Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 8, No. 1, August : 2023

LEAF DISEASE DETECTION

Prof.Aditi Patil Department of Computer Science & Engineering SKN Sinhgad Institute of Technology & Science, Lonavala Pune, India aapatil.sknsits@sinhgad.edu

Abstract
It is true that plants play a crucial role in providing energy and mitigating global warming, and crop diseases pose a significant threat to agricultural productivity and food security. Therefore, early detection of plant diseases is essential to prevent the spread of infections and increase crop yield. In recent years, deep learning techniques, particularly convolutional neural networks, have shown promising results in image-based disease detection.
The proposed disease detection model, which takes an image of a plant leaf as input and uses deep convolutional neural networks to detect and identify the disease, is a great initiative in this regard. The model, which is trained with a large dataset, is lightweight and can be implemented on a mobile platform to provide a user-friendly experience to farmers.
However, it is worth noting that automated disease detection models can never replace human expertise and observations entirely. Therefore, it is necessary to incorporate human inspection and expert guidance in the disease management process. Nonetheless, the proposed model can be a valuable tool for farmers and help them identify and diagnose plant diseases at an early stage, leading to better agricultural productivity and food security.

Keywords— Image Processing, Deep Convolutional Neural Network,Android Application, Infection identification

I. INTRODUCTION

The development of an android application for the detection of plant diseases is a significant step towards promoting sustainable agriculture and increasing crop productivity. The use of deep CNN and image processing techniques to train the model has made it possible to identify plant diseases accurately, even for low-end devices. With the help of this technology, farmers can quickly and easily detect and diagnose diseases in their crops and take appropriate actions to prevent further damage.
Leaf disease detection is an important area of research that involves identifying and diagnosing plant diseases through the analysis of the physical characteristics of plant leaves. With the increasing demand for sustainable agriculture and food security, the early detection and management of plant diseases have become critical to ensure crop yield and quality. Accurate and timely detection of plant diseases can help farmers to take necessary measures such as adjusting their crop management practices or applying targeted treatments to prevent further spread of the disease.

Recent advances in computer vision and machine learning techniques have paved the way for developing automated systems for the detection of plant diseases using images of plant leaves. These systems use deep learning algorithms to extract features from the images and identify patterns that are characteristic of different diseases. The use of such systems can significantly reduce the time and effort required for manual diagnosis of plant diseases and can provide more accurate results.

Overall, the development of automated systems for leaf disease detection has the potential to revolutionize agriculture by enabling more efficient and effective management of plant diseases, ultimately leading to increased crop yields and better food security.
In conclusion, the development of an android application for the detection of plant diseases is a crucial step towards sustainable agriculture and increasing crop productivity. By using deep CNN and image processing techniques, the application can accurately identify plant diseases, provide solutions to cure the disease, and help farmers save their crops and resources. This technology can be a game-changer

in the agricultural sector and can contribute significantly to the economy of the country by increasing the production rate of crops. solutions to cure the disease, and help farmers save their crops and resources. This technology can be a game-changer in the agricultural sector and can contribute significantly to the economy of the country by increasing the production rate of crops.

II. LITERATURE SURVEY

The literature survey is conducted to compare different methodologies previously proposed for identifying plant diseases using deep learning and image processing. Many studies have proposed different solutions to detect disease.

