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HYBRID IMAGE PROCESSING TECHNIQUE TO DETECT PLANT DISEASE USING IOT

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***ABSTRACT**-- Agriculture is the foundation of economy of Indian government. There Is necessity of a great deal of creation of harvests to satisfy the need of Indian populace. In light of illnesses, huge measure of yield generation is diminished. There are different sorts of infections on the plant leaf that causes issue being developed of yields. Human eyes are less more grounded to see the leaf maladies so people don't watch variety in the contaminated piece of leaf. These ailments some of the time may not be unmistakable to human eyes and they legitimately influencing to the harvest. The programmed ailment identification framework is utilized to programmed location and recognize the infected part on the leaf pictures and it characterize plant leaf sickness utilizing picture preparing procedures. Some significant advances are utilized for recognition like element extraction, division and grouping leaf pictures for effective infection discovery by utilizing IOT and for characterization of pictures we are utilizing the hereditary calculation.*

***Keywords**-- IOT, Image Processing, clustering, segmentation, disease detection*

I. INTRODUCTION

Agriculture is the essential source and backbone of Indian villagers. Most of the Indian population depend on the agriculture. Identification of disease in the plant is most extreme requirement for ranchers and rural specialists [1]. The principle point of the proposed framework is to identify plant illnesses utilizing IoT. In the majority of the plants the malady commencement happens on plant leaves [2]. Consequently, in the proposed work they considered location of plant infection present on leaves. The separation of ordinary and influenced plant leaf can be estimated dependent on variety in temperature, mugginess and shading. This part gives a portrayal about the improvement of a financially savvy and moderate brilliant cultivating model that can distinguish plant infection ahead of time and offer warning to ranchers with the goal that therapeutic moves could be made.

This model is planned utilizing the Arduino. Arduino is associated with a camera that can be utilized to recognize and analyse the plant malady in the field [3]. The picture gathered is moved to cloud and a Web-based framework has been created to enable the ranchers to screen the status of their plants in the field. The advancement of such a savvy cultivating plant malady location framework will enable ranchers to be able to recognize sickness at beginning time which will limit the loss of yield because of the out and out flare-up of the infection in their field [5]. The image getting from image acquisition will process and then it is sent to MATLAB and then it processes of handling begins with catching of computerized high-goals pictures. At that point images are applied for pre-

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processing for picture improvement. Caught leaf pictures are fragmented utilizing k-means bunch strategy to make groups. At long last, infections are perceived by this strategy. In this paper segment one gives a presentation and significance of disease recognition. Area two gives a plant illness key. Segment three brisk writing surveys of leaf ailment recognition methods. Segment four portrays philosophy of anticipated framework dependent on MATLAB picture handling. Area five gives results and discourse. Area six finishes up this paper alongside future work. Internet of Things and Image processing have been used in various applications [6-8]. Image feature, for example, size, shading, shape and surface are extricated from the sickness and give arrangement, which will be meet to explicit conditions. SVM and K-NN utilized for characterization of pictures and its ailments. This extensive control framework vital estimates diminishing the event of plant infection and guarantee quality and precision of discovery [9]. Utilization of IoT can consequently identify and record the provincial climatic data, temperature, mugginess, dampness, and more data identified with ecological data and to obtaining of plant unhealthy leaf pictures. Discernment, solid transmission, insightful preparing are essential thorough highlights of IoT.

II. INTERNET OF THINGS (IOT)

Internet of Things is 20 years old and was introduced by Kevin Ashton in 1999. He was working on supply chain optimization at Procter and Gamble [10]. The thought of connected device was longer around 70s those days it was called as “Embedded Internet” or “Pervasive Computing”. Ashton pull out his idea on another innovation called RFID. Internet was most smoking new design in 1999. So, Ashton called this innovation as “Internet of Things”.

III. IOT APPLICATION IN AGRICULTURE

2.1 Working with Smart Irrigation System using IOT

Smart irrigation system includes hardware’s like soil moisture sensor, Arduino UNO, WIFI Module, Pump and Motor. Software like Arduino IDE, SQL.

As the soil moisture sensor are placed in the agricultural field [2]. The information received from the sensor is sent to the board. According to the information the board sent data to the motor to switch ON/OFF [4]. This system is automatically activated when the moisture of soil is low. And according to the information received the pump is switched ON [10].

