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PS-RCV: Pesticides Spraying Remotely Controlled Vehicle

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Abstract: ***Pesticides is a substance used to kill, repel, or control certain forms of plant or animal life that are considered to be pest. Pesticides must be used efficiently to avoid any harm to the crops caused by excess use of the pesticides. To spray the pesticides evenly and efficiently we have come up with the idea of PSRCV: Pesticides spraying remotely controlled vehicle. It is an automated pesticides spraying robot that consists of the robotic arm to spray the pesticide and manipulate the jet spray by utilizing the robotic arm. It consists of a manually adjustable chassis, with the help of the adjustable chassis the RC vehicle is able to work in different types of fields and terrain.***

Index Terms: ***PSRCV, Microcontroller PIC18, Adjustable Chassis, Robotic Arm, Solar Power***

I. INTRODUCTION

A. PSRCV

It stands for pesticides spraying remotely controlled vehicle. The vehicle is used to spray pesticides on the crops of different types. It can work in all kind of terrains and can spray pesticide on crops up to 5FT of height. It consists of the adjustable chassis, battery, microcontroller PIC 18, solar panel, robotic arm, communication modules, pesticide storage tank, camera and other electronic essentials.

B. System Components

1) Adjustable chassis
2) Microcontroller PIC 18
3) Robotic Arm
4) Solar Charging circuit
5) Battery
6) Communication Module
7) Programming and software

a) Adjustable Chassis: The vehicle is provided with an adjustable chassis. The height and the width of the chassis can be manually adjusted. Different types of crops requires varied field dimensions, in order for the vehicle be able to work in these field it is essential the chassis to be adjustable. PVC material is utilized to make the chassis light weight and durable. The chassis can be made automatically adjustable also, but to make the project economical it has been made manually adjustable.

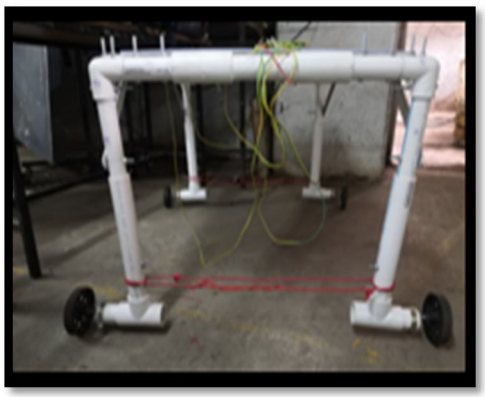

FIG 1: Front View

FIG 2: Side View

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b) *Microcontroller PIC 18:* PIC 18 is used in the vehicle to control the working of the electronic modules and components. PIC18F452 is 8-bit with 10 MIPS, CMPS, FLASH-based microcontroller that has 34 I/O pins out of 40 Pin packages. It is a microcontroller with one 8-bit and three 16-bit timers, 8-Channels 10-bit Analog-digital converter, and I2C, SPI, USART peripheral. It is a low power microcontroller unit that consumes about less than 0.2 uA standby current and 1.6mA normal current during 5V and 4 MHz operations. PIC18F452 also has the feature of Programming code protection, Power-on Reset (POR), Power-up Timer (PWRT), Oscillator Start-up timer with power saving sleep mode. The watchdog timer features its own On-Chip RC Oscillator for reliable operations. 2V to 5.5V operating voltage makes the 18F452 suitable for 3.3V and 5.0V logic level operations.

