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Plant Leaf Disease Prediction and Solution using Convolutional Neural Network Algorithm

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Abstract: ***The detection of plant leaf is an very important factors to prevent serious outbreak. Automatic plant leaf disease prediction is a complex and essential research topic. Early stage a disease will be predicted using classic image processing techniques like threshold, contrast enhancement and morphological contour operations. In a modern stage using data mining applications such as classification and clustering approaches for predicting infected leaf diseases, but some flaws are there for processing the images. The drawbacks are considered in the previous work was only the manual disease prediction, time complexity of the work was high, if the image in high quality the accuracy will differs. In the low quality image was not accessed for processing. Considered all the previous outbreaks, the proposed work is implement Convolutional Neural Network (CNN) algorithm for automated prediction of the plant leaf disease. Here the present work has divided into three stages. First the work pre-processed the image input to enhance the quality of the query image. Then structural transformation technique will be implemented for the image description. Finally using CNN algorithm to classify the plant leaf image and identify the disease information. In the experimental results provide high accuracy and efficiently predict the disease with minimal time.***

I. INTRODUCTION

India is an agricultural country; wherein about70% of the population depends on agriculture. Farmers have wide range of diversity to select suitable crops for their farm. However, the cultivation of these crops for optimum yield and quality produce is highly technical. It can be improved by the aid of technological support. The management of perennial crops requires close monitoring especially for the management of diseases that can affect production significantly and subsequently the post-harvest life. The image processing can be used in agricultural applications for following purposes. Predict plant disease from image of plants, Predict pest's attacks from image of plants. In case of plant the disease is defined as any impairment of normal physiological function of plants, producing characteristic symptoms. A symptom is a phenomenon accompanying something and is regarded as evidence of its existence. Disease is caused by pathogen which is any agent causing disease. In most of the cases pests or diseases are seen on the leaves or stems of the plant. Therefore identification of plants, leaves and finding out the pest or diseases, symptoms of the pest or disease attack, plays a key role in successful cultivation of crops. Hence to conduct high throughput experiments, plant biologist need efficient computer software to automatically extract and analyze significant content. Here image processing plays important Role.

The system provides the facility to upload image, process it and get result through SMS. At the processing side there are two Algorithms used first is colour transformation for extracting HSI values. And Second is Momentum back propagation for NN. There are three modules as Website, Server for backend and SMS for sending results. This paper provides a wide survey carried to study advances in different image processing techniques used for studding plant diseases & pests. Data set is a named collection of data that contains individual data units organized (formatted) in a specific, prescribed way and accessed by a specific access method that is based on the data set organization. In our system, we are using the data set as maize plant images for Classific ication. We've collected images from District Agriculture Research Officer. The data set is mainly deals with the both infected and uninfected leaf images. The input from the user is compared with both kind of images and the result is displayed to the user.

II. LITERATURE SURVEY

In [1] describes More than 20 fungi and oomycetes and 10 bacterial species have been described as pathogens of sugar. At least 10 species produce disease symptoms on sugar beet leaves. Cercospora leaf spot (CLS) caused by CercosporabeticolaSacc., a member of Mycosphaerellaceae, Ascomycota, without a known teleomorph, is the most destructive foliar disease of sugar beet worldwide. There is a high economic risk in terms of reduced yields and quality of the beets due to the rapid progress of the disease.

In [2] specifies particularly suited for rapid screening of food products due to its non-destructive nature and short processing time. Thus, the objective of this study was to demonstrate the efficacy of NIR spectroscopy coupled with advanced statistical analysis for rapid, non-destructive detection of potato tubers infected with ZC. This could be accomplished directly by correlating spectral features to ZC infection, or indirectly by correlating spectral features to sugar concentration (an already established procedure) which are in turn correlated with ZC. The latter would have the advantage of allowing quantification of the disease in affected tubers.

In [3] describes Pathogenic microbes such as bacteria, fungi, oomycetes, and nematodes colonize and infect plant cells and cause devastating diseases and crop losses. The extracellular matrix of plant tissues is known as the apoplast and is integral to plant physiology, signalling and defence against plant-pathogenic microbes. Initial contact between plant and pathogens is made in the apoplast and early interactions determine if a pathogen is able to colonize its host. Plant cell surface localized pattern recognition receptors (PRRs) recognize conserved pathogen molecules known as pathogen-associated molecular patterns (PAMPs) or microbe-associated molecular patterns (MAMPs) and launch initial defense responses. Activation of PRR signaling leads to PAMP-triggered immunity (PTI) with rapid accumulation of antimicrobial compounds and proteins such as proteinases, chitinases, glucanases and enzyme inhibitors that damage 2 pathogen structures and molecules.

In [4] describes the desirability of monitoring plague through tracking gerbil occupancy remotely is thus a focused example of the more general challenge of monitoring animal abundance from space. Although sparse, some examples do exist. Estimated the size of an albatross population by counting them manually in 30cm-resolution Worldview-3 imagery. Counted whales by supervised and unsupervised classification. And counted cattle in an IKONOS image by a computer-aided approach. However, no examples were found on the indirect mapping of a species by detecting traces of an animal like the burrows they built and to determine whether the animals are still present.

