JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

AUTOMATING EARLY PEST DETECTION FOR SUSTAINABLE AGRICULTURE

Developing a CNN-based Model that is capable of precisely detecting pests from crop photos, automating the identification process to lessen the necessity of human inspections

[1]Keerthana,[2]Dr. Sandeep Bhat
[1]M. Tech Student,[2]Professor
[1] Computer Science and Engineering,
[1]Srinivas Institute of Technology, Valachil, Mangaluru,Karnataka, India

Abstract: Pests play a significant impact in crop destruction. Currently, Pest infestations are causing crop production to decline, which lowers the output rate. Each year, insect infections cause up to 20–40% of crops to be lost. Conventional techniques for detecting pests are manual, labor-intensive, and more likely to make mistakes. So, Early detection can minimize crop loss, Reduced use of chemical pesticides, Ensures sustainable farming practices. CNN is used to identifying patterns, objects in images and have the Ability to process complex images and detect pests accurately. Where automated identification saves time and labor Typically, well-trained Convolutional Neural Networks (CNNs) on high-quality and diverse datasets can achieve accuracy rates exceeding 90%, with some studies reporting figures as high as 95%. For instance, a model might exhibit a training accuracy of 95%, a validation accuracy of 92%, and a test accuracy of 89%.

***IndexTerms* - CNN.**

I.INTRODUCTION

Agriculture is the most significant occupation in the world, despite thethe reality that there are numerous others. In India's economy, agriculture plays a significant role. & ships its processed food products worldwide. During crop growth, it goes through many stages as well it is influenced by various factors, like natural calamities, different types of diseases, pests' attacks, weeds management etc., Pests play a significant impact in crop destruction. Currently, Crop yields are declining because of pest- infested crops, resulting in a reduction in output rate. Pest infection causes up to 20-40% crop loss annually. .Conventional techniques for detecting pests are manual, labor-intensive, and more likely to make mistakes. The agriculture sector faces a number of challenges as a result of insect infestations, which result in significant crop losses annually. Traditional methods of pest detection are time-consuming, labor-intensive, and frequently depend on inspections by hand, which might not be effective for large-scale farming. As the demand for ecologically sustainable farming is increasing, early detection of pests becomes crucial in reducing crop damage and minimizing the use of harmful pesticides. so, Early detection can minimize crop loss, Reduced use of chemical pesticides, Ensures sustainable farming practices. CNN is employed to identifying patterns, objects in images and have the Capacity to process complex images and detect pests accurately. Where automated identification saves time and labor.CNNs are a effective deep learning method for images recognition which can be applied to automate agricultural early pest detection. By incorporating CNNs into the pest management process, farmers may detect insect infestations early and accurately, allowing them to take prompt preventive action.

The main objective of this study is to develop a CNN-based model that is capable of precisely detecting pests from crop photos, automating the identification process to lessen the necessity of human inspections. It entails gathering and preprocessing a diverse dataset of pest and plant images for training the model, and integrating the system into agricultural workflows to ensure scalability and real-world applicability. Additionally, the model's performance will be assessed according to precision, accuracy, and recall, with the goal of enabling early pest detection, reducing pesticide use, and encouraging ecological farming methods.

Several essential elements make up the architecture of the Convolutional Neural Network (CNN)-based automated pest detection system. The first step is data collecting and preprocessing, which involves gathering, resizing, and annotating a range of crops and pest photos in order to instruct the model. The CNN model, which gathers information from these photos to identify pests, is the brains behind the system. PyTorch on cloud platforms like Visual Studio or TensorFlow and to train, further deep learning frameworks are utilized.and evaluate the model. The system can process real-time image elements, etc., after it is deployed.

