Research Article

Characterization Of Plant Disease Prediction Using Convolutional Neural Network

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Abstract: Agriculture is one of the main factor that decides the growth of any country. In India itself around 65% of the population is based on agriculture. Due to various seasonal conditions the crops get infected by various kind of diseases. These diseases firstly affect the leaves of the plant and later infected the whole plant which in turn affect the quality and quantity of crop cultivated. As there are large number of plants in the farm, it becomes very difficult for the human eye to detect and classify the disease of each plant in the field. And it is very important to diagnose each plant because these diseases may spread. Hence in this paper 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 and performing required remedies to cure that disease. This approach of ours goals towards increasing the productivity of crops in agriculture. In this approach we have follow several steps i.e. image collection, image preprocessing, segmentation and classification.

1. 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, 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. As the cultivational fields are quite large and have very large number of plants in that, hence it becomes very difficult for the human eye to properly detect and classify each and every plant. And doing so is very important as even single infected plant can spread the disease. Also, most of the farmers does not have proper knowledge of those diseases and actual cure for that disease. Hiring experts may cost them heavily and use of pesticides without knowledge will harm the land. Hence in order to solve this problem we have developed the Artificial Intelligence based solution. and speed are the two main factors that will decide the success of the automatic plant leaf disease detection and classification model. The suggested model will help the farmers to correctly detect and classify the disease by scanning the leaf and alert the farmers about the disease before it starts spreading. The model is mainly divided into four steps or phases. In first one, we collect the dataset of different plant leaves infected as well as healthy. These all images will be color images. In second step, noise from the images is removed then we will create color transformation structure for the images. In third step we segment the images using clustering techniques available. This step is performed to easily extract the foreground that is leaf. Now the image set of leaves with black background is obtained. In final step, different machine learning and deep learning algorithms like logistic regression, KNN, SVM and CNN are trained and compared on the basis of accuracy and the algorithm that performs best in training as well as testing is taken in account.

2. Literature Survey

were used as input to CNN model and the output was feed into neural network known as LVQ (Learning Vector Quantization). Average accuracy of around 88 percent was achieved. Their proposed model was only for tomato related diseases Paper by Saradhambal.G, Dhivya.R, Latha.S, R. Rajesh give solution to the plant disease with image classification. In theirapproach they collect 75 images of different diseased plant leaves such as Bacterial Blight and more. There were total of 5 classes that include 4 disease classes and one normal healthy leaf class. Removal of noise is done with some image preprocessing and then conversion into lab color model was done. They segmented the image with clustering and Otsu's method. After that some feature extraction is done on the basis of which class is determined. They have not discussed the accuracy that they have achieved as well as dataset

was small [1].

Another paper named "Plant Leaf Disease Detection and Classification Based on CNN with LVQ Algorithm" clarifies that they have used CNN model for the leaf disease m classification. In their methodology they have used a dataset of 500 images divided into 400 training and remaining 100 testing. Total classes for classification were 5 including one healthy class as well. Images size used was quite well that is 512*512. Three matrixes for R, G, Bchannels [2].

"Plant Disease Classification Using Image Segmentation and SVM Techniques" by K. Elangovan, S. Nalini uses the svmmfor the classification purpose. In their methodology image was converted into another color space. After that image was cropped and with image preprocessing techniques noise was removed and smoothening was done and converted into greyscale images. Segmentation was also performed and then features were extracted. They considered color, morphology and texture as features and they were used for classification. They also does not mention about the accuracy of their suggested model

A Brief Review on Plant Disease Detection using Image Processing India is the agriculture based country, since it contributes 7.68 percent of total global agricultural output. In India, agricultural sector contributes about seventeen percentage of total Indian gross domestic product (GDP). Effective growth and improved yield of plants are necessary for increment of farmer's profit and economy of India. For this purpose farmers need domain experts for manual monitoring of plants. But manual monitoring will not give satisfactory result all the time. Moreover, domain experts are not available at all regions and are expensive as farmers have to pay fees including travelling charges. Hence, it requires developing an efficient smart farming technique which will help for better yield and growth with less human efforts. In this paper, we provide a review on methods developed by various researchers for detection of diseases in plants, in the field of image processing. It includes research in disease detection of plants such as apple, grapes, pepper, pomegranate, tomato etc.

