Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/22223
DOI URL: http://dx.doi.org/10.21474/IJAR01/22223

ISSN NO. 2320-5407

RESEARCH ARTICLE

THRIPS MANAGEMENT IN CHILLI USING IOT

Mrs. M. Swapna[1], B. Lakshmi Priya[2], Ch. Navya[2], A. Harshitha[2], Ch. Nandhini[2] and K. Harshitha[2]

1. Assistant Professor, Department of CSE, QIS College of Engineering and Technology (A), Ongole, Andhra Pradesh, India.
2. UG Student, Department of AI&DS, QIS College of Engineering and Technology (A), Ongole, Andhra Pradesh, India.

Manuscript Info

Manuscript History
Received: 04 September 2025
Final Accepted: 06 October 2025
Published: November 2025

Key words:-
Internet of Things (IoT), Precision Agriculture, Pest Management, Thrips, Arduino, Sensor Networks, AutomatedS

Abstract

Thrips infestation significantly reduces the yield and quality of chilli crops. Traditional methods of pest control are often inefficient, leading to excessive pesticide use. This paper proposes an automated, IoT-based system for real-time detection and management of Thrips. The system integrates IR and sound sensors with an Arduino Uno microcontroller to monitor pest activity. Decision-making algorithms written in Python and C++ process the sensor data to confirm infestation. Upon positive detection, the system triggers a relay module to activate a water pump and sprinkler mechanism for precise pesticide application. This approach offers a sustainable, cost-effective solution for precision.

Introduction:-

Chilli (Capsicum annuum) is a vital commercial crop globally, but its cultivation is severely impacted by pest infestations, notably by Thrips. Traditional methods of pest control rely on manual scouting and calendar-based pesticide spraying, which are labor-intensive, inefficient, and ecologically damaging. The overuse of chemicals leads to pesticide resistance, environmental contamination, and increased production costs. The integration of Internet of Things (IoT) technology in agriculture offers a paradigm shift towards precision farming. This project aims to develop an automated system that leverages IoT sensors and microcontroller technology to detect Thrips infestation in chilli crops in real-time and initiate a targeted response, thereby minimizing human intervention, optimizing pesticide use, and ensuring better crop management.

Literature Review:-

1. The development of a smart agricultural system designed for monitoring and automation of chili plants using Internet of Things (IoT) applications. The system utilizes an Arduino microcontroller, integrating various sensors such as a soil moisture sensor, a DHT11 sensor (for temperature and humidity), and an ultrasonic sensor. It also includes a servo motor for fertilizer application and a water pump for irrigation, both controllable via the Remote XY Apps. The system collects data from the sensors and transmits it to the user via the app, enabling remote control over fertilization and watering processes. The primary objective is to enhance

agricultural efficiency for farmers in Malaysia and improve crop quality and quantity, addressing the current low adoption of advanced IoT technologies in their farming practices.

2. An IoT-based smart irrigation and monitoring system for chilli plants using a NodeMCU-ESP8266 microcontroller. The system integrates temperature, humidity, and soil moisture sensors to automate watering based on real-time data. Controlled via mobile and desktop apps (Blynk and Thinger.io), it helps optimize water usage and improve crop management. Tested on a chilli farm in Malaysia, the system proved effective and efficient. Future enhancements include solar power and long-range communication support.
3. Effective integrated strategies to manage chilli thrips , a destructive pest causing significant damage to chilli crops. Thrips feeding leads to leaf curling, scarring of fruits, and reduced yield, with potential losses ranging from 11.8% to 90%. The pest is highly polyphagous and widespread, affecting over 150 plant species globally. The study emphasizes eco-friendly methods such as cultural practices, biological control, botanical extracts, and use of resistant varieties. Monitoring at an economic threshold level (ETL) is crucial, and selective chemical use is recommended when necessary. These integrated approaches aim to ensure sustainable chilli cultivation with minimal chemical dependence.
4. The effective management strategies for thrips and mites, identifying Scirtothrips dorsalis Hood (Thrips) and Polyphagotarsonemus latus Banks (Yellow mite) as significant pests that cause considerable yield losses in chilli crops. It emphasizes the importance of chilli (Capsicum annuum L.) as a major cash and commercial spice crop in India. The paper likely delves into integrated pest management (IPM) practices, which are crucial for controlling these pest populations and minimizing crop damage
5. Thrips (Thysanoptera) are significant pests that damage chili plants by piercing and sucking cell contents, leading to IEEE leaf discoloration, deformation, and potential yield loss. Although common elsewhere, their infestation on chili in Jambi, Indonesia, had not been officially reported. This study investigated the phenomenon by introducing locally sourced thrips onto 160 caged chili plants. Detailed observations of leaf damage patterns provided critical baseline data to inform future pest management strategies in the region.