Some papers are describing to detection leaf disease using various methods suggesting the various implementation ways as follow. Visual Analysis, Image Processing and Optical Sensor are mainly implemented in three ways as the disease detection method. By using these three methods, the system can be developed to detect the disease earlier and that can overcome the challenges and disadvantages. By means of the methods comparison, disease detection by using visual analysis does not give the accurate output while in case of optical sensor, the system is not easy to implement and costly. So, image processing is the only way to build the simple, robust and accurate disease detection system [1]. While working with image processing, on the other hands, the database collection is the most challenging task. For database collection, it is necessary to collect the basic information about the crop and its diseases as the important task. Therefore, a detail study should be done on the types of disease, their symptoms on crop and the patterns of disease. By observing the patterns of disease, the system will get designed. The mainly occurring diseases on leaf are Bacterial disease, Fungal disease, Viral disease and diseases due to insects. The paper gives the detailing of these diseases [2]. An IoT-based system was presented that can automatically detect and identify plant leaf diseases. The authors used sensor devices to collect images of plants and plant leaves. Image processing, k-means clustering algorithm, and artificial neural networks are used. The invented device classifies diseases based on monitoring the temperature, humidity, and moisture of the plant with an accuracy over 90% [3]. The authors proposed a system that uses an edge detection technique to detect the diseased zones of the plant or fruit. Images of the fruit are captured first. Then, image segmentation is done using a segmentation technique. Afterward, the edges of the diseased zones are calculated in pixels. Depending on the number of pixels, the rate of contamination in the plant or fruit is provided. The control and treatment methods are provided hinged on the affected disease of the fruit [4]. Deep learning neural network algorithm was explored. Tensor flow is used to process the data to be usable for training. Through the use of deep learning and neural network algorithm and based on the F1 score, the model for detecting plant diseases is built. An application was implemented and evaluated by specialists in this area of study. The accuracy of their developed model is mentioned to be 80% [5]. Different kinds of deep learning model architectures were implemented, which are based on CNN architectures, to identify plant diseases with leaf images of healthy or diseased plants. VGG CNN architecture performed the best. It accomplished the accuracy of approximately 99% in classifying 17,548 plant leaf images [6]. The authors focused on recognizing a paddy plant disease using image processing. The system takes the paddy leaf image as an input and converts the RGB image to grayscale. Then the morphological opening operation is applied to reduce noise and finally image segmentation. After these processes, they find the infected region of the paddy leaf [7]. Image Processing is a procedure to change over an image into digital shape and play out a few operations to get an enhanced image and concentrate valuable information from it. It is most recent innovations and its applications in different parts of a business. Image Processing shapes center exploration zone inside designing and software engineering trains excessively [8]. A mobile application was developed for plant disease recognition using image processing which analyzes the color patterns of the diseased marks in plant leaves and bodies. The dataset images were captured under laboratory

conditions with the help of a digital camera. The distance matrix is employed to calculate the distance between each pair of species. Image segmentation is used to partition the image of a plant into distinct regions containing each pixel with similar attributes. Mainly, the k-means clustering algorithm is implemented to identify the diseases. The authors claimed to have achieved 90% accuracy for their model using a small training set [9].

The authors showed effective and correct plant disease detection and identification techniques through the use of image processing in MATLAB. K-
means clustering algorithm and multi Support Vector Machine (SVM) methods are used which are organized for both plant and fruit disease identification.

Image segmentation and feature extraction are used to prepare the images for training [10]. The authors presented a study on various disease identification methods that are utilized in detecting plant diseases. They also described a method for image segmentation which is used to detect and identify plant diseases. The accuracy of the presented system is described to be approximately 95%.

But,the number of sample images used in the system is only 60 for 4 different species [11]. A model is trained on images of plant leaves using the deep CNN with the goal to classify both crop species and the identity of the diseases. The proposed
model can classify very quickly which is ideal for implementing into an application. However, the accuracy gained on the images which are not from the
dataset is mentioned to be just above 31% [12]. Different procedures to segment the diseased area of the plants were explained. The authors studied various feature extraction and identification methods that are used for extracting the features of the diseased leaf, additionally identifying the plant diseases. The utilization of artificial neural network methods
for the detection of plant diseases like back- propagation algorithm and SVM are discussed [13].

III. METHODOLOGY

- System Overview

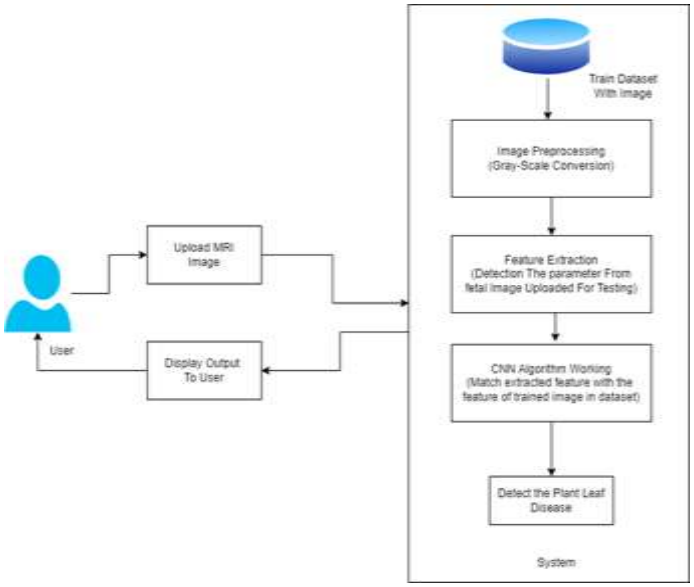
The proposed system is designed to help users identify whether their plants are healthy or diseased. The system is integrated into a mobile application . The user takes a picture of a leaf of the subject plant using their phone camera, and the captured image is then processed using a trained model. Based on the accuracy of the image, the application provides results that indicate whether the plant is healthy or diseased. If the plant is diseased, the application displays the specific disease name and suggests solutions to cure the disease.

