A NOVEL MACHINE LEARNING ALGORITHM FOR DETECTING LEAF DISEASES IN IOT BASED SMART VERTICAL AEROPONICS FARMING

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Abstract : This Agriculture has facing challenges due to receding water levels, climate change, shrinking amount of arable land and an increase in population and upward social mobility. Hence it is very difficult in traditional agriculture system to provide a fresh, clean food and to meet the need of the fast-growing population. Increasing agricultural production using modern innovative urban smart vertical farming techniques such as Aeroponics and hydroponics system is top most solution to face these challenges. The soil-less cultivation in hydroponic and Aeroponics system aimed to improve the agriculture production efficiently and an environmental impact. In recent years an intelligent sensor techniques, The Internet of things (IoT) plays a big important role in agricultural industry to plan the several activities and missions properly by utilizing limited resources with minor human interference in order to provide a support to farmers such as growth monitoring system of temperature, humidity and water supply, and also early disease monitoring and detection system.

In Aeroponics system, the plant diseases can affect the leaf any time between sowing and harvesting which leads to huge loss on the production of crop and economical value of market. Therefore, leaf disease detection plays a vital role and it requires huge manpower, more processing time and extensive knowledge about plant diseases. Hence detection and diagnosis of disease at the apparent time is crucial to the cultivator. Farmers find it cumbersome to analyze whether a plant is diseased or not manually as it requires a lot of time, labour and cost. Thus, it is always required to automate a system to identify if a plant is diseased or not earlier to evolve. This research work actualizes a machine learning system to recognize the type of malady on various plant species where phases include dataset acquisition, feature extraction, training and classification. The datasets of both healthy and diseased leaves are trained using various machine learning classifiers to detect diseases in plant leaves as it analyzes the data from different aspects, and classifies it into one of the predefined set of classes. The properties such as color, shape, intensity and dimensions of the plant leaves are taken into consideration for classification. In this paper we proposes a novel hybrid machine learning algorithm based on multi support vector machine for IOT based intelligent aeroponics system provides significant knowledge about early fault detection and diagnosis in which the farmer could monitor several parameters and they could control the entire system remotely and also to detect the various types of plant diseases and different classification techniques that are used for identifying diseases in different plant leaves

IndexTerms -Support Vector Machine, IOT, Machine Learning, Nutrient Solution, Aeroponics.

I. INTRODUCTION

Agriculture has the significant impact on the Indian economy. Because of the increase in food demand, labor cost, unpleasant environmental conditions and less area for agriculture, there is an increase in motivation for indoor farming such as hydroponics and Aeroponics.With these modern farming techniques where plants can be grown without the need of soil by means of nutrient solution, This technique uses mineral nutrient solution in a water solvent which allows plant intake of nutrients in a more efficient way than soil. Native plants can be grown with their roots exposed to the nutrient solution. The nutrients provided to the roots come from an array of various sources.

The soil less aeroponics system requires continuous monitoring and automation for proper operation, plant roots are hanging in the artificially provided plastic holder and foam material replacement of the soil under controlled conditions. The roots are allowed to dangle freely and openly in the air. However, the nutrient rich-water delivers with atomization nozzles.

The nozzles used to create a fine spray mist of different droplet size. The size of the water droplet is important for root development in aeroponics system.. In the system, plant cultivates under complete control conditions in the growth chamber instead of soil small mist of the nutrient solution is provided. The nutrient mist is ejected through atomization nozzles on a regular basis.

During the plant cultivation to make flourishing plant growth, monitoring temperature, humidity, light intensity, water nutrient solution level, pH and EC value, CO_2 concentration, atomization time, and atomization interval time is important. Now towards controlling the aeroponics plant growth IOT is used, In addition to automating the aeroponics by employing IoT technology,the machine learning which a subset of Artificial Intelligence is can be used in to detect plant leaf diseases intelligently and it has helped in automating the plant growth and early detection of diseases in plant leaf using support vector machine algorithm.

