Solar Powered Semi-Automatic Pesticide Sprayer for use in Vineyards

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Abstract

This paper presents a semi-automatic pesticide sprayer system which operates using solar power. The semiautomatic sprayer is a three wheeled vehicle which sprays pesticide in any given vineyard with almost nil human assistance. The vehicle is powered using an onboard solar powered battery which brings down the running cost.. 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 project we are trying to make a prototype model for farmers and cultivators for whom spraying of insecticides is harmful and hazardous. The control of the vehicle is achieved using an inbuilt microcontroller unit which is programmed to respond to the zigbee wireless device.

Keywords —*Solar panels, Semiautomatic sprayer, DC motors, Liquid spraying mechanism, Relays, Sensors, Zigbee technology, AT89S52 (Atmel Microcontroller).*

I. INTRODUCTION

In India, near about 70% peoples are dependent upon agriculture. So the agriculture system in India should be advanced to reduce the efforts of farmers. Agriculture is a profession of many tedious processes and practices, one of which is spraying of insecticides in the vineyards. Sprayers are mechanical devices that are specifically designed to spray liquids quickly and easily. They come in a number of different varieties. In this project we'll take a look at solar operated mechanical sprayers. A sprayer of this type is a great way to use solar energy. Solar based semiautomatic 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.

II. LITERATURE SURVEY

Dr. H. Erdal Ozkan et al. [1] The main goal of this study was to design and develop software and hardware for an intelligent sprayer that can control variable-rate spray outputs through the nozzles based on availability of a target in sight and density level of the canopy sprayed. This has been accomplished to a large degree. However there is still some ineffectiveness associated with the operation of this sprayer that can be addressed by future studies.

C.Umayaal et al. [2] This paper deals with the exposition of how robotics can be applied to various phase of agriculture. One of the most important occupations in developing country like India is agriculture. It is very important the efficiency and productivity of agriculture by replacing labours with intelligent machine like robots using latest technologies. The paper proposes a new strategy to replace humans in various agricultural operations like detection of presence of pests, spraying of pesticides, spraying of fertilizers etc thereby providing safety to the farmers and precision agriculture.

Poratkar et al. [3] The working of this manually operated multi nozzle pesticides sprayer pump is based on the principles of motion transmission due to chain and sprocket arrangement and plunger cylinder arrangement. The operator first stand behind the trolley. He will grab the handle and lift it and push the trolley forward. As trolley move forward, the wheel rotates in counter clockwise direction. As sprocket is mounted on same shaft of wheel, it also rotates in counter clockwise direction. This motion is transferred to freewheel via chain drive arrangement. The free-wheel, thus, also starts rotating in counter clockwise direction. As freewheel and big spur gear are mounted on same shaft, it also start rotating in anticlockwise direction.

A.S. Wankhede et al. [4] The Equipment is especially made to work in row crops such as cotton pulses etc. of an agricultural field. The economic condition of farmers and the cost of labor, owing to such conditions, this equipment can find its application. The equipment is intended to perform three important operations done in fields, namely, Spraying pesticide, spraying herbicide and applying urea. All the three operations can be performed simultaneously or individually. Application of urea to the crops is not being focused much by various agriculture equipment producing firm and the equipment available are mostly suitable for large field which are in hectors. Moreover, whatever methods are available for applying urea results in high wastage of urea, we have focused on the same.

III.METHODS

A. *Present Practices*

The solar powered pesticide sprayer in general has to be sprayed manually. In the commonly available ones, the user needs to exert a lot of effort to push the lever up and down to create the pressure to spray. Sometimes when the pressure becomes uneven, the nozzle gets blocked and the farmer has to spend time to rectify it. Also the pesticide is harmful and it also affects the farmers and cultivators due to their presence while spraying in the vineyard. As shown in the figure below the farmer sprays pesticide manually.