II. Literature Review

As mentioned in the above sections, P. Badar et. al. [1] have used the CNNs for automated pest identification in agriculture. It emphasizes the importance of high-quality datasets and compares deep learning techniques with conventional pest detection techniques, highlighting the benefits of automation. Additionally, the authors explore integrating these models with Internet of Things (IoT) technologies for real-time monitoring. Despite advancements, challenges remain in model adaptability, suggesting the need for additional research to enhance pest management practices and U. Kumari et. al. [2] have used an approach of pictures processing and deep learning methods to precisely determine pests that affect crops. It highlights the effectiveness of CNNs in extracting features from pest images, enabling high accuracy in classification tasks. The authors review different methods of image processing in conjunction with deep learning to increase the resilience of pest detection systems M. Islam et. al. [3] have used the advanced deep learning methods for identifying plant diseases and pests. It is centered around coherent deep learning techniques, which enhance the robustness and accuracy of pest detection systems. The authors review several algorithms, highlighting their effectiveness in processing and analyzing agricultural images to differentiate between healthy plants and those affected by various pests and diseases. J chen et. al. [4] have used a CNNs to analyze images of fruits and detect signs of pests and diseases effectively. The authors stress that successful model training requires high-quality, annotated datasets. and discuss different deep learning designs that enhance detection accuracy. By comparing these models' performances, the study illustrates deep learning's potential. approaches to automate pest disease detection, leading to improved techniques for handling pests in agriculture.

III. Implementation And Experimental Setup

Implementing the pest Deep learning detection models require a number of phases, including data preparation, model architecture, training, and evaluation. Below is a thorough description of how to apply the model:

The below flowchart is composed of five steps:

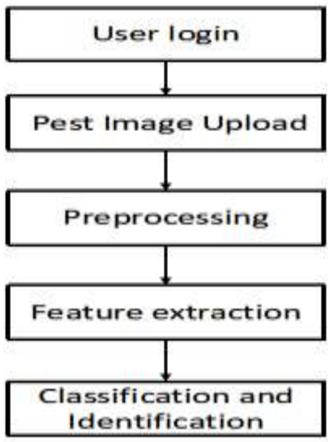

Figure 1: Flowchart of CNN classifier

The user's images will be taken first, and after pre-processing, they will be moved to a train model and sent to classification, where the outcome will indicate whether or not the pest.

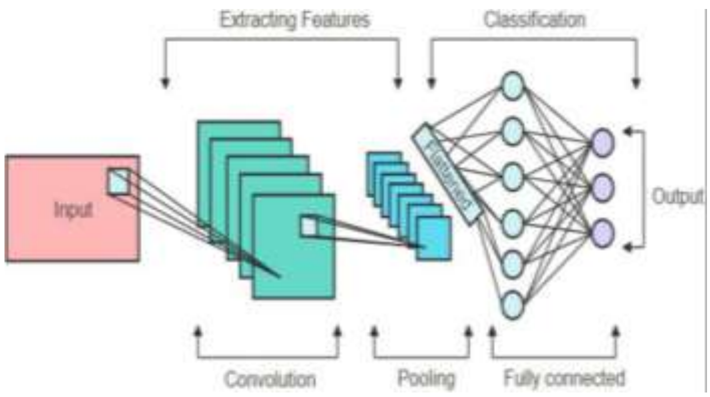

Figure 2: The CNN model

To complete tasks such as categorization or detection, a CNN automatically learns patterns and features of images. Convolutional layers, that employ filters to identify features like edges or textures, pooling layers, which minimize computation and spatial size, and completely interconnected layers, which generate final predictions, are some of its layers. CNN can precisely identify and categorize items in an image by extracting progressively more complicated information as it moves through the network, ranging from basic forms to intricate patterns.

IV. RESULTS AND DISCUSSION

The proposed The system should be tested experimentally with test data in order to guarantee that the system works as per their required specification. When the system is found working, Test it with actual data and check performance. Software testing is a critical element of software quality assurance and represents the ultimate review of specification, design and coding. Test case is a set of data that the system will process as normal input.

