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PLANT DISEASE IDENTIFICATION AND PESTICIDES RECOMMDATION USING CNN

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ABSTRACT:

Plant leaf diseases and destructive insects are a major challenge in the agriculture sector. Faster and an accurate prediction of leaf diseases in crops could help to develop an early treatment technique while considerably reducing economic losses. Modern advanced developments in Deep Learning have allowed researchers to extremely improve the performance and accuracy of object detection and recognition systems. In this paper, we proposed a deep-learning-based approach to detect leaf diseases in many different plants using images of plant leaves. Our goal is to find and develop the more suitable deep- learning methodologies for our task. Therefore, we consider three main families of detectors: Faster Region-based Convolutional Neural Network (Faster R-CNN), Region-based Fully Convolutional Network (R-FCN), and Single Shot Multibox Detector (SSD), which was used for the purpose of this work. The proposed system can effectively identified different types of diseases with the ability to deal with complex scenarios from a plants area.

Key words: SSD, R FCN, R CNN, Deep learning.

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I INTRODUCTION

Agriculture has become much more than simply a means to feed ever growing populations. Plants have become an important source of energy, and are a fundamental piece in the puzzle to solve the problem of global warming. There are several diseases that affect plants with the potential to cause devastating economical, social and ecological losses. In this context, diagnosing diseases in an accurate and timely way is of the utmost importance.

There are several ways to detect plant pathologies. Some diseases do not have any visible symptoms associated, or those appear only when it is too late to act. In those cases, normally some kind of sophisticated analysis, usually by means of powerful microscopes, is necessary. In other cases, the signs can only be detected in parts of the electromagnetic spectrum that are not visible to humans. A common approach in this case is the use of remote sensing techniques that explore multi and hyperspectral image captures. The methods that adopt this approach often employ digital image processing tools to achieve their goals.

One of the major reason behind degradation of quality and quantity of plat leaf crop is pest. The lack of technical and scientific knowledge to prevent pest diseases is the main reason for low production of these commodities. This project aims to develop a computer vision based automatic system for the diagnosis of diseases caused by pests in the plat leaf plants. Automatic disease detection using computer vision approach involves three types of feature extraction in this experiment. Diseased area of the leaf, textural descriptors using gray level co-occurrence matrix (GLCM) and color moments are extracted from diseased and non-diseased leaf images resulting

in 21-D feature vector. Genetic algorithm based feature selection approach is employed to select relevant features and to discard redundant features, generating a 14-D feature vector that reduces the complexity. Artificial neural network (ANN) and support vector machine (SVM) is used for classification. The proposed algorithm results in classification accuracy of 92.5% using SVM and 87.5% using ANN.

The existing method for plant disease detection is simply naked eye observation by experts through which identification and detection of plant diseases is done. For doing so, a large team of experts as well as continuous monitoring of experts is required, which costs very high when farms are large. At the same time, in some countries, farmers don't have proper facilities or even idea that they can contact to experts. Due to which consulting experts even cost high as well as time consuming too. In such condition the suggested technique proves to be beneficial in monitoring large fields of crops. And automatic detection of the diseases by just seeing the symptoms on the plant leaves makes it easier as well as cheaper. This also supports machine vision to provide image based automatic process control, inspection, and robot guidance .

Plant disease identification by visual way is more laborious task and at the same time less accurate and can be done only in limited areas. Whereas if automatic detection technique is used it will take less efforts, less time and more accurately. In plants, some general diseases are brown and yellow spots, or early and late scorch, and other are fungal, viral and bacterial diseases. Image processing is the technique which is used for measuring affected area of disease, and to

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determine the difference in the color of the affected area.

2. RELATED STUDY

Because the information gathered by applying image processing techniques often allows not only detecting the disease, but also estimating its severity, there are not many methods focused only in the detection problem. There are two main situations in which simple detection applies:

• Partial classification: when a disease has to be identified amidst several possible pathologies, it may be convenient to perform a partial classification, in which candidate regions are classified as being the result of the disease of interest or not, instead of applying a complete classification into any of the possible diseases. This is the case of the method by Abdullah et al. (2007), which is described in Section 'Neural networks'.

• Real-time monitoring: in this case, the system continuously monitor the crops, and issues an alarm as soon as the disease of interest is detected in any of the plants. The papers by Sena Jr et al. (2003) and Story et al. (2010) fit into this context. Both proposals are also described in the following.

Neural networks

The method proposed by Abdullah et al. (2007) tries to discriminate a given disease (*corynespora*) from other pathologies that affect rubber tree leaves. The algorithm does not employ any kind of segmentation. Instead, Principal Component Analysis is applied directly to the RGB values of the pixels of a low resolution (15×15 pixels) image of the leaves. The first two principal components are then fed to a Multilayer Perceptron (MLP)

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Neural Network with one hidden layer, whose output reveals if the sample is infected by the disease of interest or not.

Thresholding

The method proposed by Sena Jr et al. (2003) aims to discriminate between maize plants affected by fall armyworm from healthy ones using digital images. They divided their algorithm into two main stages: image processing and image analysis. In the image processing stage, the image is transformed to a grey scale, thresholded and filtered to remove spurious artifacts. In the image analysis stage, the whole image is divided into 12 blocks. Blocks whose leaf area is less than 5% of the total area are discarded. For each remaining block, the number of connected objects, representing the diseased regions, is counted. The plant is considered diseased if this number is above a threshold, which, after empirical evaluation, was set to ten.

