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Pest Identification and Control in Smart Agriculture Using Wireless Sensor and Neural Network

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A B S T R A C T

Pest identification and control methods used in agriculture are often based on manual search, chemical pesticides and knowledge, leading to inefficiency, Agricultural damage and high costs. This abstract presents a new approach to pest detection and control in smart agriculture by integrating wireless sensor networks (WSNs), neural networks and YOLOv5 object recognition algorithm. Using real-time environmental data collected by WSNs and the powerful image recognition capabilities of YOLOv5, the proposed system can accurately identify pests in fields, enabling targeted and precise pest control. This summary highlights the potential of this approach to improve agricultural productivity, reduce environmental impacts and optimize the use of resources.

Keywords: Internet of Things (IoT), Deep learning model, YOLOv5 method, Pest identification

INTRODUCTION

Global food security is an urgent challenge and pest infestation is a major threat to agricultural productivity. Traditional pest control methods, such as broad-spectrum insecticides, are often ineffective, harmful to the environment and expensive. To address these challenges, precision agriculture has emerged as a promising approach that uses IoT technologies and data analytics for targeted and sustainable pest management.

This technology focuses on the integration of three key technologies for pest detection and control in smart agriculture:

Wireless Sensor Networks (WSN): A network of small, battery-powered sensors deployed throughout the field continuously collects environmental data such as temperature, humidity, and light intensity. This information provides valuable information about pest behavior and habitat preferences.

Neural Networks: Powerful machine learning algorithms trained on large datasets of labeled pest images can accurately identify different pest species from captured images or videos.

YOLOv5: a state-of-the-art object detection algorithm known for its speed and accuracy in real-time applications. YOLOv5 can effectively detect and locate pests in captured images, enabling targeted control measures.

By combining these technologies, our proposed system provides a comprehensive and data-driven approach to intelligent agricultural pest management. The following sections delve deeper into the system architecture, algorithms and potential benefits of sustainable and Efficient agricultural practices.

METHODOLOGY

The revolutionary agricultural pest prediction system seamlessly combines cutting-edge IoT and AI technologies, with a meticulously organized set of central components aimed at transforming pest control practices in the agricultural domain. Spread across the vast expanse of the agricultural field, a network of IoT sensors serves as the front line data gatherers, capturing real-time information on a spectrum of environmental parameters, including temperature, humidity, rainfall, wind speed, and sunshine duration. This wealth of dynamic data is then seamlessly transmitted to a central hub where it undergoes rigorous processing and analysis.

At the epicenter of this technological marvel lies a highly sophisticated Deep Learning Model, empowered by the potent YOLOv5 algorithm. Functioning as the neural core, this model undertakes the intricate task of analyzing the amalgamated environmental data, generating predictive models that forecast the likelihood of pest outbreaks. The system's prowess is further underscored by its reliance on a diverse datasets of meticulously labeled pest images, as evidenced by the dedicated section on "Collected Pest Images." This feature refers to a refined integration of image recognition technology, enhancing the predictive capabilities by directly detecting pests in conjunction with the environmental data-driven insights.

Far beyond mere predictive analytic, the system showcases a commitment to perpetual refinement through elements such as "Optimization" . These components signify a forward-thinking paradigm, indicating the incorporation of mechanisms designed to continually elevate the system's accuracy and effectiveness over time. By furnishing farmers with not just predictions but also weekly pest forecasts derived from the synergistic fusion of environmental data and deep learning insights, the system equips agricultural stakeholders with invaluable tools for fine-tuning pest management strategies, ultimately leading to substantial enhancements in crop yields. In essence, the amalgamation of IoT sensors, state-of-the-art deep learning models, and image recognition technologies paints a panoramic and promising vision for the future of pest control in agriculture.