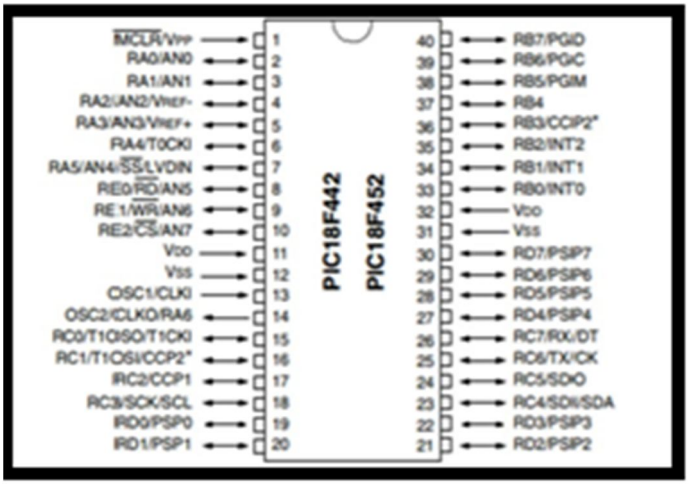

FIG 3: Pin Out diagram of PIC 18

c) *Robotic Arm:* The robotic arm has three axis movements; it is mounted with camera and nozzle to spray the pesticides at desired part of the crop. The robotic arm can make movement in 360* degree and the upper axis has the ability to make the movement in 180* degree, this configuration provides the robotic arm to be efficient and spray the pesticide in the desired direction and part of the crop. Robotic arm has the Jet spray assembly to spry the pesticide at the crop .The submersible pump is used to carry the pesticide through the tank to the nozzle of the jet spray. The movements of the robotic arm are controlled by the remote control.

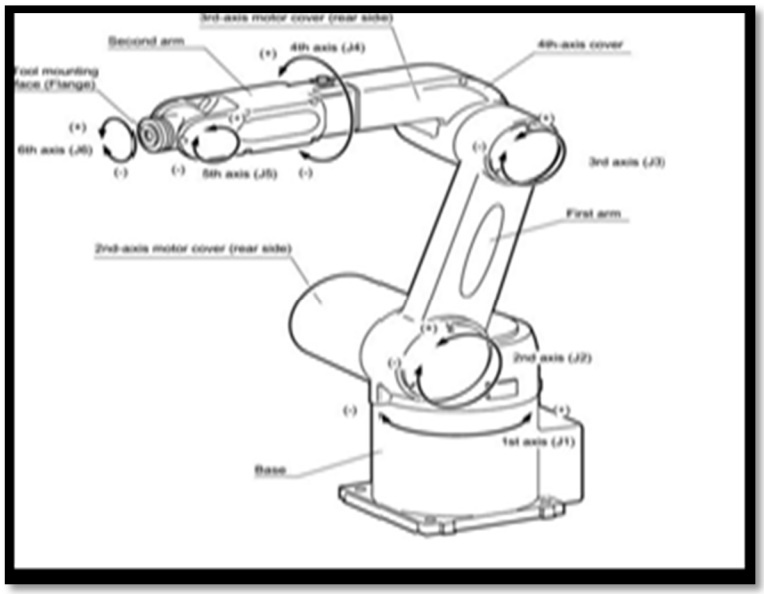

FIG 4: Robotic Arm

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d) *Solar Charging Circuit:* The solar panel is mounted on the chassis; the solar panel will convert the radiation from the sun into electrical energy. This will be used to charge the battery of the vehicle. It can be utilized in areas where the sunlight is more and this will save on the expenses for charging the battery. It is also a clean source of energy which will reduce the emission. Solar regulator is a small box consisting of solid state circuitry that is placed between a solar panel and a battery. Its function is to regulate the amount of charge coming from the panel that flows into the deep cycle battery bank in order to avoid the batteries being overcharged. A regulator can also provide a direct connection to appliances, while continuing to recharge the battery. That is, you can run appliances directly from it, bypassing the battery bank but the batteries will continue to be charge.

e) *Battery:* The 5000mah Lithium Polymer battery is used to operate the robot and solar energy is used to charge the battery. The battery is used to power the microcontroller and other essential circuitry involved in the operation of the robot .The solar panel of o/p 17V is used charge the battery using a solar charge circuit that involves LM317 as the charge controller IC. The battery is light on weight which is an important aspect in working of the robot.

