

Plant Disease Doctor App

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Abstract - Entire human growth is encircled and reliant on plant life but it is very troublesome to take care of them. As these plants have numerous types of diseases merged into them that are hard to recognize. Every time scientists or doctors can't travel from one place to another to examine them, for this kind of problem we have identified the use of Technology like mobile application and deep learning to examine the affected plant and to reduce the human efforts. This mobile Android application is built with the latest technology where all kinds of users can examine their plant to understand the disease embedded into them by simply capturing the image with a camera or by importing from the gallery and can get diagnosis reports with some useful management tips. The user can also get some helpful information about the plants and can contact the adviser or the pesticides retailer to clear their doubts and to proper advice about the diseased plant.

Key Words: Leaf Detection, Mobile Application, CNN, Firebase, Authentication.

1. INTRODUCTION

Agroforestry is an occupation where the practice of growing trees and crop farming on an equivalent area of land. It is a very important and crucial occupation in human life. But sometimes due to insects, pesticides, global climate change, or another factor of the environment, it can affect the plant and may cause economic and social loss. But many a time farmers are not able to understand the problem in the plant with their naked eyes. So, plant diagnosis is challenging work in the agroforestry field. To overcome this problem the farmer still uses the traditional techniques which are not so useful and do not give proper results.

This application can not only be used in agroforestry but also in our day-to-day life as we have plants in our house and surrounding nature. To get a more accurate and better result, we are using technology like deep learning i.e., Convolutional Neural Network with Mobile android development for detecting the disease from plant's leaf and to recommend the management remedies for the particular plant disease.

1.1 Proposed approach

Plant disease is one kind of natural disaster that can influence our economic progress as our complete human existence is dependent on it so we have to conserve and take care of them from all the natural and manmade calamities. To search out the problem from the affected plant leaf we have proposed and developed a mobile Android application with TFLite, Deep Learning, and Firebase; in which deep learning algorithm like convolution neural network is there to train the model with numerous types of plant with their different type of disease. We have gathered 15 different types of plants where 5 different types of diseases of each plant are there to train the model with TFLite. We have developed an Android application so that users can use the system anywhere and anytime. A one-time login process is there to keep track of all the users.

1.2 Motivation

As per the information, the traditional tools and technology are not very beneficial because it is time-consuming and take plenty of human effort. The plan behind our project is to develop an Android application with a simple GUI so that users with less experience can easily discover the disease from the leaf and can get advice for managing the disease.

2. LITERATURE SURVEY

According to [1], 10 - 95% of the productivity of agriculture is been affected by the disease in the plant. So, to increase the productivity problem the disease should be properly detected and be treated. For the detection of the purpose, they have adopted the machine learning algorithm and compared them to get the highest accuracy. They compared algorithms like Association rule, Support Vector Machine, Clustering, K-Nearest Neighbor, Genetic algorithm. From this algorithm, they get the result that the SVM algorithm gives more accurate and better classification prediction results for the detection. They also describe all the benefits and drawbacks of the algorithm.

Tahmina Tashrif Mim, Helal Sheikh, Roksana Akter Shampa, Shamim Reza, and Sanzidul Islam in 2019, [2] has mainly focused on particularly the single plant which is the tomato plant. For classification purposes, the CNN algorithm

of deep learning is used. The system is built with one single plant which includes 5 different types of disease with healthy plant disease like Bacterial spot, Septoria leaf, Yellow curve, Tomato mosaic, and Late blight are taken. For classification image processing and CNN algorithm gave the highest accuracy that the other system, the implemented system gives the accuracy of approx. 89%.

Shima Ramesh, Ramachandra Hebbar, Niveditha M, Pooja R, Prasad Bhat N, Shashank N, and P. V. Vinod. in 2018, [3] focused particularly on the Papaya leaf for the proposed system. The algorithms of the machine learning were compared. The algorithms like Logistic regression, Support Vector Machine, K-Nearest Neighbor, CART, Random Forest were compared. From this algorithm, Random Forest gave the highest accuracy of classification which is approx. 70%, the model is built from the random forest algorithm with the training data set of 160 images. The paper also states that the accuracy of the system can be increased by using a feature like Scale-Invariant Feather Transform, Speed Of Robust Feature, and DENSE with a Bag Of Visual Word.