3 METHODOLOGY

Agricultural products are the primary need for every country. If plants are infected by diseases, this impacts the country's agricultural production and its economic resources. This paper presents a system that is used to classify and detect plant leaf diseases using deep learning techniques. The used images were obtained from (Plant Village dataset) website. In our work, we have taken specific types of plants; include tomatoes, pepper, and potatoes, as they are the most common types of plants in the world and in Iraq in particular. This Data Set contains 20636 images of plants and their diseases. In our proposed system, we 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

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detected, such as bacteria, fungi, etc., and 3 classes for healthy leaves. As a result, we obtained excellent accuracy in training and testing, we have got an accuracy of (98.29%) for training, and (98.029%) for testing for all data set that were used.

4 RESULTS EXPLANATION

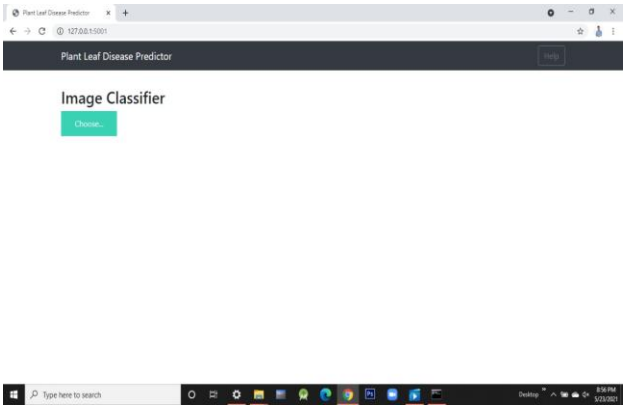

Fig.4.1. OUTPUT results.

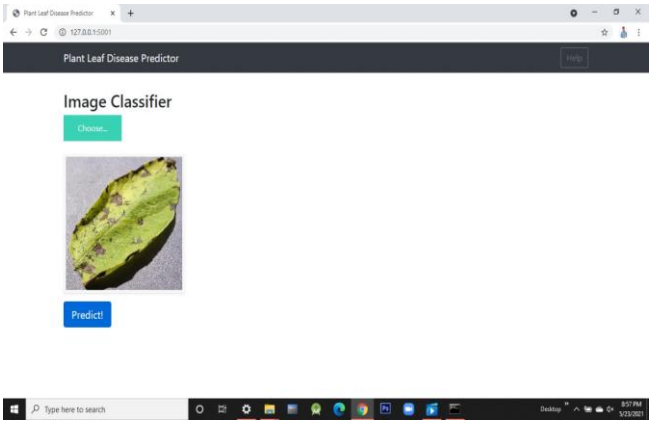

Fig.4.2. INPUT image.

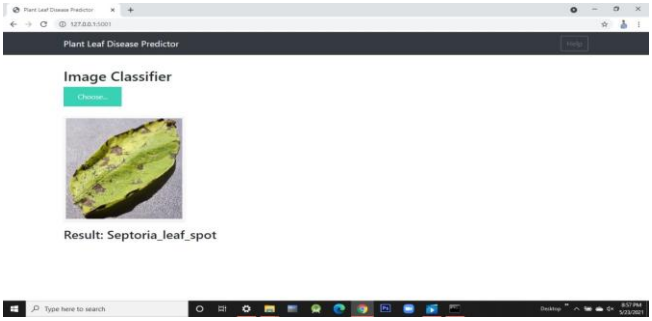

Fig.4.3. OUTPUT image.

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. In this paper, we are discussed to use recent detectors such as Faster Region-Based Convolutional Neural Network (Faster R-CNN), Region-based Fully Convolutional Networks (R-FCN) and Single Shot Multibox Detector (SSD) to detection and classification of plant leaf diseases that affect in various plants. The challenging part of our approach is not only deal with disease detection, and also known the infection status of the disease in leaves and tries to give solution (i.e., name of the suitable organic fertilizers) for those concern diseases.

CONCLUSION

This article presents, the automatic plat leaf disease detection system using different types of features like area, GLCM and colour moment. For the selection of the extracted features, genetic algorithm is used resulting in low dimensionality and computational complexity. The segmentation is done by using the k-means clustering algorithm, which provides higher accuracy with less computational time. The proposed system also compares SVM and CNN classifiers where CNN provides higher disease detection accuracy (96.7%) than SVM (92.5%). After extracting all the features, 14 relevant features are selected using genetic algorithm. To categorize the images into diseased (plat leaf blast, brown spot) and non-diseased class, two types of the classifiers are used. Depicts the detection accuracy using CNN and SVM classifiers for individual features. A 13-D GLCM feature which describes the grey level co-occurrence matrix of the image gives the highest detection accuracy of 96.75% when classified with CNN and 88.6%with SVM. The color moment feature with execution time 0.002287 seconds gives the accuracy of 95.5% using CNN and 87.25% using SVM, and the area feature that describes the

morphology of the diseased part of leaf results in accuracy of 96.5% and 95.25% when classified with CNN and SVM respectively. It shows that CNN provides better detection accuracy than that ofSVM for all the extracted features. It is also evident from the table that area features contribute less in disease detection.

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