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# Introduction

## Leaf Disease Detection System

Plant diseases have turned into a dilemma as it can cause significant reduction in both quality and quantity of agricultural products. The naked eye observation of experts is the main approach adopted in practice for detection and identification of plant diseases.

However, 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.

Automatic detection of plant diseases is an essential research topic as it may prove benefits in monitoring large fields of crops, and thus automatically detect the symptoms of diseases as soon as they appear on plant leaves. Therefore; looking for fast, automatic, less expensive and accurate method to detect plant disease cases is of great realistic significance. Machine learning based detection and recognition of plant diseases can provide clues to identify and treat the diseases in its early stages. Comparatively, visually identifying plant diseases is expensive, inefficient, and difficult. Studies show that Machine learning methods can successfully be applied as an efficacious disease detection mechanism.

There are two main characteristics of plant-disease detection machine-learning methods that must be achieved, they are: speed and accuracy. In this study an automatic detection and classification of leaf diseases has been proposed, this method is based on K-means as a clustering procedure.

In conclusion, the aim of this work is threefold: 1) identifying the infected object(s) based upon K-means clustering procedure; 2) extracting the features set of the infected objects using color co-occurrence methodology for texture analysis; 3) detecting and classifying the type of disease using.

## Problem Definition

* To provide a predictable and efficient nutrient source for plant growth.
* To increase crop yield and productivity.

## Objective

The objective of this system can be framed as:

* To create a tool to help develop smart farming.

## Scope / Limitation

Fertilizer recommendation system helps in the field of agriculture by achieving following goal:

* To help in correction of inherent crop nutrient deficiencies.

# Literature Review

KNN classification is processed and compared for the algorithm's effectiveness. All methods are able to perform in blob detection and classification effectively. Feature vectors can be extended or modified to suit different applications and images. [1]

It can obtain more accurate classification results. Our proposed method has been proving using 100 data sets, consisting of 75 training data and 25 testing data which resulted in highest accuracy rate 100% with p value on GLCM is 9 and the membership value (k) on K- NN is 3. According to the experiment result, it can be concluded that our proposed method can reach the highest accuracy. [2]

In order to improve disease identification rate at various stages, the training samples can be increased and shape feature and color feature along with the optimal features can be given as input condition of disease identification. [3]

It is feasible to predict the crop disease processes and then to display it with the virtual reality. The combination of prediction and virtual reality is an audacious attempt, not only to provide a new auxiliary way for scientific research, but also to propose a new application in social life, which increase the entertaining and the science and education for the current virtual product. [4]

Simple threshold and Triangle thresh holding methods are used to segment the leaf area and lesion region area respectively. Finally, diseases are categories by calculating the quotient of lesion area and leaf area. The accuracy of the experiment is found to be 98.60 %. Research indicates that this method to calculate leaf disease severity is fast and accurate. [5]

The techniques which are basically used for the detection and classification of leaf disease in plants which are K means clustering for segmentation, artificial neural network, Probabilistic Neural network and GLCM and SGLDM for texture analysis. There are some of the challenges appear in these techniques are, it requires huge dataset for classification and diseased symptoms are varies.

The proposed method can effectively classify the infected plant with higher accuracy. The proposed method sues k-means clustering, Segmentation and Neural network algorithm. [6]

K-Means is an algorithm that quickly group pixels on the basis of predefined feature vectors and initial centroids. The consideration of color components alone as feature space dimension is not enough to validate the results for clustering and hence an improvement by means of parameterization, feature space extension with texture or gradient is necessary. [7]

# System Design and Analysis

## System Design

Texture Statistics

SGDM matrix generation for H and S

RGB image acquisition

Creates the color transformation structure

Converts the color values in RGB image to the color space

RGB to HIS translation

Apply K-means clustering

Neural networks for recognition

Figure 1: System Architecture

## System Analysis

### Development Tools

* Programming Language: Python 3
* IDE: PyCharm
* Framework: Django for Web Development
* Libraries: TensorFlow for Deep Learning, Matplotlib for Data Visualization
* Algorithms: K-means Clustering, Partial Stretching Enhancement, Subtractive Clustering, Median Filter

### Requirement Analysis

#### Functional Requirement

* Server Requirement
  + Apache Server
  + Django
  + SQLite 3
* Software Requirement
  + Web-Technology: Django
  + Front-End: HTML, CSS, JS
  + Back-End: Python
  + Database: SQLite 3

#### Non-functional Requirement

* Front End
  + UI elements
  + UX elements
* Back End
  + A
  + Ca
  + Ca

### System Flow

Welcome and Login Screen

Input pass and username

Login Ok

Error Message

Display Input Interface

Validate Input

Perform Operation

Display result

Input OK

Figure 2: Flow of Purposed System

# Methodology

## Data Collection

* Data will be collected from kaggle.com
* The repository includes the all kinds of data set contents for data science projects.