In [5] surveyed in the agriculture environment, the detection and classification of the plant disease system plays very important role. In this first leaf image is captured and uploaded to the system where this image is compared with another image which is stored in the database. Comparison is take place with the help of algorithm which is named as content based histogram algorithm. For detecting the leaf disease image processing is used. The Image processing consist color extraction and then affected area is compare. The system helps to initial precautionary measures. If proper care is not taken then it will affected on quality, quantity and finally on productivity. This work presents survey on different detection and classification techniques for

plant diseases and also image processing technique which is used for automatic, fast and accurate detection as well as classification of plant leaf diseases.

III. EXISTING WORK

The naked eye observation of experts is the main approach adopted in practice for detection and identification of plant diseases. But, this requires continuous monitoring of experts which might be prohibitively expensive in large farms. Further, in some developing countries, farmers may have to go long distances to contact experts, this makes consulting experts too expensive and time consuming and moreover farmers are unaware of non-native diseases.

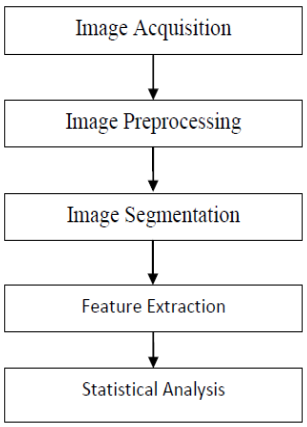
Automatic detection of plant diseases in an important research topic as it may prove benefits in monitoring large fields of crops, and thus automatically detect the diseases from the symptoms that appear on the plant leaves. This enables machine vision that is to provide image based automatic inspection, process control and robot guidance.

A. Advantages

- Its prediction accuracy is high.
- Its working is robust when training examples contain errors.
- It's simple geometric interpretation and a sparse solution.
- Like neural networks the computational complexity of CNNs does not depend on the dimensionality of the input space.
- Image pre-processing includes image enhancement and image segmentation where the affected and useful area are segmented, feature extraction and classification. Finally the presence of diseases on the plant leaf will be identified.
- In the initial step, RGB images of leaf samples were picked up. Then it is converted into HSV color space. After that the components are segmented.
- After obtaining the useful segments the texture features are computed. Neural networks are configured then for recognition.

IV. PROPOSED SYSTEM

The basic procedure of the proposed vision-based detection algorithm in this paper. First, the images of various leaves are going to acquire using a digital camera. Then image-processing techniques are applied to the acquired images to extract useful features that are necessary for further analysis.



In this work application of texture statistics for detecting the plant leaf disease has been explained Firstly by color transformation structure RGB is converted into HSV space because HSV is a good color descriptor. Masking and removing of green pixels with pre-computed threshold level. Then in the next step segmentation is performed using 32X32 patch size and obtained useful segments. These segments are used for texture analysis by color co-occurance matrix. Finally if texture

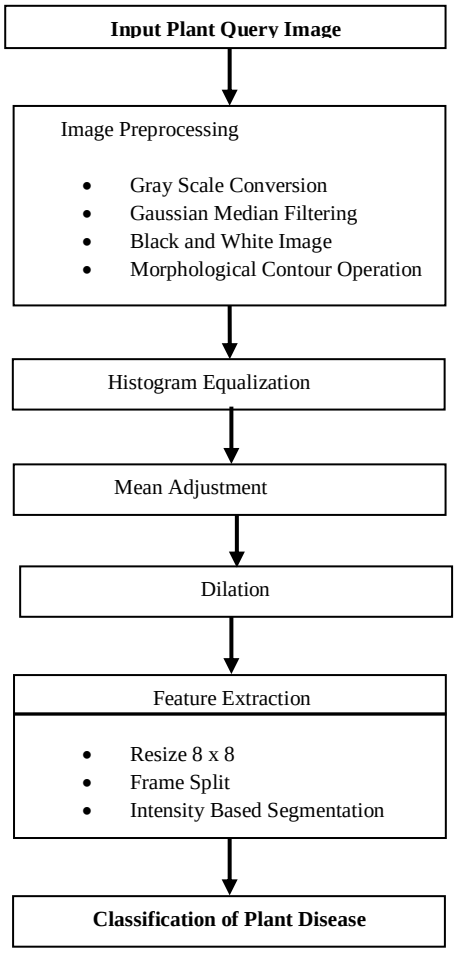
parameters are compared to texture parameters of normal leaf. The extension of this work will focus on developing algorithms and NN's in order to increase the recognition rate of classification process.

A. Drawbacks

- This classifier involves long training time.
- In SVM it is difficult to understand the learned function (weights).
- The large number of support vectors used from the training set to perform classification task.
- The first level is input layer which calculates the distance from the input vector to the training input vectors.
- The second level sums the contribution for each class of inputs and produces its net output as a vector of probabilities.
- Third Pattern level contains one neuron for each case in the training data set. It stores the values of the predictor variables for the case along with the target value.