There are a variety of flowers, vegetables, and herbs that can be grown in aeroponics. IoT has allowed farmers to automate the aeroponic for Monitoring of water level, pH, temperature, flow, and light intensity can be regulated. For e.g., during winter, water tends to freeze in some areas which in turn may hamper the cultivation process altogether.

Water temperature sensors deployed over the aeroponics farm can sense the temperature loss and alert the farmer accordingly. Similarly, the pH sensor can detect a change in nutrient levels and can pump in the minerals in suitable amounts. An assortment of sensors and controllers like ESP-8266, Arduino and Raspberry Pi, etc. can be used to instrument and automate a aeroponics farm.

To improve the agriculture productivity not only the smart farming and it is necessary to detect plant leaf diseases early because, Plant leaf diseases are one of the important reasons for the loss in the production. It is very difficult to identify Plant leaf disease in agriculture field. To ensure the safety of agricultural production and food security, plant diseases should be predicted in a timely and accurate manner, and then effectively monitored. Early detection of plant stress is important as it is necessary to minimize the loss of acute and chronic productivity. There are various methods available for leaf identification, disease detection and the estimation of the severity of a disease in plants.

Three different techniques used for identification: manual, chemical and optical. Manual identification relies on the naked eye of an expert or seasoned farmer to determine whether a leaf is diseased and, if so, the identity of the disease; chemical identification involves the use of chemicals. These conventional methods are time-consuming, slow and require a larger work force, which may lead to a huge loss in crop productivity.

Traditionally a Naked eye method is used for identifying the diseases. But it requires huge man power, inaccurate, time consuming and also useful in smaller fields. To use larger fields, it is very expensive as it requires continuous monitoring by the experts.

The severity of disease damage depends on the duration between the appearance of the disease and the time until its detection. Identification of leaf disease by eye in the absence of an expert is a complex task that may not provide to accurate results. Traditional methods of identification are time-consuming, less effective, difficult and not practical for large fields. The development of an automated tool not only guides botanists to search quickly through entire collections of plant species, but also allows farmers or other users to identify the disease and take appropriate action. This automatic biometric tool can also be used to monitor crops regularly and can also be used by botanists to pursue their research.

Botanists use the different patterns of the leaves to identify plants and their diseases. Plant leaves showing different patterns are first observed for disease symptoms. Healthy plants have green leaves, Technological advancements in machine learning and discoveries in digital image processing applications play an important role in agriculture. The application of cost-effective internet technology applied in the agricultural business sector at farm level, seasonal crop yield weather forecasts and remote sensing farm management drives research towards precision agriculture, which increases crop productivity by early detecting the leaf diseases.

Hence, machine learning and deep learning prediction methodology can be used for detecting various diseases of plant leaves caused by fungus, bacteria and virus. But they accuracy of disease prediction using classification algorithms varies for different input data. In this paper, the SVM based plant leaf diseases detection classification algorithms is reviewed.. The classification of various plant diseases, are fungal diseases, bacterial diseases and viral diseases.

In machine learning algorithm the process of optical identification uses the captured images of plant leaves which are processed to determine the type of leaf or its disease and the system involves preprocessing, image segmentation, feature extraction, feature matching and classification. Preprocessing involves the use of a Fourier transform method to transform the input image into a new image without changing the intensity or position of each pixel. The techniques that change the intensity or position of a pixel are pixel operations and local operations. Pixel operations use image arithmetic functions or gray-scale transformations to transform an input image. Local operation-based preprocessing techniques use linear, median and morphological filters to change the brightness and position of a pixel[1].

Thus the Machine learning helps in providing computers capability to perform actions on its own after being trained for a particular task. Foremost, for a machine to think like a human mind, it has first to think and learn like a human being. Human mind thinks from the past experiences and past data that is exposed to and based on that the human being takes decision for the future. The machine learning algorithm has various uses in the field of aeroponics towards controlling the plant growth, optimization of Electrical Conductivity (EC) values of the Nutrient solution and disease detection and classification [2].