In addition, the application also has a feature that allows the user to call the nearest agriculture department if the situation is too severe to handle alone. This feature ensures that the user can get professional help if needed. Overall, the system provides a convenient and efficient way for users to identify and manage plant diseases..

- SYSTEM DEVELOPMENT METHOD 1.Dataset Collection and Load

The dataset is created by PlantVillage and contains 54,305 images of plant leaves.
The resolution of the images is 256 x 256 pixels, and they are saved in JPEG format.
The dataset includes images of 14 different species of crops and 26 different diseases.
The dataset is split into 80% training and 20% validation, with 43,456 images for training and 10,849 images for validation.

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 8, No. 1, August : 2023



Proposed Architecture Diagram

1.Image Preprocessing- Preprocessing is applied in the first stage where a rank order fuzzy (ROF) filter is proposed that reduces the background noise from the plant picture.

- Techniques-

i. Data cleaning
ii. Dimensionality reduction
iii. Feature engineering
iv. Sampling data
v. Data transformation
vi. Imbalanching Data

Input Image

Preprocessing

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 8, No. 1, August : 2023

- APPLICATION USER INTERFACE AND FEATURES

Login Page

Weather and Location Detection Page

Home Page : The application shows the home page when first opened. There are login page user can enter email id and password for login. After login page there are three buttons-Location,Weather,Detection.

Scan Leaf: This button takes the user to the image scanning page. It is the main module of the application. There are two ways to load an image, either capturing a new image with the camera or load a previously captured image from the gallery. After that, pressing the "Detection" button shows the detected disease of the plant and also the accuracy of the detection.

Solution:After detecting the image, pressing the "Solution" button takes the user to the solution page where the disease and the treatment of the disease is described.

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 8, No. 1, August : 2023

Leaf Scanning Page

Result and Solution

IV. ALGORITHMS USED

- **CNN:**

A CNN is a particular type of network design for deep learning algorithms that is utilised for tasks like image recognition and pixel data processing. Although there are different kinds of neural networks in deep learning, CNNs are the preferred network architecture for identifying and recognising objects.
CNN Layers:-

Convolutional Layer:-The foundation of a CNN is a convolutional layer. It has a number of filters (or kernels), whose settings must be learned over the course of training. Typically, the filters' size is smaller than the original image. Each filter produces an activation map after it convolves with the image

Pooling Layer:-By merging the outputs of neuron clusters at the preceding layer into a single neuron at the subsequent layer, the pooling layers have the effect of reducing the dimensions of the hidden layer.

Fully Connected Layer:-A fully connected layer adds a bias vector after multiplying the input by a weight matrix. One or more fully connected layers come after the convolutional (and down-sampling) layers. As the name implies, every neuron in a layer that is fully linked has connections to every neuron in the layer above it.

Dropout:-Another typical characteristic of CNNs is a Dropout layer. The Dropout layer is a mask that nullifies the contribution of some neurons towards the next layer and leaves unmodified all others.

Activation Functions:-The input attribute value will be passed directly to the following layer via the input layer neuron node. The output of the higher node and the input of the lower node in a multilayer neural network are functionally related. The activation function is the name of this process.

V. CONCLUSIONAND FUTURE WORK

The development of an android-based mobile application using deep CNN for detecting and identifying plant diseases is a commendable achievement. The high accuracy of around 97% achieved by the trained model suggests that it is a reliable tool for farmers to identify and take necessary action against plant diseases. The affordability of android devices and the simplicity of the application interface make it practical for use by farmers, especially those in rural areas.

However, the limitation of decreased performance when images are captured outdoors suggests the need for a dataset of images captured in a real environment. This will improve the accuracy of the model when used in practical settings. Furthermore, the addition of new features to make the application more user-friendly and the use of images of other species of plants can expand the application's scope and usefulness.

Overall, the development of this mobile application is a step in the right direction towards reducing the impact of plant diseases on food production and increasing gross food production.

ACKNOWLEDGMENT

I am grateful to Dr .M.S.Rohokale and Prof Aditi Patil Department of Computer Science & Engineering at SKN Sinhgad Institute of Technology & Science, Lonavala, for their valuable guidance, help, cooperation, and encouragement.

I would like to extend my gratitude to SKN Sinhgad Institute of Technology & Science, Lonavala College for providing me with this opportunity to enhance my knowledge and skills in Machine Learning. I am also thankful to my parents and family members for their unwavering support, both morally and economically.

