Department of Electrical and Computer Engineering

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Junior Design Project

Leaf Disease Detection Using Machine Learning

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ABSTRACT

Rooftop gardening is considered as one of the most popular and emerging hobby recently in this busy over polluted city. rooftop gardening is considered as one of the most popular and emerging hobby recently in this busy over polluted city there is hardly any space for agriculture. Thus people fulfil their desire in their respective rooftops. However people also loses interest in it sooner or later. Researchers have found out why people get rid of these amazing hobby. The answer is simple their plant starts to perish after they get exposed to some disease and the owners cannot do anything. Recently research also proved that plant diseases are detected by leaf disease thus detection of plant disease through some automatic technique is the ultimate necessity is it reduces hassle free detection with remedies recommending simple remedies. This project presents a machine that is made by algorithm for image segmentation which is used for automatic detection and classification of plant leaf diseases. Our algorithm is used to segment images which is crucial step in the disease identification process for leaf diseases

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CHAPTER 1: INTRODUCTION

In this chapter, we are going to discuss about rooftop gardening. The impact of leaf diseases on rooftop gardening, why the detection of leaf disease is necessary, our project's aim, objectives, and the motivation for doing this project.

1.1 Rooftop Gardening

In this modern day and era, people of all classes try to incorporate the nature with their lives in various ways. Gardening is one of the most prominent of ways to do that. Due to the lack of open space, urban people have leaned towards rooftop gardening. Rooftop gardening refers to the practice of growing plants and vegetables on the rooftop of a building. This practice has emerged as a number one hobby for most of the urban people in recent years.

Rooftop gardening has several important benefits which includes improved air quality, increased access to fresh produce. Since the presence of green plants on the rooftop helps to absorb the increased heat due to heat absorbing materials such as concrete and asphalt, it is known to reduce the urban heat island effect. **[1]**

Overall, rooftop gardening can be considered as a great way of utilizing the limited urban space while adding several environmental, social and economic benefits.

1.1.1 Major Obstacle of Roof Gardening: Leaf Disease

Leaf disease is one of the major obstacles in rooftop gardening. Leaf disease can be considered as a small, discolored or diseased patch of a leaf that is often brought on by nematodes, insects, environmental conditions, toxicity, or herbicides. It can also be brought on by fungal, bacterial, or viral plant diseases. These tan patches or lesions frequently have a necrotic center. **[2]** Because of their exposure to wind, temperature changes, and other environmental stressors, rooftop gardens are particularly prone to leaf disease. So, it's critical to frequently check the garden for disease-related symptoms and respond quickly to stop any further spread. But, most of the urban people lack the required time and knowledge of farming. Hence, they are often unable to detect leaf diseases in time which causes the plant to perish. Ultimately, most of the urban people lose the enthusiasm for roof

gardening. To remove this obstacle, we are proposing a machine learning based technological tool that can make the leaf disease detection process much easier and less time consuming.

1.2 Machine Learning

The fact that computers and other machines are rigid logic machines with no common sense at all means that they are required to have some instructions in order to do tasks. So, to complete a task, precise and step-by-step instructions must be given to the machine. Computers are programmed to follow and carry out the instructions, and scripts are afterwards produced to do so. That is where machine learning, the concept of training computers or other machines based on the experiences from previous data, comes in. Machine learning (ML) is a topic of study focused on comprehending and developing "learning" methods, methods that use data to enhance a set of tasks. **[3]** It is considered to be a component of artificial intelligence. Machine learning uses a variety of techniques to train the computers to carry out some tasks for which there isn't a totally suitable solution. To do that one can assign some of the right answers as valid when there are many possible replies. This valid data can be used by the computer as the practice data to refine the algorithm's it employs to determine the right answers. For instance, the MNIST dataset of handwritten digits has frequently been used to train a system for the task of digital character recognition. **[4]**

1.3 Project Aim and Objective

In this modern age of technology, one would presume that technology has touched all spheres of our life. Even though it is true to some extent. But the use of technology in detecting the leaf disease is still not a common practice. Most of the people still rely on professionals entirely. Hence, the disease detection process is often time-consuming, and the accuracy of diagnosis depends on the operator's concentration level and mental state. This problem could easily make the gardener lose enthusiasm about gardening altogether. But upon achieving our aims and objectives about this project, we hope to minimize the complications to a certain degree. The aim of our project is to develop a mobile application that can detect leaf disease in real time and also suggest suitable remedies. The points below are our project's objective:

- To find an optimized dataset to build our model
- To find an optimized way for image pre-processing
- To build an easily implementable ML model for the real world
- To assist the urban people in taking necessary steps without wasting a lot of time

1.4 Motivation

The motivation of this project is totally based on the target user of gardening and the severity of the leaf disease. It is quite clear that gardening has become a common practice for urban life. Nowadays, Especially in Dhaka city we can hardly find a roof that has no plant in it. But still, we cannot neglect the fact that most of the urban people involved in gardening has no prior knowledge about farming. They do not know what are the diseases the plants can face, how to detect these diseases and finally how to remedy them. Hence, they often fail to detect the disease in time. Also, leaf disease can be both infectious and non-infectious depending on the nature of a causative agent. If not detected early it can lead to the death of the plant which could have easily been solved by a touch of technology. But most of the features of agricultural technology focuses mainly on field agricultural crops rather that residential gardening. The reason why we are taking this project is to help these urban people get acquainted with a technological tool that will help them to detect the plant diseases in real time.

CHAPTER 2: LITERATURE STUDY

To get some ideas about our project we researched some of the existing works related to our project. In this chapter we are going to discuss about these literature survey.

2.1 Existing Works Explanation

A paper has been created in [5] by Sneha Patel about leaf disease detection using convolutional neural network. The main aim of this paper is to detect the apple, grape, corn, potato, and tomato plants leaf disease. The paper proposed Deep CNN model as the solution. Also the proposed CNN model has then been compared with popular transfer learning approach such as VGG16. This paper has followed some steps like image acquisition, image pre-processing, image segmentation, features extraction and classification. The paper used a dataset containing 61,486 images. They used six different augmentation techniques for increasing the data-set size. These techniques are image flipping, gamma correction, noise injection, PCA color augmentation, rotation and scaling. It divided the dataset in 24 labels according to the diseases. The tools used by this paper are Python, Numpy, Scikit learn, Tensorflow, Keras, Compiler option and Jupiter notebook. The proposed CNN model has an accuracy of 90.23%. Whereas the VGG16 model has an accuracy of only 51.17%. So Deep CNN model has better result compared to VGG16.

A study has been done [6] by Vijai Singh and A.K. Misra to detect plant leaf diseases using image segmentation and soft computing techniques to categorize plant leaf diseases. The main aim of this paper is to detect the diseases of banana leaf, rose leaf, lemon leaf and beans leaf. This paper presents an algorithm for image segmentation technique which is used for automatic detection and classification of plant leaf diseases. The genetic algorithm is used for image segmentation, which is a crucial component of disease detection in plant leaf disease. At first, to obtain the desired picture region, the leaf image is clipped, and then the smoothing filter is used to smooth the image. The color co-occurrence approach is used for feature extraction. The co-occurrence features are computed after mapping the R, G, and B components of the input picture to the thresholder images. The co-occurrence features for the leaves are extracted, and the associated feature values stored in the feature library are compared with the extracted co-occurrence features. In order to determine a picture's distinctive qualities, a method is used in which both the texture and color of the image are taken into account. First, the classification is carried out using K-Mean Clustering and the Minimal Distance Criterion,

demonstrating its effectiveness with an accuracy of 86.54%. With the suggested technique, the detection accuracy is increased to 93.63%. With an accuracy of 95.71 percent, the SVM classifier is used to perform classification in the second phase. Using SVM, the suggested technique increases detection accuracy to 95.71%.

A project has been done in **[7]** by Department of Electronics and Telecommunication, Vishwakarma Institute of Technology, Pune, India, about plant disease detection using image preprocessing and Machine learning. In this project, they used 87000 RGB image of healthy and unhealthy images of plant leaves where they used 25 classes of images. For image preprocessing and feature extraction, they used Gray Level Co-occurrence Matrix or GLCM method. After that, they used random forest classifier for classification or detection. They have splitted their dataset into 80% training set and 20% validation testing. For finding the accuracy score, they have used K-fold cross validation technique. Their model achieved an accuracy of 93%, which is considered as best case for any machine learning algorithm.

CHAPTER 3: METHODOLOGY

In this chapter, an overview of different parts of the work is given chronologically. This chapter mainly discusses the theories, techniques, technologies and step by step workflow of the work.