f) *Communication Module:* We have used the HC12 communication module for operating the robot. The HC-12 is a half-duplex wireless serial communication module with 100 channels in the 433.4-473.0 MHz range that is capable of transmitting up to 1 km. The HC-12 is a half-duplex 20 dBm (100 mW) transmitter paired with a receiver that has -117 dBm (2×10-15 W) sensitivity at 5000 bps. Paired with an external antenna, these transceivers are capable of communicating up to and possibly slightly beyond 1 km in the open and are more than adequate for providing coverage throughout a typical house.

g) *Programming and Software:* Simulation Software: Proteus 8: The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. Microcontroller Simulation The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analog and digital electronics connected to it. This enables its use in a broad spectrum of project prototyping in areas such as motor control, temperature control and user interface design. It also finds use in the general hobbyist community and, since no hardware is required, is convenient to use as training or teaching tool.

h) *PCB Design:* The PCB Layout module is automatically given connectivity information in the form of a net list from the schematic capture module. It applies this information, together with the user specified design rules and various design automation tools, to assist with error free board design. PCB's of up to 16 copper layers can be produced with design size limited by product configuration. Programming Software: MPLAB V5: MPLAB is a proprietary freeware integrated development environment for the development of embedded applications on PIC and ds PIC microcontrollers.

MPLAB® X Integrated Development Environment (IDE) is an expandable, highly configurable software program that incorporates powerful tools to help you discover, configure, develop, debug and qualify embedded designs for most of Microchip's microcontrollers and digital signal controllers. MPLAB X IDE works seamlessly with the MPLAB development ecosystem of software and tools.

II. RELATED WORK

Previously many automated solutions were developed for pesticide spraying but majority of them are either costly or not efficient. The handheld spraying machine, pesticide spraying drone, and spraying pesticide using tractor .All these are not efficient in spraying pesticide in terms of cost, accuracy, efficiency. We are providing a solution that overcomes all of these drawbacks were present in the previously built automated mechanism of pesticide spraying.

A. Automated Spraying

1) Pesticide spraying using tractors is the most commonly used methods of spraying the pesticides for the large field. This method has been implemented by many farmers. In this method tractors are used to spray pesticides, the tractors contains the tank filled with pesticide, using the pneumatic pressure the pesticides are sprayed on crops by assembly of nozzles attached at the back of the tractor. This method has its own drawbacks like, it cannot be implemented in small field, it is efficient only on crops of lower height, in this methods consumption of fuels increases with increases in the field size, it produces carbon emission and causes harmful effects on the environment.

2) Pesticides spraying with drone have also been implemented, in this method a remotely controlled drone is flown over the target crops and pesticides are sprinkled on the crops. This method does not produce any carbon emission but the efficiency is decreased as the pesticides molecules vaporize in the atmosphere as the temperature increases. The pesticide is not sprayed properly on the crops in this method and only the upper section of the crops are sprayed the remaining portion of the crops is not affected by the sprinkle.

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B. Manual Spraying:

1) Method that most of the farmers are using for a long time, in this method a hand held pump attached to the pesticide tank is pumped; the pumping action creates the pesticide to flow out of the tank, then through the nozzle of the pump and on to the crops. This method is widely used but the the drawbacks of this method are severe. The spray of pesticides is uneven due to human error, lack of protection to person spraying the pesticide causes the person to get infected with harmful skin disease and other medical problems, due to uneven distribution of the pesticide the crops also start decomposing.

