists and consumers. This causes plant residue which is dangerous for consumers, and also affects on the environment and ecology.

Green Revolution technologies have widely been adopted. At present, different schemes on green revolution technology in different crops are successfully going on in the different states of India. Insect pests, diseases and weeds cause considerable damage to potential agricultural production. Evidences indicate that pests cause 25 percent loss in rice, 5-10 percent in wheat, 30 percent in pulses, 35 percent in oilseeds, 20 percent in sugarcane and 50 percent in cotton. These losses though cannot be eliminated can definitely be reduced. At present, consumers emphasize on safe and non chemical food. The producers should be aware of this matter and reduce pesticide to decrease farmers' and consumer's health problems by creating chemical free and pesticide free production. Therefore, a solar energy based insect pest trap for orchids and vegetables have been designed. The basic methodology of this model is illustrated in the following block diagram:

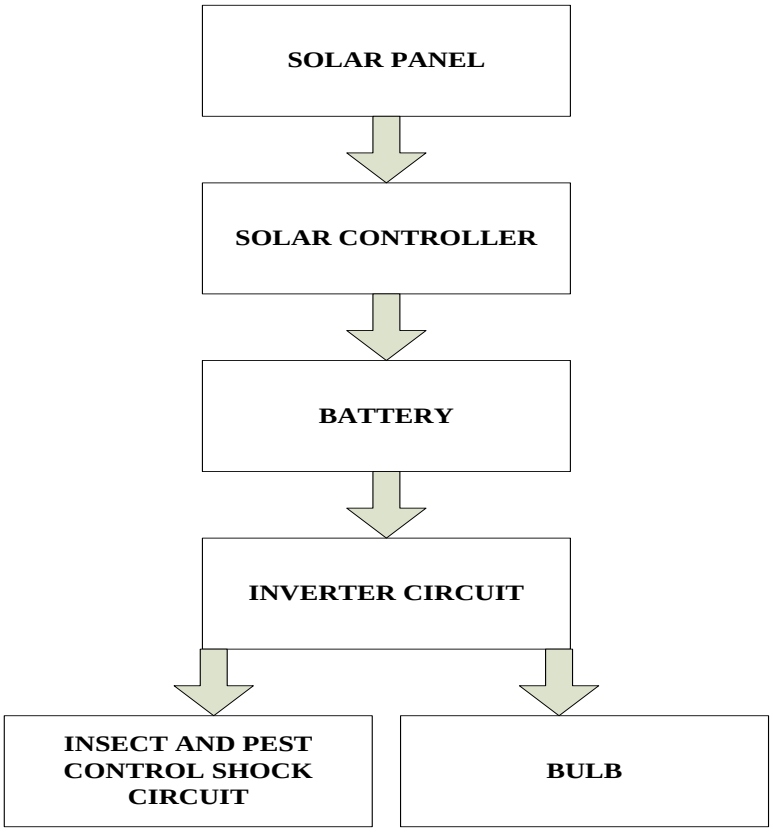

Figure 1. Block diagram showing the methodology

2. LITERATURE REVIEW:

In (1), a solar LED light technology is used that can be applied to various crops in the cotton fields, vegetables, orchids, tea plantation, and so on. This was the most preferred method for controlling the harmful insects and pests. In this technology, during the day-time, the energy from the solar panels is stored in the solar battery and during the night-time, the energy from the battery is used to drive the circuit of the LED light to control the pests (2).

2.1. IMPORTANCE OF SOLAR ENERGY:

Solar energy is defined as the energy that is obtained from the sun in the form of radiated heat and light. It supports life on earth and controls the climate and weather conditions. The energy from the sun can be used to obtain electricity with the help of various solar energy technologies.

Solar energy technologies refer primarily to the use of solar radiation for practical applications. Solar technologies are either characterized as active solar or passive solar depending on the way they capture, convert and distribute sunlight. Active solar techniques make the use of photovoltaic modules and solar thermal collectors to convert sunlight into useful outputs. Passive solar technique involves orienting a building to the Sun, selecting materials with favourable thermal mass or light dispersing properties, and designing spaces that naturally circulate air. Therefore, solar energy is the most abundant, renewable energy source in the world.

