Journal of Advanced Research in Intelligence Systems and Robotics
Volume 1, Issue 1 - 2019, Pg. No. 17-21
Peer Reviewed Journal

Article

Semi-Automatic Pesticide Sprayer

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I N F O

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How to cite this article:
Rathi A, Gupta M, Goel A. Semi Automatic Pesticide Sprayer. *J Adv Res Intel Sys Robot* 2019; 1(1): 17-21.

Date of Submission: 2019-03-14
Date of Acceptance: 2019-04-27

A B S T R A C T

The current thought manages the planning and manufacturing a pesticide sprayer which will be helpful and moderate to the farmer which will help to expand the profitability of harvests. As India is agribusiness based nation and 70% individuals do cultivating and related work. Agribusiness is needed to be blast to upgrade the GDP of the nation by improving the profitability. The efficiency of the harvests can be expanded with the assistance of nuisance control. Pesticide splashing is the essential strategy in development of the yields. This cycle is exceptionally tedious and relentless. Through this task an endeavor has been done to improve the strategy for splashing the pesticide that will upgrade the efficiency and increment the farmer's income.

The overall spraying method utilizes hand worked knapsack sprayer where steady siphoning is needed to work it which is relentless and tedious. Also, less territory is covered while showering and subsequently additional time is needed to splash the whole land. Additionally, solid and back agony issue emerges due to containing 10-20 liters tank on the back. For alleviating these problems during pesticide spraying and achieving the timeliness operation an attempt was made to develop semi automated pesticide sprayer. In this paper the focus will be on understanding the electronics behind the semi automation of pesticide spray with working and programming of Arduino board and relay circuits in integration with sensors and valves.

Keywords Semi Aautomatic Pesticide Spray, Arduino UNO, Robotics Programming

Introduction

Pesticides can set aside farmers cash by forestalling crop misfortunes to bugs and different irritations. Pesticides are utilized to control life forms that are viewed as hurtful. For instance, they are utilized to slaughter mosquitoes that can communicate possibly lethal illnesses like West Nile infection, yellow fever, intestinal sickness. They can likewise slaughter honey bees, wasps or ants that can cause unfavorably susceptible responses. Pesticides can forestall affliction in people that could be brought about by rotten food or ailing produce.

A wide assortment of hardware is accessible for applying pesticides. Great outcomes happen just on the off chance that you select hardware reasonable for your application, set it up and use it accurately, keep up it so it works appropriately. All producers are required to have a general knowledge of hand worked have a sprayers, blast sprayers, granular implements, wick applicators. In addition, tree fruit and strawberry growers should be happy with air-blast sprayers and green house farmers must be familiar with misters, foggers and smoke fumigators. The pattern of pesticide usage in India is different from that for the world in general.

The techniques used for pesticide spraying are as follows

- **Hand Operated Sprayers:** Hand worked sprayers are utilized to apply little amounts of pesticides inside nurseries or to do little positions outside for example, weed control around structures. It is either hand kept or down pack type sprayers. Hand held sprayers have a vacuum apparatus which packs air into the tank and pressurizes the splash blend. The weight gradually drops as the fluid is splashed. At the point when the weight gets too low, the spout splash design is poor. You should quit splashing and siphon to modify the weight. Knapsack sprayers are fitted with an outfit so the unit can be carried on the administrator's back. It tends to be difficult to consistently contain an area with aerosol utilizing hand operated sprayers.
- **Boom Sprayers:** It distribute pesticides using a boom with spray nozzles spaced at regular intervals. The most common example would be wide horizontal booms used on field sprayers to spray field crops. Depending on how the motorized sprayer is equipped, these sprayers can be used for a wide variety of tasks. A high degree of spray coverage uniformity is possible with constant spray pressure through uniformly spaced nozzles traveling at constant speeds
- **Granular Applicator:** Granular applicators are utilized to apply granular pesticides to soil. Granules should be joined (blended in with the dirt) during or quickly following application. Joining in the dirt keeps flying creatures from eating the granules likewise, contact with soil dampness initiates the pesticide

Related Work

Sandeep H. Poratkar, Dhanraj R. Raut in there paper Development of Multi nozzle Pesticides Sprayer Pump, has described the construction and working of the mechanical sprayer pump but they have not incorporated the automation of the machine.

