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Disease and Pest detection of Crops and Agricultural community forum using image processing techniques

Group 22 literature review document by

Runisi Nikoya Samaranayake – 20221247

Damitha Udara Weerasinghe – 20210669

Seth Nimthaka Rajarathne – 20211344

Yasini Mandara Karunanayake - 20221151

Supervised by

Ms. Kalhari Walawage

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CONTENTS

INTRODUCTION

In recent years, the agricultural industry has faced a major challenge - the rising threat of diseases and pests to our crops. This menace- has grown significantly, putting food security and agricultural sustainability at risk. Our project aims to tackle this issue- by utilizing advanced image processing techniques. We envision a future- where our innovative approach re-volutionizes the detection of crop diseases and pests. Through this endeavour, we strive to safe-guard our agricultural resources and ensure- a sustainable future for everyone involved in farming.

RELEVANT WORK

DISEASE AND PESTS' DETECTION OF CROPS

There have been several researches done to identify diseases and pests of crops. With the automated leaf and pest detection. (Ngugi, Abelwahab and Abo-Zahhad, 2020) which tells about the development of efficient and accurate methods for plant disease recognition using Image Processing Technologies (IPTs) and Deep Learning Techniques.

Have used Support Vector Machines (SVM), Random Forest and Artificial Neural Networks (Domingues, Brandão and Ferreira, 2022) to automatically detect, identify, and predict pests and diseases, ultimately contributing to the goals of smart farming, precision agriculture, reduced pesticide usage, and improved crop quality and production.

Another research was conducted by (Miguel Ángel Rodríguez-García, García-Sánchez and Valencia-García, 2021) . This work presents a novel solution that combines language technology and semantic concepts to assess the likelihood of specific pests based on reported symptoms, eliminating the need for human experts. The paper then showed an accuracy of 98.8% was obtained by using a natural language processing model to automatically populate the ontology from unstructured documents, also A rule-based model to classify symptoms into crop pests and diseases and developed their own ontology model called CropPestO to represent the crop pest domain and integrate data from heterogeneous sources.

This paper (Liu and Wang, 2021) summarizes recent research in plant disease and pest detection based on deep learning, a branch of artificial intelligence that can automatically learn features from data and uses convolutional Neural networks for classifying plant diseases and pest images. The authors utilized mature network structures prevalent in computer vision. They highlight the challenges of small dataset sizes and propose solutions such as data amplification, transfer learning, and designing reasonable network structures.

This paper (Francisco et al., 2023) which aims to find studies on automating processes in detecting, identifying, and classifying diseases and pests in agricultural crops. The review found that Convolutional Neural Networks (CNN) models were the most commonly used, with 54.2% of the studies referring to them and others were used to train the datasets, classify the diseases and pests.

The paper (Tiwari and Richmond, 2019) uses Deep Neural Networks and Transfer Learning techniques for the identification of pests and diseases in tea leaves. They use deep learning framework(Resnet34) retrained on a dataset of tea leaf images and Convolutional Neural Network(CaffeNet) develop an Image Classification model which has achieved an overall accuracy of 98.4%.

The paper (Suresh et al., 2020) by employs a Convolutional Neural Network (CNN) for image classification and uses TensorFlow Lite (TFLite) for model deployment on mobile devices. The research problem in this paper is to develop an automatic and accurate plant disease detection system using image processing techniques.

The paper (Lathusha Sritharan, Manikavasagar Anjanan and Gamage, 2022) by uses image processing and deep learning techniques to detect and classify plant diseases and suggest pesticides and management methods. The authors have created an image recognition system based on multiple linear regression, and uses Convolutional Neural Networks (CNN) to extract features from plant leaf images and classify them, and an accuracy of 98% obtained detecting plant diseases.

The paper (Pest Detection using Image Processing, 2019) proposes a method to detect pests on plant leaves using image processing and machine learning techniques such as nucleus counter to classify and count the pests. The paper claims that their method can help farmers to detect the pests early and take appropriate measures to protect the crops.