2.2. INSECT AND PEST CONTROL:

There are various control methods used by farmers to destroy insect and reduce damages caused by pests, such as:

- Biological Control or Bio control. This method uses pests' natural killers to destroy and control the outbreaks. For example, Chelisoches morio (Fabricius) and Krigrogramma wasp to control were used by farmers to destroy the weed Brontispa longissima Gestro which harmed the top of coconut trees. Other natural pest killers are Rove beetle, Parasite, Pathogen, Entomogenous nematode, etc.
- Plant Resistance: This method uses Pest-Resistant Crop Variety planted appropriately in farm. The plants are improved to prevent pests from breeding. These improved plant variety are called Transgenic Crop Plants (TCP). Nowadays the crops that fall under TCP include corn, potato, bean, tomato, cotton, tobacco, rice, wheat, etc. The products from TCP are referred as Genetically Modified Organisms; GMOs.

- Cultural Method: In this method, only one group of pest in a time is controlled. Such methods include: using transplantation instead of seeding, choosing mulching materials, intercropping, and crop rotation to cut pest's life circle.
- Mechanical and Physical Method: This method controls the important pests in every group by using light, radiation, sound and heating techniques to control and prevent pest; this method requires high technology which is expensive. For example, Nylon net covers are used over vegetable bed to protect moth laying eggs on leaves. The nylon net can prevent Pultella xylostella, Armyworm, and Caterpillar. The drawback of the nylon net is that it gets destroyed by the blowing wind or windy storm in open area.
- Chemical Control: It uses pesticides or agro pesticides or other chemicals, but these may affect the crop lands in an adverse manner. There are many other pesticides for effective pest control. Nowadays, the botanical pesticides are quite safe for both injectors and consumers; such as natural Neem extracts.
- Legal Control: In India, at present two categories of regulatory measures are in operation for control of pests, diseases and weeds. They are: i) Legislative measures through Plant Quarantine, and ii) Legislative measures through State Agricultural Pests and Diseases Act.
- Integrated Pest Control. It is uses more than 2 methods of previous control together. This method is developed to IPM (Integrated Pest Management) to reduce chemical and increase environmental safety.
- Natural or Organic Farming. This method uses organic fertilizers and compost like cow dung manure, compost, vermicompost etc. are used.

3. METHODOLOGY:

In the proposed paper, a Solar Energy based Insect Pest Trap has been designed. The basic idea of this model is to invent a solar energy based insect trap by using LED bulb as light source. Solar cells are used to change solar energy to electric energy which can be used efficiently for controlling the harmful insects and pests. After that, the trap is brought to test its effectiveness in agricultural areas.

- Design: In this model, the general items such as the electronic mosquito trap, a wooden acrylic frame are used. The material requirements are: Solar panel 20W which consists of many small photovoltaic cells that can convert the sunlight into electricity; a Solar cell battery: The charge from the battery is used to light the bulb at night-time; an LED bulb to attract the insects; a solar charge controller: The controller connects the solar panel and the battery. It controls the charging of the battery. The connections through the controller are shown in the figure below:

Figure 2. Solar charge controller with the battery and solar panel connections

The installation of the LED bulb is as shown:

Figure 3. Installation of LED bulb in the model

In addition to this, it also consists of a Zapper Circuit (shock): It is made up of diodes and capacitors so that the voltage can be multiplied to a high voltage level; the inverter circuit, the wooden frame and connecting wires. The design of the Zapper circuit, its installation in the model and inverter circuit is shown in the figure below:

