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Design and Implementation of Mobile Application for Smart Agriculture Using AI and IOT

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ABSTRACT: The rapid advancement of technology has paved the way for innovative solutions in various sectors, including agriculture. This project focuses on the design and implementation of a mobile application tailored for smart agriculture, integrating Artificial Intelligence (AI) and Internet of Things (IoT) technologies. The application aims to empower farmers by providing real-time insights and actionable recommendations to optimize crop production, resource utilization, and overall farm management. Leveraging AI algorithms, the application analyses data collected from IoT sensors deployed across the farm, including plant moisture, temperature, humidity, and crop health indicators. Through intuitive user interfaces, farmers can access personalized recommendations for irrigation scheduling, pest control, fertilizer application, and crop monitoring, enhancing decision-making processes. Additionally, the application facilitates remote monitoring and control, enabling farmers to manage farm operations efficiently from anywhere, using their smartphones or tablets. The integration of AI and IoT in agriculture not only enhances productivity and sustainability but also contributes to the advancement of precision farming practices. This project contributes to the ongoing efforts to modernize agriculture and ensure food security in a rapidly evolving world.

KEYWORDS: Agriculture, Plant diseases, Mobile Application, Convolutional Neural Network(CNN).

I.INTRODUCTION

India is a rapidly developing nation, and agriculture is the backbone of the country's early growth. Agriculture is struggling to meet its needs as the global population grows at a rapid rate of the younger generation. Climate change, pollinator decline, crop pests, lack of irrigation, and other factors continue to pose a threat to food security. Crop disease reduces both the quantity and quality of food produced. Crop diseases not only has an effect on global food security, but they also have a negative impact on small-scale farmers whose livelihood is dependent on safe cultivation. The benefit is that crop diseases can be monitored by detecting them as soon as they appear on the crops. It has been possible to provide an effective solution to this problem thanks to the advent of the field of computer vision. In order to minimize the occurrence of diseases as well as maximizing the productivity and ensuring agricultural sustainability, there is a need for advanced disease detection in preventing damages to crops the integrity of the plant by himself. CNN (Convolution Neural Network) is one of the methods to detect whether the plant has a particular disease by taking a picture of the plant leaves and feeding it to a model to know the results. Using CNN the disease in the plants is identified and has proven the results are 86% correct. On the other hand, deep-learning-based techniques, particularly CNNs, are the most promising approach for automatically learning decisive and discriminative features. Deep learning (DL) consists of different convolutional layers that represent learning features from the data [19,20]. Plant-disease detection can be accomplished using a deep-learning model.

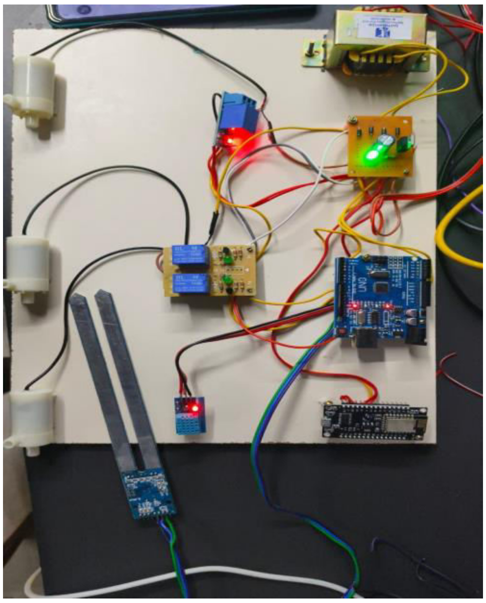
II. RELATED WORK

The Philippines is an agricultural country, and one of the issues in today's farming environment is the prevalence and exacerbation of diseases caused by fungus, which impact the overall quality of the produced or harvested crop. This study focuses on a corn field, especially the top three corn crop diseases in the Philippines, which are corn rust, leaf blight, and grey leaf spot. The YOLO V5 architecture was used to identify corn crop diseases. After training, the result had an map score of 0.97. The model also achieved 100 percent testing accuracy and detection accuracy ranging from 98.90 percent to 99.43 percent. The accuracy of training, testing, and validation were promising, and it could be implemented into the device to solve the issue of detecting corn leaf diseases.

Immediate identification of plant disease is one of the important solutions in Agricultural problems. In this study, the researchers develop an early detection system for tomato leaf diseases. It is important to create a system that will detect and classify a certain disease present in the leaf to prevent further loss. In order to do that, the researchers used an algorithm called YOLOv3 for training a model that accurately detects specific diseases for tomato leaves. The proposed model is able to classify the diseases and has a mean average precision(mAP) of 98.28 %. The result of the trained model varied with the ranging from 75% - 99%, for detecting the two common tomato leaf diseases such as, Early Blight and Septoria Leaf Spot.

III. PROPOSED METHODOLOGY

This paper is based on hydroponic agriculture. Hydroponics is a soil less agriculture that can be easily combined with technology. This project can be split into three parts, First section will be hardware implementation. This can be implemented using different sensors to analyse different parameters in hydroponic agriculture method. The proposed method monitors the parameters like humidity, temperature, water level in the field, PH level of water that can be used in the field for growing plants. Then the sensor values are continuously store in the IOT. based on the data given by water level sensor we can decide the amount of water required for the field. The Arduino receives all the data from the sensor and convert into digital value shown in the PC. Second section will be software implementation, python language used for this projects.



