International Journal of Scientific Research in Computer Science, Engineering and Information Technology
ISSN : 2456-3307 (www.ijsrcseit.com)
doi : https://doi.org/10.32628/IJSRCSEIT

IOT Enabled Smart Agro-Sprayer using Solar Energy

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Article Info
Volume 8, Issue 3
Page Number : 394-401

Publication Issue :
May-June-2022

Article History
Accepted: 03 June 2022
Published: 15 June 2022

ABSTRACT

Increasing Globalization, Industrialization creating lot of problems for many sectors like agriculture field where the farmer must face a lot of problem with availability of Manpower. The basic essential requirement to execute operations like water spray controls and pesticides spraying is difficult to execute for a whole field by a farmer. The Manual spraying of a pesticides to crops which is harmful to the former's health. This paper presents innovative idea of a spraying machine which carrying the pesticides or water and controlled with a IOT based operation and execute operation of spraying a water or a pesticide to the plants which makes easy for the farmer. The idea behind this technique is IOT technology with sensors.

This paper proposes a solar powered automated pesticide spraying machine. The machine sprays the pesticides to the crops based on the crop's height. And we can also measure a moisture content of the soil. The machine is controlled by WIFI Enabled Android Application. The Android App will help for the movement of machine-like front, back, left, right. The IP camera is used to provide live streaming of agriculture land.

Keywords: IoT, Wi-Fi, Automated Pesticide Sprayer, Soil moisture detection, IP camera.

I. INTRODUCTION

Around 60-70 % (predicted value) Indian population directly or indirectly depends on agriculture. That effects on food security and economic growth of India. With help of Precision, agriculture process can easily monitor or observe of crop growth based on collected information (soil condition and weather information) from a crop field. This mechanism also called as satellite farming or site-specific crop management (SSCM), manually can't be able to collect environmental information because it is a tough task. New farmers are coming out without knowledge of soil characteristics because insufficient soil testing labs properly not available in the states of the country. So now what is the importance of IoT in agriculture? The solution is Manual data collection; absolutely it is a risk for farmers and to processes from the crop field. So, it is difficult for farmers to get optimal levels of efficiency. To solve this difficulty, IoT (Internet of Things) is only the solution. It plays vital role in

collecting information. IoT has been already in raising with novel multiple techniques [1].

The economic contribution of agriculture to India's GDP is steadily declining with the country's broad-based economic growth. Still, agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India. So, increase the productivity is main aim of the pesticides. Proper techniques of application of pesticide and equipment used in applying pesticides are vital to the success of the productivity. A sprayer is a device used to spray a liquid. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops. Solar energy is the non-conventional energy source. The energy which available from the sun are free of cost and non-polluting. Solar operated pesticide sprayer is based on solar energy. In this project solar energy is converted into electrical energy and stored in battery. Pump is used to spray the pesticide through nozzle by use of battery [5].

To observe the plant growth, we are using a WIFI Enabled camera which is fixed at one side of the robot which picks the video and send it to the farmers mobile app so that the farmer can take a decision while pesticide spraying action. We are using a moisture sensor during idle condition of the robot which measures the moisture level of the soil and intimate the farmer through IOT and mobile IOT app so that the farmer can spray the water through IOT app.

The power requirement for the overall robot operation is done with solar energy with chargeable battery which charges during sunlight available and provides the power to all the stages [2]. Proper water irrigation is realized via the monitoring of the soil moisture and accurate determination of the soil moisture content. Therefore, it is beneficial to study and understand the dynamic changes and spatial distribution of soil moisture as well as the different requirements of different crops for soil water content in the same period. Owing to the varying soil moisture content requirements in different periods and the influence of soil moisture content on crop yields, ensuring that the soil has an appropriate amount of moisture is an important factor to consider for protecting healthy crop growth [3].

II. EXISTING MODEL

In Existing Model, pesticide spraying machine was basically working on electrical energy and it doesn't detect the hight, width and empty spaces in agricultural field and it used to simply spray the pesticides to the crop. A machine was controlled by remote by using radio frequency technology. And here farmer cannot view the live video of the field while spraying pesticides. A machine was not able to detect the moisture content of the soil.

DRAWBACKS OF EXISTING SYSTEM:

There are few drawbacks of existing system which are described below:

- **Maintenance** – If the farming field is larger in area, spraying pesticides manually is a challenging task for a farmer.
- **Labour issues** – Agriculture is seasonal occupation; the laborers are weak and illiterate. Finding a labourer to work in agricultural field is very difficult.
- **Lack of implementation of modern technology** – Lack of upgradation into modern tools and technology, usage of renewable resources.

