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IoT BASED DESIGN AND DEVELOPMENT OF SOLAR ASSISTEDPESTICIDE SPRINKLER

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ABSTRACT
Pesticide spraying is an important agricultural task that preserves crops from pests, diseases, and insect infestation and controls weeds. This conventional sprayer causes user fatigue because of its huge and bulky construction. We make this design and fabrication of a model that is a solar sprinkler, this will ergonomically eliminate the back attachment of the sprayer, reducing the user's fatigue level. Solar panels generate electricity by converting sunlight into electrical energy. This energy is used to power the entire system and the energy is stored in a battery which can be used to power the devices when sunlight is not available. The fuel-powered spray pump's engine will be eliminated resulting in reduced vibrations and noise. Our technique is going to be less harmful to the environment as we eliminate the fuel that is used. The NODE MCU contains an ESP8266 Wi-Fi module connected to the l298n motor driver module which controls all motors via an application created using the Internet of Things (IoT) application called blynk. The Blynk application is used to control and monitor the entire assembly.
Keywords— NODE MCU, Pesticides, Wi-Fi module, Solar panel, Motor driver module.

1. INTRODUCTION

Agriculture is a significant contributor to India's economy, employing more than half of the workforce and providing approximately fifteen percent of GDP. India is the world's second-largest agricultural producer, and its agricultural sector has transformed significantly in recent years. India's agriculture is distinguished by an extensive variety of crops, ranging from staple essentials including rice, wheat, and legumes to cash crops such as cotton, sugarcane, and tea. The country boasts a wide range of agriculture-climatic zones that maintain a broad variety of crops, and the nation has achieved significant progress in areas such as irrigation, seed technology, and agricultural research. However, the sector confronts numerous difficulties, including poor productivity, climate change, shortages of water, and land degradation. In recent times to address these concerns, the Indian government has taken numerous measures, including promoting organic farming, introducing crop insurance policies, and encouraging the adoption of new technologies such as precision agriculture and smart farming.
In agriculture, automation approaches have been implemented to address these challenges. Agricultural automation can help farmers reduce time as well as cash. The use of machinery and technology to automate numerous agricultural operations such as planting, harvesting, irrigation, and pest management is known as agricultural automation. It involves the utilization of cutting-edge technologies such as robots, sensors, artificial intelligence, and the Internet of Things (IoT) to improve the effectiveness and long-term sustainability of agriculture. Machines have been engineered to be able to focus efficiently when simultaneously carrying out functions independently. The proposed proposal uses the vehicle for carrying out tasks such as water and pesticide spraying. These responsibilities can be integrated and carried out in a single vehicle.
The fundamental idea behind a pesticide sprayer is to precisely pinpoint the required area, hence maximizing the use of agricultural pesticides. The size of the droplet, kind of sprayer nozzle, target time, drift, correct usage of sprayers, evaporation of the droplet, weather conditions, volatilization,

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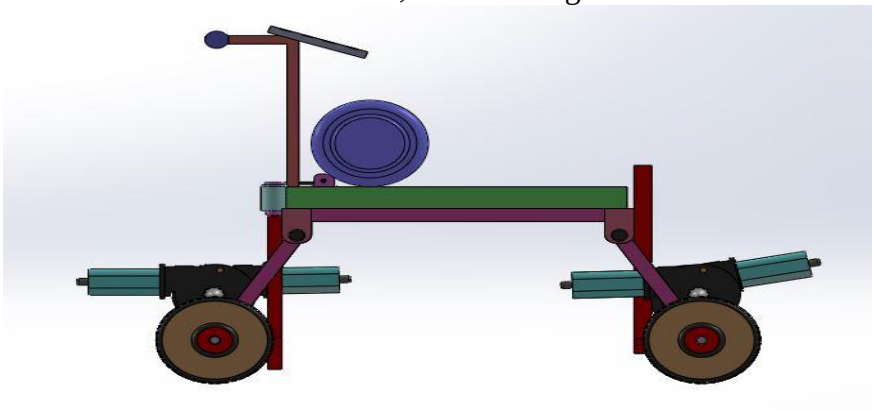
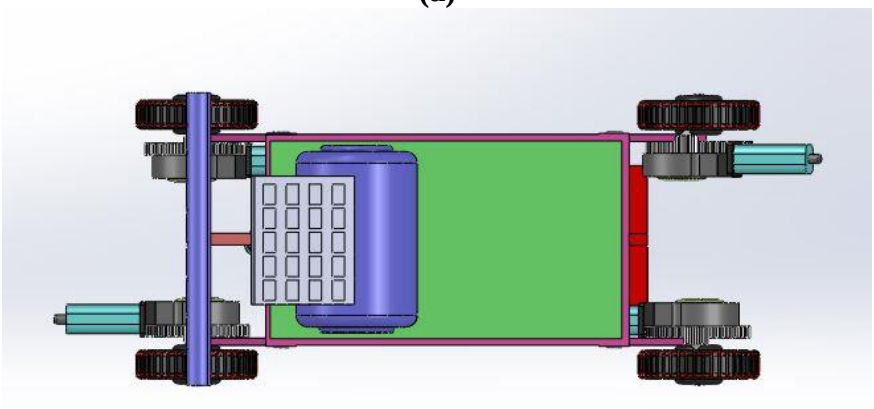
distance, and height of spraying are some very important characteristics. Droplet distribution will be properly uniform as a result of this. There are several varieties of pesticide sprayers, including those that are mechanically powered and those that must be carried by hand. Boom sprayers were initially used in Australia in the early years of 1900; however, they developed in France and the US in 1980. Plenty of benefits of the boom and hydraulic nozzle system of the sprayer have been emphasized by Rutherford et al