The paper by (Mohammed and Yusoff, 2023) have reviewed and compared various techniques and algorithms that have been used in previous studies, such as k-means clustering, SVM, ANN, CNN, etc, and in this paper it proves that using CNN are superior to other methods in terms of accuracy and performance. The paper aims to help researchers and farmers in improving crop production and quality by using image processing techniques.

In this research paper (Miranda, Gerardo and Tanguilig III, 2014) discusses an automated pest detection and extraction system for rice fields, which uses image processing techniques to estimate pest densities. The system uses background modeling, median filtering, and coordinate scanning to detect and extract insect pests. The system aims to help crop technicians and farmers monitor and manage pest infestations, reducing human effort and errors.

The paper (Xin and Wang, 2021) The paper presents a DCNN-G model for image recognition of crop diseases and insect pests, combining DCNN and Google data analysis. The model achieves high accuracy, speed, and cost, while also addressing data imbalance and image degradation. The improved network YOLO-V4 is used for verification.

The paper (Pooja, Das and Kanchana, 2017) uses Support Vector Machines (SVM) as the classifier to identify and label the diseases based on the extracted features. the K-Means technique is used for image segmentation. The paper uses various image processing techniques such as K-Means Clustering, Otsu's method, and boundary and spot detection algorithms to refine the injected regions of the plant leaves. The proposed methodology achieves a high recognition rate of 98.67%.

In this research (Itnal et al., 2019) proposes a methodology that uses image processing techniques to detect pests on plant leaves. The authors have applied several models such as Gaussian blur to reduce noise, and using segmentation techniques to separate the pests from the background. The paper claims that the method can help farmers to identify pests early and take preventive measures to avoid crop losses.

This paper (Mohanty, Hughes and Salathé, 2016) This paper explores the use of deep learning for image-based plant disease detection, aiming to identify 14 crop species and 26 diseases from plant leaf images. The authors also test the feasibility of smartphone-assisted diagnosis in real-world scenarios.

The paper (Nagar and Sharma, 2021) The main approach is to use wavelet transformation and oriented FAST and rotated BRIEF (ORB) to extract features from leaf images and classify them as with or without pest. The models they have used are Dynamic Time Warping (DTW) for feature comparison and Support Vector Machine (SVM) for classification.

This paper (Li and Chao, 2021) The study explores the use of semi-supervised few-shot learning for improving plant disease recognition accuracy in images with limited labeled and unlabeled samples. It also discusses adaptive selection of pseudo-labeled samples and verification of the methods' correctness and generalization under various domain splits and parameters.

The paper (Ferentinos, 2018) This paper aims to develop deep learning models for plant disease detection and diagnosis using simple leaves images of healthy and diseased plants. Challenges include the complexity of plant diseases, lack of representative data for training and testing, and the feasibility of the models for practical applications like mobile devices or autonomous agricultural vehicles.

COMMUNITY FORUM

The paper(Sivakumar et al., 2023) proposes an Android application that can help farmers and transport service providers to pool their resources and optimize their logistics and tells by using AI systems it enables early detection of plant diseases and pest's infestations. They have used Natural Language Processing (NLP) for chatbot and machine learning model for virtual assistant.

This paper (Poonkuzhali Ramadoss et al., 2023) The paper proposes an AI chatbot for pest detection and guidance in smart agriculture, along with a deep learning crop disease detection model and a soil sensor-based fertilizer recommendation system. It highlights the potential of AI in meeting food demand and improving farming productivity and sustainability.

This paper (Jain et al., 2022) user-friendly and real-time mobile application that can provide accurate detection and suggestions for rice disease control.

This paper (S, S and C, 2022) design and implement a conversational AI bot for smart agriculture that can assist farmers with various information and advice related to farming and crops.

This paper (Omara et al., 2023) develop a mobile application that can diagnose crop diseases and provide real-time feedback and recommendations to smallholder farmers in sub-Saharan Africa. Uses Convolutional Neural Network (CNN) model trained on cassava leaf images to classify five types of diseases and pests.

In this paper (Lacasta et al., 2018) creates an ontology and a recommendation system for agricultural crop protection, using heterogeneous and unstructured data sources and facilitates the identification of pests and the selection of suitable treatments for different crops and regions.