Shuangjie Huang, Guoxiong Zhou, Mingfang He, Aibin Chen, Wenzhuo Zhang, And Yahui Hu in [4], aimed at the background interface and the noise problem with image processing on the peach disease plants. This paper states the detection method for the peach disease with the Asymptotic Non-Local Means Image algorithm and fused with the Parallel Convolution Neural Network. The ANLM method is to reduce the interference of background from the images. The model of the system is built by using 25513 images and has an accuracy of approx. 86% with a particular disease leaf.

Peng Jiang, Yuehan Chen, Bin Liu, Dongjian He, and Chunquan Liang in [5], focused on real-time detection of the images of the diseased plant. Disease like Alternaria Leaf, Mosaic, Brown Spot, Grey Spot, and Rust of the Apple plant has been implemented in the proposed solution. The paper is based on real-time detection using the CNN algorithm with Googlenet Inception and Rainbow concentration. The model of the system is composed of a dataset of 26,377 images of the apple plant which gave an accuracy of approx. 78%.

Chunnu Khawas, Pritam Shah in [6], stated the importance of Android mobile development with firebase over the website. The Android application is the fastest as compared to the RDBMS. The paper also gave the important idea of the Android development with features like Firebase Analytics, Notification, Crash Reporting, etc. They also compare the firebase with SQL and MS SQL and display how firebase is preferable to a website.

3. COMPARISON ANALYSIS

For the comparison analysis, we have compared different machine learning algorithms like SVM, Logistic Regression, KNN, Decision Tree, CNN. The overall result of classification gave the accuracy of 78% using logistic regression, 73% for SVM, 93% for CNN, 83% for KNN. From the comparison, we get to know that CNN is preferable as it gives better classification and higher prediction results for the detection of leaf diseases.

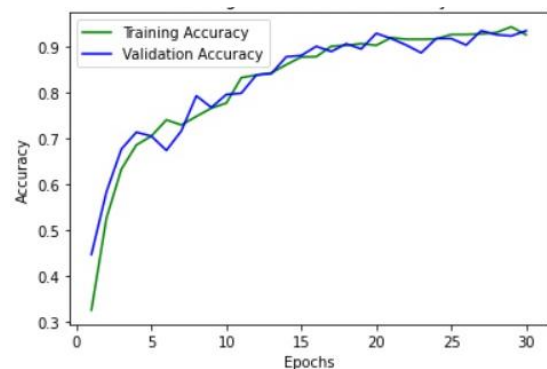


Chart 3.1: Accuracy of CNN Algorithm

4. ARCHITECTURE

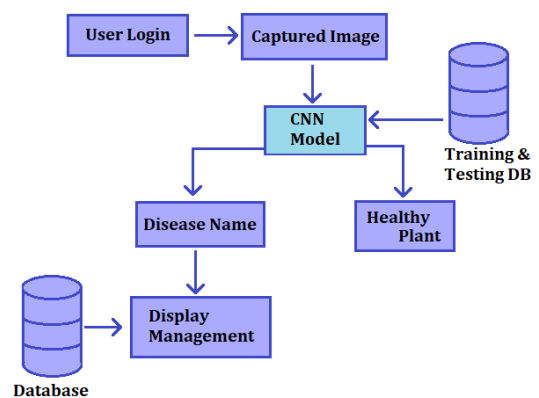


Chart 4.1: System Architecture

Above is the architecture of the system that represents overall the working of the system. Firstly, users can simply log in through their phone number then the user can capture the diseased leaf or can select the leaf image from the gallery. Once the image is selected, the CNN model built with the dataset compares the image with the dataset and displays the result. The predicted disease result is then searched into the database for fetching the symptoms and management of the disease's leaves and then the fetched information is displayed with both the images of leaves i.e., the captured image and compared image.

5. METHODOLOGY

This system is developed by using the Deep Learning algorithm i.e., CNN. The Convolutional Neural networks have been used to create and train the system model with the different types of plant leaf datasets as input. The system is built in the android studio using Java and Kotlin language, for the remedy management we created a backend using PHP Language, for user login authentication firebase is used.

5.1 Convolutional Neural Network

For image processing Convolution Neural network is the most effective and reliable algorithm. For automatic processing of the image, CNN is the most reliable algorithm. All the images are a combination of RGB (Red, Green Blue). Images are difficult for the computer to read as computers only understand the numbers, so the CNN algorithm makes the images simpler and easier so that computer can be processed and understood. All the colored images are stored in 3-dimensional arrays where the first two dimensions pertain to the height and width of the image and the last dimension corresponds to the red, green, and blue colors present in each smallest element of an image. Convolutional Neural Network consists of mainly 3 layers i.e., first Convolutional layer, then pooling layer, and then fully connected layer.