Plant Leaf Disease Detection and Classification Using Image mProcessing Techniques These days, Computerized imaging innovation needs in the farming field. It can help agriculturists to create early discovery and classification of leaf plant disease. In the agribusiness field, there are a few sorts of the infection that can attack and appear through the leaf. In case the disease isn't identified early, it can be provide a few influences to the sum and quality of the generation. Leaf plant disease can be identified and classified utilizing advanced image processing. Leaves of the plant are utilized to decide the type of diseases that contaminates the crops. Agriculturists can make early choices which are they can analyze the leaf plant infection. Advanced Image processing could be a quick technique, consistent and more exact procedure for leaf plant malady discovery. In this paper, we review leaf plant disease detection and classification using image processing methods from different authors that help agriculturists in the agriculture field. It contains a few stages such as image acquisition, image processing, segmentation, feature extraction, and classification.

Plant health analyser India considers agriculture as it back bone in terms of economy. Every tree originates from seed and saplings are considered to be a small tree. Sapling stage is considered to be sensitive as it is more prone to diseases. Saplings require utmost care for it to have a healthy growth. This project is carried out to implement an Automatic plant health checking vehicle with the help of MATLAB where a rover keeps moving in a nursery capturing the image of the leaves. The image taken is processed using MATLAB and checked for certain diseases present. Depending on the disease detected the cause and its remedy are provided.

Image processing based automated identification of late blight disease from leaf images of potato crops Late Blight is one of the most common and devastating disease for potato crops in all over the world. For less use of pesticide and to minimize loss of potato crops, identification of late blight disease is necessary. The conventional method of disease identification is based on visual assessments which is a timeconsuming process and involves manpower. The proposed work presents image processing based automated identification of late blight disease from leaf images. In the proposed method, adaptive thresholding is used for segmentation of disease affected area from leaf image. The threshold value is calculated using statistical features of image which makes the proposed system fully automatic and invariant under environmental conditions. The proposed method is tested on leaf images of potato crops obtained from plant village database associated with Land Grant Universities in the USA and achieved 96% accuracy. The experimental results indicate that proposed method for segmentation of disease affected area from leaf image is convincing and computationally cheap.

An approach for identification of infections in vegetables using image processing techniques Vegetables are the indispensable ingredient for any nutritious diet. While using them, due care should be taken, so as to ensure

that they are free from any form of diseases and infections. Considering this in large scale, certain techniques in image processing are used with some standard procedure. These existing systems of approach, even though we can't say them as ideal, in present day scenario, these are all the popularly used setup. This paper presents a study on different methods of identification of diseases in vegetables by using various feature extraction techniques and also various classification methods are utilized. This comparative Analysis is an approach towards optimizing an ideal Algorithm with efficient methods of feature extraction and classification techniques in identifications of diseases in vegetables.

3. Existing System

In developing countries, farming land can be much larger and farmers cannot observe each and every plant, every day. Farmers are unaware of non-native diseases. Consultation of experts for this might be time consuming & costly.

Also unnecessary use of pesticides might be dangerous for natural resources such as water, soil, air, food chain etc. as well as it is expected that there need to be less contamination of food products with pesticides

Disadvantages of Existing System:

Farmers cannot afford so much money for persons who visit the crop for disease prediction.
Speed and accuracy of getting result is delayed.
As the cultivational fields are quite large and have very large number of plants in that, hence it becomes very difficult for the human eye to properly detect and classify each and every plant.