The paper(V Rajeshram et al., 2023) they proposed in this paper is to develop a deep learning technique for leaf diseases prediction, pest detection and pesticides recommendation using plant leaf images. They have used Deep neural networks for pesticide recommendation and pre-processing of leaf images.

COMPARISON TABLE OF RELEVANT WORK

Research	Author	Year	Dataset	Model used	Metric
DISEASE AND PESTS' DETECTION					
Recent advances in image processing techniques for automated leaf pest and disease recognition – A review	Lawrence C. Ngugi a, Moataz Abelwahab a, Mohammed Abo-Zahhad	2021	300 potato leaves drawn from the Plant Village dataset	SVM,	Over 98.5%
Machine Learning for Detection and Prediction of Crop Diseases and Pests: A Comprehensive Survey	Tiago Domingues, Tomás Brandão and João C. Ferreira	2022	Plant Village, Plant Doc, IP102, Flavia and MalayaKew Leaf.	SVM, Random Forest, ANN	Does not specifically mention the accuracy
Plant diseases and pests' detection based on deep learning: a review	Jun Liu and Xuewei Wang*	2021	1)Northern Leaf Blight - maize dataset 2) IP102: Insect Pest Recognition Database: contains 75,000 images of 8 common tomato pests	CNN	does not report a single accuracy metric

Algorithms and Models for Automatic Detection and Classification of Diseases and Pests in Agricultural Crops: A Systematic Review	Mauro Francisco, Fernando Ribeiro, José Metrôlho and Rogério Dionísio	2023	Not mentioned	Not specified but CNN commonly used	Accuracy for tomato crops - 90.3% to 99.89% 88.96% to 98% for citrus crops, and 89% to 97% for potato crops.
Knowledge-Based System for Crop Pests and Diseases Recognition	Miguel Ángel Rodríguez-García, Francisco García-Sánchez, and Rafael Valencia-García	2021	The dataset for preliminary validation contains 212 symptoms, linked to 75 pests and diseases in three crops: almond tree, olive tree, and grape vine.	A natural language processing model and a rule-based model	98.8%
The development of methodology and techniques for crop disease identification	N. S. Tiwari, J. W. Richmond	2019	Dataset containing 500 images	Deep learning (Resnet34) and CNN(CaffeNet)	The model trained on the original data set achieved accuracy - 98.4%. modifying the original dataset – 98.3%
Plant Disease Detection using Image Processing	Mr.V Suresh, D Gopinath, M Hemavarthini, K Jayanthan, Mohana Krishnan	2020	Plant Village dataset – 54,305 images of diseased and healthy plant leaves	CNN	93%

Plant Diseases Detection Using Image Processing and Suggest Pesticides and Managements	Lathusha Sritharan; Manikavasagar Anjanan; Anjalie Gamage	2022	Used Kaggle dataset – containing more than 20,000 images	CNN	98%
Pest Detection using Image Processing	Shilpa Itnal, Mathena Akhila, Syed Sha Noorulla Khadri, Vanukuri Meher Sreemaiee	2019	Not specified	machine learning techniques such as nucleus counter	accuracy not clearly defined
Detection and classification of plant leaf diseases using image processing methods: review	Lele Mohammed, Yusliza Yusoff	2023	Not specified	Not mentioned as compared various techniques and algorithms that have been used in previous studies	All the techniques used in previous studies has achieved accuracy over 80%
Pest Detection and Extraction Using Image Processing Techniques	Johnny L. Miranda, Bobby D. Gerardo, and Bartolome T. Tanguilig III	2014	Images were collected but not specified	image processing techniques – background modelling.	Not mentioned
Image Recognition of Crop Diseases and Insect Pests Based on Deep Learning	Mingyuan Xin and Yong Wang	2021	train 640 data samples, and then using 5000 test samples for testing	DCNN-G model and YOLO-V4	95%
Identification of Plant Leaf Diseases Using Image Processing Techniques	Pooja V, Rahul Das, and Kanchana V	2017	For which a training set of 227 images and a testing set of 121 images is constructed. The training and test set	SVM	92.4%

