Multidisciplinary Journal for Applied Research in Engineering and Technology (MJARET)

Vol. III Issue 5, September – 2023, Pages: 38-43

DOI : https://doi.org/10.54228/mjaret0923008 **ISSN : 2583-1100**

Solar powered pest trap using internet of things

Archit Kukdey, Varun Jain, Shreyash Ekare, Kaustubh Raut, Sakshi Pathak
Department of Elecrtonics Engineering
Nagar Yuwak Shikshan Sanstha's
Yeshwantrao Chavan College of Engineering
(An autonomous institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)

Abstract: This paper represents a smart device which can be used to overcome the problem faced due to attack of pest and insects on the crops present in the agricultural farms. In this paper the development and implementation of solar powered pest trap using IOT (Internet of Things) has been demonstrated. This device consists of an ultraviolent lamp which is used to attract the insects. The lamp is surrounded by electrical fence which is used to stun the insect as soon as it comes in contact with it. The stunned insects are collected in a tub which can further be used in compost. The device uses the concept of IoT thus, enabling the user to control it from his / her home itself with the help of a smartphone. The device works on solar energy thereby making it cost effective and affordable. The implementation of the device has resulted in the reduction of pests and insects in the farms and that too at a low cost as compared to other farms which use traditional methods.

KEYWORDS: Internet of Things; insect trap; solar energy

INTRODUCTION

In India, agriculture is the primary occupation. Every year farmers face the problem of pest attack which implement a serious damage on crops. There are various methods which are used to prevent pest attacks like as mechanical method, physical method, biological method, and chemical method. Using pesticides and chemical method directly affects on agriculturists and consumers, for example, pests are chemical resistant which leads farmers using more and more pesticides. This causes plant residue which is dangerous for consumers, and also has an adverse effect on environment and ecology.

The solar insect trap helps the farmer to overcome all the above-mentioned problems and that too in a smart and effective manner. The simplicity and efficiency of the device makes it a perfect and affordable gadget to be used in farms and even in homes. Also this device can be operated from the home so, the user can easily turn ON or OFF the device based on his/ her requirement. In the farms various insects are present which feeds on the leaves of small plants. So, the device consists of a UV light which is used to attract the insects. The UV light is surrounded by an electric fencing. Now as soon as the insect comes in the contact of electric fence, it experiences an electric shock. Like this the insects trap helps in prevention of the attack of pests and bugs on the crops.

Solar energy makes the device eco-friendly and cost efficient and also it promotes the idea of sustainable development. The shock mechanism is adapted from the mosquito killing racket .It consists of a capacitor which stores the electric charge. As soon as it comes in contact with an insect, it suddenly discharges thus, giving a shock. The device consists of Lithium Ion battery which is charged with the help of solar energy. Besides it, the switching mechanism is controlled with the help of a relay. The relay is operated with the help of Node MCU Wi-Fi module thus enabling the user to operate the device wirelessly.

RELATED WORK AND LITERATURE

The Solar Energy-Based Insect Pest Trap research is an experimental research. The purpose is, to produce and invent Solar Energy-Based Insect Pest Trap by using ultraviolet LED bulbs as light source. The ultraviolet is effective wavelength to tempt insects. Solar cells are used to change solar energy to electric energy and change to battery for pest trap. After that,

bring the trap to test the effectiveness and results of pest trap in agricultural areas. The idea behind the working of our prototype was studied based on various literatures. These include the research papers related to ultrasonic pest repellents, solar energy powered devices. Initially ultrasonic sound was used to repeal the insects. Here, a DTMF module was used to produce an ultrasonic sound of varying frequency. But this device was not effective as in some cases there was no effect on insects. Besides the device had a normal switch making the user to turn it ON/OFF manually by going all the way in the farms. The previously made devices are very costly and also they have a complex mechanism. The device is made based on various studies related to Internet of Things. These studies include patent works and literatures based on wireless communication and remote sensing. Research also tell that the use of wireless communication has been new but an also an efficient way to solve the problems related to pest attack.

