WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Hybrid Approach of Disease Detection for Enhanced Crop Health and Yield

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A B S T R A C T

Diseases can significantly harm the growth of plant which in the end has an impact on the agriculture. The timely detection of diseases is very crucial as it helps to keep the expected productivity and this is where the research focuses. The study presents a full procedure that can create a system relying on the machine learning model and that can recognize know diseases of plants by just leaf pictures. The study involves such activities as data collection, data pre-processing, model training, ensemble model developing, model evaluation, and results analysis. Different machine learning models are fitted and tested to display their representing capability between the categories of "healthy" and "diseased" with plant. The highlighted models are Random Forest, Support Vector Machine (SVM), Multi-Class SVM, and Ensemble model. The work presents a practical and face-to-face system for disease detection and visually enjoyable, which in turn can help in the prevention of diseases definitely increasing the yield and quality of the crop. One of the major points of the research is the imperative of constantly making the models up-to-date and the opening of new horizons by the application of deep learning.

Keywords: Disease Detection, Leaf Images, Data Collection, Data Preprocessing, Crop Yield, Agricultural Productivity

I. Introduction

Plant diseases are important factors because its effects human being as well as animals etc. that's why as it can cause significant reduction in both quality and quantity of crops in agriculture production. Therefore, detection and classification of diseases is an important and urgent task. Traditionally farmers identify the diseases by naked eye observation method. Some researchers have used image processing techniques for fast and accurate detection of plant diseases and identifying the diseases in an early stage only and control them. When some diseases are not visible to naked eye but actually, they are present, then it is difficult to detect it with the naked eye. And when it is visible it will be too late to detect disease and can't help anymore. Earlier, microscope is used to detect the disease, but it becomes difficult as to observe each and every leaf and plant. So, the fast and effective way is a remote sensing technique. Detection and recognition of diseases in plants using machine learning is very fruitful in providing symptoms of identifying diseases at its earliest. For small scale farmers, early identification of disease is very much possible and able to control the insects by organic pesticides or by the use of minimal number of chemical pesticides. For large scale farmers frequent monitoring and early identification of disease is not possible and it results in a severe outbreak of the disease and pest growth which cannot be controlled by organic means. In this situation farmers are forced to use the poisonous chemicals to eradicate the disease in order to retain the crop yield. This problem can be solved by automating the monitoring process by use of advanced image processing techniques and machine learning.

The proposed work aims in making the automated system easily available for the farmer's using the device for early detection of the diseases in plants. Robotic is included in this system a field robot goes through the field and captures the images of the leaves and processing of the image is done using the processor that is integrated in it. After the evaluation of the diseases the result is sent to the farmer/owner of the field in the form of SMS. The steps involved in disease detection are Digital image acquisition, Image pre-processing (noise removal, Color transformation, and histogram equalization), K-means Segmentation, Feature extraction, and classification using the support vector machine algorithm which is a supervised learning algorithm. The processing that is done by using these components is divided into two phases. The first processing phase is the offline phase or Training Phase. In this phase, a set of input images of leaves (diseased and normal) were processed by image analyzer and certain features were extracted. Then these features were given as input to the classifier, and along with it, the information whether the image is that of a diseased or a normal leaf. The classifier then learns the relation among the features extracted and the possible conclusion about the presence of the disease. Thus, the system is trained.

Fig: Image Based Plant Detection

II. Literature Review

[1]Sunitha.Mhas carried out seeding robotics for the irrigation system. Some of the major problems in the Indian agricultural are rising of input costs, accessibility of skilled labors, lack of water resources and crop monitoring. To overcome these problems, the automation technologies with robots were used in agriculture. The automation in the agriculture could help farmers to reduce their efforts.

[2]Ankit Singhwas focused on rover's navigation is performed by remote guiding devices fortified with the positioning system. It uses Arduino Atmega2560 controller and ultrasonic radar sensor for obstacle avoidance. It is controlled using wireless module that can be control by PC/TAB/Mobile. It gives acknowledgement massage of seed tank empty or full to the farmer. The agribot which perform only two operations like digging hole in field that is ploughing in the field and then planting a seed at a regular interval and cover the plough area with soil. To drop the seed stepper motor is used and to dig a hole, spike wheel is used.

[3]N. Firthous Begum, gave the motivation of this research is to decrease harvesting cost and increase the productivity. Conventional harvesting method is highly labor intensive and inefficient in terms of both economy and time. Machine harvesting systems by robot are a partial solution to overcome these issues by removing fruits from the trees efficiently. Thus reduce the harvesting cost to about 35-45% of total production cost. An agribotis designed to reduce harvesting cost.

[4] Buniyamin N, has said that Mobile robot path planning has a few main properties according to type of environment, algorithm and completeness. The properties are whether it is static are dynamic local or global and complete or heuristic. The static path planning refer to environment which contains no moving objects or obstacles other than a navigating robot and dynamic path planning refers to environment which contains dynamic moving and changing object such as moving obstacle.