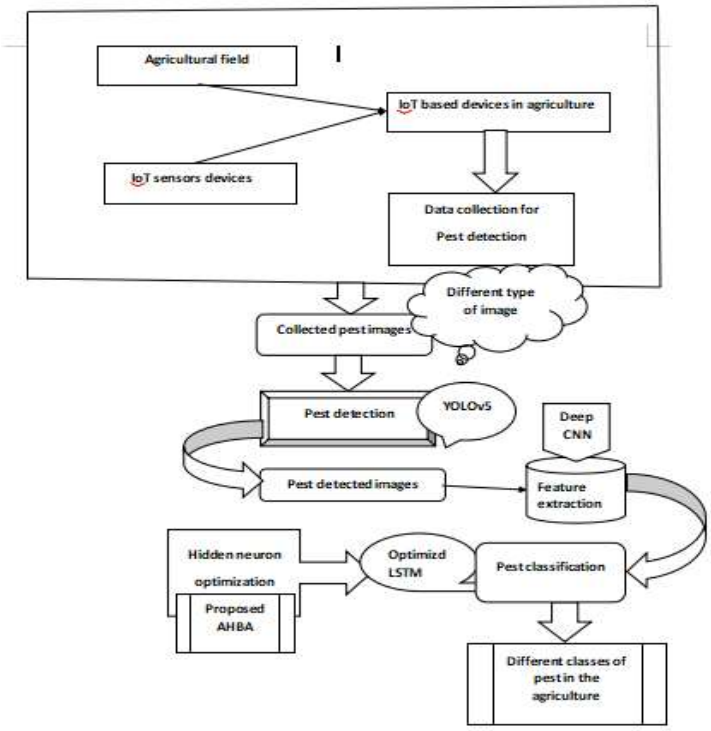

Fig.1-System design

RELATED WORK

Title	Publish Year	Author Name	Goal
Applying IOT in monitoring and control of an irrigation system For sustainable agriculture for small scale farmers in rural communities	2018	R. Mulenga, J. Kalezhi	Proposed IoT enabled crop eenvironment monitoring to recommend irrigation water based on directly sensed data.
State-of-art IOT in protected agriculture	2019	X. Shi, X. An, Q. Zhao	Presented different prospects of IoT applications for protected agriculture.
A framework for a agricultural pest and disease monitoring based on IOT and unmanned aerial vehicles	2020	D. Gao, Q. Sun, B. Hu	Shows the concerned about Disease detection through spectrum analysis technology which is based on Unmanned Aerial Vehicles(UAVs).
Prediction of pest insect appearance using sensors and machine learning	2021	D. Markovic, D. Vujicic	Proposed pest prediction by temperature and humidity. According to the study the neural network based accuracy is best in prediction of pest attack.
IOT based cotton whitefly prediction using deep learning	2022	M. S. Latif, R. Kazmi	A suggested method for predicting pest infestation in rice crops involves utilizing the IoT in combination with feedforward neural network.

A new pest detection method based on YOLOv5m	2023	M. Dai, M. M. H. Dorjoy	Shows the new(YOLOv5)deep leaning technique for pest detection.

CONCLUSION

The agricultural pest prediction system represents a groundbreaking fusion of IoT and AI technologies, offering a holistic approach to pest control in farming. With a network of IoT sensors capturing real-time environmental data, a sophisticated Deep Learning Model powered by the YOLOv5 algorithm, and the integration of image recognition technology through a dataset of labeled pest images, the system demonstrates a multi-faceted strategy for pest detection and prediction. Moreover, the commitment to continuous improvement, as indicated by elements like "Optimization" and the "Proposed AHBA," underscores a forward-thinking approach, ensuring the system's adaptability and effectiveness over time. By providing farmers with insightful weekly pest forecasts, this system empowers agricultural stakeholders to optimize their pest management strategies, ultimately contributing to improved crop yields. The convergence of these advanced technologies paints a promising picture for the future of precision agriculture, where data-driven insights and AI play pivotal roles in addressing challenges and enhancing productivity in the agricultural sector.

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