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Image Processing based Application for Leaf Disease and Soil Type Classification using MATLAB

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ABSTRACT: The proposed work aims to develop and test approaches for automating the classification procedure of plant leaf diseases and soil types using image processing in MATLAB. The main part of plant to examine the plant diseases is leaf. The detection and classification of leaf diseases accurately is the key to prevent the agriculture loss. Different plant leaf bears different diseases. The major categories of plant leaf diseases are based on viral, fungal and bacteria. The naked eye observation of experts is the main approach used in practice for detection and identification of plant diseases but this needs continuous monitoring of experts. When there is a large farm, this approach might be prohibitively expensive. 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 is an important research topic as it may prove benefits in monitoring large field of crops, and thus automatically detect diseases from symptoms that appear on plant leaves. Thus, automatic detection of plant disease with the help of image processing technique provides more accurate and robot guidance for disease management. Comparatively, visual identification is less accurate and time consuming. Similarly, Soil is one of the most important resources and vital component of earth's critical zone. Soil supplies ecosystem services, filters water, provide nutrients to the vegetations (crops, plants) which supplies us food, energy and fiber to maintain the human health and habitation. There are extraordinary pressures on soil due to urbanization, industrialization or from degradation; soils are reducing their quality which are unbalancing the agricultural practices and food production. Consequently, soil quality and its management with planning are essential to preserve the soil with its quality for future generations. In addition, soil mapping and classification plays a vital role in planning, management of landform and soil use for sustainable growth of the area. Accordingly, digital assessment of various soil properties, classification along with its mapping is mostly an imperative task for agricultural practices like crop growth and condition monitoring and worldwide food production as crop growth is mostly rely on soil nutrients. However, globally soils are very heterogeneous and dynamic in environment as compared to air and water which structure, study and processes are also complicated and formidable both spatially and temporally. In land use and soil is most important factor of environmental change such as deforestation, habitat fragmentation, urbanization, and wetland degradation. Soil deals with the physical features or vegetation as evident on the land whereas land use is about what economic activity or use the land is put to Research in land use.

KEYWORDS: MATLAB, Plant Leaf Disease, Soil Classification, DIP, Machine Learning, SVMs

I. INTRODUCTION

The Plants suffer from leaf diseases like: Alternaria Alternata (fungal), Anthracnose, Bacterial Blight (bacteria), and Cercospora Leaf Spot. Plant disease will be basically identified by observing different patterns on the parts of the plant like leaf, fruit and stem. The indications on the leaf are taken into consideration for detecting the disease. In ancient days, the expertise person would manually monitor and analyze the plant disease that involved huge work and also was time consuming. Image processing is one such technique that is used to detect the disease in plant. There are few countries where farmers are not having enough facilities to contact the expertise since it is time consuming and at the high cost. In such situation, image processing technique comes into picture and is beneficial in monitoring the field. The symptoms on the leaves will help in automatically detecting the disease, which is easy and also cheap. Image processing is a technique that measures the affected area of disease, determines the texture, color and shape of the affected area, and also classifies the disease. The disease can be categorized as bacterial, viral, fungal etc. The proposed

work emphasizes on identifying and categorizing the disease like Alternaria Alternata, Anthracnose, Bacterial Blight, and Cercospora Leaf Spot which are basically found on pomegranate, rice, soya bean, carrot, rose, watermelon, mango etc., using the technique called as image processing. In India 10% to 30 % of the total vegetable crop is destroyed yearly by diseases. To achieve good accuracy and efficiency of disease detection and classification is challenging task. Traditional method of human eyes observation of plant is unpredictable for proper drug treatments. Using different techniques of Image processing leaf diseases will be identify and classify accurately. Continue observation of leaf is crucial and effective for exact disease identification. It goes toward proper drug treatment to crop which is helpful for farmer. Different image processing techniques are followed by distinguish researcher for leaf disease detection with help of Android application, client-server architecture, sensor technology. Initially image acquisition using android mobile camera or web camera, image enhancement using histogram comparison, conversion of RGB image, image segmentation using clustering and classification using ANN are common steps for leaf disease detection [1].

