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Plant Leaf Disease Detection Fertilizer Suggestion Using CNN

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Abstract

Every country's primary need is Agricultural products. If plants are infected by diseases, this impacts the country's agricultural production and its economic resources. In agriculture for an efficient crop yield early detection of diseases is important. Automatic methods for classification of plant diseases also help taking action after detecting the symptoms of leaf diseases. In the agricultural sector, identification of plant diseases is extremely crucial as they hamper robustness and health of the plant which play a vital role in agricultural productivity. These problems are common in plants, if proper prevention methods are not taken it might seriously affect the cultivation. The current method of detecting disease is done by an expert's opinion and physical analysis, which is time-consuming and costly in the real world. We are introducing the artificial intelligence based automatic plant leaf disease detection and classification for quick and easy detection of disease and then classifying it. This main aim of ours system is towards increasing the productivity of crops in agriculture. In this approach we have follow several steps i.e. image collection, image preprocessing, extraction of feature and classification.

Keywords: - Convolutional Neural Network (CNN) ,Fertilizer ,Leaf Diseases , Agriculture.

Introduction

Agriculture plays a very important role in the economic growth of any Country. It is the field which highly affect the GDP of the countries. Agriculture sector contributes around 16% of GDP of India. There are various factors that affects the quality and quantity of crops cultivated. Due to different weather and local conditions these plants are exposed to various diseases. And if these diseases remain undetected may cause some serious losses. In India itself around 15-25 percent of crops are lost due to diseases, pest, and weeds. Also, we can take reference of the incident of Georgia (USA) in 2007 in which there was loss of around 540 USD due to plant diseases. With the advancement of new advances, the field of agriculture becomes more prominent as it not only used as food feeding to major population but also used in many applications. Plants are very essential in our life as they provide source of energy and overcome the issue of global warming. Plants nowadays are affected by many diseases such as they cause devastating economic, social and ecological losses and many more. Hence, it is most important to identify plants disease in an accurate and timely way. Plant diseases can be extensively grouped by the idea of their essential causal operator, either irresistible or non-infectious. Digital image processing tools are employed by the used method to obtain the desired output. It is not possible for a human eye to identify the disease extent accurately, as the resultants are subjective in nature. The observations done by the naked eye are usually used to decide diseases severity in the area of production. The significant development has done by the image processing in the field of agriculture. For the identification of the fungi disease, several neural network techniques have been utilized such as Back Propagation, Principal Component Analysis (PCA).To detect plant leaf disease by improving required rate in classification technique. Till now linear SVM is used which is a multiclass classification that only classify the data into two classes which is very inefficient and reduce accuracy of classification. The main objective that were focused in this system is to study different types of diseases which are found in plant leaf and also to study and analyze different techniques for plant leaf disease detection using image processing technique and main goal was to propose improvement in existing classification techniques for plant leaf disease detection using machine learning.

Literature Survey

Marwan Adnan Jasim et. al[1],In system, they used the convolutional neural network (CNN), through which plant leaf diseases are classified, 15 classes were classified, including 12 classes for diseases of different plants that were detected, such as bacteria, fungi, etc., and 3 classes for healthy leaves. As a result, they obtained excellent accuracy in training and testing, they have got an accuracy of (98.29percent) for training, and (98.029%) for testing for all data set that were used.

Poojan Panchal et al[2], An overview of image segmentation using K-means clustering and HSV dependent classification for recognizing infected part of the leaf and feature extraction using GLCM. The efficiency of the proposed methodology is able to detect and classify the plant diseases successfully with an accuracy of 98% when processed by Random Forest classifier.

Jiten Khurana and Anurag Sharma[3], Proposed an integrated deep learning framework where a pre-trained VGG-19 model is used for feature extraction and stacking ensemble model is used to detect and classify leaf diseases from images so as to reduce production and economic losses in agriculture sector. A dataset consisting of two classes (Infected and Healthy) and a total of 3242 images was used to test the system. Their proposed work has been compared with other contemporary algorithms (kNN, SVM, RF and Tree). Adem Tuncer et. al[4] Proposed a new deep learning method using CNN for automatic feature extraction and classification. Color information is actively used for plant leaf disease researches. In model, the filters are applied to three channels based on RGB components. The LVQ has been fed with the output feature vector of convolution part for training the network