2. METHODOLOGY

After an in-depth examination of the material, the conceptual design for the model that was suggested has been started with a sketch before the final design of the model is produced. The primary challenge in this situation was figuring out exactly where for mounting the sprinkler, solar panel, and battery, which are essential components of the entire system. Line diagrams were thoroughly drawn, subsequently a design concept was created. The design concept was solid modelled using the AUTOCAD software tool shortly after it was decided upon. The sprayer's length (L), width (W), and height (H) are determined according to the crop and agricultural land circumstances in India. The distance between the two front wheels is 50 cm, as is the length between the rear and front wheels.



(a)



(b)

Fig. 1. Model design using Auto-CAD (a) side view, (b) top view.

IoT-based design and development of a solar-assisted pesticide sprinkler for use in communities and farms for preventing germs, insects, and microorganisms under control. Farmers are helped by techniques like these for the reason that they save time and cash. In recent years, technology has gravitated towards automation and intelligent IoT. Subsystems that are performed with greater accuracy and effectiveness throughout their lifetime because our solar-assisted pesticide sprinklers are effective and durable, they can function both automatically and manually, with or without human

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involvement. Solar panel installations in India will reach 71 GW by the end of 2022, with approximately 85 percent of solar panels implemented in the entire country. In the first quarter of 2019, India remained the third-largest solar market by volume solar energy is an ideal source. Solar panel generation of electricity discharges no greenhouse gases into our surroundings. Solar panels gather solar radiation and transmit electrons that produce a current flow of direct (DC) energy, which can be converted into functional alternating current (AC) via silicon photovoltaic silicon cells. It functions by the solar module producing 12 V and 20 Watts of electrical power to the charging the device. Node MCU microcontroller, ESP8266 Wi-Fi module, 12V lead acid battery, geared motor, relay, pump, sprinkler, and BTS7960 motor driver are used in our project. IoT serves to monitor all chemical information on the website. The Internet of Things (IoT) is a network that links all physical devices to the cyber world via network devices. The Internet of Things authorizes remote-controlled devices to function on existing networks. The Internet of Things transmits data over networks without that requiring human-to-human or human-to-computer interaction. The Internet of Things combines hardware and applications.

3. RESULTS AND DISCUSSION

3.1 BLOCK DIAGRAM

The block diagram of solar spray system is shown in Fig.2. It consists of eight units namely: Solar panel 12 volt 10 watt capacity, Charge Controller Circuit, Battery 12 volt lead acid battery, Wi-Fi Module ESP8266, Node MCU Microcontroller, Relays, Motor drive and Motors.