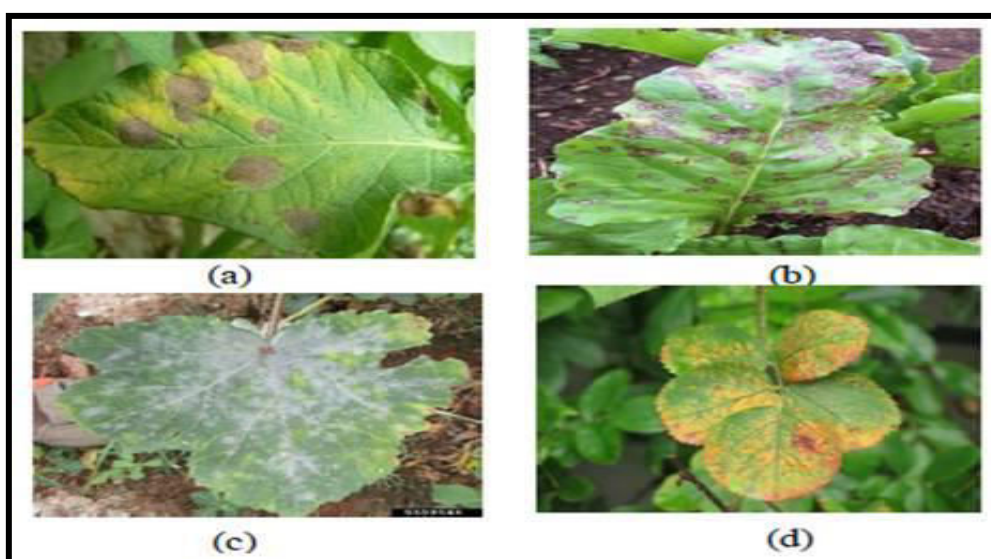


Fig. 1 Sample diseased leaf images for (a) Bacterial Blight, (b) Cercospora leaf spot, (c) Powdery Mildew and (d) Rust. [1]

Soil classification has been the matter of interesting research in the field of engineering. The engineers need to have some primary information about the type and structure of the soil. Earlier methods of soil classification included standard penetration test (SPT), cone penetration test (CPT), pressure meter test (PMT), and vane shear test (VST). The initial methods were time consuming and required presence of an expert for accurate results. With the development of machine learning methods as a part of Artificial Intelligence (AI), many techniques have been progressively developed to automate the soil classification process. The developed techniques include Decision Trees (DT), k-Nearest Networks (k-NN), Artificial Neural Networks (ANN) and Support Vector Machines (SVM). Machine learning is used to classify soils based on various detectable features such as soil moisture content, soil nutrients, soil structure, soil quality, soil pH, and soil texture [2].

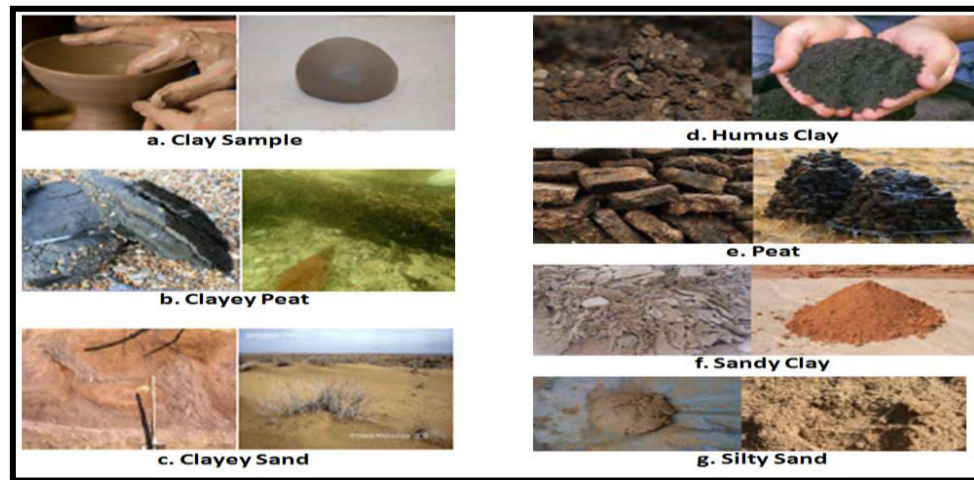


Fig.2 Different Soil Samples used for Classification [2]