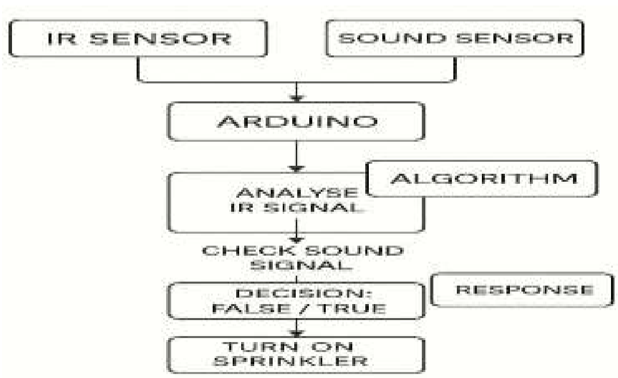
System Design:-

Hardware Components:

The core hardware components include an Arduino Uno microcontroller, which acts as the central processing unit. The sensing module consists of IR sensors to detect physical presence and acoustic sensors to identify specific frequencies associated with Thrips activity. The actuation module includes a relay switch, a DC water pump, and a sprinkler setup for pesticide spray. The system is powered by a standard 12V power supply.

System Architecture:

The system architecture follows a linear flow from sensing to actuation:-



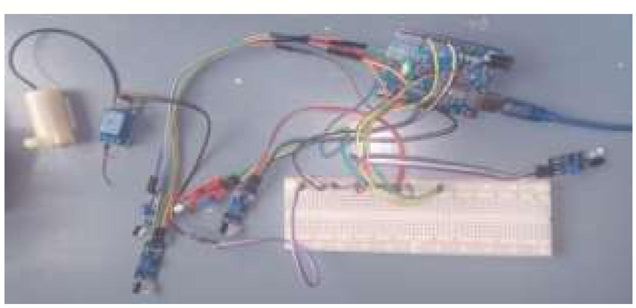


Fig:3.2.1

Methodology and Implementation:-

The implementation of the automated Thrips management system was carried out in a structured sequence of stages, integrating both hardware configuration and software development to achieve a closed-loop control system.

Hardware Assembly and Integration The physical system was constructed according to the architectural design outlined in Figure 3.2.1.The implementation involved the following key steps:

i. Sensor Integration: The IR obstacle avoidance sensor and the sound detection sensor were mounted on a frame and positioned to monitor chilli plant leaves effectively. These sensors were connected to the Arduino Uno's analog input pins (A0 and A1) to provide continuous environmental data.
ii. Microcontroller Wiring: The Arduino Uno was established as the central processing unit. A 5V relay module was connected to a designated digital output pin (e.g., Pin 7) on the Arduino to serve as the electronic switch for the actuation mechanism.
iii. Actuation Setup: The DC water pump was connected to the relay module's switched circuit. The pump's inlet was submerged in a reservoir containing a water-pesticide solution, and its outlet was connected to a network of tubing and sprinkler nozzles positioned above the crop area.

Software Development and Algorithm:
The core logic of the system was implemented through firmware written in C++within the Arduino Integrated Development Environment (IDE). The program follows a sequential workflow:

1. Initialization The system initializes the serial communication and sets the sensor pins as inputs and the relay control pin as an output.
2. Data Acquisition The Arduino continuously reads analog voltage values from the IR and sound sensors at a fixed sampling rate.
3. Data Processing The raw analog readings are compared against predefined empirical threshold values (T_ir and T_sound) that were calibrated to indicate Thrips activity.
4. **Decision Making A conditional statement determines the system's response:**

1. If both sensor readings exceed their respective thresholds for a consecutive number of samples, the Arduino interprets this as a confirmed infestation.
2. Then it sets the digital output pin to HIGH, energizing the relay coil.
3. Else the pin remains LOW, and the system continues monitoring.

Actuation:
The activated relay completes the circuit powering the DC water pump, which engages for a predetermined duration (e.g., 10 seconds), delivering a targeted spray of pesticide onto the crops. After the duration elapses, the Arduino sets the pin back to LOW, turning off the pump, and the monitoring loop continues.

Calibration and Testing The system was calibrated in a controlled environment that simulated a chilli crop setting.Threshold values for the sensors were determined empirically by observing readings in the presence of known stimuli. The system's response was tested by simulating infestation events to verify the reliability of detection and the precision of the automated spraying response. Units

i. Sensor distances are reported in centimeters (cm).
ii. Electrical values are given in volts (V) and amperes (A).
iii. Time duration for spraying is measured in seconds (s).

Equations:
The decision to trigger the spray mechanismis based on the:
Ac2tivate Spray= {1if (Sir>Tir) AND (S sound>T sound) {1 otherwise
where Siris the IR sensor reading, Tiris its threshold , S soundis the sound sensor reading, and Tsoundis its threshold.