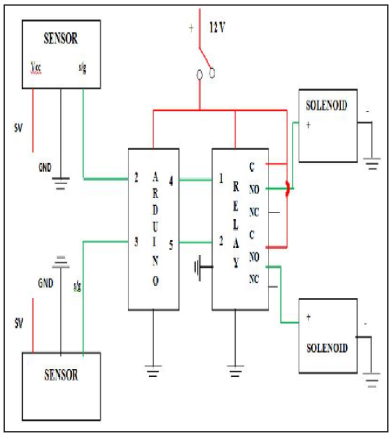

Figure 1.Circuit Diagram of Mechatronics System

Dr. SR Shankapal, in his paper Multifunctional Autonomous Agrobots for Agricultural Mechanization, has described the robots in the agricultural field called as agrobots, their sensing, controlling and working which really helped us to gain the knowledge in this filed.

Mechatronics System Description

Here we will discuss the mechatronics part behind the semi automatic pesticide sprayer and their components along with the algorithm for operation. The mechatronics system consist of sensors, Arduino, relay board and solenoid valve. The following circuit is shown in the figure.

Solenoid Valve

A solenoid valve is an electro mechanically operated valve. The valve is constrained by an electric flow through a solenoid on account of a two port valve the stream is turned on or off. Solenoid valves are the most habitually utilized control components in fluidics. Their undertakings are to stop, discharge, portion, appropriate or blend liquids. They are found in numerous application territories. Solenoids offer quick and safe exchanging, high unwavering quality, long administration life, great medium similarity of the materials utilized, low control force and conservative plan. A^2 route valve, for instance, has 2 ports in the event that the valve is open, at that point the two ports are associated and liquid may stream between the ports if the valve is shut, then ports are isolated. If the valve is open when the solenoid is not invigorated, then the valve is termed usually open (N.O.). Similarly, if the valve is closed when the solenoid is not energized, then the valve is termed usually closed (N.C.).

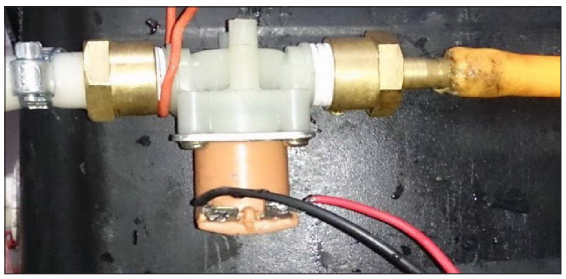

Figure 2.Solenoid Valve

Arduino Board

An Arduino board comprises of an Atmel 8-bit AVR micro controller with corresponding parts that encourage programming and fuse into different circuits. A significant part of the Arduino is its standard connectors, which allows clients to associate the CPU board to an assortment of compatible extra modules known as shields. A few shields speak with the Arduino board straight forwardly over different pins, however numerous shields are independently addressable by means of sequential transport countless shields can be stacked and utilized in equal. Official Arduinos

have utilized the mega AVR series of chips, the ATmega8, ATmega168, ATmega328, ATmega1280 and ATmega2560. Most sheets incorporate a 5 volt direct controller and a 16 MHz gem oscillator (or artistic resonator in certain variations). An Arduino's micro controller is additionally premodified with a boot loader that disentangles transferring of projects to the on chip streak memory, contrasted and different gadgets that ordinarily need an outside developer. This makes utilizing an Arduino more direct by permitting the utilization of a common PC as the developer.

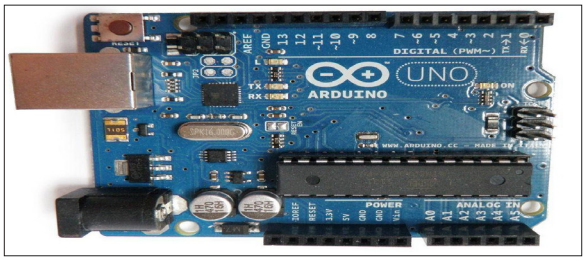

Figure 3.Arduino Board

Relay

A relay is an electrically worked switch. Numerous transfers utilize an electromagnet to precisely work a switch, however other working standards are additionally utilized, for example, strong state transfers. Transfers are utilized where it is important to control a circuit by a low power signal (with complete electrical seclusion among control and controlled circuits), where a few circuits should be constrained by one sign. Transfers were utilized broadly in phone trades and early PCs to perform sensible activities. Transfers with adjusted working attributes and now and then different operating coils are utilized to safeguard electrical circuits from load or faults.

