Leaf Disease Detection Using Image Processing Technique and IoT

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***Abstract*: The agricultural sector is the backbone of our country, because 90% of the population depends on crop production. In this article, we discussed the use of image processing techniques to detect leaf diseases. For image analysis, the k-means clustering algorithm is used. The main objective of this paper is to identify the disease affected area of the leaf at the earlier stage and to prevent the larger farms. In agricultural research, leaf disease detection is a necessary and important topic, because it has the advantage of monitoring crop forms in the field, so the disease symptoms can be automatically detected by this method. This article provides the best way to detect the percentage of leaf affected by disease and provides the information to the farmers at early stage through the IoT system. In this article, we have done this process for paddy and sugarcane leaves simultaneously, and the percentage of affected areas are identified. It will reduce the cost of pesticides and other products. This will lead to an increase in agricultural productivity.**

Index Terms: Leaf Disease, Image Processing, K-Means Clustering, Arduino, Wi-Fi Module, Think Speak.

I. INTRODUCTION

India is famous for its agricultural production. Most of the population lives on agriculture. Farmers have many options to grow crops in the fields. Nevertheless, the cultivation of these crops in order to obtain the best harvest and the best production quality is done through technical means. Therefore, technology can be used to increase yield and improve quality. Generally, whenever a plant disease occurs, we can say that leaves are the main indicator of plant disease. These diseases are due to lack of nutrients and minerals. Some are due to climatically changes and some are due to micro-organisms such as bacteria, virus, fungus, etc. In most cases, due to disease, we can see spots on its leaves. However, when the plant has a large amount of disease, the entire leaf will be covered by disease spots.

The Internet of Things (IoT) is the connection of physical devices, vehicles, household appliances, and other items embedded in electronics, software, sensors, actuators, and networks, allowing these items to attach and exchange data, creating opportunities for more direct mergers to enter the physical world based on Computer system, thereby reducing human intervention. By 2050, the global population will reach 9.6 billion. Therefore, to feed such a large population, agriculture must adopt IoT technology. The demand for more food must be met to cope with challenges such as severe weather conditions and detailed farming methods. Smart agriculture based on the Internet of Things technology has increased agricultural crop yields.

The detection of plant diseases is an urgent need for farmers and agricultural experts. The main purpose of the proposed system is to use the Internet of Things to detect plant diseases. In most plants, the disease occurs on plant leaves. Therefore, in the proposed work, we considered detecting plant diseases on leaves. The difference between normal and affected plant leaves can be measured based on changes in temperature, humidity, and color.

II. IMAGE PROCESSING METHODOLOGY:

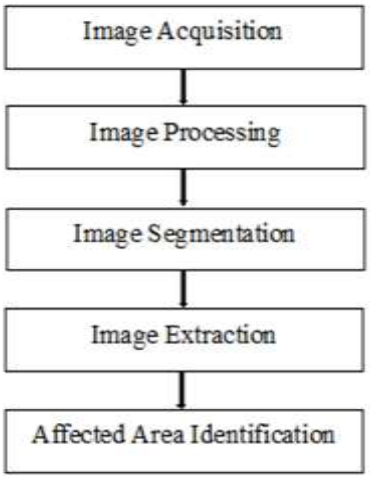

Fig.1 Flowchart for the proposed system

IMAGE ACQUISITION:

The image acquisition stage involves pre-processing, such as scaling. First, RGB color images of the leaves are taken with a digital camera with the required resolution to obtain good quality. The construction of the image database obviously depends on the application.

IMAGE PREPROCESSING:

Image pre-processing is one of the simplest and most attractive areas in digital image processing. Basically, the idea behind the enhancement technique is to bring out the details that are occluded, or just to highlight certain features of interest in the image. A common example of enhancement is when we increase the contrast of an image because it looks better.

IMAGE SEGMENTATION:

Image segmentation is the process of separating or grouping images into different parts. There are many different image segmentation methods, from simple threshold method to advanced color image segmentation method. These parts usually correspond to things that humans can easily separate and view as a single object. Generally speaking, the more accurate the segmentation, the greater the probability of successful recognition. The segmentation step finds the infected area. Segmentation can be done mainly through k-mean clustering and edge detection algorithms. Here, we used k-means clustering for segmentation. First convert the RGB image to a laboratory format. Then after reshaping the image k-means clustering is applied to the images. The next step is to extract the useful segments.

IMAGE EXTRACTION:

After segmenting the infected area, various features are extracted to describe the infected area. HSV color and texture features are used for area description. HSV color features are important for perceiving the image environment, recognizing objects and conveying information. Texture is one of the most important features, which can be used to classify and recognize objects.
The gray level co-occurrence matrix is a statistical method. It is an ancient and used feature extraction method for texture classification. It has always been an important feature extraction method in the field of texture classification. It calculates the relationship between pairs of pixels in the image. Texture features can be calculated from the generated GLCM, such as contrast, correlation, energy, entropy, and homogeneity. By calculating skewness, standard deviation, homogeneity, contrast, smoothness, correlation, kurtosis, energy, entropy, mean, variance, RMS and IDM.