2.2 Fertilization using IOT

Fertilization depend on the soil nutrient. As the soil nutrient is good no fertilizer required to the plant. If the soil nutrient is low the fertilizer is most required to stable the plant. As this is the hand work for the farmer to check the fertilizer of each plant at presence of there. Therefore, the IOT plays most important role in the agriculture field that it checks the soil nutrient by the sensor and even sends the information to the farmer. This is done using the sensor like soil moisture and pH sensor. Mainly the soil nutrient contains the Nitrogen(N), Phosphorus(P) and Potassium(K). The pH sensor holds a threshold value which is like 0-14 where 7 is neutral [11]. Range below 7 is acidic and above 7 is alkaline. As the pH sensor send the information as per the received information the board collects data and store it in the cloud and even sends the information to the farmer by the SMS or MMS.

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2.3 IOT in Plant Disease Detection

Monitored the diseases at early stage by using the sensors like temperature, humidity and soil moisture after that it will provide recommendation about disease and its fertilizers. The train and test dataset are used. In train dataset there are number of images were taken for training and some sample images for testing. After testing phase, the dataset is match with the train dataset image with the tested sample images. Here the MATLAB is used for comparing the images with the neutral images which are not affected with any diseases. The image getting from image acquisition will process and then it is sent to MATLAB and then it processes of handling begins with catching of computerized high-goals pictures. At that point images are send for pre-processing to get picture improvement [3]. Caught plant leaf pictures are fragmented utilizing K-Means bunch strategy to make groups. At long last, infections are perceived by this strategy. Segment four portrays philosophy of anticipated framework dependent on MATLAB picture handling. Area five gives results and discourse.

2.4 Weather Condition Prediction

Weather plays an important role for farming. Having inappropriate information about climate heavily disintegrates the amount and quality of the crop generation. But the solutions of IOT empowers to know the actual weather conditions. In the agriculture field the sensors are place in and out of the field. So that the data is collected from the environment where it is used to pick the perfect harvests which can make and support in the explicit weather conditions. The whole system of IOT is made of sensors where it can detect actual weather conditions like humid, rainy, temperature and with precisely [13]. There are many sensors available to detect these parameters and configure as per your suit for smart farming requirement. The sensors placed are monitored the condition of the crops and the climate surrounding it. If any disturbance is found in the weather, they send an alarm to the farmer. In these the farmer is not required to present in the field. Farmer will automatically will get the notification and according to notification the farmer has to react and take action [14]. Due to this it will eventually increase the profitability and help the farmers to collect more agriculture advantage.

2.5 Smart Greenhouse

The smart greenhouse is an IOT system where it automatically adjusts the climatic condition as per the situation. IOT in a greenhouse has absence the human invention. This entire process is cost effective and increasing accuracy at the same time. The sensors placed in the greenhouse sends the real time data which helps in monitoring the greenhouse. The sensors provide the data like water consumption, light level, humidity, temperature and pressure. This all works automatically as per the situation like if in the greenhouse the water consumption is less it will start the motor as per the notification from the sensor [14]. If the light level is less. It will switch ON the light for the plants to give the better product as expected. Due to this the human effort has been reduced that it will automatically complete its task whenever it is necessary. The smart greenhouse will not have any human effort to monitor the field day night. All things will be monitored by IOT [15]. And it will send all the information in cloud that if the farmer is not at that place then farmer can access it from anywhere. This all process is using the IOT implementation and it will provide the better accuracy that it will not harm the crops. The smart greenhouse is a revolution in agriculture using IOT. Smart Greenhouse has better irrigation system that if any required of water to

the particular plant then that particular plant will get the water using smart irrigation system. the sensor has to send the notification and as per the sensor notification the whole process will work accordingly.

2.6 Management of Crop Cultivation using IOT

Due to the global warming many plants get affected and could not provide the better crops. As per this the farmer has to check each and every plant for the better crops. Sometimes farmers will not have any particular solution for the particular affected plant and due to that the plant will get dried and not useful 14]. For this the IOT comes with the solution that it provides better accuracy for the crops by placing a sensor. The sensors which are placed will provide the notification of temperature, humidity, pest detection, level of water and detection of weed. As the sensor get the data and forward it to the cloud as per the notification the action is carried out. If the sensor sends data of pest efficiency, then the as per the notification the farmer has to provide the pest and if the notification got as weed detection then according to that the following action will be carried out [13]. If the water level is less the sensor checks the water level and sends the notification to the farmer. It even checks the temperature, humidity. If the humidity is beyond the threshold value it will raise an alarm and warn the farmer according to it [15]. Smart Management of crops provide the best accuracy and less human effort and it is very cost effective that farmer can use it. In this system crops can be maintained well and it will be monitored continuously so that if any disturbance occurs it will send direct alarm to the farmer itself.