The pattern neurons add the values for the class they represent. As Existing methods are much slower than multilayer perceptron networks their training phase requires only one pass through the training patterns.

B. Architecture Diagram



V. EXPERIMENTAL RESULT

Color Transformation Structure: First, the RGB images of leaves are converted into Hue Saturation Intensity (HSI) color space representation. The purpose of the color space is to facilitate the specification of colors in some standard, generally accepted way. HSI (hue, saturation, intensity) color model is a popular color model because it is based on human perception. Hue is a color attribute that refers to the dominant color as perceived by an observer. Saturation refers to the relative purity or the amount of white light added to hue and intensity refers to the amplitude of the light. Color is one of the most widely used

feature in image retrieval because of its robustness, effectiveness & computational simplicity. The color of the image is represented through some color model. The commonly used color models are RGB (Red, Green, Blue), HSV (Hue, Saturation, Value) and Y,Cb,Cr (luminance and chrominance),hence any color of the image of color contents are characterized by3-channels from some color model. The color feature can be described by color the color moment has the lowest computational complexity hence it is suitable for image retrieval

Masking green pixels: In this step, we identify the mostly green colored pixels. After that, based on specified threshold value that is computed for these pixels, the mostly green pixels are masked as, if the green component of the pixel intensity is less than the pre-computed threshold value, the red, green and blue components of the this pixel is assigned to a value of zero. This is done in sense that the green colored pixels mostly represent the healthy areas of the leaf and they do not add any valuable weight to disease identification and furthermore this significantly reduces the processing time. It has been applied in order to specify the varying threshold value which chooses the threshold to minimize the interclass variance of the threshold black and white pixels. Next, the green pixels are masked as follows: if the green component of pixel intensities is less than the computed threshold value, then, the red, green and blue components of the this pixel are cleared. The next step in this phase is focused on deleting both the pixels with zeros components and the pixels on the boundaries of the infected cluster

Removing the masked cells: The pixels with zeros red, green, blue components were completely removed and the other remaining pixels are stored in binary image. This is helpful as it gives more accurate disease classification and significantly reduces the processing time. Mostly green colored pixels, in this step, are masked. In this, we computed a threshold value that is used for these pixels. Then in the following way mostly green pixels are masked: if pixel intensity of the green component is less than the pre-computed threshold value, then zero value is assigned to the red, green and blue components of this pixel

Matrix Generation: The new binary image is taken into consideration which has pixels with value of 0 and 1. From this binary image we can generate the matrix which contains values of 0 and 1 and this matrix is transferred to Neural Network.

Neural Network: The neural networks are used in the automatic detection of leaves diseases. Neural network is chosen as a classification tool due to its well known technique as a successful classifier for many real applications. The speed of convergence of a network can be improved by momentum backpropagation; most standard backpropagation algorithms employ a momentum term in order to speed convergence while avoiding instability.

C. Self-Organizing Map

The Self - Organizing Map is one of the neural network models, based on unsupervised learning (human intervention is needed during the learning). The Self - Organizing Map was developed by professor Kohonen in 2001.Self - organizing maps are different from other artificial neural networks in the sense that they use a neighborhood function to preserve the topological properties of the input space. A self -organizing map consists of components called nodes or neurons. Each node has a weight vector of the same dimension as the input data vectors and a position in the map space. The nodes are usually arranged in a two - dimensional regular spacing in a hexagonal or rectangular grid. The self -organizing map describes a mapping from a higher dimensional input space to a lower dimensional map space. The procedure for placing a vector from data space onto the map is to find the node with the smallest distance weight vector to the data space vector.

VI. Conclusion and Future Work

A. Conclusion

An image processing technique that can be easily implemented on smart phones, capable of recognizing plant lesion features has been presented. The preliminary measurement results in the recognition of the number of spots and their area on plant leaves showed accuracy higher than 90%.

In this project, respectively, the applications of colour transformation and Neural Networks (NNs) have been formulated for classification of diseases that affect on plant leaves. Recognizing the disease is mainly the purpose of the proposed approach. Thus, the proposed Algorithm was tested on various diseases which influence on the plants; they are Stem borer, Brown stripe downy mildew etc. The experimental results this algorithm will work. An extension of this work will focus on developing algorithms such as genetic algorithms and NNs in order to increase the recognition rate and severity of the detected disease.

B. Future

In future work the color features of the recognized spots will also be taken into consideration for safer plant disease diagnosis and the presented algorithm will be implemented on smart phones and tested under outdoor conditions.

The future work to understand the opportunity of complementing mathematical models with machine learning based models; to examine other experiences where issues such as making model results understandable and reliable by non-experts or model maintainability have been faced. The results of this analysis will influence the design and development of a decision support system for technicians of the advisory service of our region when dealing with the management of critical pests for apple.

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