FIG 5: Use of Tractor to spray pesticides

FIG 6: Use of Drone to spray

III. METHODOLOGY

This four wheel robot have long diameter and small width wheel which is very suitable for better performance and better grip in mud surface. Wheel is driven by individual motor. The width of wheel keeps minimum which required minimum torque to get rotate. When machine get started, the connection is made between remote and robot by means of RF communication. The RF module used has very large range so it can communicate over large land. The rotation of individual motors control by remote .Lithium polymer type power source is used to provide power source for robot. Container is placed on the chassis to carry pesticides up to 5kg. The submersible pump is used in container which provides pesticides at different rate according to selection of mode. Normal adjustable sprinkler is provided which is useful for single type of crops in a land which have generally same height and required pesticides at constant rate. The type of pesticides spraying is achieved by robotic hand .Robotic hand consist of camera placed on it and get spray which provide pesticides spray on target. By means of camera the specific fruit or other element can be targeted. The camera use provides continuous pictorial data of the targeted field to the user, according to the current status of targeted field user can take successive action over it. While robot running in the field, if suddenly any obstacle comes, it will sense by ultrasonic sensor and send interrupt to the controller for emergency stop or changing the direction. The height of the robot and width between the wheels is adjustable, which makes the robot to work any kind of terrains .If any of the four wheels gets stuck in the mud the other three wheels will provide extra force by locking the individual wheel that is stuck in the mud.

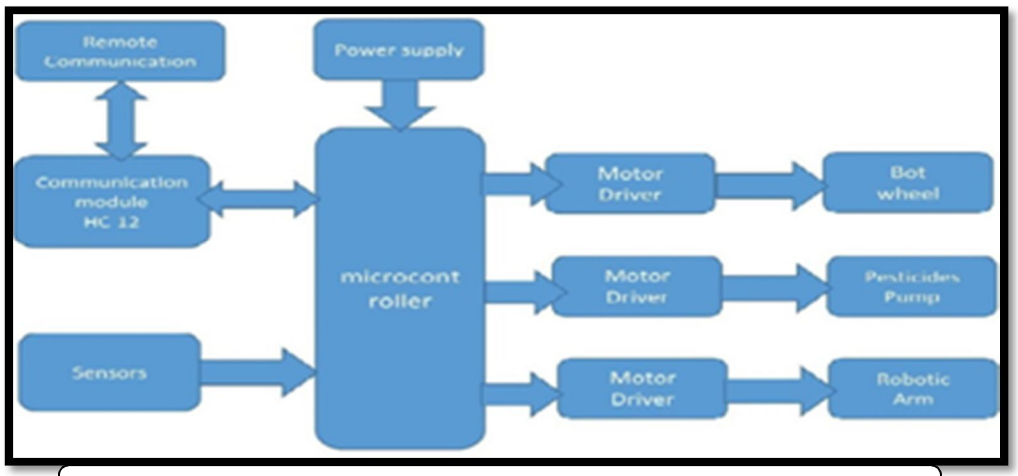

FIG 7: Block Diagram of the proposed system

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IV. SPECIFICATIONS

A. Chassis

1) Width = 1.5FT to 2FT (Adjustable)
2) Length = 3FT
3) Height = 1.5FT to 2FT (Adjustable)
4) Chassis Weight = 10KG
5) Max Weight Capacity = 12KG

B. Motor Torque

1) Rated Torque (kg-cm) = 5
2) Full Stall Load Torque (kg-cm) = 24

C. Power Consumption

1) No Load , No Inclination = 0.8A
2) Load , No Inclination = 1.2A to 1.4A
3) No Load , Inclination 30^{θ} = 1.4A to 2A
4) Load , Inclination 30^{θ} = 2.2A to 2.5A

D. Power Supply

1) 230V input
2) 16V output
3) Lithium Polymer Battery: 3.5V 1500mah Single Cell, series and parallel combination is used to get the desired output.
4) Battery Combination output = 12V , 2.5A

E. Solar Panel

1) Panel Rating = 240 Watts 12V
2) Charging Time = 5Hours

V. CONCLUSION

PSRCV is an automated, economical, efficient, robust, durable, and low power consumption solution for small and large scale field disinfection. It will provide an automated and accurate method for disinfection of the crops. The use of solar and other advance electronic modules makes it an unique and more efficient solution as compared to the currently used methods of the pesticide spraying. We will make more up gradation in the future by utilizing Internet of Things, Automated chassis adjustment, path detection and tracking. We have successfully implemented the prototype of the PSRCV.