Here we have used the relays to control the actuation of the solenoid valve depending upon the signal sent by the proximity sensors. When the sensors sense the presence of the tree, they send signal to the relay to actuate the solenoid valve for the desired spraying action.

Sensors

The IR proximity sensor of range 2 m is used to sense the targeted crop.

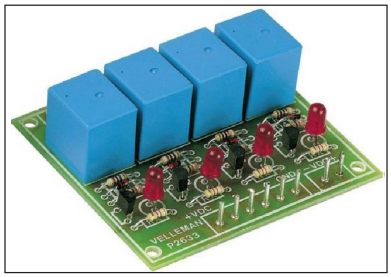

Figure 4.Sensors

Algorithm and Programming

The Arduino coordinated advancement climate (IDE) is a cross stage application written in Java, gets from the IDE for the Processing programming language and the Wiring ventures. It is intended to acquaint programming with craftsmen and different newcomers new to programming improvement. It incorporates a code manager with highlights, for example, language structure featuring, support coordinating, programmed space, is likewise fit for ordering and transferring projects to the board with a single click. A program or code written for Arduino is called a sketch.

The algorithm below describes the flow of control. Here it starts with the IR proximity sensors which sense the presence or absence of the tree or plant and accordingly sends the signals to the relay to actuate the valve. If there is the presence of three in the range of the sensors then it sends signal 1 to the relay which in turn actuates the valve and the pesticide is sprayed from the nozzles.

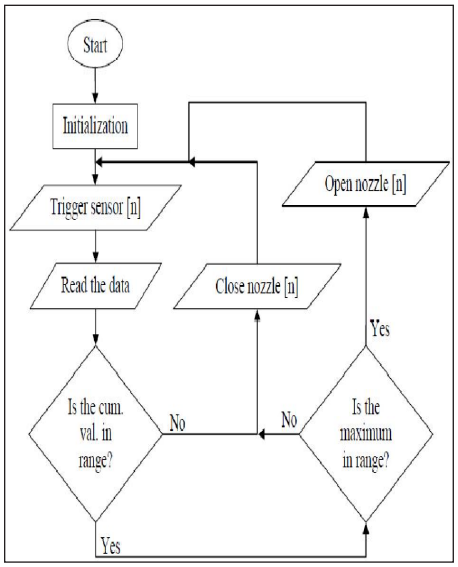

Figure 5.The Flow of Control

Program for Spraying System

Initialization

```
int  x = 0
int y = 0
RELAY1=4
RELAY2=5
```

Configuration for Aurdino and Relay

```
VoidSetup()
{Serial.begin(9600)
PinMode (2, INPUT)
PinMode (3, INPUT)
PinMode (RELAY1, OUTPUT)
PinMode (RELAY2, OUTPUT)
```

Input to The Arduino (Trigger Sensors)

```
Voidloop()
{x = digitalRead(2)
y = digitalRead(3)

Serial.print(x)
Serial.println(y)
delay(500)
if(x==1)
```

Conditiona l Clause

```
{digitalWrite(RELAY1, 1)
else {digitalWrite(RELAY1, 0)
if(y==1)
{igitalWrite(RELAY2, 1)
else { digitalWrite(RELAY2,0)
```

Working

Elements of Spraying System

- Arduino Board
- IR Proximity Sensors
- 12 Volt Battery
- Nozzles
- 12V (120 Psi) Mini Compressor
- Solenoid Valve

Arduino is the brain behind the working of the sprayer. The arduinouno (micro controller) is connected to a 12V battery from which it receives power. The board is connected to a relay circuit as it requires only 5 volt supply for its working. Uno is further connected to the IR sensors.

The sensors are calibrated to work in desired range (here 50 cm) sends the signals in the form of waves. The wave if encounters any plant in between, will send signal to the arduino in the form of change in voltage. UNO is programmed in such a way that if it senses the desired change in voltage it will send a signal to solenoid valve. This will spray a specified amount of pesticide only.