II. RELATED WORK

Aarju Dixit et. al. in this paper is highlighting the outliers about the wheat leaf disease detection. India is the second larger producer of wheat after china. The wheat diseases are harmful to wheat production, but there are algorithms that can effectively identify common diseases of wheat leaves. The wheat diseases are generally viral, bacterial, fungal, insects, rust etc. There are many types of disease which are presents in wheat leaf. Recently, wheat disease detection through leaf image and data processing techniques are used extensively and in expensive system especially for assisting farmers in monitoring the big plantation area. Machine learning techniques are described for wheat leaf disease detection and its classification also. The key issues and challenges in wheat leaf disease detection are also highlighted. A vast collection of papers, books and standards are listed in the reference list, which gives useful information to the researchers and farmers in agriculture [3].

T. Thamil Azhagi et. al. The main objective of this paper is detection of diseases at the early stage. In this paper, we mainly focus on image processing techniques. This includes a series of steps from capturing the image of leaves to identifying the disease through the implementation in Raspberry PI. Raspberry PI is used to interface the camera and the display device along which the data is stored in the cloud. Here the main feature is that the crops in the field are continuously monitored and the data is streamed lively. The captured images are analyzed by various steps like acquisition, preprocessing, segmentation, clustering. This in turn reduces the need for labor in large farm lands. Also the cost and efforts are reduced whereas the productivity is increased [4].

Vinaya Mahajan et. al. publish that agricultural productivity is something on which economy highly depends. This is the one of the reasons that disease detection in plants plays an important role in agriculture field, as having disease in plants is quite natural. If proper care is not taken in this area then it causes serious effects on plants, due to which respective product quality, quantity and/or productivity is affected. For instance a disease named little leaf disease is a hazardous disease found in pine trees in United States. Detection of plant diseases through some automatic technique is beneficial as it reduces the tedious work of monitoring in big farms of crops, and at very early stage itself it detects the symptoms of diseases i.e. when they appear on plant leaves. This paper presents an algorithm for image segmentation technique which is used for automatic detection and classification of plant leaf diseases. Image segmentation, which is an important aspect for disease detection in plant leaf disease, is done using genetic algorithm. It uses fuzzy logic for detection of plant disease. The parameters are skewness, extract mean and extract deviation. A test image is taken and compared with database image and then dissimilarity is calculated with extracted parameters [5].

P. M. Kumar et.al. focus on the design and development of an embedded system framework to test the suitability of the soil for urban terrace farming. The need to rush to an agricultural officer or department can be reduced to a certain extent in testing the quality and type of soil at regular intervals with this system. This helps the user in deciding the best plant (specifically cash crops) and fertilizers that are to be used for the growth of plants in the given soil conditions. The soil conditions can be estimated by measuring the pH and moisture content in the soil. The concentration of

hydrogen ions (pH) and moisture sensors are used to estimate the pH and soil moisture levels for a particular cash crop. The idea behind the implementation of the proposed system using FPGA is to design it as an Application Specific Integrated Circuit (ASIC) to ensure the features of parallel processing computations, field re-programmability and faster time-to-market, low cost and power consumption. The proposed user-friendly system eases the process in checking the suitability of the soil, predicting the plants that can be grown in any given condition. The developed framework has been calibrated with the help of a standard pH meter to satisfy the intended use [6].