There are three sorts of Machine Learning algorithms - Supervised learning, un-supervised learning, reinforcement learning. In this research work, plant leaf images are trained under various classifiers to recognize the plant malady on plant leaves.

Plant malady is due to virus, bacteria or fungi. Virus – a microorganism that pervades into living cells of plant leaf. Ex. Mosaic virus. Bacterial – leaf infected by microscopic organisms which are one-celled. Ex. Bacterial spot, scabs. Fungus-organisms which create spores and sustain on organic entity. Ex. Powdery mildew.

2. Literature Survey

Singh and Misra [3] present the review on various diseases sorting methods utilized in plant leaf illness location and a calculation for picture division strategy that can be utilized for characterization of plant leaf ailments and programmed identification. With less computational endeavors, the ideal outcomes were acquired, which likewise demonstrates the proficiency of proposed

calculation in acknowledgment and characterization of the leaf illnesses. Another favorable position of utilizing this technique is that the plant's illnesses can be distinguished at
the beginning period or the underlying organize. To enhance acknowledgment rate in grouping process, simulated neural network, Bayes classifier, fuzzy logic, and crossbreed calculations can likewise be utilized.

RajKumar and Sowrirajan [4] have proposed image-processing-based way to deal with consequent order of the ordinary or infected leaves (Early leaf spot, late leaf spot, alternaria leaf spot), and furthermore give the cure to a similar which would be gainful to novices in cultivating or planting (as the semaladies are basic in blossoming plants like rose too). In this approach, they have joined all the mixture highlights of a leaf to prepare the ANN (BPN-FF) and have made utilization of Lloyd's bunching which is more productive than compared to test pictures using *K*-implies grouping to section.

Arivazhagan et al. [5] proposed a new method in which the RGB images are converted into HSI plane, and only the hue component is used for further analysis. Then, the green pixels are masked, and the masked green pixels are removed. The useful components are obtained upon segmentation, and only the texture feature is extracted using co-occurrence matrix. Then, the neural network employing SVM classifier is used to detect and classify with the efficiency of 94.74%. Here, only a single feature extraction is employed and the classifier is not that efficient in classifying the disease but effectively detects whether the leaf is diseased or not.

Kaundal et al. [6] modeled an automatic weather-based plant disease severity forecasting system using machine learning approaches to predict the severity level of rice blast disease. A web server using an SVM that predicts the severity of a disease and the relevant control measures in rice plants has been developed and is freely available for farmers or researchers to optimize the frequency of the application of chemicals on plants. For rice plants, the severity of disease is more dependent on weather conditions. Different empirical, conventional and simulation models based on weather were developed using regression (REG) models

Melik e Sardogan, Adem Tuncer, Yunus Ozen[7] proposed Classification based on CNN and LVQ Algorithm, Convolutional Neural Network and Learning Vector Quantization algorithm method to detect tomato leaf diseases and classify. The dataset repository comprises 500 images of leaves having four types of malady. Created a CNN to extract feature and classify.

Serawork Wallelign, Mihai Polceanu and Cedric Buche[8] proposed a, "Soybean Plant Disease Identification Using Convolutional Neural Network and Designed a model to identify Soybean plant diseases Septoria, Frogeye and Downy Mildew using CNN classifier. A dataset contains 12673 leaf images with four classes and achieved 99.32% accuracy.

Konstantinos P. Ferentinos, [9] Developed CNN classification technique for recognition of diseases in crops. The dataset containers 87848 images of 25 different plants in set of 58 disease and achieved with accuracy 99.53%.

Sukhvir Kaur , Shreelekha Pandey and Shivani Goel[10], "Semi-automatic leaf disease detection and classification system for soybean culture", Used for soybean culture to detect three different diseases Downy Mildew, Frog eye, and Septories leaf blgh. They reported with average classification accuracy approximately 90% using big dataset.