B. *Methodology*

Hand compression sprayers are either pressure retaining or non-pressure retaining type. The pressure retaining type has an advantage that air charged once may last for weeks, but requires sturdy tank and high pressure, therefore these are not in common use. Non-pressure retaining type is the most commonly used hand compression sprayer. Like other sprayers, it consists of an airtight, metallic tank, air pump, lance fitted with trigger type or shut off valve, gooseneck bend a pair of shoulder mounted straps and nozzle. It is carry it on the back. All the parts are made from brass alloy and the tank is fabricated to withstand high pressure up to the order of 18 kg/cm^2. For operation, the tank is filled to three fourths of its capacity and pressurized by hand plunger pump, which remain inside the tank or from a compressor. The pressure inside the tank is usually maintained at 3-4 kg/cm^2. The operator mounts the sprayer on his back securing it by shoulder straps and operates the trigger valve, which enables the spray liquid to flow through lance and nozzle. The lance is directed towards the target. A single person can operate the sprayer. For maintaining proper atomization of the spray liquid, the tank requires frequent pressurization decreases with decrease in pressure.

Fig.1 Hand Compression Spray

The power sprayer consists of an integrated or external spray tank; a high pressure piston pump usually powered by a petrol engine a pressure regulating valve and a hose of up to 50 m of length. Spray tanks are too big to be carried as a knapsack. The power sprayer is produced in a number of versions. Most simple and common is an engine driven pump mounted on a frame without wheels, a 200 l drum and hose and lance. Flow regulation is to be done via a pressure regulating valve and/or by restrictors (basic power sprayer) and the size of the nozzle. At the other end of sprayers mounted on wheels, equipped with pressure regulators. Technically, the power sprayer has a lot in common with the motorized knapsack-sprayer. The unit is generally set for high volume spraying, transporting the droplets with high pressure. Hallow cone nozzles are the preferred type of nozzles.

Power Tiller Mounted Orchard Sprayer: It consists of an HTP pump, trailed type main chassis with transport wheels, chemical tank with hydraulic agitation system, cut off device and boom equipped with turbo nozzles. It is fitted with turbo nozzles with operating pressure of 9-18 kg/cm^2. It generates droplets of 100-150 micron sizes. Depending upon the plant size and their row spacing, the orientation of booms can be adjusted. The spray booms are mounted behind the operator.

Fig.2 Power Tiller sprayer

IV.SCOPE OF RESEARCH

Autonomous service robots for orchards and vineyards: 3d simulation environment of multi sensor based navigation and applications Linz, A. Ruckelshausen and E. Wunder (2014),[1] - The authors are working in the fields of unmanned or remote controlled autonomous field robots, navigation, image-based sensors fusion as well as agricultural applications. Within an interdisciplinary research group these technologies are transferred to robot applications in vineyards and orchards. The goal is the availability of an autonomous service robot, whereas first applications are site-specific plant protection (e.g. precise spraying), mulching and picking up fruit boxes. A first version of the robot with electrical drives and precise sprayers has already been developed. The applications, however, show a large range of field conditions which have to be considered for the vehicle application design. Thus the authors have developed a 3D simulation environment which allows the virtual test of the robot

platform prior to its application.

V. PROPOSED METHODOLOGY AND DISCUSSION

The proposed system Automatic Pesticide Sprayer which is expected to achieve better results compared to the previous methods without any nil human assistance. This would be a semiautomatic 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. Proposed system requires IR sensors, Motor drivers, Ziggbee transmitter & receiver and controller as main blocks for the design. Selection of Controller will be done on the basis of number required memory size, number of analog and digital input/output pins. Hence for system design AT89S52 (Atmel microcontroller) microcontroller will be considered. Depending upon number of peripheral used and memory size required for system design, system will be design using AT89S52 microcontroller as main control unit due to following design issues. Microprocessors brought the concept of programmable devices and made many applications of intelligent equipment. Most applications, which do not need large amount of data and program memory, tended to be costly. The microprocessor system had to satisfy the data and program requirements so, sufficient RAM and ROM are used to satisfy most applications .The peripheral control equipment also had to be satisfied. Therefore, almost all-peripheral chips were used in the design. Because of these additional peripherals cost will be comparatively high.