2.6 Cattle Monitoring and Management using IOT

Cattle monitoring and management is as same as the crop management. There is an IOT device which will be attached to the animals in the farm that it will monitor the health of the animal. This device mainly monito the temperature, health, activity of the animal and its nutrition. The device will be attached individually to the cow that whenever the cow is in unhealthy [14]. It will buzzer an alarm to the farmer that particular animal is in bad condition. If the cattle are in not at the place and the farmer wants to know the location, then farmer can easily find the location of the particular animal. The device will be monitored continuously that whenever the animal is in bad condition the device provide a notification about the particular animals [15].

IV. IMAGE PROCESSING IN AGRICULTURE

Prosperity watching and illness acknowledgment on plant is fundamental for sensible cultivating. It is hard to screen the plants ailments physically. It needs goliath proportion of hard work, aptitude in the plant's infirmities, and besides require the absurd taking care of time [1]. Thus, picture processing is used to recognize the plants infections. Agricultural picture preparing is one of the gigantically inventive and basic picture handling regions perceive. Since there is an immense scope of related in subdomain it is having the consideration of the looks into. Just as, it is additionally investigated the acknowledgment model with a more extensive view [5]. Truth be told, the applications towards farming produce the earth perception information which supports expanding territory under yield power and profitability. It is finished with two techniques that are advanced and furthermore simple [7]. Particularly, the picture examiner uses a few rudiments of comprehension while utilizing a portion of the picture systems. Strategies utilized in image processing are:

- Image Acquisition
- Image Pre processing
- Image Segmentation
- Feature Extraction
- Classification

3.1 IMAGE ACQUISITION

Stacking of a picture is that the primary method of automated image methodology and it's addressed as getting the image through cutting the edges of the picture and reserve it in mechanized media format for extra MATLAB undertakings [5]. In their work, using camera they tend to got strong and debilitated images of leaves and natural item two for MATLAB picture getting ready structure [8]. This image will be in RGB (Red, Green and Blue) arrangement.

3.2 IMAGE PRE-PROCESSING

The main motive for image pre-processing is to improve the image format containing undesirable defects [1]. Pre-processing method uses many techniques such as dynamic size and shape of the image, noise reduction, image transfer, image enhancement [5]. Colour images have primary colours red, green and blue. It is hard to apply the applications using RGB because of its range that is 0 to 255. For that the RGB image is convert into the grey images.

3.3 IMAGE SEGMENTATION

Segmentation means dividing picture into many bit of identical features or having some related to it. The division should be conceivable using various systems like k-mean batching [7]. Segmentation of picture is that the strategy for change of automated picture into many fragments and manifest of an image into something for examination. The k-means bunch algorithmic principle is applied to characterize the articles into K assortment of classes per set of highlights [8]. The grouping is finished by limit the absolute sequence of separations among data substances and in this manner the specific group.

3.4 FEATURE EXTRACTION

Feature extraction accept a huge activity for separating verification of a thing. Surface suggests how the concealing is passed on in the image, the brutality, hardness of the image [1]. It can moreover be used for the distinguishing proof of corrupted plant areas [2] [3]. These methods are useful when image sizes are big [4]. Feature Extraction is a technique where it is capturing the visual content of pictures for indexing & retrieval. In these it is mention of an application of gray level co-occurrence matrix (GLCM) to extract the motion estimation of images [5]. The main algorithm for feature extraction is the GLCM. Its functions are to characterize the texture of a picture by calculating the pairs of pixels with specific values and specified spatial relationship occur in a picture.

3.5 IMAGE CLASSIFICATION

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After the feature extraction is done, the classification of image is carried out where it uses the algorithm like SVM, Random Forest, Otsu's classifier and KNN. These all classifier classify infected images. After that it will compare to get the result and forward it to the disease name.

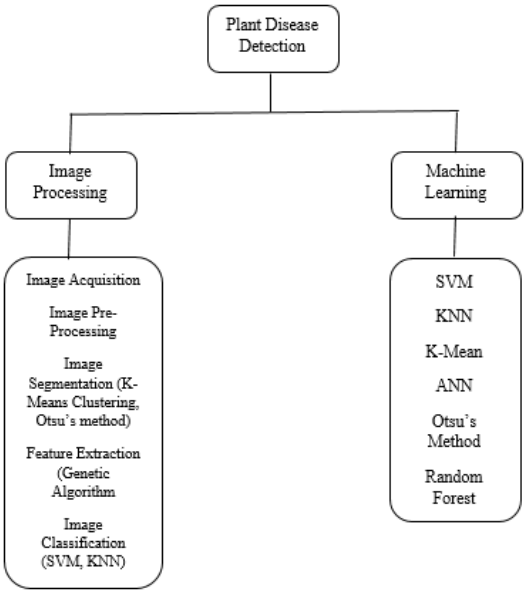

Figure 1: Plant disease detection using image processing

Arrangement system is accustomed to instructing and testing the leaves of the plants. The Random forest classifier is utilized for characterization. Portrayal of remotely distinguished data is used to name contrasting levels concerning packs and homogeneous characteristics, with the purpose of isolating various articles from each other inside the image [8]. The level is called class. Request will be executed on the base of awful or unpleasantly portrayed features, for instance, thickness, surface, etc in the segment space.