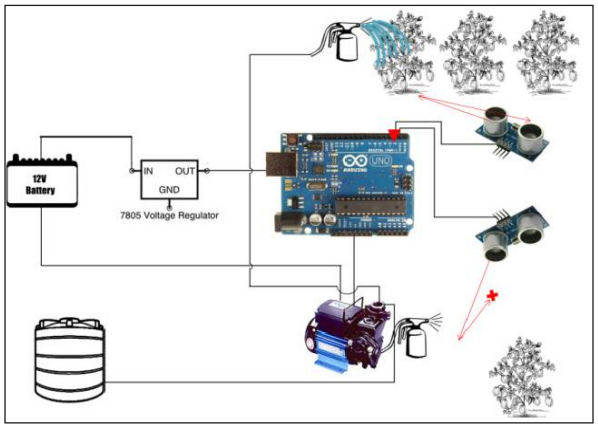

Figure 6.Working of The Circuit When Target is Not Sensed

In case there is no plant while the sprayer is moving. In this case pulse will be sent by the sensor but it will not receive a reflected pulse. As a result there will be no voltage change sensed by the micro controller so no spraying will occur in that part of field.

Mechanical System

- A solenoid valve is used which will dispense a fixed amount of pesticide
- The valve receives signal from arduino which will actuate the spraying
- This pesticide is mixed with the compressed air from the (12 V 120psi) compressor and finally the mixture will get sprayed
- A total of 7ml pesticide is to be sprayed (according to field data)

Observations

Sensor Testing

The IR Proximity sensors have an emitter and a receiver due to which it senses the distance of the target (crop).

Table 1.Sensor Testing

S. No.	Distance (cm)	Time (sec)
1.	80	5
2.	70	4.6
3.	60	4.2
4.	50	3.8
5.	40	3.4
6.	30	3
7.	20	2.8

The time required by the sensor to sense is in ms hence the readings are taken for 10 spray cycles. The plants distance from the sensors is varied from 80cm to 10cm and the time required by the sensor is calculated with the help of stop watch. The red led indicates the initiation and termination of the sensing operation.

Table 2.Spray Timing

S. No.	Distance (cm)	Time
1.	80	66
2.	70	62
3.	60	58
4.	50	53
5.	40	48
6.	30	42
7.	20	38

Spray Timing

The spray timing consist of the time required to sensor to detect plus solenoid valve plus the time till the pesticide spraying to the particular crop is completed. The solenoid valve actuation is requires 1.5 sec for actuation. The spraying time is calculated for 10 spray cycles.

Volume Dispensed Per Spray

The amount of pesticide dispensed depends on the time interval for which target is being sensed i.e. more the time elapsed while sensing more will the amount sprayed and vice versa. This signifies that the amount dispensed will actually depend on the speed of the trolley. Hence the readings taken are respect to the time for which target is sensed.

Table 3.Volume Dispensed Per Spray

S. No.	Sensed Duration (sec)	Amount (ml)
1.	0.5	3
2.	0.7	3.5
3.	0.9	4.7
4.	1	5
5.	1.2	6
6.	1.3	6
7.	1.5	6.5

The respective amount is calculated by measuring the quantity of discharge accumulated in the volumetric measuring beaker.

All the readings are taken by keeping the valve of the air pressure vessel by 3-4th revolution only. Hence the readings are subjected to change if the valve opening is varied. The distance between the crops was maintained to be 30 to 32 cm throughout the experimentation process.

Results and Conclusions

- The time required for sensing for one spray cycle through the IR Proximity sensor takes about 0.5 sec to .28 sec as the distance of the crop varies from 80 cm to 10 cm respectively. Thus there is a time lag observed in the readings which can be eliminated by the use of Ultrasonic sensors
- From the observation, it is clear that the time required for one complete spraying action takes about 6.6 sec to 3.8 sec when the distance of crop varies from 80 to 10 cm respectively. This spraying time can further be reduced by providing a pump in the spraying system
- The amount dispensed directly depends on the duration till which the sensor is actuated

Future Scope

The Sensing System

The present system is equipped with IR proximity sensors and the programming of the relay is also according the same. In future, the IR sensor can be replaced with the following:

- The ultrasonic sensors for different ranges and discharge and their programming can be varied for variable discharge according to the size of the plant
- The image sensing sensors which would specifically spray on the plants and would any sense any other object. This would widen its application in orchards and horticulture

Use of Feedback Mechanism

The sensors would be equipped with one transmitter and one receiver. The signal sent by the receiver would be of a definite intensity and the receiver would receive the feedback intensity which would depend upon the size of the cotton pods. Thus this feedback signal can be used to control the valve opening by controlling the input voltage to the valve. This would ensure adequate pesticide dispensing to the crop along with reduced voltage.

Semi Automated to Fully Automated

The manually adjustable parts like spray angle, nozzle height, nozzle discharge can be made automatic using suitable electro mechanical equipment.

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