This acknowledgement would be incomplete without expressing my heartfelt thanks to everyone who has contributed directly or indirectly to this work. Any inadvertent omission is purely unintentional and does not reflect a lack of gratitude on my part.

REFERENCES

1) A. Miyatra, S. Solanki. 2014. "Disease and Nutrient Deficiency Detection in Cotton Plant," International Journal of Engineering Development and Research, vol. 2, no 2, pp. 2801- 2804

2) V. A. Gulhane, A. A. Gurjar. 2011. "Detection of disease on cotton Leaves and Its Possible Diagnosis", International Journal of Image Processing (IJIP), vol. 5 : no 5 : pp. 590-598.

3) Thorat, N., Nikam, S.: Early Disease Detection and Monitoring LargeField of Crop By Using IoT. (IJCSIS) International Journal of Computer Science and Information Security. vol. 15, pp. 236-248 (2017).
4) D M, S., Akhilesh, Kumar, S., M G, R., C, P.: Image based Plant Disease Detection in Pomegranate Plant for Bacterial Blight. 2019 International Conference on Communication and Signal Processing (ICCSP). pp. 0645-0649. IEEE, Chennai, India (2019). doi: 10.1109/iccsp.2019.869800
5) Valdoria, J., Caballeo, A., Fernandez, B., Condino, J.: iDahon: An Android Based Terrestrial Plant Disease Detection Mobile Application Through Digital Image Processing Using Deep Learning Neural Network Algorithm. 4th International Conference on Information Technology (InCIT).pp. 94-98. IEEE, Bangkok, Thailand (2019).doi: 10.1109.
6) Ferentinos, K.: Deep learning models for plant disease detection and diagnosis. Computers and Electronics in Agriculture. vol. 145, pp. 311- 318 (2018).doi: 10.1016/j.compag.2018.01.009
7) Mahalakshmi, J., Shanthakumari, G.: Automated Crop Inspection and Pest Control Using Image Processing. International Journal of Engineering Research and Development. vol. 13, pp. 25-35 (2017).
8) Prof. Sanjay B. Dhaygude and Mr.Nitin P.Kumbhar, "Agricultural plant Leaf Disease Detection Using Image Processing" International Journal of Advanced Research in Electrical,Electronics and Instrumentation Engineering Vol. 2, Issue , January 2013
9) Thakre, G., More, A., Gajakosh, K., Yewale, M., Shamkuwar, D.: A Study on Real Time Plant Disease Diagnosis System. International Journal of Advance Research, Ideas and Innovations in Technology. vol. 3, pp. 1118-1124 (2017).
10) Raut, S., Fulsunge, A.: Plant Disease Detection in Image Processing Using MATLAB. International Journal of Innovative Research in Science, Engineering and Technology. vol. 6, pp. 10373-10381 (2017).doi: 10.15680/IJIRSET.2017.0606034
11) Singh, V., Misra, A.: Detection of plant leaf diseases using image segmentation and soft computing techniques. Information Processing in Agriculture. vol. 4, pp. 41-49 (2017). doi: 10.1016/j.inpa.2016.10.005
12) Mohanty, S., Hughes, D., Salathé, M.: Using Deep Learning for Image-Based Plant Disease Detection. Frontiers in Plant Science. vol. 7, (2016). doi: 10.3389/fpls.2016.01419
13) Khirade, S., Patil, A.: Plant Disease Detection Using Image Processing. 2015 International Conference on Computing Communication Control and Automation. pp. 768-771. IEEE, Pune, India (2015). doi: 10.1109/iccubea.2015.153
14) Ramesh, Shima, Ramachandra Hebbar, M. Niveditha,
R. Pooja, N. Shashank, and P. V. Vinod. "Plant disease
detection using machine learning." In 2018 International conference on design innovations for 3Cs compute communicate control (ICDI3C), pp.41-45.
IEEE, 2018.
15) Hajgude1, Jayshree, Jayesh Kriplani, Dhiraj Chhabria,
and Anish Verliani. 2022. "Plant Leaf Disease Detection Using Machine Learning". International Research Journal Of Engineering And Technology (IRJET) 09: 3113-3117.
16) Rothe, P. R., and R. V. Kshirsagar. "Cotton leaf disease identification using pattern recognition techniques.In 2015 International conference on pervasive computing (ICPC), pp. 1-6. IEEE, 2015.
17) Liu, Jun, and Xuewei Wang. "Plant diseases and pests detection based on deep learning: a review." Plant Methods 17, no. 1 (2021): 1-18.