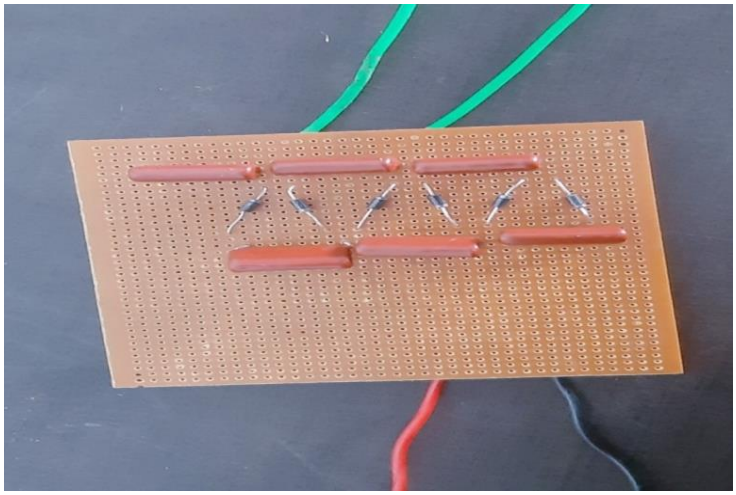

Figure 4. Zapper Circuit consisting of diodes and capacitors

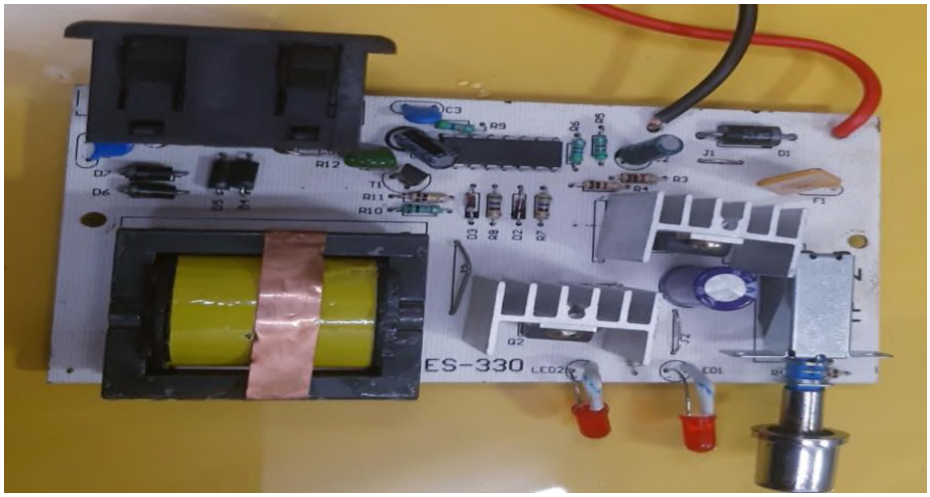

Figure 5. Inverter Circuit

- Construction: The main structure of Solar Energy-Based Insect Pest Trap is made from wooden frame for its effective use in agricultural fields. On the top of the solar pest trap, a 20W solar cell panel is installed. The insect tempt consists of a clear square box which can let the light from the bulb out of the box. On the inner side of the box, there is a mesh wire of electronic mosquito trap. On the top of the insect tempt is a wooden box that contains the battery, the solar charge controller, the inverter circuit and the zapper circuit to prevent it from any damage. The connections of the zapper circuit are brought out to the mosquito trap through a hole. The arrangement of the model is as shown in the figure below:

Figure 6. Solar energy based insect pest trap model

- Working: When sunlight hits the solar photovoltaic cells, the energy from the sun in the form of photons are absorbed. This then hits the free electrons in the cell. Thus, an electric field is created which forces the electrons to move in a particular direction and results in the formation of electric energy in the form of direct current (DC). Since an LED bulb is used, so this DC current is converted to an AC one using the inverter circuit. Also, a solar charge controller is used which connects the battery and the solar panel with it. The charge controller prevents the battery from overcharging. A zapper circuit is designed to give the necessary shock to the electronic trap.

4. RESULT:

When the light was switched ON and the zapper circuit was made active, it was found that the insects and pests could be effectively controlled with the help of the electronic mosquito trap. Also, it was found that the voltage at 10am to 2pm during which the solar cells got the most solar energy was 17 volt. When connected to the battery charger, the current 1.2 amp was transferred to the battery. As the battery was also fully charged, the bulb was on for 5 to 6 hours, which was enough to light the bulb at night-time.

5. CONCLUSION:

The solar energy based pest controller is the most efficient and eco-friendly method for the control of pests harming the agricultural crops. Farmers encounter great difficulty every year because of the insect pests harming the crop lands. Therefore, the utilization of pesticides had brought great attention in removing the pests harming the crops. However, when pesticides are used in large quantity, they cause adverse impacts on people, animals and the environment. Therefore, this model is very effective in controlling different insect pest without the use of any chemical pesticides in the agricultural fields. It is electrically operated and is stationary in nature. Hence the solar light trap may be considered as the alternative method as it has several advantages over the chemicals that were used previously. It is portable in nature and can easily be fixed at any place in the field. Many organizations may also utilize this useful tool for successful implementation of green revolution technology in the crop field to provide necessary safe guard to nature. Thus, it can be concluded that it is the best model for controlling insects and pests harming the agricultural crops.

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