Convolutional Layer: In a usual interconnected system where each input neural is related to the next hidden layer. In CNN, only a small domain of the input layer neural combines with the other hidden layer.

Pooling Layer: This layer is used to decrease the dimensionality of the feature map. There will be various activation and pooling layers inside the hidden layer of the CNN.

Fully-Connected layer: This layer forms the last few layers in the network. The input to the fully connected layer is the output from the last Pooling layer or from the Convolutional layer.

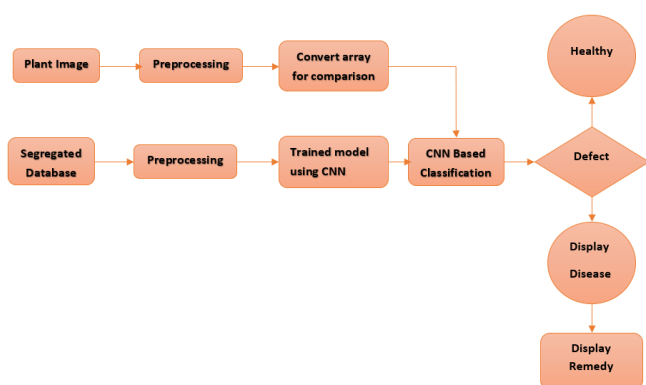


Fig 5.1: CNN Model Block Diagram

5.2 Login and Authentication in Firebase

The best way to focus on users and their activities is through Firebase Authentication. Firebase is deliberate as a web application platform. It helps developers build excellent apps. It stores the information in JavaScript Object Notation (JSON) format that doesn't use a query for inserting, amending, deleting data to it. It is the backend of a system i.e., used as a database for storing data. To authenticate our users, all we need is to take the verification credentials from the consumer and then pass these references/ credentials to the Firebase Authentication SDK. These references can be email-password or mobile number or any token from identity providers like Facebook, Google, Twitter, GitHub, etc. The choice is given to the user about how to present login to the user. The user can build the interface or can take advantage of open-source UI, which is fully customizable. No matter which one to use, once a user authenticates information about the user is returned to the device via callback. This allows personalizing the application user experience for those specific users. Firebase will also manage the user session so that users will remain logged in after the browser or application restart.

6. IMPLEMENTATION

Plant disease doctor application is an end-to-end mobile Android application where an algorithm-like neural network is used. The convolutional neural network model is created that is accurate and lightweight. A lightweight model means the exported model is low in size which is favorable for building a mobile application. We used the plant village dataset and trained and tested more than 20000 plant leaf images. This algorithm is the simplest choice in automatic image processing. The application also consists of a backend section created with PHP Technology for the management of blogs and remedies. Firebase is a Google mobile platform that helps in developing high-quality applications. This firebase is used for login purposes. With firebase OTP authentication the user can authenticate themselves and enters into the home screen of the application when OTP is verified, else the users will get verification failed error message. We have also used retrofit, i.e., a Rest client for Java and Android with the help of this we established a client-server connection via HTTP protocol such as to get and post which sends a request to a webserver, and return a response.

7. SYSTEM DESIGN

The system design comprises the UML Diagram and Sequence Diagram.

7.1 UML Diagram

The UML i.e., Unified Modelling Language is a use case diagram that summarizes the analyses of our system's consumer and their communication with the system. To build one, we have used a set of specific characters and connectors. An effective use case diagram has helped our team to explain and represent our plan.



Fig 7.1.1: UML Diagram

7.2 Sequence Diagram

A sequence diagram shows object relation ordered in a time sequence. It presents the communication between the objects by passing messages from one object to another in respect of time in a system.