III. HARDWARE METHODOLOGY:

The main objective of this project is the detection, identification of the affected area of leaf diseases using image processing technique and all information about the disease is sent to the farmer's mobile phone through IoT. In this system we are using Arduino with Wi-Fi Module to detection the leaf disease. Using Think speak platform the affected area percentage is sent to the farmers by which the disease spread can be identified and destroyed at the very beginning stage.

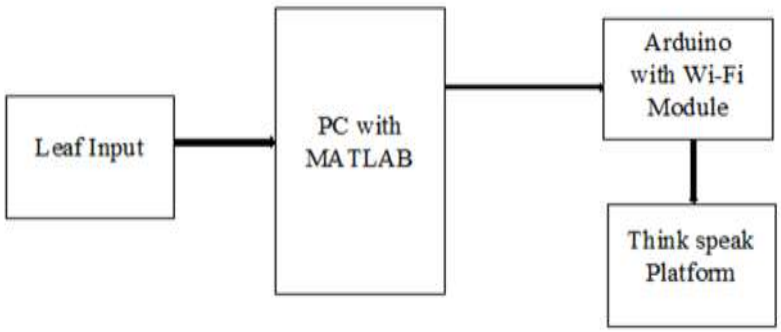

Fig.2 Block Diagram of the Proposed System

IV. ARDUINO:

Arduino Uno is a microcontroller board based on the 8-bit ATmega328P microcontroller. Together with ATmega328P, it consists of other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (6 of which can be used as PWM outputs), 6 analog input pins, a USB connection, a power barrel jack, an ICSP connector, and a reset button.

V. WI-FI MODULE ESP8266:

The ESP8266 module is only suitable for 3.3V, any voltage exceeding 3.7V will kill the module, so please pay attention to your circuit. The best way to program ESP-01 is to use an FTDI board that supports 3.3V programming. If you don't have one, it is recommended to buy one, or you can use an Arduino board temporarily. A common problem that everyone faces when using ESP-

01 is the startup problem. This module consumes a bit of power during programming, so you can use the 3.3V pin on the Arduino to power it, or just use a voltage divider. So, it is important to make a small voltage regulator for 3.31v that could supply a minimum of 500mA.

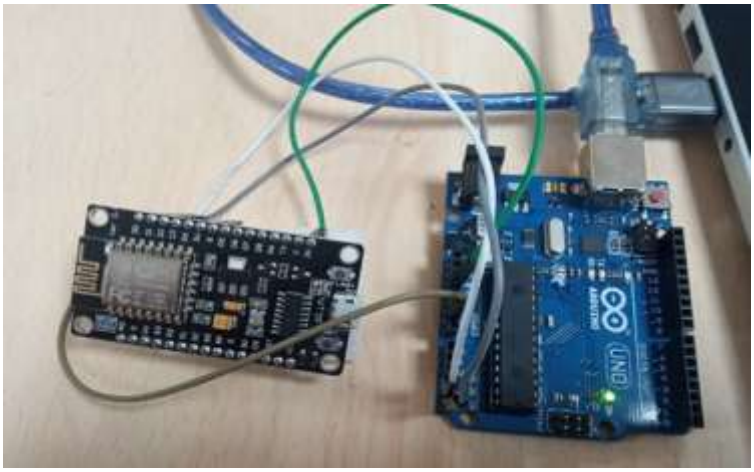

Fig.3 Hardware Setup

VI. THINK SPEAK PLATFORM:

Thing Speak is an IoT analytics platform service that allows you to aggregate, visualize and analyze real-time data streams in the cloud. Thing Speak provides instant visualization of the data posted to Thing Speak by your device. With the ability to execute MATLAB code in Thing Speak, you can analyze and process data online as it enters. Thing Speak is usually used for prototyping and proof of concept of IoT systems that require analysis.

The Internet of Things (IoT) describes an emerging trend in which a large number of embedded devices (things) are connected to the Internet. These connected devices communicate with people and other things, and often provide sensor data to cloud storage and cloud computing resources, where the data is processed and analyzed to obtain important insights. Inexpensive cloud computing capabilities and increased device connectivity are driving this trend.