D. D. Kumar et.al. propose that flexible pavement structure consists of a different layer system. The layers are designed with different materials to reduce the stress on the sub grade. The usage of industrial products in pavement construction has gained a lot of attention in the last few decades. The utilization of the industrial products in strengthening the base layer is showing better performance in Low Volume Roads. Glass is a pozzolanic material when blended with soil it gives additional strength. With this background, this paper is aimed to provide an optimum percentage of glass powder as a soil stabilizer to improve the performance of the base layer and a suitable machine learning technique is also identified to predict the strength of the soil. The two types of machine learning techniques used in this study are SVM and ANN. Various performance measures like RMSE, R-Squared, MSE, MAPE, MAE, and Chi-square are calculated and compared between ANN and SVM. [7].

Suparna Biswas et.al. implement General Regression Neural Network (GRNN), Artificial Neural Network (ANN), Fully Connected Neural Network (FCNN), Support Vector Regression (SVR) and Linear Regression (LR) models have been in order to predict the composition of soil with respect to the Standard Penetration Test (SPT), and soil depth. The primary focus has been on determining a significant correlation between the soil composition with SPT value and depth. Data sets have been used from ward 14, Mymensingh district of Bangladesh and from a construction project along India-Myanmar border. In this study, 8 types of soil, namely, fine sand, silty clay, clayey silt with fine sand, clayey silt, fine sand with silt, silty fine sand, sandy silt, and rubbish has been classified, and the probability of obtaining the soil type classification has been determined [8].

III. METHODOLOGY

Proposed Framework for Leaf Disease Classification: The various steps are followed in image processing to detect the botanical leaf disease are: Image acquisition, image preprocessing, image segmentation, feature extraction and classification. The three main steps of automatic identification and verification are preprocessing, feature extraction, classification.

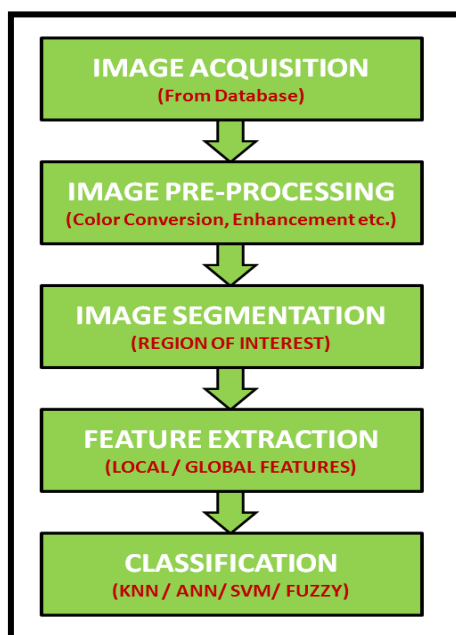


Fig.3 Steps in Botanical Leaf Disease Detection using Image Processing Techniques

Image Acquisition: In Image acquisition step, images of plant leaves are acquired to perform some operations on image in Image processing system. The images can be acquired through a digital camera or can be downloaded from a authenticated plant image site. The acquired images and their features are stored in an image database. The image database consists of healthy set and diseased set of images. The efficiency of image database depends on eminence of images so the images should be of high quality. The efficiency of database defines the vigor of the system. The images are altered into device independent color space.

Image Pre-Processing: The pre-processing techniques are accomplished to make the image applicable for further processing. The image is resized in preprocessing step of plant disease detection. The pre-processing of images consists of image enhancement, color conversion, removal of noise. In Image enhancement the quality of image is enhanced to increase the visuality. In color space conversion, the RGB image is converted into grayscale using various color models. For the purpose of noise removal, various filters are used. After performing the resizing, color space conversion and enhancement, Histogram equalization methods are used to designate intensities.

Image Segmentation: In Image Segmentation the image is segmented into various part based on the similarity between various features. The parts having same features are grouped together. Image can be analyzed easily with segmentation. . Image segmentation can be Local segmentation in which a specific part of image is considered and Global segmentation in which the whole image is considered.