Web enabled disease detection system have been proposed by Nandhini, A., Hemalatha, Radha, Indumathi[11]. The system proposed a segmentation method which has used mean based strategy for computing threshold and textual features were extracted and classification was done by SVM.The accuracy of prediction of the severity of rice blast using a regression-based SVM provided better results than any other machine learning approach considering the mathematical relationships between the different stages of infection and seasonal weather.

The machine learning techniques used by Kaundal simulate an automatic forecast of rice blast severity using an SVM based on weather. SVMs are flexible for complex non-linear relationships and interactions compared with the neural network approaches of REG, BPNN and GRNN. This model was validated on real data collected from the fields at five different locations for five years based on early/late seasonal information regarding rice plants.

Ahmad Nor Ikhwan Masazhar [12] proposed a Digital Image Processing Technique for Palm Oil Leaf Disease Detection using Multiclass SVM.oil palm leaf diseases Chimaera and Anthracnose detection achieves accuracy of 97% and 95% respectively.

Monzurul Islam, Anh Dinh and Khan Wahid[13]proposed a, "Detection of potato Diseases Using Image Segmentation and Multiclass Support Vector Machine", Potato plant diseases are Late blight and Early blight detection over 300 publically available images with accuracy 95%.

Nithesh Agarwal, Jyothi Singhai and Dheeraj K. Agarwal[14] proposed a, "Grape Leaf Disease Detection and Classification Using Multi- Class Support Vector Machine" the Grape leaf diseases Black Rot, Esca and Leaf Blight are classified with accuracy using features from both LAB and HSI colour model.

Md. Selim Hossain, Rokeya Mumtahana Mou, Mohammed Mahedi Hasan, Sajib Chakraborty and M. Abdur Razzak, [15] Developed a method to identify diseases in Tea plants. Three different types of diseases with less in features are detected using SVM classifiers. The developed method classified the diseases with accuracy of 90%.

Taohidul Islam, Rudra ,RoyChoudhury[16] proposed a Image Processing of affected area of leaf A level of RGB from the influenced area is separated, gathered into different classes, and delivered to a Naive Bayes classifier which characterizes the malady into different classifications. It recognized three rice sicknesses - dark colored spots and bacterial blight This procedure is productive as it requires least computational time.

Swetha V, Rekha Jayaram[17] proposed a machine learning system to recognize the type of malady on various plant species where phases include dataset acquisition, feature extraction, training and classification. The datasets of both healthy and diseased leaves are trained using various machine learning classifiers. Feature extraction is done using Histogram of Oriented Gradient (HOG) where features of color, shape and texture are extracted. Then, the accuracy of all classifiers is compared to obtain the best classifier.

Manav Mehra, Sameer Saxena[18] proposed a" IoT based hydroponics system using Deep Neural Networks". towards controlling the hydroponic plant growth, some amount of research has been done in applying machine learning algorithms like Neural Networks and Bayesian network. Internet of Things allows for Machine to Machine interaction and controlling the hydroponic system autonomously and intelligently. This work proposes to develop an intelligent IoT based hydroponic system by employing Deep Neural Networks which is first of its kind. The system so developed is intelligent enough in providing the appropriate control action for the hydroponic environment based on the multiple input parameters gathered. A prototype for Tomato plant growth as a case study was developed using Arduino, Raspberry Pi3 and Tensor Flow.

Imran Ali Lakhiar, Gao Jianmin[19] proposed a" Monitoring and Control Systems in Agriculture Using Intelligent Sensor Techniques: A Review of the Aeroponic System". In the system, plant cultivates under complete control conditions in the growth chamber by providing a small mist of the nutrient solution in replacement of the soil. The nutrient mist is ejected through atomization nozzles on a periodical basis. During the plant cultivation, temperature, humidity, light intensity, water nutrient solution level, pH and EC value, CO2 concentration, atomization time, and atomization interval time are monitored for flourishing plant growth. Therefore, the objective of this review study was to provide significant knowledge about early fault detection and diagnosis in aeroponics using IOT. So, the farmer could monitor several paraments without using laboratory instruments, and the farmer could control the entire system remotely.