Gaurav Langar et al[5] The main motive in their system was to reduce the use of pesticides and thus yield a good crop and increase the production rate. Plant disease can be detected using image processing. Disease detection follows some steps like pre-processing of the image, feature extraction, classification, and prediction of classified disease. Thus creating a recognition system can help in evaluating high precision image of the plant for proper cure and further prevention

System Architecture

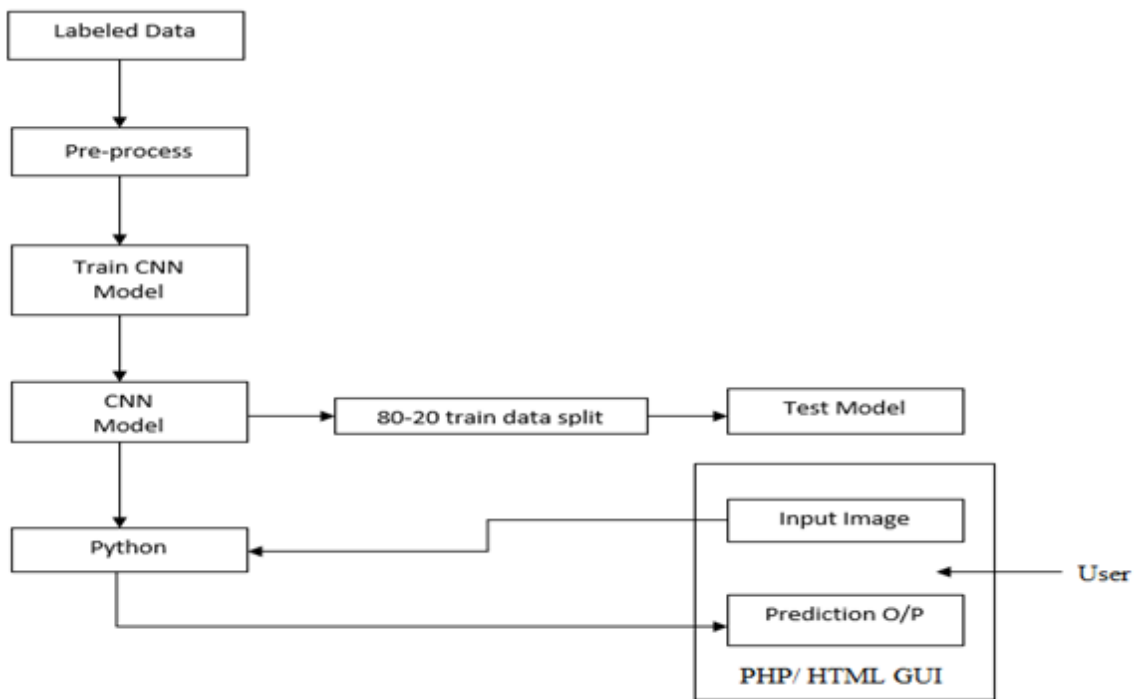


Figure 1: System Architecture Diagram

Plants are susceptible to several disorders and attacks caused by diseases. There are several reasons that can be characterizable to the effects on the plants, disorders due to the environmental conditions, such as temperature, humidity, nutritional excess or losses, light and the most common diseases that include bacterial, virus, and fungal diseases.

Those diseases along with the plants may shows different physical characteristics on the leaves, such as a changes in shapes, colors etc. Due to similar patterns, those above changes are difficult to be distinguished, which makes their recognition a challenge, and an earlier detection and treatment can avoid several losses in the whole plant. The proposed system starts with Data collection of leaves through some steps and then finally detect the diseases

from image. The steps involved are as follows:- Data Collection, Image Pre-processing, Feature Extraction, Classification.

Sequence Diagram

A sequence diagram is a type of interaction diagram because it describes how and in what order—a group of objects works together. These diagrams are used by software developers and business professionals to understand requirements for a new system or to document an existing process.