Nilam R. Thorat et al have monitored the diseases at early stage by using the sensors like temperature, humidity and soil moisture after that it will provide recommendation about disease and its fertilizers. They used train and test dataset. In train dataset there are number of images were taken for training and some sample images for testing. After testing phase, they tried to match the train dataset image with the tested sample images.

After that disease images foreword to the pre-processing phase. In the Pre-processing phase k-means clustering is used for cluster the image into number of parts and then that parts will be classified by using SVM classifiers. Edge detection is done by using the genetic algorithm and then it will give effective results. They have evaluated three objectives of this philosophy work like monitoring, detection and quality of services [1]. Colour images have colours like red, green and blue. It is hard to apply the applications of RGB because of their range that is 0 to 255. For that They convert the RGB images into the grey images for better accuracy and better response from the system. Abirami Devaraj et al they have used the image processing techniques for detection of disease and the fruit grading in plant. They also use K-Means cluster methodology and GLCM (grey level co-occurrence matrix) for extracting the feature and at last they have used Random forest algorithm is used for image classification. They provide less time taking solution [2]. Apeksha Thorat et al deployed the sensors like soil moisture sensor, Temperature sensor, Humidity sensor. They deployed the camera for finding the diseases on a leaf. Information got from the sensors are send to the Raspberry PI. They created a server where the data is checked and compared

with the values got from a data like a temperature, humidity and soil moisture sensor value [4]. If any difference phased from the given threshold value then SMS is sent to the farmer on mobile phone. The farmer gets full information about the crop and even the atmosphere of the farm from wherever needed [3]. Rajesh Yakkundimath et al The data collected from these sensors are sent to the Arduino UNO kit from which the information platform for analysis. They have used the www.thingspeak.com as a cloud platform. The data collected are compared with the dataset in order to get whether the leaf is normal or affected [4].

Muhammad Hanif Jumat et al [5] they have designed the system using the combination of the Raspberry PI and Arduino UNO where Raspberry PI is connected to a camera that can be used to detect and diagnose the plant disease in the greenhouse. The data collected are transferred to the cloud and they have developed a web-based system where the farmer can monitor the status of the plants in greenhouse. The most important feature of this system is its ability in categorising the Septoria plant disease by using the machine learning algorithm such as support vector machine (SVM), KNN classifier, Random forest classifier, Naïve Bayes and logistics regression. Sachin D. Khirade et al [6] uses the technique of image processing for detecting the disease on the plant leaf. The images are caught by camera and the images will be in the form of RGB (Red, Green and Blue). As the image is captured, to remove noise or another object removal. Thy have used the equation for converting the RGB image into the Grey image:

f(x)=0.2989*R+0.5870*G+0.144*B …… (1) image segmentation partitions the image into numerous parts with same feature. They have used the methods like Otsu' method, k-means clustering, converting RGB images into HIS model. They also use K-Means cluster methodology and GLCM (grey level co-occurrence matrix) for extracting the feature and at last they have used Random forest algorithm for image classification.

Qualities of service	Algorithm
Precision, recognition of diseases	k-Means, Feature classification, Neural N/W
Matching percent and Misclassification rate	Segmentation, threshold Methods
Classification rate	KNN, Adaptive Bayes Classification,
Disease matching Accuracy	Analytical discriminative techniques
Accuracy in detection	SVM Classifier, Minimum distance criterion
Accuracy in classification	SVM and spectral vegetation indices
Precision of classification and detection, time speed for computation	Otsu's Method, KNN clustering and classification
Analysis, identification, precision, recall	IOT, Hidden Markov Model (HMM)
True noise calculation	Gamma coefficient calculation, Robust procedure method
Detection of plant disease	k-Means algorithm, ANN, SVM
Monitoring and Recognition rate	Fuzzy reasoning and fusion, Apriori, IOT