III. LITERATURE SURVEY

A literature review is an overview of the previously published works on a specific topic. The term can refer to a full scholarly paper or a section of a scholarly work such as a book, or an article. The purpose of a literature review is to gain an understanding of the existing research and debates relevant to a particular topic or area of study, and to present that knowledge in the form of written report.

Mr. Joshi Dhruv Bharatbhai Automatic Agriculture Pesticide Spraying Vehicle [5]. Spraying of pesticides is done to control pest and diseases for that purpose sprayer are used. There are many types of pesticides sprayer pump are available in India. In India the spraying done in farm is by traditional technique. But mostly used sprayer is backpack type sprayer which is used by farmers because it is cheaper, easy to use, easily available and main thing about it is cost efficient. With the help of this machine farmer spray pesticides in their farm, but it requires lot of time and thus high operational cost, low efficiency, health problem and low profit. Also, the farmer who is spraying pesticides is affected by it as it is harmful to human health and human also affect by the lumbar pain and shoulder disorder due to weight of equipment and weight of tank on person`s shoulder. **Key Words: Spraying Vehicle, Boom Sprayer, Self-propelled sprayer**. From this paper we get the knowledge on the power conversion efficiency. The solar cell Power Conversion Efficiency can be calculated by using the relation, P = Incident Solar radiation x Area of the Solar Cell The output power (P) = V * I out [5].

Shruti A Jaishetty, Rekha Patil proposed an agricultural application of wireless sensor network for crop field monitoring [6]. These systems fully equipped with two type sensor nodes to measure humidity, temperature, and an image sensing node to compare information by taking images of crops. Parameters play an important role for taking a good decision making for healthy crop within a time. The parameters are temperature, humidity, and images. By following these methods can achieve high stability of sensors with low consumption of power. With it's a long period of monitoring the agriculture field area.

Shahajada Mahmudul Hasan, Syed Mamun R Rasid, Avijit Mallik, Md. Rokunuzzaman, Development of a Wireless Surveillance Robot for Controlling from Long Distance [2]. International Journal of Engineering Research and Management (IJERM), ISSN: 2349- 2058, Volume-05, Issue-09, September 2018 **[3].** A robot has been developed which can be used for multipurpose application related to surveillance and security systems. From ground testing of this robot, it has been found that it can be controlled from unlimited distance as the system is based on World Wide Web (www). This robot also has a teleoperation system based on **radio frequency** (RF) for signal processing. It has been found that this robot shows about 78% efficiency when a constant 512 kbps Wi-Fi internet connection is applied. Visual Basic software has been used to operate the robot. Four cameras are attached with the robot for acquisition of images from the surroundings. Instead of radio frequency we are using the **WIFI Enabled** mobile application for operating the **pesticide spraying machine**.

Shalini D.V and others. A robotic based guidance method is presented to guide a robot platform which is designed independently to drive through the crops in a field according to the designed concept of open architecture [8]. Thus, the robot platform is designed in real time to guide the platform on the basis of detection of crop using Ultrasonic sensor. The proposed system is basically developed to implement an agricultural production. This type of system is very useful in agriculture field where we need to spray the pesticide to different crops. This system automatically senses crop of both sides by using ultra-Sonic sensor. Embedded Chip ARM 7 LPC2148is heart of this work and the system and KEIL C software is used to code the algorithm. **We can overcome this drawback by using IP (INTERNET PROTOCOL) Camera it is providing live video of field so that user can monitor the field at remote places.**

IV. PROPOSED METHODOLOGY

Methodology is the study of research methods, or, more formally, "a contextual framework for research, a coherent and logical scheme based on views, beliefs, and values, that guides the choices researchers make".

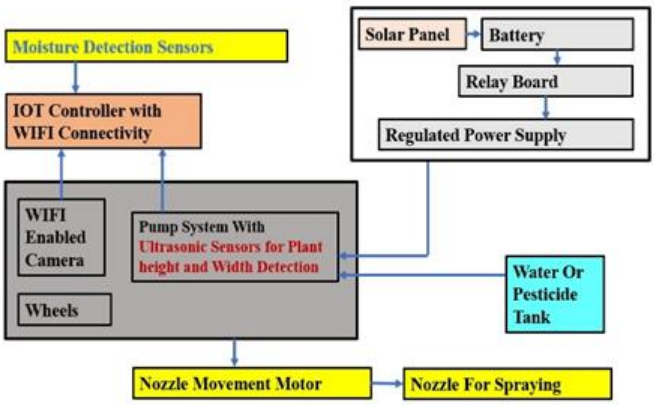


Figure 1: Block Diagram Representing Workflow of Agro-Sprayer

The Spraying Machine is placed in the farm and is switched on through IoT and its direction is controlled by Android application. The spraying of pesticides, which can be done with the help of pesticide sprinkling pump, this can be periodically sprayed whenever the relay switch is on. The system focuses on the design, development and the fabrication of the agricultural Spraying Machine with pesticide spraying system.