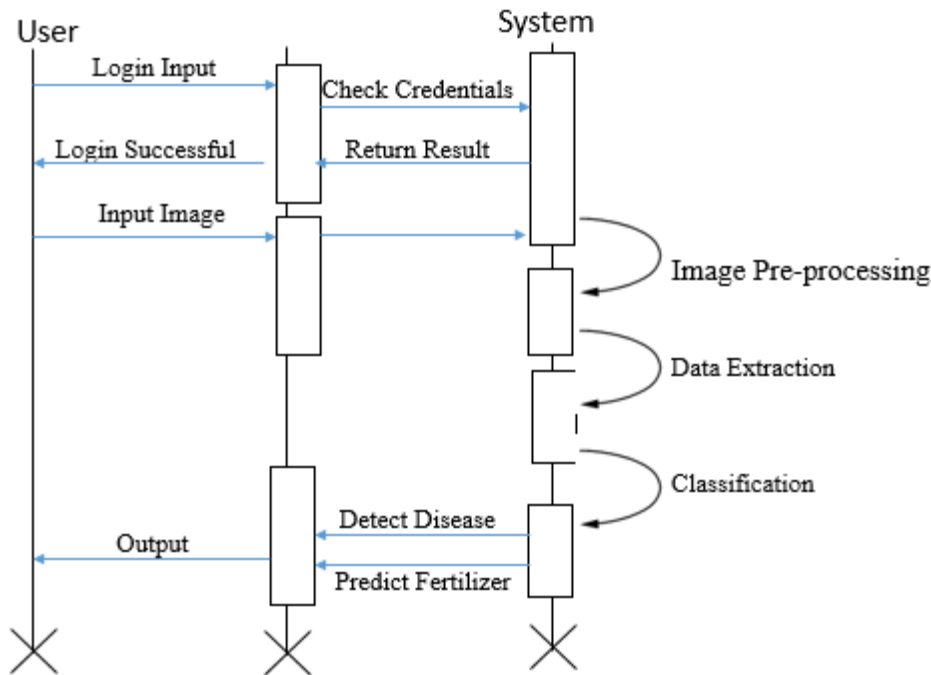


Figure 2: Sequence Diagram

Mathematical Model

A] Set Theory

Let S be as system which allow users to detect the disease occurred to the leaf and to predict the fertilizer for it.

$$S = \{ In, P, Op, \}$$

Identify Input In as

$$In = \{ Q \}$$

Where,

Q = Input Leaf Image

Identify Process P as

$$P = CB, C, PR$$

Where,

CB = Perform pre-processing on the input

C = Extractions of features and storing extracted features for further comparison

PR = Classification using Convolutional Neural Network

Identify Output Op as

$$Op = \{ UB \}$$

Where,

UB = Output

Failures: Huge database can lead to more time consumption to get the information.

Hardware failure, Software failure.

Success: Search the required information from available in Datasets. User gets result very fast according to their needs.

Space Complexity: The space complexity depends on Presentation and visualization of discovered patterns. More the storage of data more is the space complexity.

Time Complexity: Check No. of patterns available in the datasets= n If $(n.1)$ then retrieving of information can be time consuming. So the time complexity of this algorithm

Software Testing

Test Plans

A system should always be tested thoroughly before implementing it, as regards its individual programs. This is because implementing a new system is a major job which a lot of man hours and a lot of other resources, so an error not detected before implementation may cost a lot. Effective testing early in the process translates directly into long term cost saving from reduced number of errors. This is also necessary because in some cases, a small error is not detected and corrected before installation, which may explode into much larger problem. Programming and testing is followed by the stage of installing the new computer based system. Actual implementation of the system can begin at this point using either a parallel or a direct changeover plan, or some blend of two. Testing and implementation of fire fighting robot controlled using android application is carried out as below. Software testing is a critical element of Software Quality Assurance (SQA) and represents the ultimate review of specification, design and coding. The purpose of product testing is to verify and validate the various work products viz. units, integrate unit, final product to ensure that they meet their respective requirements.

Testing Procedure

Software Testing is the critical element of the Software Quality Assurance and represents the ultimate review of specification, design and coding. Testing is the process of checking whether software works according to the specification. Testing will be performed by running the program using the test data. Testing is vital to the success of the system. It will also test whether the system identifies the problem correctly.