III. Methodology

Many of the system designed for agriculture operations of seeding, weeding and fertilizer spraying are based on the camera and machine vision. The navigation of the vehicle is based on Wi-Fi and wireless-controlled system. Use of these systems can achieve the level of accuracy but the final cost of the product is very high. The system proposed in this paper is cost effective and does not require the costly equipment's for its navigation; it is designed to be automatic and light weight. These advantages make it real aid to farmers.

Pesticide sprayer can be used for the following purposes:

STEP1: Identifying the defective and non-defective leaves in plants.

STEP2: Classifying the type of disease attacked in the leaves.

STEP3: Pesticide spraying in defective areas.

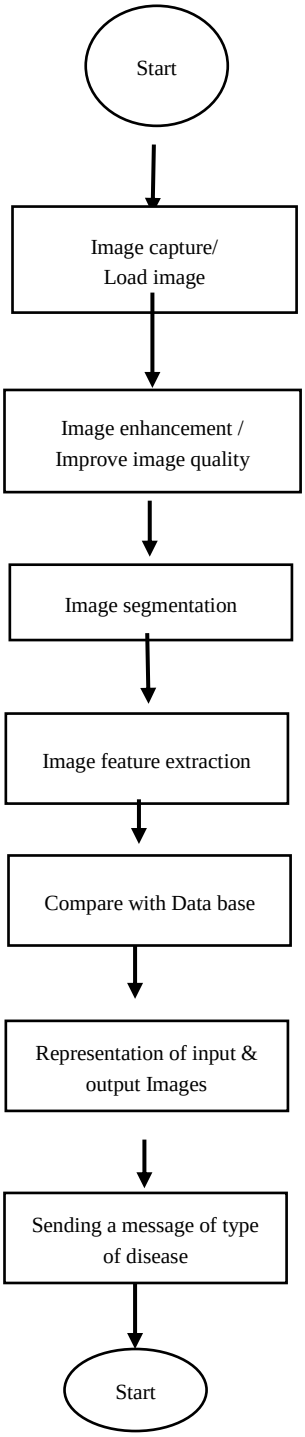
An automatic pesticide sprayer is involved to spray the pesticide to the localized area of the affected crops. This system is based on the sprayer that is filled with pesticide. This provides a continuous flow of pesticide and an accuracy that is not affected by varying fluid properties and flow conditions and also sprays pesticide on affected area of plant by adjusting the height of pesticide sprayer. This can be controlled by using MATLAB software through mobile remotely. The design is ideal for pesticide sprayer application.

Disease detection module

- Digital cameras (Laptop Cameras) are integrated to capture particular patterns on the plant body surface arising out of any disease the crop might have got effected from and again the information is processed though the IP unit ,feeding the identified information to the controller, which is Sent to robot to take actions.

- All the identified data and the suitable actions need to be taken is sent as alert to the centralised cloud for storage and the farmer's smartphone for necessary response.

Flow Diagram



IV Result Analysis

The result of this research can be seen from accuracy that calculated from several combination of features. Table 3 shows classification accuracy of this research. When single feature is used, shape feature has the lowest accuracy of 51% because rust in sugarcane has various shape of lesion so it is difficult to analyze it by solidity, extent, minor axis length and eccentricity of image. But normal and diseased images have different shape. Healthy leaf has no lesion and rust diseased leaf has lesion, so system can recognize the pattern.

Features	**Accuracy**
SHAPE	51 %
COLOR	87 %
TEXTURE	96, 5 %
COLOR + TEXTURE	97, 5 %
COLOR + SHAPE	86, 5 %
SHAPE + TEXTURE	96 %
COLOR + SHAPE + TEXTURE	97, 5 %

V Conclusion

This project proposed a leaf image pattern classification to identify disease in leaf with a combination of texture and color feature extraction. Initially the farmers send a digital image of the diseased leaf of a plant and these images are read in MATLAB and processed automatically based on SVM and the results were shown. The results of this project are to find appropriate features that can identify leaf disease of certain commonly caused disease to plants. Firstly, normal and diseased images are collected and pre-processed. Then, features of shape, color and texture are extracted from these images. After that, these images are classified by support vector machine classifier. A combination of several features is used to evaluate the appropriate features to find distinctive features for identification of leaf disease. When a single feature is used, shape feature has the lowest accuracy and texture feature has the highest accuracy. A combination of texture and color feature extraction results a highest classification accuracy. A combination of texture and color feature extraction with polynomial kernel results in good classification accuracy. Based on the classified type of disease a text message was sent to the user in the project with fully-automated farms in the future, robots can perform all the tasks like mowing, fertilizing, monitoring of pests and diseases, harvesting, tilling, etc. This also enables the farmers to just supervise the robots without the need to operate them. The project can be enhanced to any other kinds of crop. Hence, it can be applicable to the real time agricultural field.

VI Future Scope

In this project, we demonstrated only few types of diseases which were commonly caused and it can be extended for more disease in future. Here only a text message was sent to the farmer but in future a robot can be sent to spray the pesticides to the plants automatically without human interaction.

VII References

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