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Smart Crop Disease Management System using Deep Learning, IoT and Blockchain in Precision Agriculture (SCDMS)

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ABSTRACT: Crop diseases pose a significant threat to global food security, causing substantial yield reductions and economic losses estimated at billions of dollars annually. The traditional way of managing diseases, which often relies on the visual inspection of farmers, is susceptible to mistakes and a delay in detection. This research develops a new system of Smart Crop Disease Management that employs Deep Learning, the Internet of Things, and blockchain technology to revolutionize the way that is used in precision agriculture. The SCDMS capitalizes on a unique dataset derived from field experiments, it focuses on user-oriented design principles that are intended to provide practical advice that is specific to farmers. Cooperative agreements with stakeholders and policy makers promote the practicality of the proposed solution in the real world and contribute to the development of smart agriculture and the pursuit of global food security.

KEYWORDS: Crop disease management, deep learning, Internet of Things (IoT), Blockchain, precision agriculture, image recognition, remote sensing, smart agriculture.

I. INTRODUCTION

The increasing number of humans has placed a constant burden on the global food system. Agriculture serves as the crucial pillar that supports this essential need, however, its capacity to fulfil increasing demands is frequently impaired by multiple factors. Among the challenges, crop diseases are prominent as a significant danger, this threat is associated with the loss of significant amounts of money and the reduction of annual income in the billions of dollars.

Traditional approaches to crop disease management that are primarily based on visual inspection by farmers are not only time-consuming and subject to error, but also lack the specificity needed for disease management. This often results in misdiagnoses that are delayed or ineffective, which further diminishes the health of the crop and overall productivity. The increasing popularity of precision agriculture has the potential to address these issues. By utilizing data-driven approaches and targeted strategies, precision agriculture is able to maximize the utilization of resources and promote healthier crops. This research explores the creation of a Smart Crop Disease Management System (SCDMS), a comprehensive solution that combines the power of Deep Learning, the Internet of Things (IoT), and blockchain technology in the context of precision agriculture. SCDMS capitalizes on a unique dataset that is derived from extensive field experiments, this dataset is effective in real-world scenarios.

The SCDMS is more extensive than simply recognizing disease. It's designed with a user-oriented philosophy at its core, this philosophy aims to provide practical, specific advice to farmers regarding crops. This grants them the power to make informed decisions about disease control strategies, which would ultimately lead to increased yields and reduced losses. Additionally, by promoting cooperative agreements with stakeholders and policy makers, the SCDMS promotes its practicality in the real world and facilitates the larger development of agricultural smart practices.

II. PROBLEM DEFINITION

Crop diseases are a major challenge for farmers worldwide, leading to yield losses estimated around 20-40% annually [1]. Traditional disease management practices rely on visual inspection by farmers, which is subjective and prone to errors in identification, particularly in the early stages of disease development [2]. The main issue we're trying to solve is finding a better way to help farmers deal with crop diseases. We need a solution that does three main things:

- **Helps farmers find diseases quickly:** The old way of checking fields for disease, by manually scouting, can be a slow and tiring process. Farmers might spend hours walking up and down rows of crops, carefully examining each plant for signs of trouble. This not only takes away valuable time they could be spending on other farm tasks, but it can also be prone to human error. This new system takes the guesswork out of the equation. It uses cameras to capture images of the crops and then relies on clever computers, called deep learning models, to analyse those images and automatically identify diseases. This way, farmers can be alerted to problems much faster, allowing them to take action before the disease spreads and damages their crops.
- **Makes sure diseases are identified correctly:** Telling exactly what's wrong with a plant can be tough. Different diseases can have similar signs, making it confusing for farmers to know what they're facing. Using the wrong treatment can be ineffective or even harm the plants. This system tackles that challenge. It uses powerful computer programs trained on many pictures of sick plants. By analysing close-up photos, the system can pinpoint the exact disease. This way, farmers get a clear answer and choose the right treatment to save their crops.
- **Gives farmers useful advice:** Once the system identifies the disease, it doesn't stop there. It acts like a helpful advisor, suggesting the best way to fight it. This advice considers how bad the disease is, what crop it's attacking, and what resources the farmer has on hand. For example, the system might recommend specific treatments depending on the severity, or suggest organic solutions if the problem is minor. This tailored guidance empowers farmers to take the right steps and save their crops.