4. Proposed system

The model that is proposed by us to detect and classify the infected plant leaves consists of 4 phases. Those phases are Dataset Collection Image Preprocessing Segmentation Selection of Classifier

Advantages:

Farmer can predict the diseases so that can use the right cultivation and fertilizers method. So that they can improve the product quality and crop yield prediction.
Based on our proposed system we achieved the best model for prediction of diseases in variety of crops.

Modules

Dataset CollectionImage Preprocessing Segmentation Selection of Classifier

Dataset Collection:

Firstly, the images of leaves were collected from online sources such as GitHub, Kaggle and also some of the image's dataset consists of 20,000 images divided into 19 different classes. The dataset consists of both healthy and infected leaves which covers diseases like black rot, rust, bacterial spot, early blight, late blight, leaf scorch, target spot, mosaic mvirus of different crops like apple, potato, tomato, grape, strawberry, corn.

Image Preprocessing:

In this step images are resized to smaller pixel size in order speed up the computations. The acquired images contain some noise. This noise is removed using some filtering techniques like Gaussian Blur. After that images are present in RGB format which is not appropriate for further work as RGB format is unable to separate image intensity. Hence it is converted to another color space that is HSV which separate color from intensity. Also, RGB color space is noisier than HSV.

Segmentation:

In this step, segmentation of images is done in order to separate the leaves from the background. Segmentation is performed using K-means clustering with 2 cluster centers, one for background and one for foreground. K-means clustering is unsupervised learning technique that is used to segregate the data points in the predefined number (k) of clusters or groups on the basis of their similarities.
After finding the two clusters, one with background and other one with leaf part, the clustered image is used to change the pixel value of the background of the leaf to black. By doingso the useless information from the image is eliminated which in turn increasesaccuracy.
Selection of Classifier

This is the classification problem as we have to classify the type of disease on the leaf of the plant. So, we have plenty of machine learning as well as deep learning algorithms that we can apply on this dataset. We have decided to start with low complex algorithms and increasing the complexity level in order to increase accuracy of the model. We have selected four classifiers namely – logistic regression, KNN, SVM and CNN.
DOMAIN SPECIFICATION

5. Input design and output design

INPUT DESIGN

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system. The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input Design considered the following things:
What data should be given as input?
How the data should be arranged or coded?
The dialog to guide the operating personnel in providing input.
Methods for preparing input validations and steps to follow when error occur.

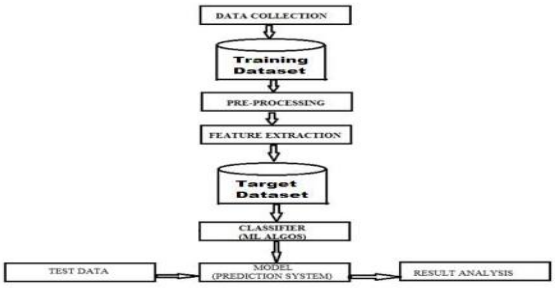
Objectives

1. Input Design is the process of converting a user-oriented description of the input into a computer-based system. This design is important to avoid errors in the data input process and show the correct direction to the management for getting correct information from the computerized system.
2. It is achieved by creating user-friendly screens for the data entry to handle large volume of data. The goal of designing input is to make data entry easier and to be free from errors. The data entry screen is designed in such a way that all the data manipulates can be performed. It also provides record viewing facilities.
3. When the data is entered it will check for its validity. Data can be entered with the help of screens. Appropriate messages are provided as when needed so that the user will not be in maize of instant. Thus the objective of input design is to create an input layout that is easy to follow