Muhammad Hanif Jumat, Mohd. Saleem Nazmudeen[20]proposed a"smart farming plant disease detection system will allow farmers ability to detect disease at an early stage which will minimize yield loss from full-blown disease our break in green house.they used random forest classifier algorithm to detect disease.

The SVM is used with cross-location and cross-yearly validation models in terms of the correlation coefficient. A high value of the coefficient of determination and the correlation coefficient indicates the severity of the rice blast disease. The minimum percentage of mean absolute error indicates the classification error of the machine learning algorithm used.

Proposed System

Automation helps to guide agriculturists to the optimum usage of chemicals while lowering environmental hazards. Machine learning algorithms can be used to generate precise plant ecology simulation models, considering the effect of pathogens, weather and others factors which affect plants in the real time environment. Plant diseases are also referred to as "biotic stresses" and these can be bacterial, viral or fungal. When disease attacks, leaves change color to yellow, light-brown or red, or develop a distorted surface.Advances in image processing, optical identification, automation and machine learning methods enable the identification of plants and the detection of diseases affecting them in less time with minimal human intervention and effort.

There are several classification algorithms in machine learning that are used for classifying diseases in plant leaves. The classification algorithms are divided into supervised and unsupervised classification algorithms Fig. 1. Illustrates the various types of classification algorithms for plant leaf disease detection