III. METHODOLOGY

3.1 Functionalities of SCDMS

- **Early Disease Detection and Diagnosis:** The system's deep learning model analyses real-time images and detects early signs of disease, allowing for prompt intervention. The model's high accuracy ensures accurate diagnosis, enabling farmers to implement targeted treatment strategies.
- **Personalized Treatment Recommendations:** Based on disease identification and environmental data gathered by sensors, the system provides personalized recommendations for disease management. These recommendations may include specific pesticides, fungicides, or other treatments, taking into account factors like crop variety, disease severity, and local environmental conditions.
- **Automated Disease Control:** The system can be integrated with automated irrigation systems and robotic sprayers. By receiving recommendations from the system, these automated units can execute precise treatment protocols, minimizing waste and optimizing resource utilization.

3.2 Technologies enabling SCDMS

- **IoT Sensors:** The SCDMS leverages a network of IoT sensors strategically deployed in agricultural fields. These sensors continuously collect real-time data on crucial environmental factors such as temperature, humidity, and soil moisture, which are crucial indicators of disease development [3]. Early detection of changes in these parameters can enable timely intervention and disease prevention even before visible symptoms appear on the crops.
- **Deep Learning:** High-resolution images of crops captured by mobile devices or drones are fed into the system. Deep Learning algorithms, specifically Convolutional Neural Networks (CNNs) such as VGG16 or Resnet, analyse these images with high accuracy, identifying and classifying various crop diseases [4]. CNNs excel at pattern recognition in images, making them highly suitable for this task. The system will be trained on a large dataset of labelled crop images with various disease manifestations. Once trained, the CNN model can accurately identify diseases in new images uploaded by farmers.
- **Blockchain Technology:** Blockchain technology offers a secure and transparent platform for recording disease outbreaks, facilitating targeted interventions and supply chain management. Real-time data on disease outbreaks captured by IoT sensors can be immutably stored on the blockchain, enabling authorities to track the spread of diseases and implement targeted control measures. Additionally, blockchain can ensure transparency in the food supply chain. Farmers can record the health status of their crops on the blockchain, allowing consumers to verify the information and make informed purchasing decisions.

- **Novel Dataset and Case Study:** This research utilizes a unique dataset collected from extensive field trials conducted in collaboration with agricultural organizations. The dataset encompasses high-resolution images of a specific crop (e.g., wheat, rice) with various disease manifestations, along with corresponding environmental data captured by IoT sensors deployed in the field trial area. Focusing on a specific crop allows for in-depth analysis of the relationship between environmental factors and disease development. This data will be used to train and validate the Deep Learning model for accurate disease identification.

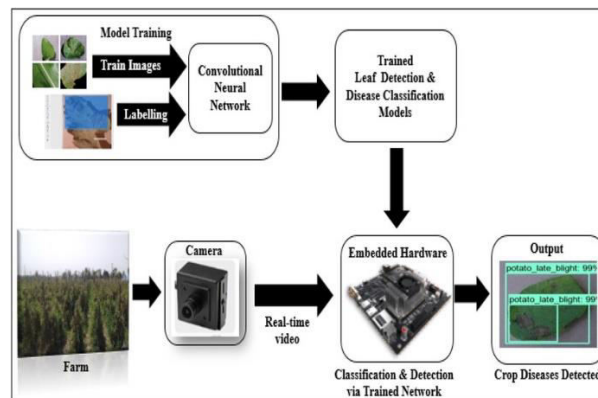


Fig. 1 Technologies Enabling SCMS

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<https://www.researchgate.net/publication/352328073/figure/fig1/AS:1179940066213902@1658331042616/Block-diagram-of-the-complete-crop-disease-detection-system.png>

IV. SYSTEM ARCHITECTURE

The SCMS is designed with user-centred design principles at its core, ensuring ease of use and accessibility for farmers with varying technical backgrounds. The user interface will be intuitive and user-friendly, allowing farmers to easily upload images of their crops using a mobile application. The system will then process the image through the trained Deep Learning model and provide real-time results on the disease identified, if any. Additionally, the system will access real-time data from IoT sensors deployed in the field and provide farmers with insights on relevant environmental parameters.