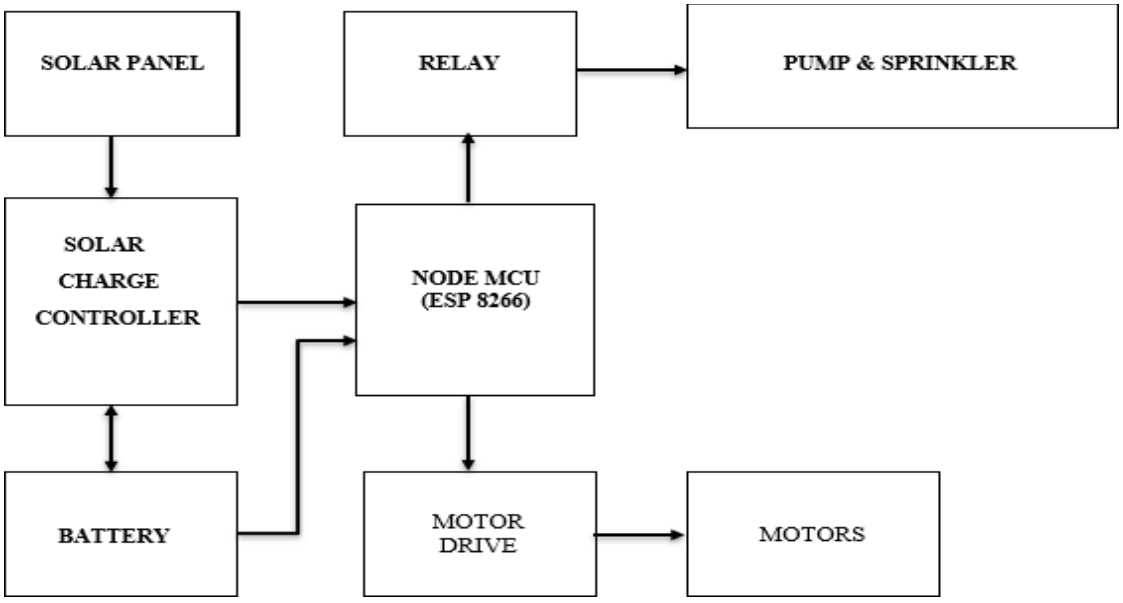

Fig. 2. Block Diagram

3.2 COMPONENTS OF FABRICATED MODEL

The different components along with their technical details have been mentioned in table 1.

TABLE I. SPECIFICATIONS OF MODEL

SL.NO	Components Details			
	Parts	***Quantity***	***Features***	***Technical Details***
01	Wheel	03 Nos.	Nylon Fiber	φ 48 cm

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02	Node MCU ESP8266	01 No.	Size 49mmx29mm Pin Spacing 0.9" (22.86mm),	Speed 80 MHz, Input Voltage 4.5V-10V
03	Frame	-	Mild Steel	120 cm
04	Solar Panel	01 No	Polycrystalline solar panel with strong aluminum frame	12 volt, 10 watt capacity
05	Submersible Pump	01 No.	PVC with outer body, 9watt motor	Can lift water up to 1.2 meter height, pumping capacity 50 liters per hour
06	Battery	02 Nos.	12 volt lead acid battery	2.5 AH capacity
07	Charge Controller Circuit	01 No	Light Weight (40.0 grams), zero drop, shunt type	Voltage regulation: 5mV (no load to full load)
08	Pesticide Tank	01 Nos	Commercially available PVC Type	6 Liter capacity
09	Valve	01 Nos	Easy to regulate flow rate	½ inch diameter 5 psi pressure
10	Pressure Switch	03 Nos.	Electronically controlled Light weight, small size with stainless steel impeller shaft	External threads: 1/2 inch
11	Nozzle	01 Nos	Full Cone Spray Pattern, For fine mist to jet stream	0.3 mm nozzle tip diameter with nozzle include spray angle 45^0
12	Motor driver	01 Nos	Convert step and input controller to currents and voltages compatible motor	capability of up to 25 kHz,

3.3 EXPERIMENTATION

The sprayer's solar panels are subjected to direct sun radiation exposure. Based on the photovoltaic effect, photovoltaic cells directly convert solar radiation onto electric power. 12v Lead-Acid battery

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connected in series receives the same power for charging. The battery's stored energy is utilized for powering the pumping mechanism. Pesticides are sprayed wherever necessary, regardless of the time of day using power. To extend the life of the battery while preventing overcharging, a charge controller has been included in the setup. Similar to this, two motors linked to the back wheels supply some additional DC power. The submersible pump requires the DC power output from the battery to power the sprinkler pump. The 5-liter pesticide tank's submersible pump has been placed inside of it. Through three nozzles, insecticides are sprayed into the crop at an adjustable height when the pump continues to operate at the set pressure. A single hose pipe connects these pairs of nozzles, and pesticide circulates through it. To enable the nozzle height to be adjusted to match the height of the plants, flexible support is provided.

3.4 SPECIAL FEATURES OF PROPOSED MODEL

The IoT-based design and development of the solar-assisted pesticide spray is suitable for spraying herbicides that are on agricultural grounds in remote regions lacking access to conventional electricity.

- The IoT-based design and development of the solar-assisted pesticide spray machine provide minimum expenses for operation and upkeep.
- Low cost, cost-effective, and yet efficient compared to other equipment. Simple to operate, easy to install, and durable.
- Environmentally conscious tools.

4. CONCLUSION

The submersible pump requires the DC power output from the battery to power the sprinkler pump. The 5-liter pesticide tank's submersible pump has been placed inside it. Through three nozzles, insecticide is sprayed onto the crop at an adjustable height when the pump continues to operate at the set pressure. A single hose pipe connects these three pairs of nozzles, and pesticide circulates through it. To enable the nozzle height to be adjusted to match the height of the plants, flexible support is provided. The IoT-based design and development of a solar-assisted pesticide sprinkler machine are very useful for farmers to carry out pesticide spraying operations in a single machine. All the parts are arranged in such a way that in every stage of agriculture, the equipment can be rearranged to perform the specified action. Our team has successfully combined many ideas from various fields of mechanical engineering and agricultural knowledge to improve the yield and by reducing the labour effort, expenses and reducing hazards from pesticides on human health. This mechanism is designed to move independently and be manually operated with the assistance of the BLYNK open-source smartphone app.

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