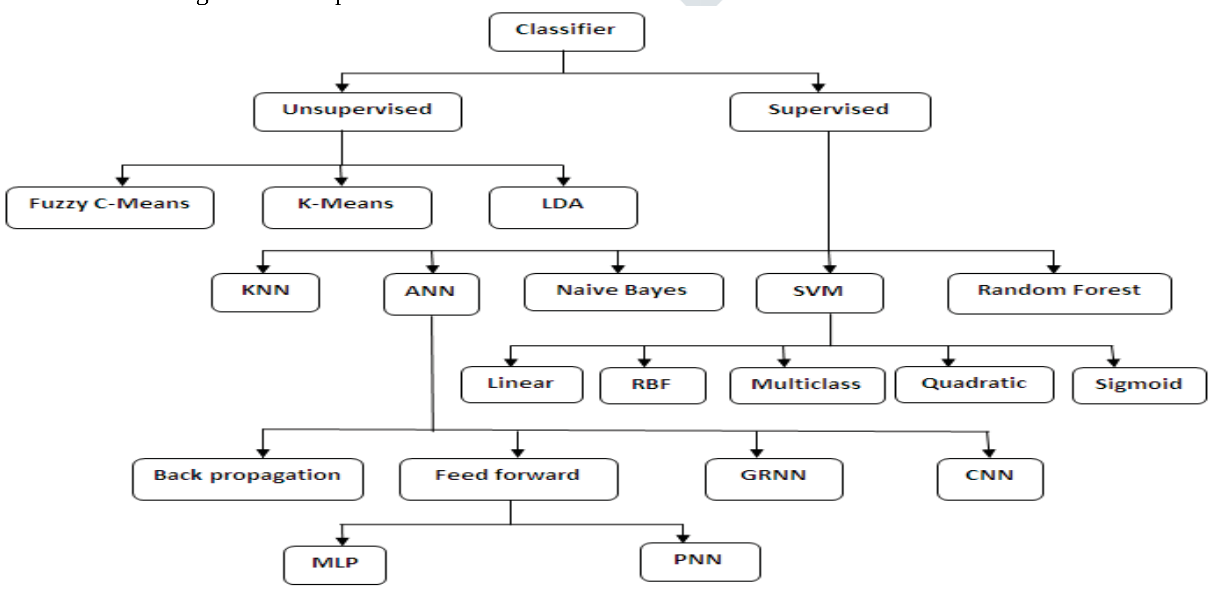

Fig. 1. Types of Classification Algorithms

A. Unsupervised Classification Algorithms

Fuzzy C-means is an iterative algorithm which helps to find the cluster centers that minimize a dissimilarity function and to handle the overlapped data efficiently. It gives better results in cases where data is incomplete or uncertain, but computation time is longer and it is sensitivity to noise. Fuzzy C-means clustering Neural Network consists of unsupervised fuzzy clustering and supervised artificial neural networks which help in achieving more optimal results with relatively few data sets. K-means is an iterative learning helps in finding the cluster centers for each group and has no guarantee for optimum solution. It is easy to implement and computationally faster. But the number of cluster prediction is difficult. Principal Component Analysis is an unsupervised technique helps in finding the most accurate data representation and maximizes the variance. Linear Discriminant Analysis finds the projection to a line and maximizes the component axes for class separation.

B. Supervised Classification Algorithms

K Nearest Neighbor is a used for statistical estimation and pattern recognition. It is easy, simple, flexible and robust to noisy training data but computation cost is higher. Artificial Neural Network uses forward propagation which is the heart of a neural network. Probabilistic Neural Network is a feed forward algorithm which is very faster and more accurate than multilayer perceptron network. Generalized Regression Neural Network is a supervised algorithm used for classification. Convolution Neural Network is a class of deep, feed-forward Artificial Neural Network which consists of input, output as well as multiple hidden layers, convolutional layers, pooling layers, fully connected layers and normalization layers. Pooling reduces the dimensionality of the features map by condensing the output of small regions of neurons into a single output. Fuzzy-Relevance Vector Machine is effective in dealing with unbalanced data and reducing the effects of noise or outliers. Relevance Vector Machine is a machine learning technique that uses Bayesian inference for regression and probabilistic classification.

In this paper we propose a machine learning algorithm based on image processing support vector machine based machine learning techniques in plant leaf disease detection.

3. A Multi-SVM based Machine Learning for Detection and Classification of leaf Diseases

The SVM provides a leading method for a supervised learning classification algorithm, Datasets with feature vectors and class labels use a supervised learning SVM, while datasets without feature vectors or class labels use unsupervised learning clusters. If the leaf input image has only two classes—healthy and unhealthy regions—then an SVM binary classifier can be applied. There are two types of SVM: linear and non-linear. The SVMs allow the drawing of a hyper plane that determines the maximum distance (margin) between the data samples of either class. If the data are distributed uniformly, then a linear SVM classifier allows a straight hyperplane to be drawn between classes. A non-linear SVM classifier is used in real-world applications where the data are scattered in various directions and have high dimensions.

Diverse machine learning approaches, the support vector machine (SVM), neural network models and clustering models help to predict specific diseases and classify various diseases from the input plant leaf images of different plants. These algorithms also explore different strategies for the quantification of disease severity in plants. Computer simulation models provide fast and accurate results, supporting increased crop productivity by reducing the frequency of monitoring and controlled measures..

The support vector machine primarily helps to detect diseases in plant to prevent the loss in product yield. The proposed work focuses on disease detection in plants in aeroponics system using image processing and machine learning techniques to attain few objectives such as: i) To detect diseased leaf, ii) To quantify affected area by disease, iii) To find the boundaries of the affected area, and iv) To determine the color and shape of the affected area, v) To build a prediction model for disease type classification. The images of various plants like tomato, potato, pepper, etc are given as input affected with diseases like cercospora leaf spot, black spot, Alternaria alternata, anthracnose, etc. Diseased region is detected using edge (sobel and morphological) and color based methods and segmented separately. Multiclass SVM is used thereby to classify type of disease.

The flow diagram of the proposed work is depicted in Fig.2.