The proposed smart crop disease management system is composed of three interconnected components:

- **IoT Sensors and Data Acquisition:** A network of IoT sensors deployed across farm fields collects data on various parameters relevant to plant health, including soil moisture, temperature, humidity, and light intensity. Advanced sensors equipped with image capture capabilities capture real-time images of crops. Data collected from the sensors is transmitted securely to a centralized cloud platform.
- **Deep Learning for Disease Detection and Diagnosis:** The cloud platform hosts a deep learning model trained on a massive dataset of labelled images of healthy and diseased crops. The model analyses the images captured by the IoT sensors, identifying potential disease symptoms and classifying the specific disease with high accuracy. The model's output, including disease type and severity, is seamlessly integrated with the system's data analysis and recommendation engine.
- **Blockchain for Data Security and Traceability:** Blockchain technology is utilized to secure and authenticate all data collected and processed by the system. Each data point is encrypted and stored in a distributed ledger, ensuring immutability and transparency. Farmers and stakeholders can access and verify the authenticity of data, fostering trust and accountability. The blockchain also facilitates secure and efficient data sharing between farmers, agricultural experts, and researchers, enabling collaborative efforts in disease control.
- **Actionable Insights for Farmers:** Based on the identified disease and real-time environmental data, the SCMS will provide farmers with actionable insights tailored to their specific needs. This may include:

- **Disease Management Recommendations:** Upon identifying the specific disease affecting the crop, the SCDMS doesn't stop there. It acts as a helpful advisor, suggesting the most effective control measures to combat the identified disease. These recommendations consider various factors to ensure optimal results, including the severity of the disease outbreak and the specific crop variety affected. The system prioritizes environmentally friendly options whenever possible, such as organic fungicides or biological control agents, while also providing details on application dosages and recommended schedules for maximum effectiveness.
- **Targeted Spraying:** By integrating data on disease location obtained from image analysis with real-time field data from IoT sensors, the system can recommend targeted spraying of control measures, minimizing pesticide use and environmental impact. This precise approach minimizes the amount of pesticide or fungicide needed, significantly reducing waste and environmental impact. Furthermore, targeted spraying helps to protect healthy plant sections, promoting overall crop health and minimizing the risk of resistance development in targeted pests or diseases.
- **Yield Estimation:** By combining plant health data with environmental data, the system can potentially estimate crop yield. This valuable information empowers farmers to make informed decisions regarding resource allocation and planning. With an accurate yield estimate, farmers can optimize their use of fertilizers, irrigation water, and manpower throughout the growing season, maximizing efficiency and profitability.

V. CONCLUSION

This research proposes a powerful combination of Deep Learning, IoT, and Blockchain technologies that holds immense promise for the future of sustainable crop disease management. By directly addressing the challenges faced by farmers, this system empowers them to identify and combat diseases quickly and accurately. Furthermore, the system prioritizes eco-friendly solutions, minimizing environmental impact. This innovative approach not only advances the field of smart agriculture but also significantly contributes to global efforts towards ensuring food security and building a more sustainable future for our planet.

REFERENCES

- [1] Nikesh Gandhara, Rd. R. S. Kawita, "IoT based Smart Agriculture", IJARCCCE, Vol. 5, Issue 6, June 2016.
- [2] Bala Murugan MS, Manoj Kumar Rajagopal, Diproop Roy, "IoT Based Smart Agriculture and Plant Disease Prediction", November 2021 Journal of Physics Conference Series 2115(1):012017.
- [3] Zareen Narowal Reza, Faiza Nuzhat, Nuzhat Ashraf Mahsa, Md. Haider Ali, "Detecting jute plant disease using image processing and machine learning", 2016 3rd International Conference on Electrical Engineering and Information Communication Technology (ICEEICT).
- [4] Meliks Erdogan, Adam Tuncer, Yunus Ozen, "Plant Leaf Disease Detection and Classification Based on CNN with LVQ Algorithm", 2018 3rd International Conference on Computer Science and Engineering (UBMK).
- [5] Yuzhen Lu, Sierra Young, "A survey of public datasets for computer vision tasks in precision agriculture, Computers and Electronics in Agriculture.", Volume 178, 2020, 105760, ISSN 0168-1699.
- [6] Mohanty, Sharada P., David P. Hughes, and Marcel Salathia. "Using deep learning for image-based plant disease detection." *Frontiers in plant science* 7 (2016): 1419



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