3.1 Workflow

A workflow diagram displaying the complete process of the proposed method is shown below:

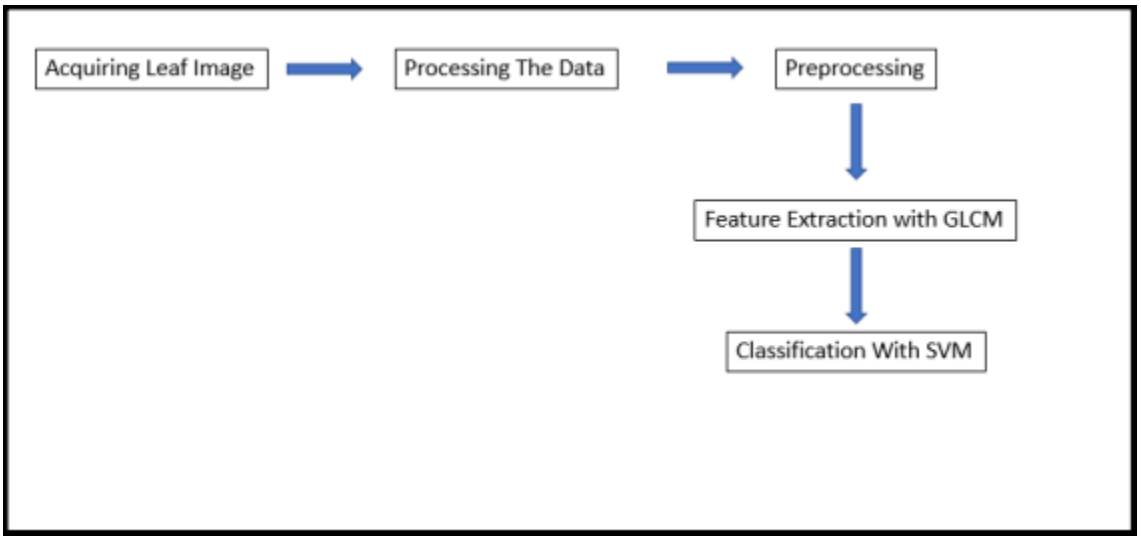

Figure 1: Workflow of the proposed method

3.2 Data Collection

The dataset that has been collected from [8] containing .jpg type of image. There are five types of plants containing 2273 pictures of both healthy and diseased leaves. All the images in the dataset has similar background. The resolution of all images are also same.

3.3 Preprocessing

Before applying the feature extraction algorithm, all the images has to be preprocessed. In the first step of preprocessing, all the images are resized into 256x256 size. Resizing is one of the important steps in preprocessing. Resizing of image helps with training and interference speed. Then we apply a Gaussian filter on the image to remove any background noises by smoothing the image. After that, we convert the image into a grayscale image.

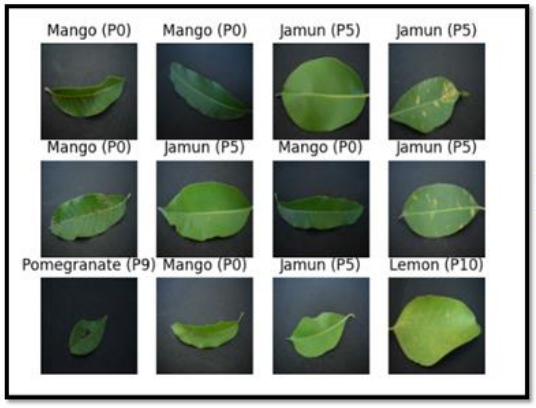

Figure 2: Original Image

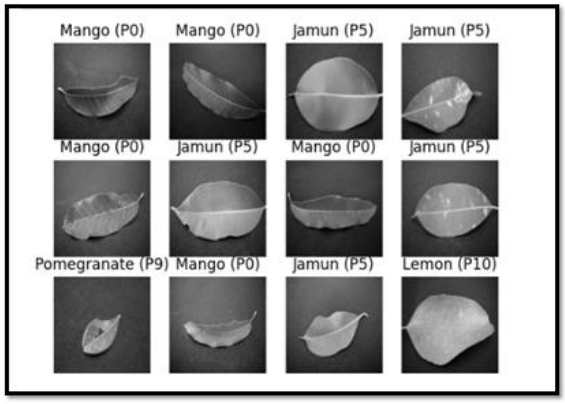

Figure 3: Grayscale Converted Image

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