System is tested by following steps:

- Unit Testing: Each program is tested individually using dummy records to see whether that program produce satisfactory reports.
- Sequential Testing: The program, whose output will affect the processing done by another program, will be tested using dummy records. Testing: The system is corrected in such a way that it does not affect the forced system failure. This testing is done with low volumes of data

Test Strategy

The test strategy consists of a series of different tests that will fully exercise the system. The primary purpose of the test is to uncover the system limitations. Following are the several tests that will be conducted:

Unit Testing:

Testing conducted to verify the implementation of the design for one software element (e.g., unit, module) is called unit testing. The purpose of unit testing is to ensure that the program logic is complete and correct and ensuring that the component works as designed. In this module, each unit will go through Unit testing after the completion of the module. The bugs in module testing will be reported in Test Log document and will be reported to the developers. After fixing the bug successfully, one more iteration of module testing (Regression Testing) is done. This process is repeated till all critical test cases pass.

Integration Testing:

Testing conducted in which software elements, hardware elements, or both are combined and tested until the entire system has been integrated. The purpose of integration testing is to ensure that design objectives are met and ensures that the software, as a complete entity, complies with operational requirements. This type of testing will be done after all module test cases are passed through module testing, security testing, performance testing, user interface testing and regression testing

Performance Testing:

In developing the system, we are going to use Java which will reduce the response time. In Performance Testing, We are going to test Response time for each Screen. It is a type of non-functional testing. Performance testing is testing that is performed; to determine how fast some aspect of a system performs under a particular workload. It can serve different purposes like it can demonstrate that the system meets performance criteria. It can compare two systems to find which performs better. Or it can measure what part of the system or workload causes the system to perform badly. This process can involve quantitative tests done in a lab, such as measuring the response time or the number of MIPS (millions of instructions per second) at which a system functions.

Regression Testing:

Testing done to ensure that, the changes to the application have not adversely affected previously tested functionality. Here testing will take care of the test cases passed during Test Cases The listed tests were conducted in the software at the various developments stages. Unit testing was conducted. The errors were debugged and regression testing was performed. The integration testing will be performed once the system is integrated with other related systems like Inventory, Budget etc. Once the design stage was over the Black Box and White Box Testing was performed on the entire application. The results were analysed and the appropriate alterations were made. The test results proved to be positive and henceforth the application is feasible and test approved.