The agricultural Spraying Machine is used to control the function like pesticide spraying and controlled through cloud computing module (WIFI Enabled) which will communicate between android application and Spraying Machine with low budget.

The system is provided with dc motors for moving the Spraying Machine and WIFI Enabled camera for visualising the field by sitting at remote places. We use two tanks for storing water and pesticides, if the moisture level of soil is detected below the required range, in an android application the message is displayed, by which a person can enable the water tank nozzle to spray the water.

V. REQUIREMENT ANALYSIS

Requirement specifications are divided into two categories. Those are hardware and software requirements. Requirement specification is a description of a software and hardware system to be developed. It lays out functional and non-functional requirements and may include a set of use cases that describe user interactions that the software must provide.

A. HARDWARE REQUIREMENTS

- Node MCU IOT Model
- Relay Board
- Ultrasonic Sensor
- Battery 6V
- DC motor 60 RPM
- L298 motor Driver
- Solar Panel

1. Node MCU IOT Model

Node MCU is an open-source firmware based on LUA which is developed for ESP8266 Wi-Fi chip. Node MCU is used for prototyping board designs. The name Node MCU has arrived from the node and MCU (micro-controller-unit). The system development environment is SOC (system on chip). The main reason for using Node MCU other than Raspberry Pi and other devices that it has inbuilt Wi-Fi module and it is cheaper.

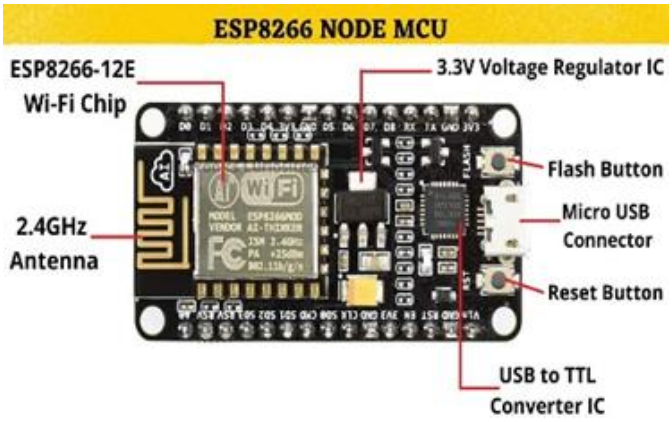


Figure 2: Node MCU IOT Model

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna.

2. Relay Board

Electromagnetic Relays are basically an electromechanical switch that is used to switch ON or Off a circuit with the help of the electromagnet. Electromagnetic relays work on the principle of magnetic attraction. It works similar to the contactor, but a low range of the ampere as compared to the contactor.

Figure 3: Relay Board

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relay with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but we can solder wires directly to the pins providing we take care to avoid melting the plastic case of the relay.

Relays are used in a wide variety of applications throughout industry, such as in telephone exchanges, digital computers and automation systems. Highly sophisticated relays are utilized to protect electric power systems against trouble and power blackouts as well as to regulate and control the generation and distribution of power. Relays are used in home appliances like Refrigerators, Washing machines, Dishwashers, etc.

3. Ultrasonic Sensors

Figure 4: Ultrasonic Sensors

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

4. Battery 6V

Figure 5: Lead Acid Battery

A 6-Volt battery, which is commonly known as lantern battery is a lead-acid type cell that is made up of a collection of four larger cells, usually D batteries with 1.5V per cell. With this compositions, 6-Volt Batteries offer a wider space for energy storage and thicker plates for sturdiness that can last for longer usage. Moreover, most 6V batteries are cycled to maximize its capacity to store and to discharge energy suitable even for a low-cost budget, making it a great choice especially to motorists and electricians as it extends the cycle of charging and discharging.

5. DC Motor 60 RPM

An Electric motor is an electrical device which converts electrical energy into mechanical energy.

Figure 6: DC Motor 60 RPM

The basic working principle of a DC motor is: "whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force". The direction of this force is given by Fleming's left-hand rule and its magnitude is given by F = BIL.

Were

B = Magnetic flux density,

I = Current flowing through the conductor,

L = Length of the conductor within the magnetic field.

6. L298N Motor Driver

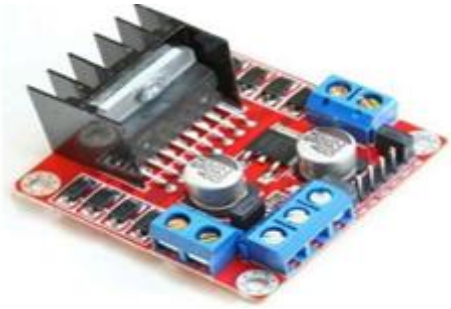


Figure 7: L298N Motor Driver

The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time. The module can drive DC motors that have voltages between 5 and 35V, with a peak current up to 2A. The module has two screw terminal blocks for the motor A and B, and another screw terminal block for the Ground pin, the VCC for motor and a 5V pin which can either be an input or output. Input 1 and Input 2 pins are used for controlling the rotation direction of the motor A, and the Input 3 and Input 4 for the motor B. Using these pins we actually control the switches of the H-Bridge inside the L298N IC.