The patent works includes various methods like the use of android-based agricultural insect trap monitoring system. The project was conducted to monitor the voltage level of the battery and weight of the insect trapped through Desktop Application and Android- based monitoring system. The study used Voltage Sensor and load cell in monitoring the voltage of the battery placed beside the prototype as-well-as the volume of trapped insect. The concept of insect killer is also an efficient way to get rid of the pests. It is based on the principle of electronic mosquito repelling devices using aedes albopictus mosquitos. The shock mechanism used in this paper is made based on the module used in mosquito killing rackets. The idea of using IoT in the device is based on a patent related to analysis of various function in wireless sensor network applied in precision agriculture. It says that Precision Agriculture is the idea of instantaneous observation of environmental and field parameters like soil moisture, humidity, temperature, soil PH etc. and transfer of the values of those parameters to the remote central server, which on the basis of these values, takes appropriate action to control the use of different resources like pesticides, water, fertilizer etc. in an optimized way in order to maximize the crop yield in terms of both quality and quantity. Many studies and literatures like smart trap for mosquito classification are used for perfect and efficient working of our device. The literature says that Classification of mosquitoes is typically done through the wing beat frequency by either noise or light interruption. It is important to be aware that not all mosquitoes are harmful and any data that may be collected concerning the harmful mosquito should be as accurate as possible to avoid altering the food supply in any particular area.

Also other existing insect traps are studied to get the proper idea of the designing and fabrication. These traps are perfect for catching living insects, specifically fruit flies, is provided having a catch container, a base, and a funnel- shaped insert. The funnel shaped insert has a funnel wall, a plurality of slits in the funnel wall, and a funnel exit opening. The insects to be caught are able to slip through the funnel exit opening, but not through the slits. Furthermore, the trap includes an attractant container in the catch container and/or in the base having a liquid attractant and a wick. Thus these are some literature works which has enabled us to design a perfect device that would work in a precise manner.

METHODOLOGY

A. Hardware Requirements

The device consists of Microcontroller EPS8266, Solar Panel, Battery, Relay Module, Electric shock module, UV light, and a Voltage Sensor.

1) Microcontroller ESP8266:(NodeMCU):

This is the most important component present in the system. It controlls the working of the whole system and enables the device to take decision accordingly. It is the brain of the system. All the components are connected to the Node MCU.

Node MCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems. It consists of 17 GPIO pins (11 are Digital I/O pins), out of which one pin is an analog pin, 4 pins support PWM, 2 pairs are for UART (UART0 and UART1), and supports 1x SPI and 1x I2C protocol. It has 128Kb of Ram, 4 MB of Flash memory, and a maximum clock speed of 160MHz (80 -160). The operating current is 80mA (average).

2) Solar Panel:

The solar panel is used to collect energy from the Sun in the form of sunlight and convert it into electricity that is used to give power to the system. Solar panel is further connected to a solar charge controller unit followed by a battery. Thus, the battery gets charged at day time. The device proposed above runs on a 20Watt solar plate.

3) Relay Module:

Multidisciplinary Journal for Applied Research in Engineering and Technology (MJARET)

Vol. III Issue 5, September – 2023, Pages: 38-43

DOI : https://doi.org/10.54228/mjaret0923008 **ISSN : 2583-1100**

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof.

4) Voltage Sensor:

A voltage sensor is a sensor used to calculate and monitor the amount of voltage in an object. Voltage sensors can determine the AC voltage or DC voltage level. The input of this sensor is the voltage, whereas the output is the switches, analog voltage signal, a current signal, or an audible signal. Sensors are devices that can sense or identify and react to certain types of electrical or optical signals. The implementation of a voltage sensor and current sensor techniques have become an excellent choice for the conventional current and voltage measurement methods.

5) Electric shock module:

This module is responsible for generating the electric shock in order to stun the pests and insects. It consists of electrical fence which gives electrical shock to the insect as soon as it comes in contact with it.

B. Design and Connections

- Whole device is mounted on a 4 feet tall iron stand. It also has a circular structure which is 8 inch in diameter which is used to hold the container that will store the stunned insects. Solar plate is mounted on top of the iron stand.
- Voltage sensor has 3 pins. The S pin of the sensor module is connected with the analog pin of the Node MCU esp8266 wife module and the –ve (negative) pin is connected with ground of the Node MCU module. while the +(positive) pin is not connected.
- The relay module is connected with the the electric shock module. It is responsible for turning ON / OFF of the shock module. The Ground (GND) pin of Node MCU to –ve (negative) pin of Relay. Node MCU Supply (3v3) pin is connected to +ve (positive) pin of Relay. The Node MCU Digital pin (D4) is connected to Input pin of Relay.
- The Lithium Ion battery is used to give power to the device. This is a rechargeable battery which is charged with the help of a solar plate.