Results

Screen shots

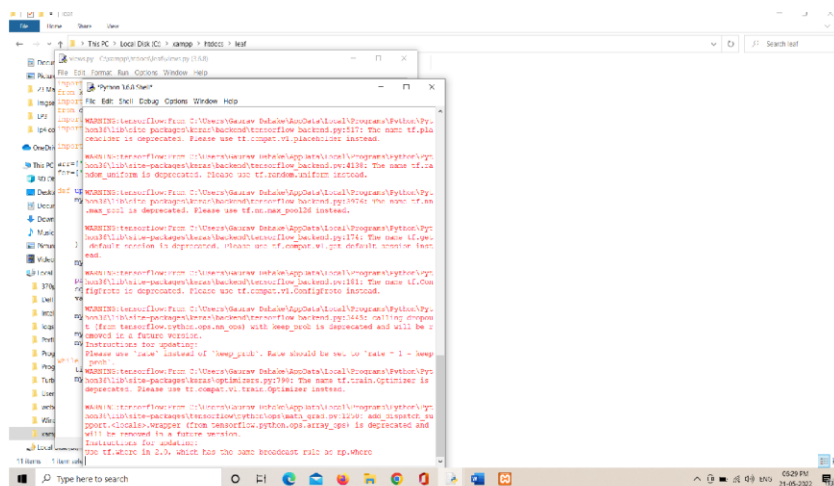


Figure 3: Code Implementation



Figure 4: Homepage

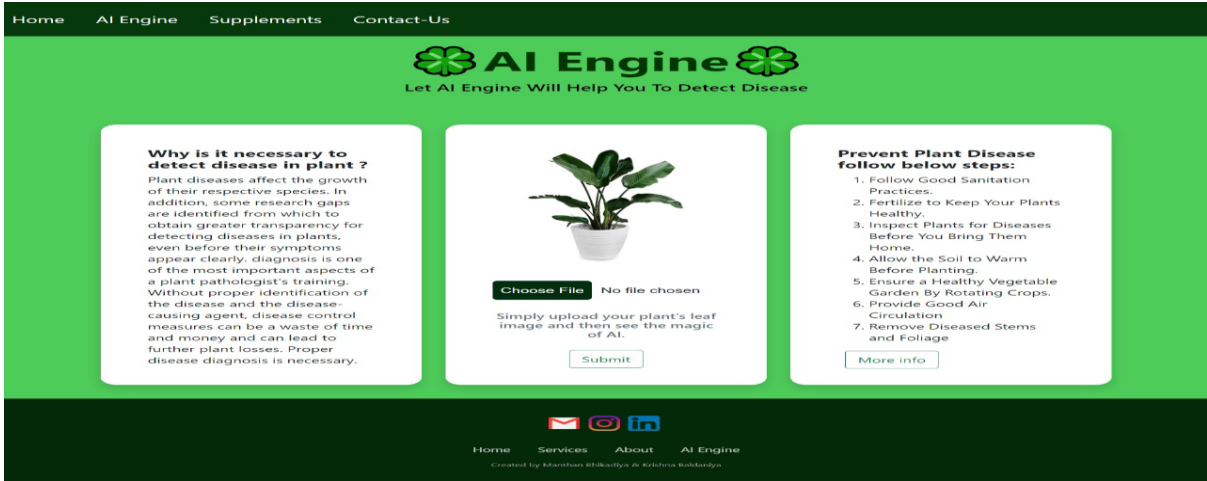


Figure 5: AI Engine



Figure 6: Disease Prediction and Information

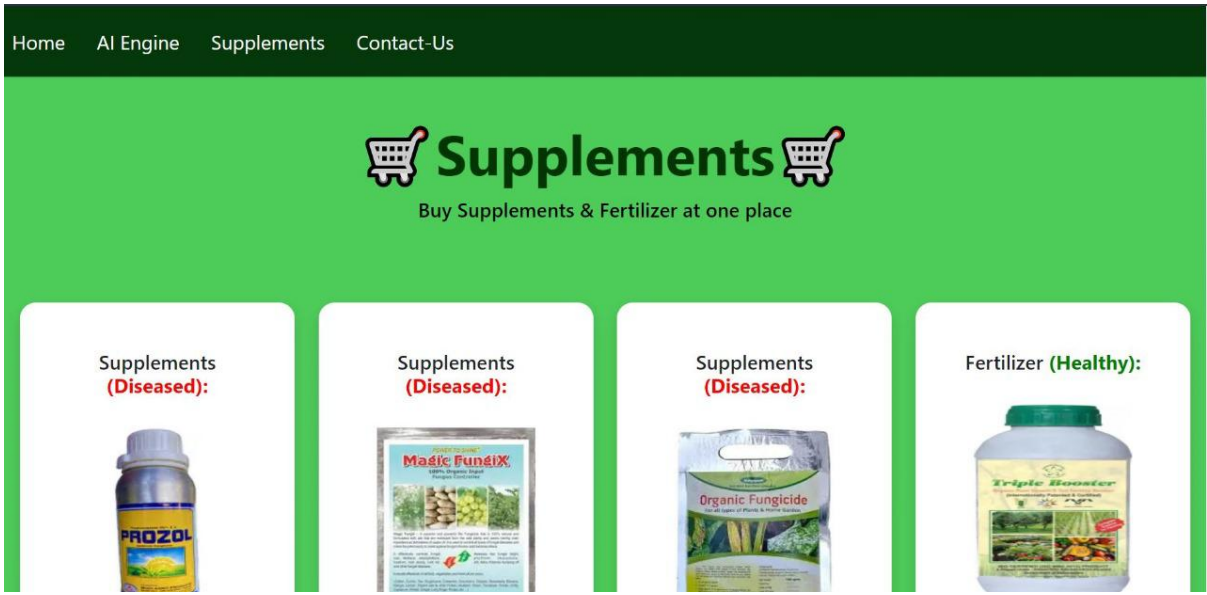


Figure 7: Supplements

Conclusion

In the proposed framework the detection of typical and faulty Leaf Diseases based utilizing CNN technique is proposed. This strategy can likewise be applied to distinguish nature of leafs with more exactness. The processing of image is done, features such as color, size, and glare are extracted and processed for detection of various diseases of leaf. The system is also build for prediction on fertilizer on diseased leaf. Thus proposed framework can helps in accelerate the speed, improve exactness and accuracy as compared to existing systems.

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