7. SOLAR PANEL

Figure 8: Solar Panel

Solar power is arguably the cleanest, most reliable form of renewable energy available, and it can be used in several forms to help power appliances. Solar-powered photovoltaic (PV) panels convert the sun's rays into electricity by exciting electrons in silicon cells using the photons of light from the sun. This electricity can then be used to supply renewable energy to battery, by lowering utility bills, these panels not only pay for themselves over time, and they help reduce air pollution caused by utility companies. We chose a solar panel of 10W.

B. SOFTWARE REQUIREMENTS

1. Operating System

- Windows 7 or Above

2. Blynk IOT Cloud Mobile Application

“With Blynk, we can create smartphone applications that allow you to easily interact with microcontrollers or even full computers such as the Raspberry Pi”.

The focus of the Blynk platform is to make it super-easy to develop the mobile phone application. As you will see in this course, developing a mobile app that can talk to your Arduino is as easy as dragging a widget and configuring a pin. With Blynk, you can control an LED or a motor from your mobile phone

with literally zero programming. This is actually the first experiment that I will demonstrate in this course. We can use it to monitor the soil humidity of our Agriculture field and turn on the water, with
your phone. Blynk is free to use for personal use and prototyping.

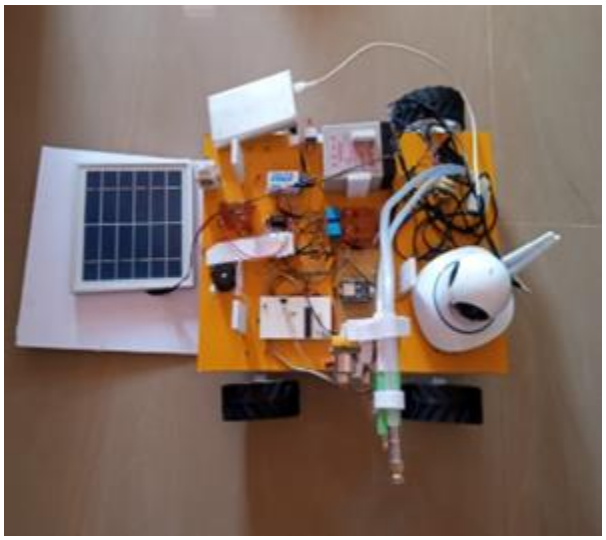
3. DIP Trace PCB Designing Software

DipTrace is a software suite for electronic design automation (EDA) to create schematic diagrams and printed circuit board layouts. DipTrace has four modules: schematic capture editor, PCB layout editor with built-in shape-based auto-router and 3D preview, component editor, and pattern editor.
DipTrace has a launcher application with five buttons that help users easily start each DipTrace module:

a. Schematic Capture
b. PCB Layout
c. Component Editor
d. Pattern Editor
e. Get Started with Video Guide (link to video and PDF tutorial webpage)

VI. EXPERIMENTAL RESULTS

Experiment Results means any tangible and intangible outputs of the Experiments that are generated by or on behalf of the Experimenter as well as any rights attached to them.



VII. CONCLUSION AND FUTURE SCPOE

The proposed system is very efficient and can be used in agricultural field very effectively. This technology is most suitable for Energy Alternate Device for power sprayers.
The machine is pollution free because it is Solar enabled. The remote monitoring feature enables user to control the machine by sitting at remote places. The automatic spraying helps to minimize unnecessary wastage of pesticide and keep farmer away from harmful diseases sprayers.
Soil moisture detection and notifying the user through the mobile application helps to keep track the presence moisture content in soil and water the plants accordingly.

Future Scope

- Usage of voice-controlled navigation for spraying machine movements.
- To enhance the performance of IoT based smart agriculture systems, modern technologies such as AI, ML can be incorporated into the system.
- AI-based autonomous robots can be built specially to serve the purposes of farming. The robot should be capable of analysing data that are grabbed from sensors and make necessary decisions to serve the purposes for which it is designed.

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Cite this Article

Prof. Nagaraj Telkar, Miss. Annapurna Belamakar, Miss. Megha Malali, Miss. Poornima Medar, Miss. Preeti Patil, "IOT Enabled Smart Agro-Sprayer using Solar Energy", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 8 Issue 3, pp. 394-401, May-June 2022.

Journal URL : https://ijsrcseit.com/CSEIT12283110