Feature Extraction: Feature extraction step retain the various image features that are passed to classifier as its input. Classifier easily classifies the image data into clusters by using features. Features can be grouped into two classes. Local features: Geometric features such as concave/convex, endpoints, branches etc. belongs to the category of local features. Global features: Topological features such as connectivity, number of holes etc. belong to the category of global features.

Classification: Classification is of two types supervised classification and unsupervised classification. In the supervised classification the set of classified classes are known in advance but on the other side in unsupervised learning set of classes are not known. Classifiers are used for the purpose of classification. Techniques for classification are: artificial neural network, decision tree, support vector machine(SVM), Fuzzy measure etc.

Proposed Framework for Soil Type Classification: In the proposed work the automatic classification of soil samples is done using image processing techniques. The automated soil sample classification system is performed by four main steps:

1. Soil Sample Image Acquisition.
2. Soil Sample Image Enhancement
3. Soil Sample Feature Extraction
4. Soil Sample Classification

The application of computer vision techniques to the image retrieval problem in this case classification and detection of soil type from images is the problem of searching the relevant digital images using the actual contents of the image, i.e. colors, shapes, textures or other information that can be derived from the image itself. Figure below shows the basic framework of the classification or detection system based on image processing.

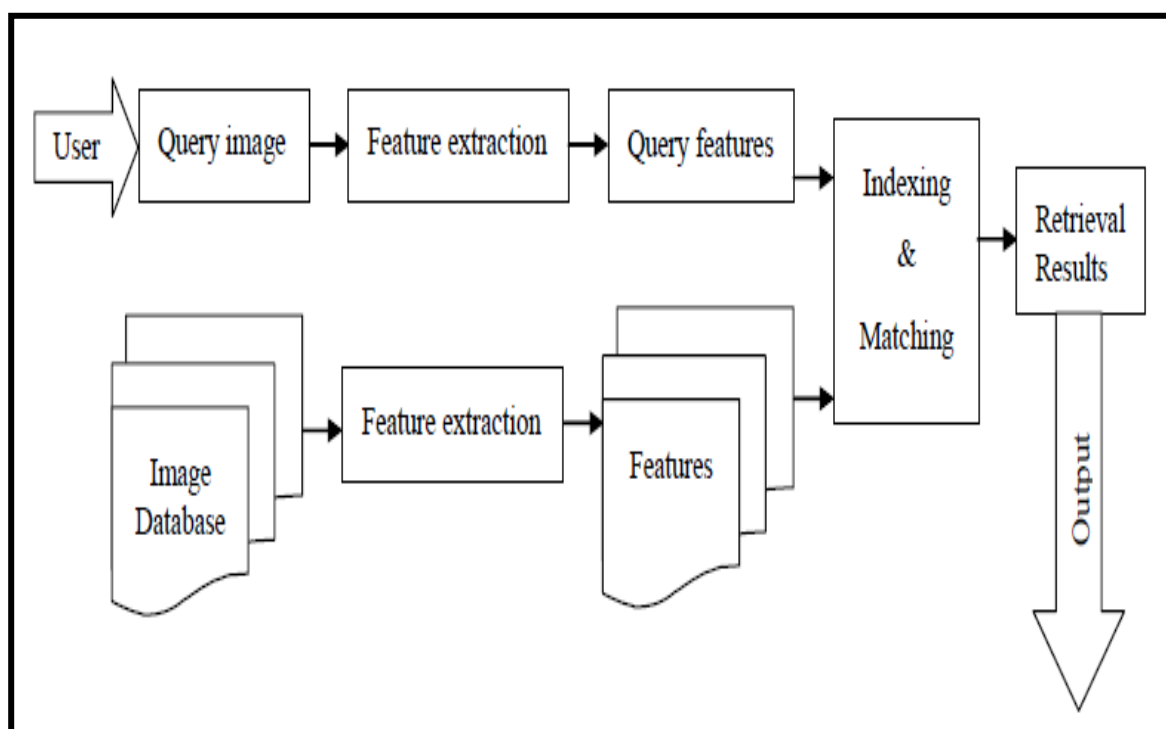


Fig.4 Basic Framework of Classification or Detection using Image Processing

In this system, images are automatically indexed by their visual features such as texture, color and shape. These features are automatically extracted from images. This system is used in many applications. These systems have proven to be very useful in many fields to browse and search very huge image databases.