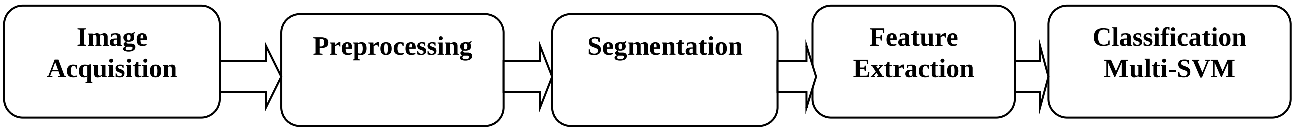

Fig 2.Process flow of Disease Detection System

3.1. Preprocessing

An image of a plant leaf is given as input to detect whether the plant is infected or not and classification is performed if the plant is an infected one to detect the disease type. In preprocessing stage the unwanted distortions are removed to enhance the relevant features in the image. The background of the image is eliminated and the median filter is used to remove noise in the given plant image.

3.2. Segmentation

Segmentation of diseased portion of the leaf is performed using edge based and color based methods. Edge based method is used to locate the pixels that match with the boundaries of objects in an image. If it is a closed boundary, then the number of objects is equal to the number of boundaries in an image. Soel bedge detection method is used for determining the edges and boundaries. Then, color based methods are used to spot the diseased region. Thereby, the preprocessed input images are color transformed from RGB image to one of the color space named as YCbCr, HSI and CIELAB color spaces. Based on the color threshold values,, the diseased part of the leaf is identified. Further K-mean clustering technique is used to segment the diseased region.

The diseased spots are detected based on the signs and symptoms. Here, Hough transform is used to detect based on shape of affected leaf spots. Majority of the disease appears to be circular or oval spots at very early stage. The Hough transform is used to find imperfect instances of objects within a certain class of shapes by a voting procedure. Since the bacterial spot is circular we use Hough transform to detect the disease. Therefore, it is easy to find circles in imperfect image.

3.3. Feature Extraction

Features extracted from the segmented region for leaf disease detection are color, texture, and shape based methods. The selected features in the diseased leaf image are extracted by color, size of disease (size of diseased spot), and distances of diseased spots from each other. Texture features (listed in Table 2) gives more responsive impact towards disease classification in addition with basic color feature values.

3.4. **Clustering Algorithm for Disease Classification**

Multi-class SVM is used to build the classifier based on the features extracted from the segmented diseased region and ground truth labels for 800 training images. The Clustering algorithm groups the data that are closely related. The clusters are based on similarity and do not predict any target class. The measure of similarity ranges from 0 to 1. Some of the similarity measurement procedures include the calculation of the Euclidean distance, Manhattan distance and cosine similarity. Clustering algorithms are used to group different types of stresses: soil-, water- or nutrient-related. The most significant clustering algorithm is the k-means clustering algorithm, which groups the data in a dataset into k clusters or centers. These centers are placed into different set of data points close to the nearest centroid. The accuracy of this method can be improved by constructing decision tables with different sets of extracted features as shown in the following Fig 3.

