**IMPLEMENTATION**

**MODULES:**

1. Image Acquisition
2. Preprocessing
3. Segmentation
4. Feature Extraction
5. Classification

**MODULE DESCRIPTION:**

**1. Image Acquisition:**

* The first stage of any vision system is the image acquisition stage.
* The image has been obtained by Gallery.

**2. Preprocessing:**

The objective of the preprocessing phase is to apply possible image enhancement techniques to obtain the required visual quality of the leaf image. Preprocessing having two steps,

1. Image Smoothing
2. Histogram Equalization Image

**1. Image Smoothing:**

After the image acquisition, smoothed image is obtained. In [image processing](https://en.wikipedia.org/wiki/Image_processing), a Gaussian blur (also known as Gaussian smoothing) is the result of blurring an image by a [Gaussian function](https://en.wikipedia.org/wiki/Gaussian_function). It is a widely used effect in graphics software, typically to reduce [image noise](https://en.wikipedia.org/wiki/Image_noise) and reduce detail.

**2. Histogram Equalization Image:**

The contrast enhancement of the image can be observed by applying histeq (enhance contrast using histogram equalization). The histogram equalization techniques are adopted to enhance the quality of the leaf image. It eliminates the background information, redundant and hidden details to process in a fast and easy manner. It also deals with enhancing the contrast of suspicious areas in the leaf image. It is used to increase the contrast of the image without affecting the information structure.

**3. Segmentation:**

* After the preprocessing of leaf, go to color conversion for increase the efficiency of segmentation result. Then K-means clustering is preformed for segmentation.
* K -means clustering algorithm is an unsupervised algorithm and it is used to segment the interest area from the background. Subtractive clustering method is data clustering method where it generates the centroid based on the potential value of the data points. So subtractive cluster is used to generate the initial centers and these centers are used in k-means algorithm for the segmentation of image.

**4. Feature Extraction:**

* Feature extraction plays an important role for identification of an object. In many application of image processing feature extraction is used.
* Color, texture, morphology, edges etc. are the features which can be used in disease detection such as leaf disease and pest detection. In our work, considers color, texture and shape as a feature for disease detection.
* Texture means how the color is distributed in the image, the roughness, hardness of the image. It can also be used for the detection of infected leaf areas.

**i. Color Feature Extraction:**

* The color spaces are used for producing the color histograms. Each color is represented as a mixture of the three primary color channels (Red, Green, and Blue) in the RGB color space. The shortcoming of this scheme is the sensitivity to illumination changes. The RGB color space is converted into the HSV (Hue, Saturation, and Intensity) color model, which separates the intensity from the chromaticity. It also obtains a histogram resilient to normal variation in plant leaf images.
* In color based, color hsv histogram features such as mean and standard deviation are extracted for segmented leaf image.

**ii. Texture Feature:**

* In statistical texture analysis, texture features are computed from the statistical distribution of observed combinations of intensities at specified positions relative to each other in the image. According to the number of intensity points (pixels) in each combination, statistics are classified into first-order, second-order and higher-order statistics.
* The Gray Level Co-ocurrence Matrix (GLCM) method is a way of extracting second order statistical texture features. The approach has been used in a number of applications, Third and higher order textures consider the relationships among three or more pixels.
* Gray Level Co-Occurrence Matrix (GLCM) has proved to be a popular statistical method of extracting textural feature from images.

**iii. Shape Feature Extraction:**

* The shape feature used in our proposed system is the area.

**5. Classification:**

* The classification process is done by extracted color, texture, and shape features in affected leaf region. The main novelty here is the adoption of K-Nearest Neighbour.