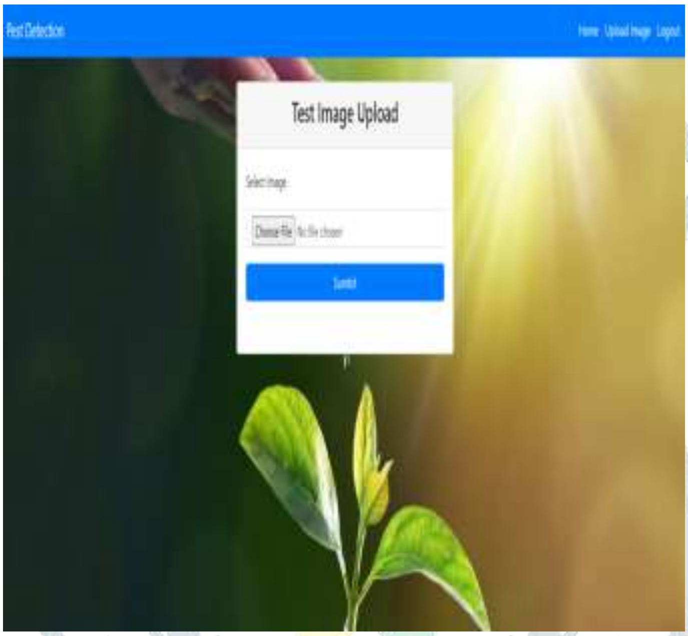

Figure 1: Page for user to Upload Image

This page allows users to select and upload an image from their device to be used or processed within the application.

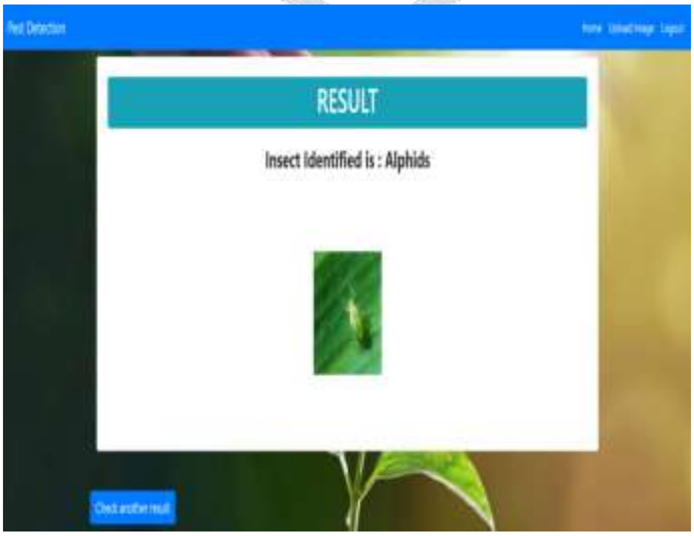

Figure 2: The final result of Pest detection through CNN

The result that the system is currently displaying is realized in figure 2. This describes the image is Alphis.

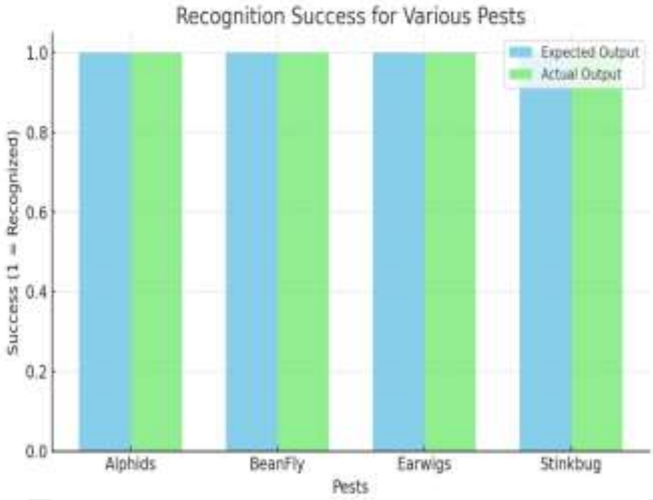

Figure 3: Recognition success for various pests

In Figure 9 it shows the recognition success for various pests using bar graph.