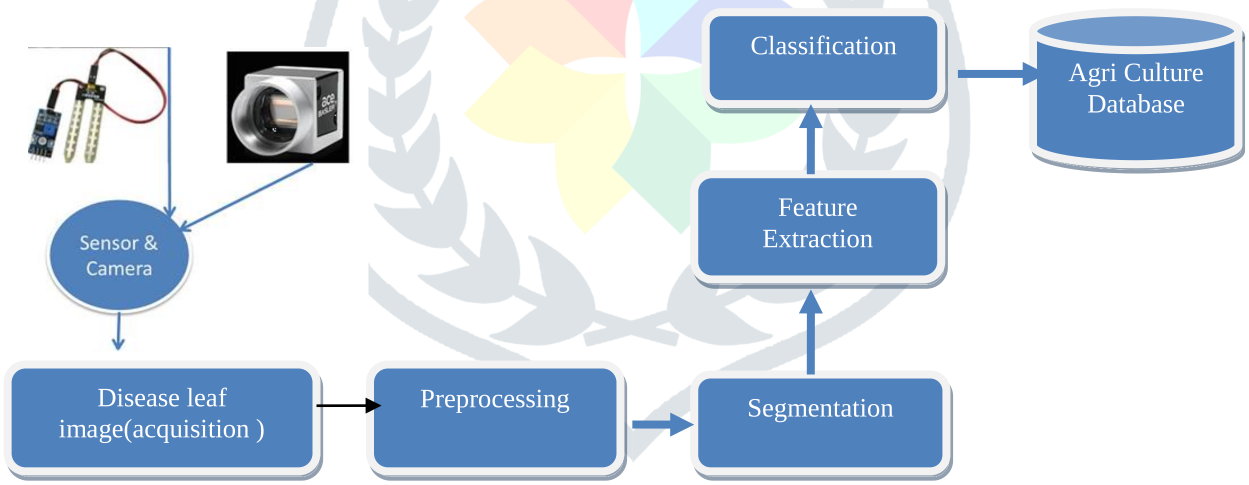

Fig.3. Flowchart of SVM based classification process

3.5. Identification of Leaf Disease

Changes in the color of a leaf are the first symptom to identify a disease in plants. Similarly, the texture of a leaf is very useful for the detection of various diseases. By processing a plant leaf image, various diseases can be detected, such as rust, powdery mildew, downy mildew and so on. To forecast and estimate the severity level of diseases affecting plants, the first step involved is to segment the infected part from a diseased leaf. The infected leaves are categorized based on the color of the leaves. The infection in the leaves will be reflected by turning the green color into yellowish or brownish or white shaded colors, with or without dots on the leaves.

The proposed disease detection and classification system , is tested with diseased leaf images of various plants like tomato, pepper, potato, etc., affected with diseases such as cercospora leaf spot, alternia, alternata, anthracnose, bacterial blight, leaf curl virus, mosaic virus and whitefly damage, which are collected from plant village dataset.

3.6. Multi-SVM Algorithm for Disease Classification

1. *Load the input image from the dataset.*
2. *The image is then enhanced using edge based detection.*

3. The diseased portion of the leaf is extracted by Hough transform (circular spots are highlighted).
4. K-means clustering method (Euclidean distance) is used to divide the image into various clusters,then the cluster which contains the majority of the diseased part has to be selected.
5. Using the color, texture and shape based features the leaf image is classified using SVM.
6. The diseased image label and the dataset label is compared to evaluate the performance

4. Conclusion

In an aeroponics system the timely detection and protection of plants from diseases plays a vital role in a farmer's life towards improving the yield. In such case, accuracy of disease detection can be improved using image processing and machine learning techniques. Image processing techniques are used to effectively segment the diseased portion of the leaf image using color and edge based segmentation by applying K-means clustering and thresholding. Further the diseased spots present are accurately detected using Hough transform. Features extracted from the diseased portion are classified to identify the disease at an earlier stage, for known diseases like cercospora leaf spot, alternia, alternata, anthracnose, bacterial blight, leaf curl virus, mosaic virus and whitefly damage. The diseased region identification on plant leaves showed accuracy of higher than 90% in tomato and pepper plant, and the overall classification accuracy was 65%. As all the features extracted across diseases caused by the various pathogens were similar and difficult to discriminate, it results in misclassification. This paper gives an insight to detect a variety of plant diseases for different plant species in aeroponics. Moreover, various machine learning classifiers are used to compare the results. It is verified that Multi support vector machine Classifier provides highest accuracy for almost all plant types with minimum or large dataset collected. Thus, the system will be useful for cultivators to recognize the malady in yield for better cultivation. In future proposed work, classifiers could be modeled for disease caused by each of the pathogens individually based on its symptoms. Ensemble approach or hybrid approach can be used to combine the decision of individual class models. Thus, the system will be useful for cultivators to recognize the malady in yield for better cultivation.

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Author Profile

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