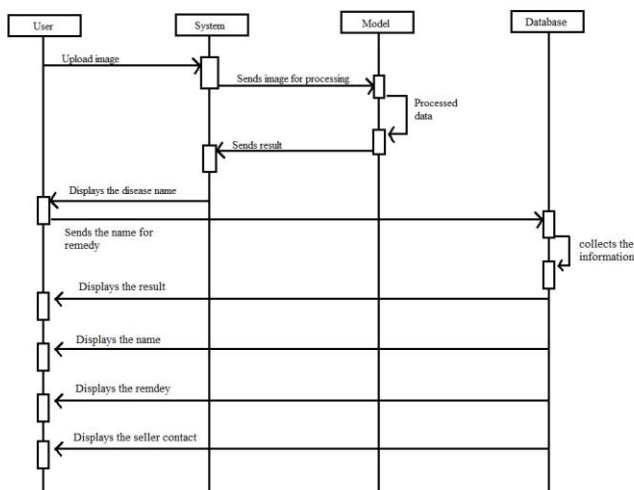


Fig 7.2.1: User Sequence Diagram

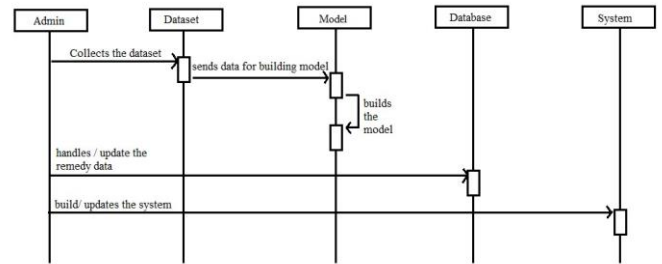


Fig 7.2.2: Admin Sequence Diagram

8. ADVANTAGE

1. Easy to detect disease

Nowadays every one of us has a smartphone, by installing the application into the mobile phone any user can quickly scan the image with their phone and get the disease prediction.

2. Less time and inexpensive to get diagnosis result

With the help of the latest technology like deep learning, the CNN model is built. The result of the diagnosis will be predicted within a minute at free of cost as installing and using the application is free.

3. Recommendation of pesticides

With the PHP language, the backend is created for recommendation purposes. The user can get the remedy tips and pesticides recommendation for disease.

4. Provide seller and consultant

As the system is not only for scanning and the result purpose. The user can also get access to call and to contact the pesticides seller or with the consultant to get their problems solved

5. Provide the blogging system

The blogs are very useful. As nowadays is useful to spread awareness of many useful things. Through the blogs, the user can get to know the various latest information and more useful tips regarding the plans many more.

9. FUTURE SCOPE

- To increase the number of images, present in the predefined database and to modify the architecture by the dataset for achieving the best accuracy.
- More enhanced recommendations of pesticides and diagnoses.
- Integrating drones for capturing images from large fields.

- Adding an e-commerce site for ordering pesticides.
- Integration of a chatbot for more advice and integration with users.

10. RESULT

CNN with the mobile application can permit the user to get the prediction of disease that emerged into the plant at an early stage. Also, it recommends useful tips and remedies for managing the affected plant. The user can also get chat access and call the seller or consultant to ask for any kind of doubts. The application also has a blogging system where the user can get to know the latest news and tips about the plants for better economic growth. Following are some images of the system.

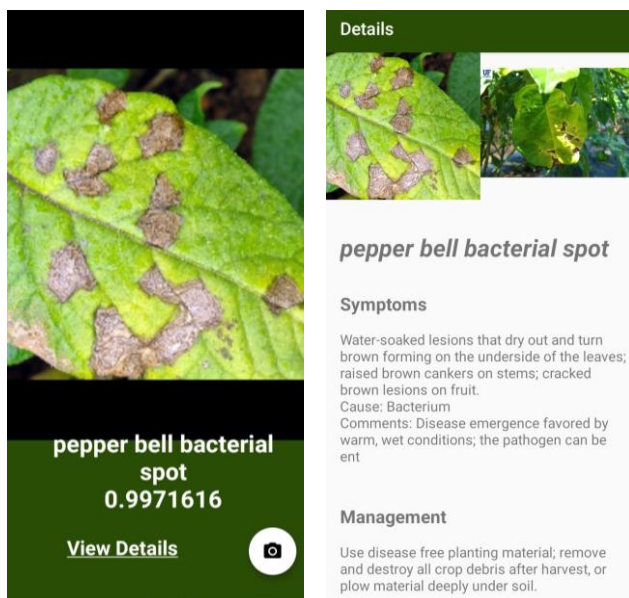


Fig 10.1: Implemented system

11. CONCLUSION

An android application for detecting plant disease and for providing remedy recommendations for a particular disease has been implemented with technologies like deep learning, android application, and firebase. The proposed system is implemented on 15 types of plants like apple, pepper bell, corn, blueberry, etc. This system can recognize the disease at an early stage and can provide helping tips for it. A future enhancement of the project is to develop hardware technology for automatic detection with less human effort.

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