## Selection of Parameters

Table 1: Leaf Disease Categories

|  |  |
| --- | --- |
| Range | Disease |
| 0-10 | A |
| 10-30 | B |
| 30-50 | C |
| 50-70 | D |
| 70-80 | E |
| 80-100 | F |

## Implementation Algorithms

### K-means Clustering

K-means clustering is used to partition the leaf image into four clusters in which one or more clusters contain the disease in case when the leaf is infected by more than one disease. The k-means clustering algorithms tries to classify objects (pixels in our case) based on a set of features into K number of classes. The classification is done by minimizing the sum of squares of distances between the objects and the corresponding cluster or class. In present experiments, the K-means clustering is set to use squared Euclidean distances. So, K-means is an iterative algorithm in which it minimizes the sum of distances from each object to its cluster centroid, over all clusters.

Let us consider an image with resolution of and the image has to be clustered into k number of clusters. Let be an input pixel to be cluster and ck be the cluster centers. The algorithm for k-means clustering is following as:

1. Initialize number of cluster and center.
2. For each pixel of an image, calculate the Euclidean distanced, between the center and each pixel of an image using the relation given below.
3. Assign all the pixels to the nearest center based on distanced.
4. After all pixels have been assigned, recalculate new position of the center using the relation given below.
5. Repeat the process until it satisfies the tolerance or error value.
6. Reshape the cluster pixels into image.

Although k-means has the great advantage of being easy to implement, it has some drawbacks. The quality of the final clustering result depends on the arbitrary selection of initial centroid. So, if the initial centroid is randomly chosen, it will get different result for different initial centers. Thus, the initial center will be carefully chosen so that we get our desire segmentation. Computational complexity should also be considered while designing the K-means clustering as it relies on the number of data elements, number of clusters and number of iterations.

### Median Filter

Median filtering is used as a noise removal in order to obtain a noise free image. After segmentation is done, the segmented image may still present some unwanted regions or noise. So, to make the image a good and better quality, the median filter is applied to the segmented image. We can use different neighborhood of . But generally, neighborhood of is used because large neighborhoods produce more severe smoothing. [8]

### Partial Contrast Stretching

Most images which have been used for the analysis may have their own weakness such as blurred or low contrast. So, a contrast enhancement technique such as Partial Spatial Stretching (PCS) is used to improve the image quality and contrast of the image. It is done by stretching and compression process. By applying this technique, the pixel range of lower threshold value and upper threshold value will be mapped to a new pixel range and stretched linearly to a wide range of pixels within new lower stretching value, and the remaining pixels will experience compression. In this way, this algorithm is used for Contrast Enhancement.

### Subtractive Clustering

Subtractive clustering is a method to find the optimal data point to define a cluster centroid based on the density of surrounding data points. This method is the extension of Mountain method which estimates the number and initial location of the cluster centers. It distributes the data space into gridding point and compute the potential for each data point base on its distance to the actual data point. So, the grid point with many data point nearby will have high potential value. Thus, this grid point with highest potential value will be choose as first cluster center. Similarly, after selecting the first cluster center we will try to find the second cluster center by calculating the highest potential value in the remaining grid points. As grid points near the first cluster center will reduce its potential value, the next cluster center will be grid with many data points. This procedure of acquiring new cluster center and reducing the potential of surrounding grid point repeat until potential of all grid points falls below a threshold value. So, this method is one of the simplest and effective methods to find the cluster centers. But within crease in the dimension of data, its computation complexity grows exponentially. Here, subtractive clustering algorithm is used to solve the computational method associated with mountain method. It uses data points as the candidates for cluster center and the computation of this method is proportional to the problem size.

# Working Schedule

Table 2: Working Schedule

|  |  |  |  |
| --- | --- | --- | --- |
| **Task** | **Start Date** | **End Date** | **Duration** |
| Requirement gathering | 7-Feb-19 | 20-Feb-19 | 13 |
| UI Design | 12-Feb-19 | 16-Feb-19 | 4 |
| Coding | 17-Feb-19 | 10-Mar-19 | 21 |
| Unit testing | 11-Mar-19 | 23-Mar-19 | 12 |
| System Testing | 24-Mar-19 | 10-Apr-19 | 17 |
| Bug Fixes | 15-Apr-19 | 10-May-19 | 25 |
| Improvements | 1-May-19 | 21-May-19 | 20 |
| Final Testing | 21-May-19 | 23-May-19 | 2 |

# Expected Result

In this digital world each and every sector is undergoing a dramatic change due to IT field. But, in agriculture field, till date not much work has been done. We have proposed a model for advanced farming using multiple techniques. Through this model farmer will be able to get details regarding required fertilizers from his leaf sample. This is used to improved crop production with reduction in cost of fertilizer and thus improves the agriculture sector in Nepal. The data is collected in the database regarding crop details and leaf conditions which provides total fertilizer requirements.

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|  |  |
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