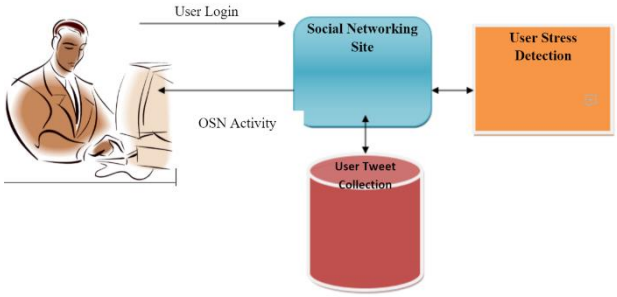
Output design

A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.
1. Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should Identify the specific output that is needed to meet the requirements.
2. Select methods for presenting information.
3. Create document, report, or other formats that contain information produced by the system.
The output form of an information system should accomplish one or more of the following objectives.
Convey information about past activities, current status or projections of the
Future.
1.Signal important events, opportunities, problems, or warnings.
2.Trigger an action.
3.Confirm an action.

SYSTEM ARCHITECTURE:



SYSTEM DESIGN



Data flow diagram:

1.The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of input data to the system, various processing carried out on this data, and the output data is generated by this system.
2.The data flow diagram (DFD) is one of the most important modeling tools. It is used to model the system components. These components are the system process, the data used by the process, an external entity that interacts with the system and the information flows in the system.
3.DFD shows how the information moves through the system and how it is modified by a series of transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output.
4.DFD is also known as bubble chart. A DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional detail.

System study

FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

1.ECONOMICAL FEASIBILITY
2.TECHNICAL FEASIBILITY
3.SOCIAL FEASIBILITY

Economical feasibility

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

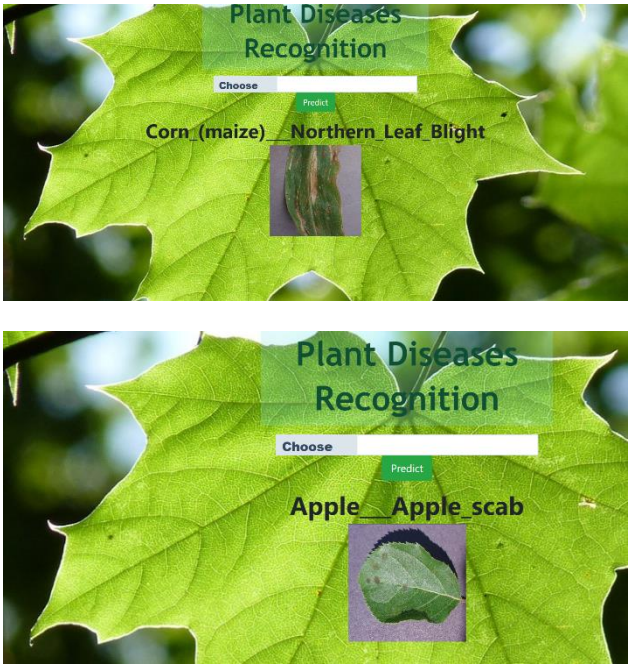
Technical feasibility

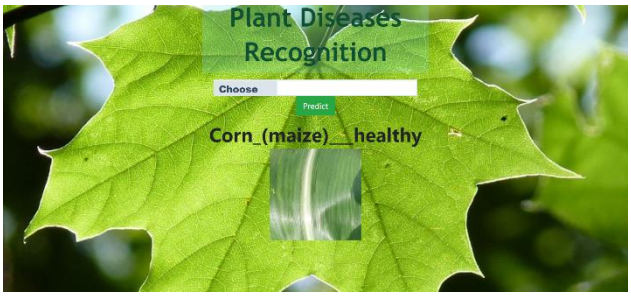
This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

Social feasibility

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened bythesystem, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

6. Result





7. Conclusion

In this paper, a very accurate artificial intelligence solution for detecting and classifying different plant leaf disease is presented which makes use of convolutional neural network for classification purpose. The presented model used the dataset that consists of more than 20,000 images with 41 total classes. The following nmmodel can be extended by using even more large dataset with more categories of diseases and the accuracy can also be improved by tuning the hyperparameters. The remedies for the classified disease can also be included in the model. The model then can be deployed on android and as well as iOSn platform to reach out the farmers who can make the actual use of the proposed system.

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