Fig. 1. Circuit diagram using all the components

C. Work Methodlogy:

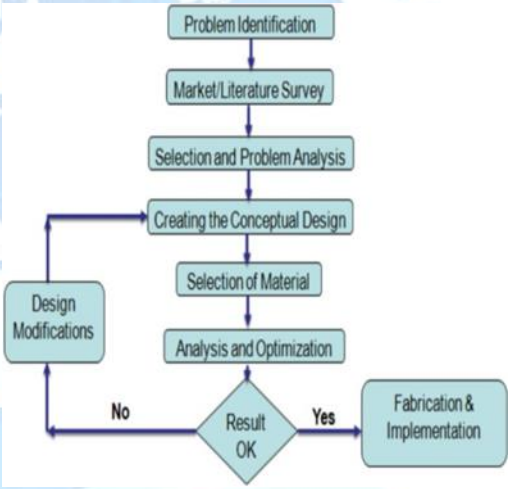

Fig. 2. Flowchart of the Work Methodology

D. Working

The proposed system generally uses the solar energy to trap the insects. This system gets the power input through the solar energy. The Solar plate is connected to the solar charging unit followed by a Lithium Ion battery. The battery gets charged during the daytime. Then at night the device starts working as initiated by the user . The UV light attracts the insects towards it. As soon as the insect comes near the UV light , it comes in contact with electric fence and thereby it gets stunned and falls in the collection tub.

The shock mechanism is completely through a relay. The circuit board of shock module k is a combination of three different circuits namely charging circuit, high voltage generator circuit, and voltage multiplier circuit. The joule thief concept is used in this inverter circuit, wherein only a single NPN transistor and a center-tapped transformer execute sustainable oscillation across the two winding of the transformer which is responsible for generating a spark that stuns the insect. Like this all the insects approaching the system gets electric shock and the stunned insect falls in the collection tub.

Node MCU is the main component of the device. Node MCU is responsible for providing a wireless connection which enables the user to switch ON/OFF the device remotely. The whole functioning of the device is controlled by Node MCU. The battery health and voltage levels can be seen on the website. This website can be viewed on the mobile or a laptop. Through this website, the user can turn ON/OFF the device with a single click. The working can be understood with the help of following diagram

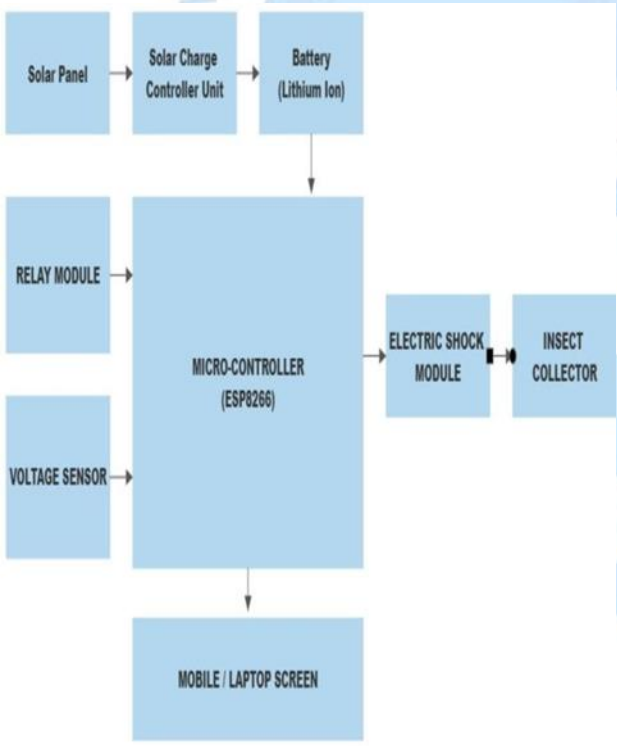

Fig. 3. Block diagram of the circuit

RESULTS AND OBSERVATION

After the successful implementation of the device, various demonstrations were done to check the effectiveness of the device. The device is tested in a farm. It is seen that the battery voltage can be perfectly monitored from the mobile or a laptop as seen in the figure below.