The sample leaves are taken from the field should trained by image processing multiple time then it can be separated as test image and trained image then the images captured through the camera can be compared with the trained image to find percentage of diseases occurred in the plant. During the training process, the model continuously uses different parameters in an attempt to find the most suitable model for the given dataset. The test data given as input into the model and combined with the sensor data from the orchard to analyse the level of damage and the growth stages of the plant. To make the system more accessible and convenient to farmers, we designed a mobile application with a photography function. The mobile application is also capable of updating the environmental data at any time. The mobile application makes it possible for farmers to identify pests. The identification results are sent to the cloud to analyse the location of the pest, so the farmers can be informed as to the best time for pesticide spraying with the goal

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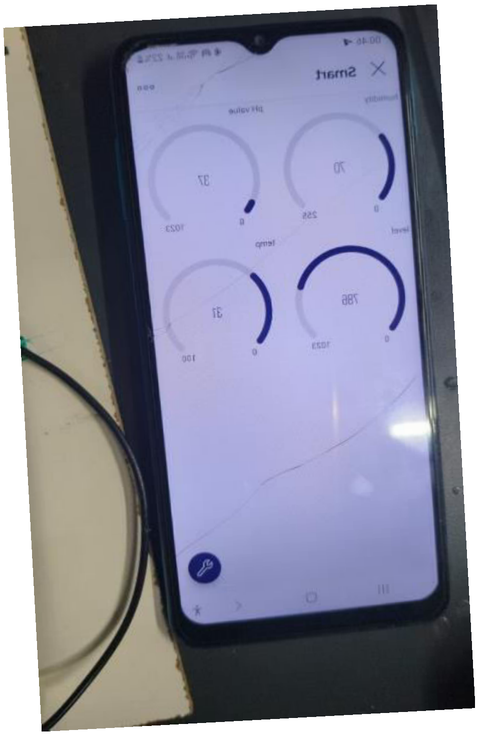
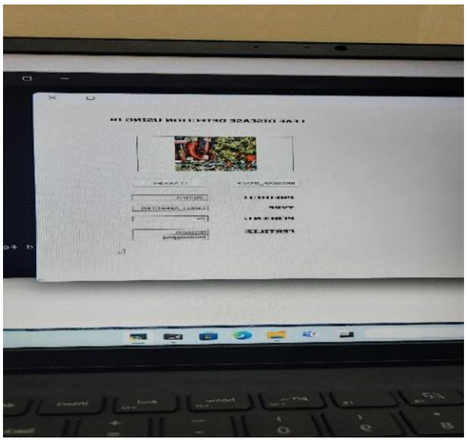
of improving pest prevention and management. At the last part water, fertilizer, and pesticide can be sprayed through the DC pump based on the data shown in the mobile application.

IV. RESULT AND DISCUSSION

Agriculture is a very significant field for increasing population over the world to meet the basic needs of food. Meanwhile, nutrition and the world economy depend on the growth of grains and vegetables. Many farmers are cultivating in remote areas of the world with the lack of accurate knowledge and disease detection, however, they rely on manual observation on grains and vegetables, as a result, they are suffering from a great loss. Digital farming practices can be an interesting solution for easily and quickly detecting plant diseases. To address such issues, this paper proposes plants leaf disease detection and preventive measures technique in the agricultural field using image processing and two well-known convolutional neural network (CNN) models.

Overall system performance: The performance of the overall system can be evaluated by testing it on a variety of leaf images and soil samples with different characteristics. The system should be able to accurately detect a range of leaf diseases and provide appropriate fertilizer recommendations based on the soil analysis. The system's performance can be improved by continuously updating and refining the dataset used for training and testing, as well as by optimizing the model architecture and algorithm parameters. In conclusion, the leaf disease detection and fertilizer recommendation system using CNN algorithm has the potential to significantly improve crop and plant health by quickly and accurately detecting diseases and recommending appropriate fertilizers. However, the system's accuracy will depend on the quality of the dataset, soil analysis, and algorithm used, and continuous refinement and optimization are necessary to ensure the best possible performance. Finally, a graphical layout is also demonstrated to provide a preventive measures technique for the detected leaf diseases and to acquire a rich awareness about plant health. A total of 12 classes have been fed to the model, out of which 12 classes are of diseased plant leaves names, Brown Spot rice disease, leaf smut rice disease, rice healthy, early blight potato, late blight potato, potato healthy, early leaf spot groundnut, tikka groundnut, groundnut healthy Septoria leaf spot tomato, target spot tomato, tomato healthy.





V. CONCLUSION

The leaf disease detection and fertilizer recommendation system using CNN algorithm is a powerful tool that can benefit farmers, gardeners, researchers, and educators alike. By accurately detecting and diagnosing leaf diseases and providing appropriate fertilizer recommendations, the system can improve crop and plant health, increase yield and quality, and prevent the spread of diseases. However, the success of the system depends on several factors, including the quality and size of the dataset used for training and testing, the accuracy of the soil analysis, and the complexity and accuracy of the machine learning algorithms used for disease detection and fertilizer recommendation. To achieve the best possible results, continuous refinement and optimization of the system are necessary, including updates to the dataset, model architecture, and algorithm parameters. With the right inputs and optimization, the system can be an invaluable tool for promoting sustainable and healthy agriculture and horticulture practices, as well as for advancing our understanding of plant health and disease prevention.

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