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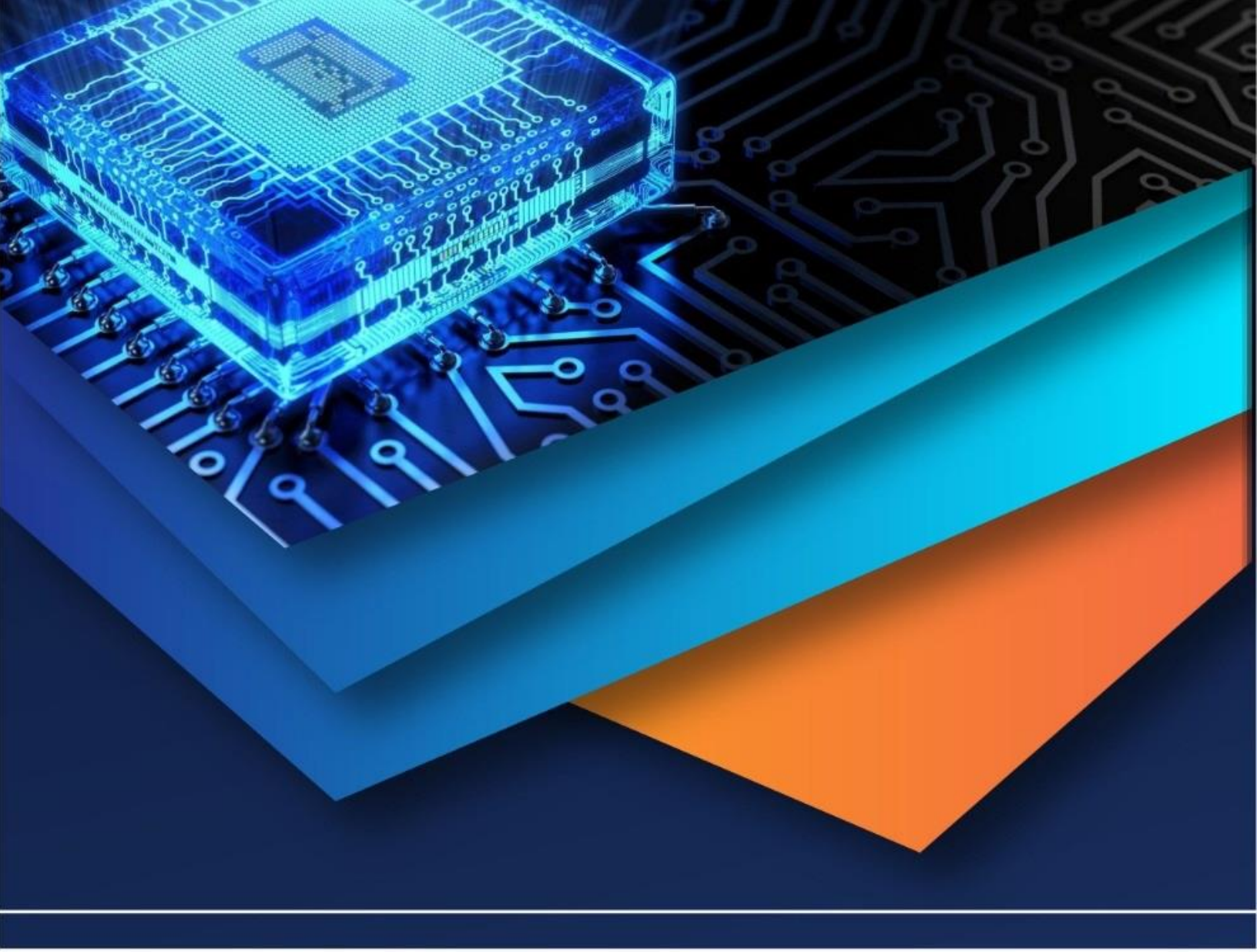

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