Image Acquisition: In Image acquisition step, images of plant leaves are acquired to perform some operations on image in Image processing system. The images can be acquired through a digital camera or can be downloaded from a authenticated soil image site. The acquired images and their features are stored in an image database. The image database consists of set of soil images. The efficiency of image database depends on eminence of images so the images should be of high quality. The efficiency of database defines the vigor of the system. The images are altered into device independent color space.

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IV. EXPERIMENTAL RESULTS

The snapshot of Application Graphical User Interface for Botanical Leaf Disease System which was developed using MATLAB GUIDE Tool is shown in figure below. It consists of 07 buttons which have been assigned different functions to be performed by the application. The display for images and results are provisioned in the same window in this GUI. A GUI with similar structural and functional aspects is to be developed for Soil Type Classification Application.

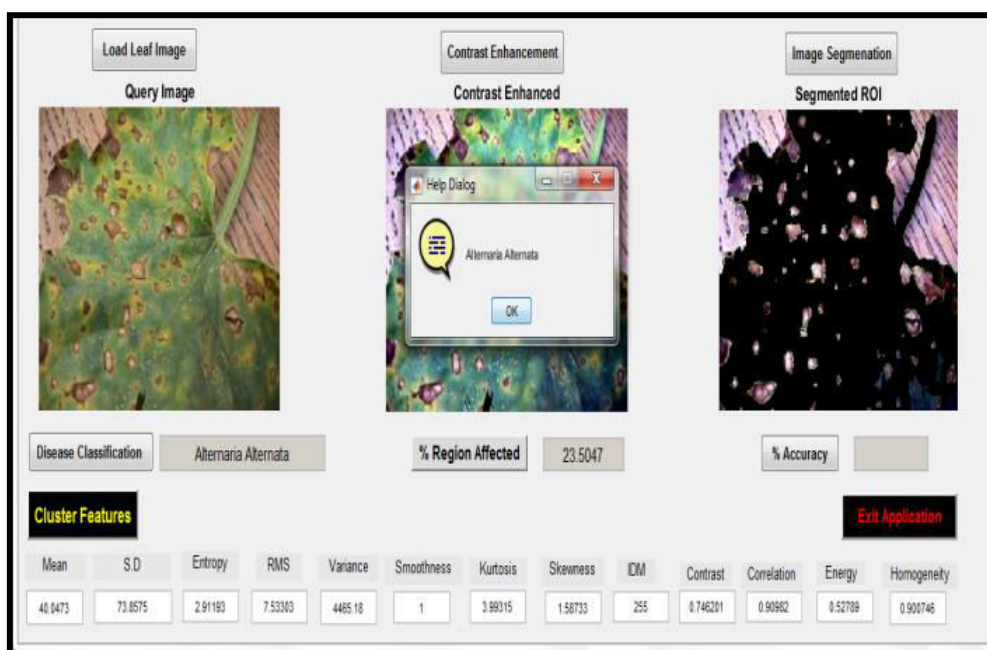


Fig. 5 Application Graphical User Interface for Leaf Disease Classification System

V. CONCLUSION

The Application Graphical User Interface for Leaf Disease Classification System has been developed along with initial stages of Plant Leaf Image Acquisition, Plant Leaf Image Enhancement, Plant Leaf ROI Extraction, Plant Leaf Classification Features Calculation and Plant Leaf Disease Detection or Classification with percentage accuracy and percentage affected area. A similar application GUI will also be developed for soil type classification system to have a to give a robust agriculture related virtual Lab testing system. The application is to be tested on a leaf disease database and soil database for accuracy and performance and analytical comparisons are to be made on basis of testing.

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