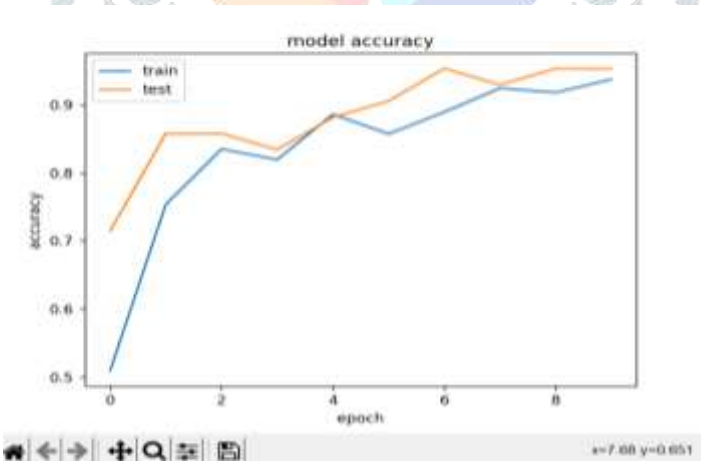

Figure 4: The CNN model accuracy results.

Ten percent of the 420 photos in the dataset are used for testing, while the remaining 90% are used as training data. The model's accuracy is 90.34%.

VI. CONCLUSION AND FUTURE WORK

The paper proposes a noteworthy development in pest management utilizing deep learning's capabilities and computer vision technologies. By providing accurate, real-time pest detection capabilities, By assisting farmers in implementing prompt interventions, the suggested method can lower crop losses. and promoting sustainable agricultural practices. CNNs and real-time monitoring technologies collaborate to improve detection efficiency and lessen the necessity of chemical insecticides, including eventually helps the environment and farmers alike.

In Future research could focus on increasing the system's capacity to identify a greater variety of pests and illnesses in different crops and environmental settings. Examining how to incorporate other technology, such mobile apps and drone observation, could improve the system's accessibility and usability for farmers. The successful application of this technology in various agricultural contexts will also depend on continued work to enhance model resilience and generalization as well as the development of larger annotated datasets. By continually refining and adapting the system, the project aims to make a lasting impact on global agricultural practices and food security.

ACKNOWLEDGMENT

I sincerely thank Dr. SandeepBhat, Professor, Department of Computer Science and Engineering, for his expert guidance, mentorship, and constant support during this research. I also extend my gratitude to the faculty of Srinivas Institute of Technology for their valuable feedback and motivation. I am deeply thankful to my family for their encouragement and patience throughout this journey. This work is built on the contributions to develop a CNN-based model that is capable of precisely detecting pests from crop photos, automating the identification process to lessen the necessity of human inspections. Finally, I appreciate the department for providing a supportive academic environment and access to essential resources for completing this study.

REFERENCES

[1] Agriculture and Food, Drones for crop health monitoring, https://www.maxinai.com/resources/drones-for-crop-healthmonitoring-taking-agriculture-to-new-heights.

[2] Perform Object Detection With YOLOv3, https://machinelearningmastery.com/how-to-perform-object_x0002_detection-with-yolov3-in-keras/

[3] F. Ren, W. Liu and G. Wu, "Feature Reuse Residual Networks for Insect Pest Recognition," in IEEE Access, vol. 7, pp. 122758-122768, 2019, doi: 10.1109/ACCESS.2019.2938194.

[4] Nutter, F.W., Jr.; Esker, P.D.; Coelho, R. Disease assessment concepts and the advancements made in improving the accuracy and precision of plant disease data. Eur. J. Plant Pathol. 2006, 115, 95–113. .

[5] Ghosh, S., et al. (2020). A deep learning approach for detecting pests in agricultural fields. Computers and Electronics in Agriculture, 178, 105721.

[6] Bashir, A., et al. (2021). Deep learning for plant pest detection: A review. Computers and Electronics in Agriculture, 182, 105935..

[7] Ferreira, F. J., & Bui, D. T. (2021). Pest detection and classification in precision agriculture using deep learning. Agronomy, 11(4), 703.

[8] Zhang, Z., et al. (2020). Crop pest detection based on deep learning: A survey. Computers and Electronics in Agriculture, 174, 105475.

[9] Zhang, S., et al. (2021). Application of deep learning in pest detection: A review. Journal of Agricultural and Food Information, 22(2), 146-156.

[10] Alzubaidi, L., et al. (2020). Review of deep learning models for plant disease detection. International Journal of Computer Applications, 975, 1-9.