			consists of a combination of 5 diseases and pests		
Pest Detection using Image Processing	Shilpa Itnal, Mathena Akhila, Syed Sha Noorulla Khadri, Vanukuri Meher Sreemaiee	2019	Images were acquired but dataset not mentioned	Gaussian blur	Not mentioned
Using deep learning for image-based plant disease detection	Sharada P. Mohanty, David P. Hughes, and Marcel Salathé	2016	Used 54,306 images of diseased and healthy leaf images.	CNN	99.35%
Pest Detection on Leaf using Image Processing	Harshita Nagar, R.S. Sharma	2021	Dataset of 47 images – 15 leaf images and 32 pests images	DTW, SVM	Precision score – 0.96
Semi-supervised few-shot learning approach for plant diseases recognition	Yang Li1 and Xuewei Chao	2021	Plant Village Dataset	CNN	Not mentioned average improvement by the single semi-supervised method is **2.8%**, and iterative semi-supervised method is **4.6%**.

Deep learning models for plant disease detection and diagnosis	Konstantinos P. Ferentinos	2018	87,848 images - 25 different plants having 58 unique classes including healthy leaves.	CNN architectures: AlexNet, AlexNetOWTBn, GoogLeNet, Overfeat, and VGG.	99.53%
COMMUNITY FORUM					
Farmer's Friend: Conversational AI BoT for Smart Agriculture	Venkata Reddy P S, Nandini Prasad K S, Puttamadappa C	2022	SASI IOT system, Conversational AI	NLP	96.1%
Artificial Intelligence based Agricultural Chatbot and Virtual Assistant for Delivery of Harvested Crops	Dr. S. A. Sivakumar, Dr. B. Maruthi Shankar, Ms. B. Anuradha, Mr. K. A. Karan, Mr. A. Karthik, Mr. R. Karthik, Dr. Jambi Ratna Raja Kumar7	2023	-	NLP for chatbot and Machine learning model for virtual assitant	-

E - Xpert Bot - Guidance and Pest Detection for Smart Agriculture using AI	Poonkuzhali Ramadoss, Vasanth Ananth, Navaneetha M, Oviya U	2023	-	Google dialogflow	-
Automatic Rice Disease Detection and Assistance Framework Using Deep Learning and a Chatbot	Siddhi Jain, Rahul Sahni, Tuneer Khargonkar , Himanshu Gupta, Om Prakash Verma, Tarun Kumar Sharma, Tushar Bhardwaj, Saurabh Agarwal, and Hyunsung Kim	2022	The dataset consists of 762 images	1. CNN - **VGG 16** 2. **VGG 19** 3. **MobileNet** 4. **LeNet5** 5. **ResNet 50** These are to identify the diseases.	91%
A field-based recommender system for crop disease detection using machine learning	Jonathan Omara, Estefania Talavera, Daniel Otim, Dan Turcza , Emmanuel Ofumbi and Godliver Owomugisha	2023	AgroQA dataset	(CNN) model trained on cassava leaf images to classify five types of diseases and pests.	Not mentioned
Agricultural recommendation system for crop protection	Javier Lacasta, F. Javier Lopez-Pellicer, Borja Espejo-García, Javier Nogueras-	2018	Not mentioned	OWL, Spring Batch, Apache Jena	Not mentioned

	Iso, F. Javier Zarazaga-Soria				
Leaf Diseases Prediction Pest Detection and Pesticides Recommendation using Deep Learning Techniques	Rajeshram V, Karthikeyan S, Prathab S, Rithish B	2023	Plant Village Dataset	DNN	100%

SUMMARY

Our core objective is to develop an advanced system for the accurate and timely identification of diseases and posts in agricultural crops. Central to our approach is the utilization of cutting-edge technologies, including Convolutional Neural Networks (CNNs) and computer vision, to create a powerful AI model. This model will be capable of analysing images of crops and pinpointing the presence of diseases or posts with remarkable precision. we plan to establish an agricultural community forum where farmers, researchers, and experts can collaborate and share their insights. This forum will serve as a platform for knowledge exchange, enabling farmers to access valuable information, receive timely advice, and contribute their observations to further improve our disease and posts detection system. Our overarching goal is to provide a comprehensive and accessible tool that empowers farmers to make informed decisions and safeguard their crops effectively.

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