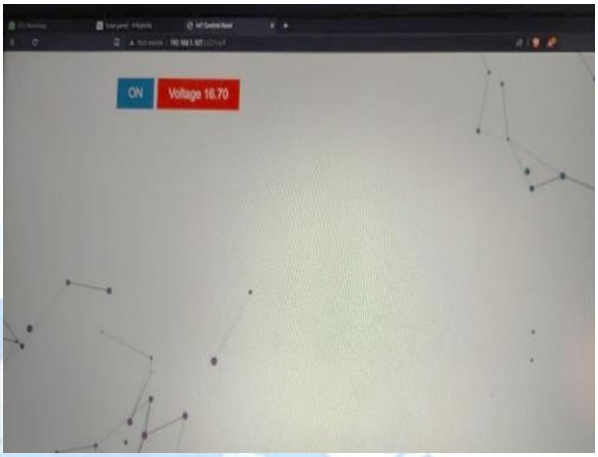

Fig. 4. Interface of the website showing ON / OFF control and battery health

A. Graphs

a) Charging of battery: The Lithium ION battery is charged with the help of solar energy.A 22 Watt solae plate is used for the purpoe of charging. The variation of voltage with respect to time can be understood with help of graph.

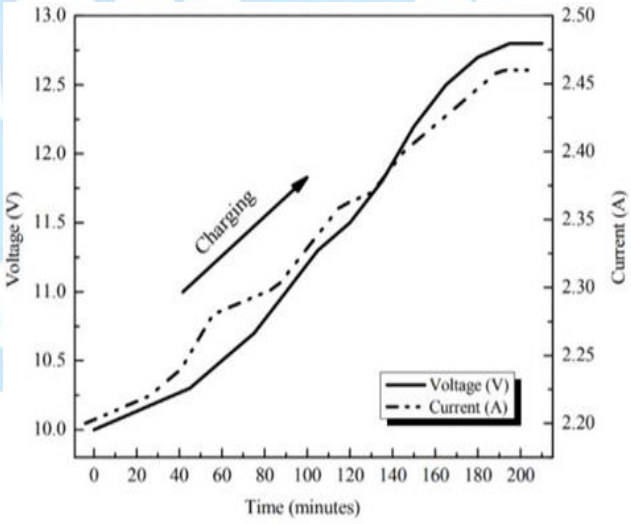

Fig. 5. Readings of charging of battery

b) Discharging of the battery:

Multidisciplinary Journal for Applied Research in Engineering and Technology (MJARET)

Vol. III Issue 5, September – 2023, Pages: 38-43

DOI : https://doi.org/10.54228/mjaret0923008 **ISSN : 2583-1100**

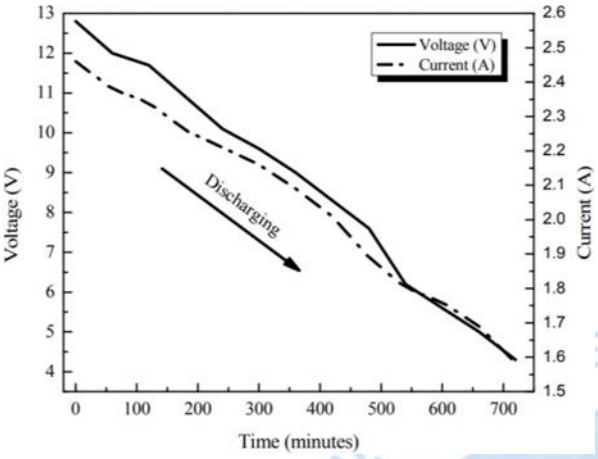

Fig. 6. Readings of discharging of battery

Thus from above graphs the variation of battery voltage can be easily understood .A 20-watt rating solar panel has been used along with a solar charge controller in this project to charge a 12-volt battery. With fully charged battery, the device can easliy work for approximately 10 hours and that too in an efficient manner. However, more precise performance can also be achieved with a high efficient battery and solar panel.

CONCLUSION

We are actively developing this project based on all of the surveys we have conducted. Until far, we have undertaken study in numerous agricultural domains, namely about the various pest control approaches. We read several study articles, papers on other alternative pest management strategies that are presently being implemented. We have also completed a market investigation regarding the components and approximate estimate of expense for our device, as well as the calculations for it; nevertheless, we are still limited to the production of the device. Normally, solar insect traps are employed on a big scale, which costs a lot of money, but in this project, we are constructing a prototype at a lower cost so that every farmer can afford.