Conclusion:-

This project designed and implemented a cost-effective IoT- based system to automate detection and management of Thrips infestation in chilli crops. By integrating IR and acoustic sensors with an Arduino microcontroller, the system enables real-time pest activity monitoring. A threshold-based algorithm processes sensor data to activate a targeted pesticide spray mechanism via a relay-controlled pump and sprinklers, creating a functional closed-loop solution. This approach overcomes limitations of traditional blanket spraying by significantly reducing pesticide use, minimizing environmental impact, and optimizing resource efficiency—promoting both sustainable farming and crop protection.Future enhancements may include solar power integration for energy independence, GSM/Wi-Fi modules for real-time alerts, and machine learning to improve detection accuracy. The system provides a scalable foundation for eco -friendly agricultural pest management.

Acknowledgment:-

The successful completion of this project would not have been possible without the support and guidance we received. We extend our sincere thanks to the principal and management of our institution for providing the necessary resources and laboratory facilities. We are deeply grateful to our project guide for their invaluable expertise, patient mentorship, and insightful feedback throughout every stage of this work. We also wish to acknowledge our colleagues for their constructive discussions and encouragement..

References:-

1. Azman, N., Ali, D. M., & Yusuf, Y. (2023). Smart Agricultural Monitoring System using IoT Application for Chili Plants. Journal of Advanced Research in Applied Sciences and Engineering Technology, 33(1), 53-66.
2. Yadav, M., Singh, B., Devi, G., Kumari, P., Kumar, N., & Choudhary, P. (2023). Thrips parvispinus (Karny):
3. Kumari, H. (2024). Management of Thrips and Mites in Chilli Crop.
4. Sam-on, M. F. S., Mustafa, S., Yusof, M. T., Hashim, A. M., & Aizuddin, K. N. A. K. (2024). Exploring the Global Trends of Bacillus, Trichoderma and Entomopathogenic Fungi for Pathogen and Pest Control in Chili Cultivation.
5. Italiya, J. V., Kalasariya, R. L., Dodiya, R. D., Barad, A. H., & Patel, N. A. (2023). Economically management of thrips by insecticides in chilli under field condition.
6. Kartikey Singh, Nahida Afreen, Rajat Singh, Prince Sahu. (2023).Biotica Research Today 2023, 5(8): 606-608.
7. Shani Raj, A.K. Awasthi. (2020). International Journal of Entomology Research ISSN: 2455-4758.
8. Asni Johari, Siti Herlinda, Chandra Irsan, Yulia Pujiastuti. (2020). American Journal of Agricultural and Biological Sciences 2016, 11 (3): 103.109.
9. Shri O. P. Verma, Dr. A. Siddiqui, Dr. D.K. Nagaraju, Shri Manoj Puri Goswami. (2020). Technical Booklet-IPM-01/2022.
10. Kotresh S, Dr. Raghuraman M and Srushtideep A. (2020). Journal of Entomology and Zoology Studies 2020; 8(4): 669- 673.
11. Roja, K., & Kiran Kumar, M. J. (2021). Smart Driver Alert Control System Using Arduino and IR Sensor. International Journal of Creative Research Thoughts (IJCRT), 9(6), 463–467.
12. Indu, P. S., & Nithya, K. S. (2022). Smart Driver Drowsiness Alert System Using Arduino. International Research Journal of Engineering and Technology (IRJET), 9(5), 357–360.
13. Mandal, L., & Mondal, P. (2023). Relative abundance and population dynamics of chilli thrips (Scirtothrips dorsalis) and its correlation with weather parameters. International Journal of Bio-resource and Stress Management, 14(2), 135–140.
14. Nandini, B., Mawale, K. S., & Giridhar, P. (2023). Forestalling the thrips (Thysanoptera) infestation in chili plants by bio- nanosilver particles treatment. SSRN Electronic Journal.
15. Mounika, V., Reddy, I. V. S., Rao, K. S. T., Krishna, G. V., & Gowd, T. Y. M. (2024). Integrated cultural management practices for controlling black thrips infestation in chilli. International Journal of Research in Agronomy, 7(11), 423–426.
16. Chandan Maity*, Aritra Santra, Laltu Mandal and Palash Mondal. Management of chilli thrips with some newer molecules of chemichal. Vol. 1(3) : 119-125,2015
17. K. Sireesha1, B.V.L. Prasanna, T. Vijaya Lakshmi and R.V.S.K. Reddy. Outbreak of invasive thrips species Thrips parvispinus in chilli growing areas of Andhra Pradesh Vol. 24
18. G. Venu Gopa, K. Vijaya Lakshm, B. Sarath Babu,P. Kishore Varma population dynamics, yield losses and management of thrips, Scirtothrips dorsalis Hood infesting chilli
19. G Venu Gopal, K Vijaya Lakshmi, B Sarath Babu and P Kishore Varma. Seasonal incidence of chilli thrips, Scirtothrips dorsalis hood in relation to weather parametersJEZS 2018; 6(2): 466- 471
20. JP Lodaya, Meeral Suthar, HC Patel, DB Sisodiya, RR Acharya, AT Raval, NP Trivedi and AR Mohapatra 2022. Status of invasive species of thrips, Thrips parvispinus (Karny) infesting chilli grown in middle Gujarat TPI 2022; 11(3)