VI. PROPOSED BLOCK DIAGRAM

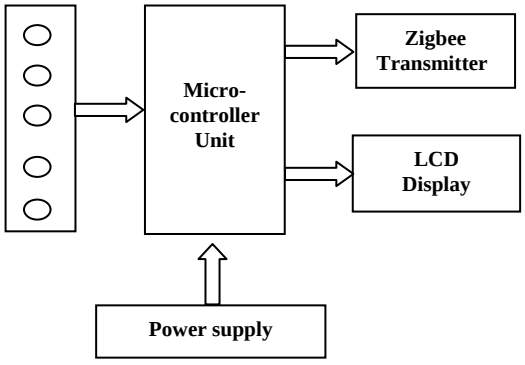

Fig. 3.1 Block Diagram of Transmitter

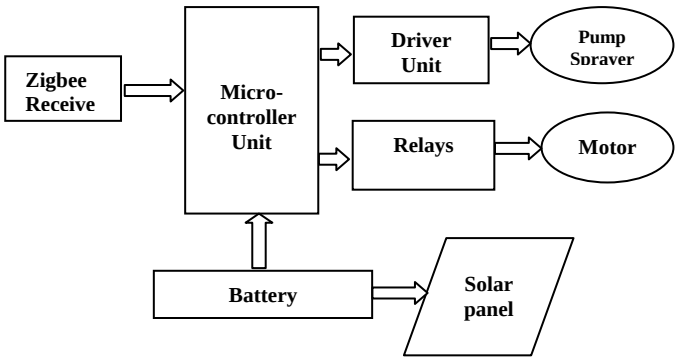

Fig.3.2 Block Diagram of Receiver

The diagram shown above is a block representation of the actual circuitry; the working is as given below -

1. A 12V battery powers the entire unit including the D.C. motors, pump, relays, Zigbee device and micro-controller. As soon as the control switch is on the vehicle starts moving and spraying.
2. When we press the control switch it sends signal F indicating forward direction via Zigbee Transmitter to microcontroller.
3. The vehicle receives a command to move forward - In this case the relays which were initially in normally closed position get switched and the relay controlling the right motor goes to open condition, thus shutting off the right motor. Thus facilitating a forward motion.
4. To make a right or left turn, signal R or L is send to the micro-controller and vehicle receives the signal and in this case the relay controlling the left motor goes to open and thus shutting off the left motor.
5. This loop continues until the entire area has been sprayed with pesticide and the pump is switched off.

A. Microcontroller:

It is the heart of our system. It is the main control block and all other blocks are interfaced to the controller. The software fed into the controller is the main logic of our system. The completion and implementation of our system depends on this logic and finally worked by the controller. We have selected ATMEGA 2560 microcontroller. Motor driver keypad, led and LCD display are interfaced to the various ports of 2560.

B. Sensor:

It is the most important element of this system. We are using IR sensors for obstacle detection, after detecting the object, the sensor sends a pulse to the microcontroller. Then microcontroller decide its path. The sensors is used to detect the obstacles on the path of the robot where it has to perform the seed sowing operation, then the robotic system takes a deviation and start with the next

predefined loop of the land.

C. *Display:*

Here we are using LCD type display; LCD display is display of welcome message of project and direction of vehicle.

D. *Liquid Crystal Display*

A liquid crystal display (LCD) is a thin, flat device made up of any number of colour or monochrome pixels arrayed in front of a light source or reflector.

E. *Enable (E)*

This line allows access to the display through R/W and RS lines.

F. *Read/Write (R/W)*

This line determines the direction of data between the LCD and micro-controller.

G. *Register Select (RS)*

With the help of this line, the LCD interprets the type of data on data lines.

H. *Logic Status on Control Lines*

- E - 0 Access to LCD disabled - 1 Access to LCD enabled
- R/W – 0 Writing data to LCD - 1 Reading data from LCD
- RS – 0 Instruction - 1 Character

I. *Writing Data to the LCD is Done in Several Steps*

- Set R/W bit to low
- Set RS bit to logic 0 or 1 (Instruction or character)
- Set data to data lines (If it is writing)
- Set E line to high
- Set E line to low

J. *Power Supply Unit:*

Power control unit consists of a lead acid battery with specifications of 12V/2A. A low weight power supply unit can be proposed for better system performance. The power supply in this robotic based farming system is used as back source in the case of low energy supplied from the solar panel.

VII. CONCLUSIONS

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.

The future scope of this project include –

1. Take up build a full-scale prototype which can be utilized in the fields in real time.
2. Facilitate charging of the battery using a solar charger thus bringing the costs even further down.
3. Battery energy can be saved by using PWM scheme for driving pump.

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