FUTURE SCOPE

To acquire a complete understanding of the environment, the gadget may also be fitted with temperature and humidity sensors. This would also allow the device to predict the weather and act appropriately. In addition, the system may be improved to safeguard crops against rodent and stray animal infestation.

REFERENCES

[1] V Thanigaivelan and M Loganathan, "Effect of Ethanol Addition on Performance & Emission of CNSL Biodiesel- Hydrogen Operated Di Dual Fuel Engine", IJMET, vol. 10, no. 1, pp. 1209-1220, 2019.

[2] V Thanigaivelan, M Loganathan and C.G Saravanan, "Recital Exploration of Enclosure of Hydrogen to Compression Ignition Diesel Engine with Biodiesel Blends", Journal of Engineering and Applied Sciences, vol. 12, no. 7, pp. 8111-8116, 2017.

[3] Otoniel Mario Lopez , Hector Migallon , "Monitoring pest insect traps by means of lowpower image sensor technologies", IEEE 2015.

[4] SARIKA DATIR , SANJEEV WAGH , "Monitoring and detection of agricultural disease using wireless sensor network",0.5120/15193-3573 .

[5] Edi Leksono , Muhammad Iqbal, "Development of battery management system for cell monitoring and protection", IEEE 2019.

[6] Roy M. Amante , Liza N. Cudera , " Android-based agricultural insect trap monitoring system using solar panel", IEEE 2021.

[7] Danish Ali Aehmad , Sergei Petrovskii, "Estimating insect population density from trap counts ", Science Direct 2011.

[8] N. AFLITTO AND T. DEGOMEZ , " Sonic Pest Repellents", IEEE 2018.

[9] Nur Najiah, Mohd Nasir , "DESIGN A SMART INSECT REPELLER USING ULTRASONIC SENSOR", IEEE 2012.

[10] Ra. Lavanya, Anushka Saksena and Aparnika Singh, "Effective Networking on Social Media Platforms for Building Connections and Expanding E-commerce Business by Analyzing Social Networks and User's Nature and Reliability", AI Techniques for Advanced Computing Applications. Lecture Notes in Networks and Systems, vol. 130, pp. 503-514.

[11] A. Bridget Matikainen-Ankney, C. Marcial Garmendia, M Ali, K Jonathan, Salem G., Nanami L. Miyazaki, et al., "RAD- Rodent Activity Detector an Open Source Device for Measuring Activity in Rodent Home Cages", Journal of society for neuroscience, vol. 6, no. 4, pp. 0160-19, June 2019.

[12] Dileep Kumar Tiwari and Mamtaz Alam Ansari, "Electronic Pest Repellent: A Review", research gate IEEE sponsored conference (ICIIECS-16), March 2016.

[13] Arindman Roy , " AN ANALYSIS OF VARIOUS FUNCTION IN WIRELESS SENSOR NETWORK APPLIED IN PRECISION AGRICULTURE", 2018 IEEE.

[14] Schumaker, "Electronic Rodent Repellent Devices- A Review of Efficacy Test Protocols and Regulatory Actions", National Wildlife Research Center Repellents Conference, Aug-1995.

[15] M. Telaumbanua and S. Waluyo, "Control System Design for Rat Pest Repellent in the Rice Field Using a Modified ATMega328 Microcontroller Modified with Ultrasonic Sound Wave", International Journal of Engineering Inventions, vol. 7, no. 8, pp. 22-28, August 2018, ISSN 2278-7461.

[16] Wohr Markus, K. Rainer and W. Schwarting, "Ultrasonic Communication in Rats: Can Playback of 50-kHz Calls Induce Approach Behavior", PLoS ONE, vol. 2, no. 12, pp. e1365.

[17] M. Sivashankar, G. Balaji, R. K. Barathraj and V. Thanigaivelan, "Phenomena of brake specific fuel consumption and volumetric efficiency in CI engine by modified intake runner length", IOP Conference Series: Materials Science and Engineering, vol. 402, pp. 012086, 2018.

[18] Hans-Dietrich Reckhaus , “Live trap for catching living insects” , IEEE 2022.

[19] [19] Satish K. Cherukumalli, Terry DeBriere , “Smart trap for mosquito classification” , IEEE 2019.

[20] Brady Clapsaddle, Joe Fredrickson, William Bell, Trevor Haanstad, Jeff Martin , “Humidity tolerant carbon dioxide generator for arthropod trap and method of using same”, IEEE 2017.