Table 1: Quality services and its algorithm

Proposed Techniques	Classification	Detection Accuracy
Image processing technique	Neural Network	93%
Support Vector Machine	Automatic non-linear classification	86%
1) Framework for detection of plant leaf/steam disease. 2)K-mean technique	k-nearest neighbors	85%
Image segmentation algorithm	Pixel Classification	70.04%
local data-dependent class interaction models	1) Adaptive Bayes classification. 2) k-nearest neighbors used for pixel classification	90%

Table 2: Detection Accuracy

For detection Four stages are used

- In the first stage the colour conversion of the images is found.
- In second stage it is segmented by using k-means clustering algorithm.
- Third calculates the texture feature from the segmented parts then finally matched the parts through the neural network.
- By using the image processing techniques fast and automatic detection is done of the leaf disease by using IOT [1]

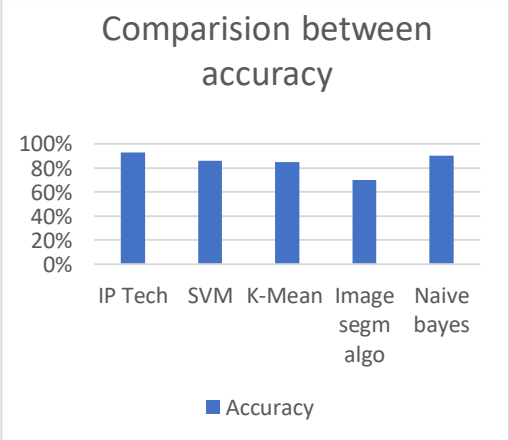

Figure 2: Comparison of accuracy level

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V. TYPES OF DISEASE

5.1 BACTERIAL DISEASE SYMPTOMS

This is the disease where the leaf gets spot with yellow halo and it mainly occur in warm, humid, rainy environment [2]. This disease makes leaf a water soaking due to the bacterial disease [8]. The leaf will be like canker form and make crown gall which enters the plant through wounds in roots or stems and make the plant grow in disorganised way.

Figure 3: Bacterial Disease

5.2 FUNGAL DISEASE SYMPTOMS

Fungal disease makes the dark spot [2] in the leaf and most noticeable impact of illness on the plant [3]. This disease changes the shading, shape of the plant and this are done due to the plant is sick and this disease make the plant in unstable condition [8].

Figure 4: Fungal Disease

5.3 VIRAL DISEASE SYMPTOMS

Among all plant leaf diseases, these diseases are most tangled to investigate. This disease will change the pattern of the leaf like mosaic leaf pattern and it make the leaves in crinkled form [8]. This disease converts the

Figure 5: Viral Disease

System proposed	Techniques	Accuracy
1	NN (Neural Network)	90%
2	Pixel Transformation	78%
3	KNN and adaptive byes	86%
4	Image Process	78%
5	SVM (Support Vector Machine)	91%
6	NN/ Fuzzy algorithm	83%
7	HMM (Hidden Markov Model)	90%
8	K-Means	89%
9	KNN (K-Nearest Neighbor) + ANN (Artificial Neural Network)	86%
10	K-mean + ANN	90%

Table 3: Proposed Techniques Accuracy

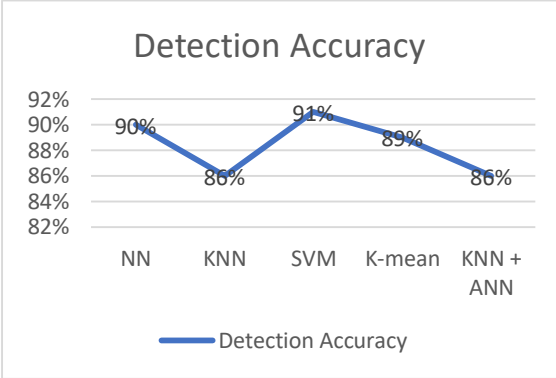

Figure 6: Detection Accuracy

The above figure and table show the methodology and the detection accuracy of the system. where these algorithms are used for detecting the disease in the plant. These algorithms are used for segmentation and classification of the image which gives the exact detail of the disease and provide accordingly accuracy. KNN and SVM are used for classification of the image whereas, k-mean is used for segmentation of the image.

VI. CONCLUSION

In this paper, we have sort out various methods and classification for plant disease detection system using image processing and IOT. Main disease like Fungal disease, Bacterial disease and Viral disease with their symptoms is discussed. Image processing technique is used using MATLAB for identifying the diseases. This paper also includes the early stage detection of a plants and also to diagnose the disease occurring in the plants. Using IOT the farmers gets the notification of the disease occurs in the plant in the phone or the server created by him/her. The data are stored in the cloud to get access at anywhere required. The algorithm like SVM, KNN, K-mean are used for getting the better accuracy while detecting the disease using the image processing.

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