VII. RESULT AND DISCUSSIONS:

PADDY LEAF:

Fig. 4 Paddy Leaf with Disease

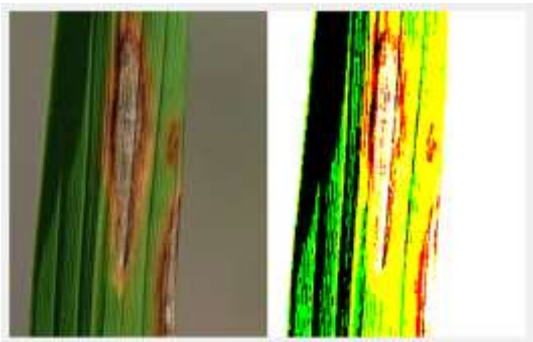

Fig.5 Otsu Binarization Image of Paddy Leaf

Fig.6 Contrast Enhanced Image of Paddy Leaf

Fig.7 K-Means Clustering Image of Paddy Leaf

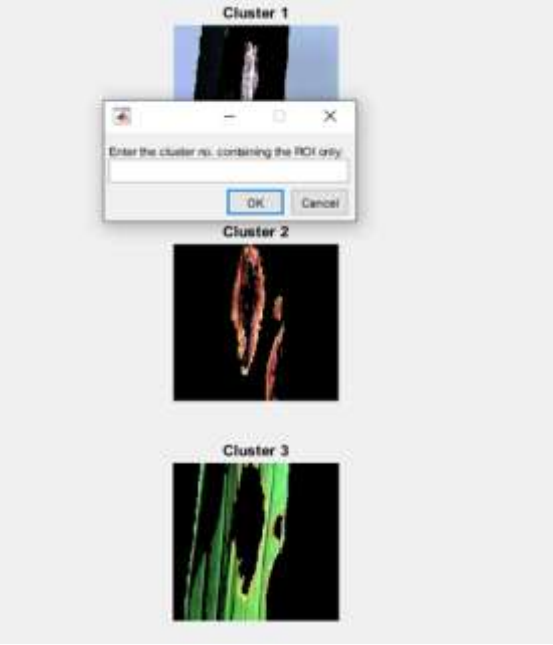

Fig.8 Disease Detecting Cluster Image of Paddy Leaf

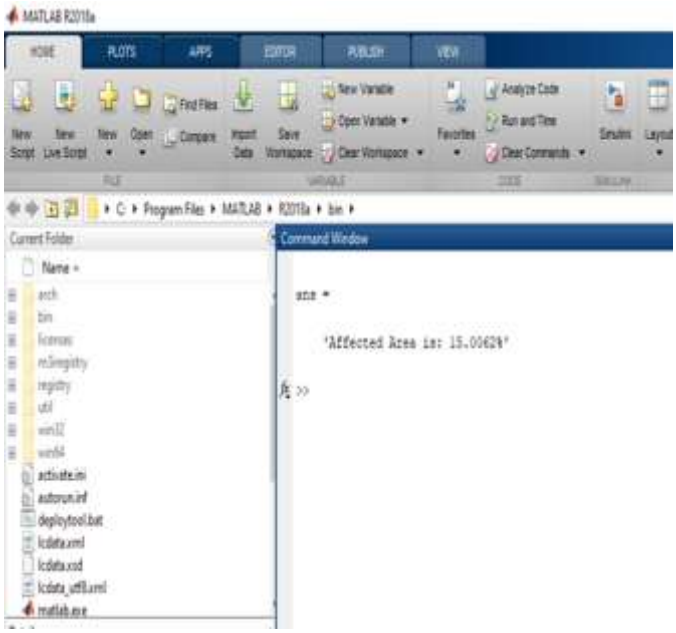

Fig.9 Disease Percentage Determined for Paddy Leaf

SUGARCANE LEAF:

Fig.10 Sugarcane Leaf with Disease

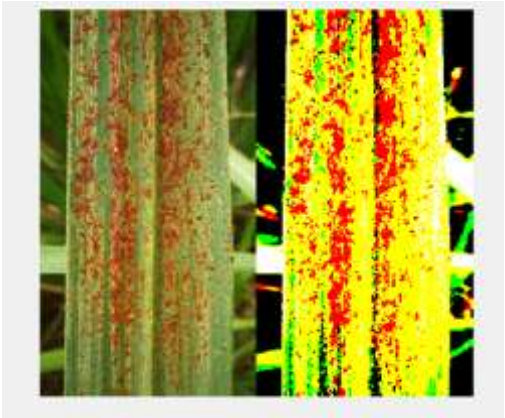

Fig.11 Otsu Binarization Image of Sugarcane Leaf

Fig.12 Contrast Enhanced Image of Sugarcane Leaf

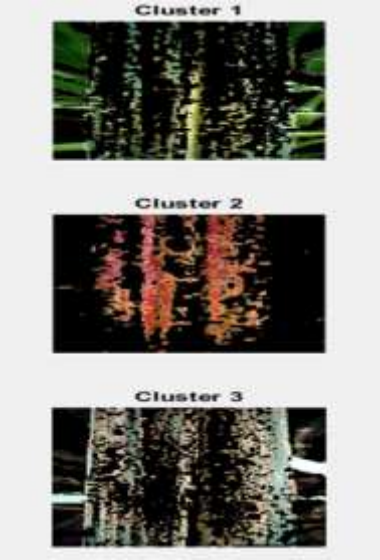

Fig.13 K-Means Clustering Image of Sugarcane Leaf

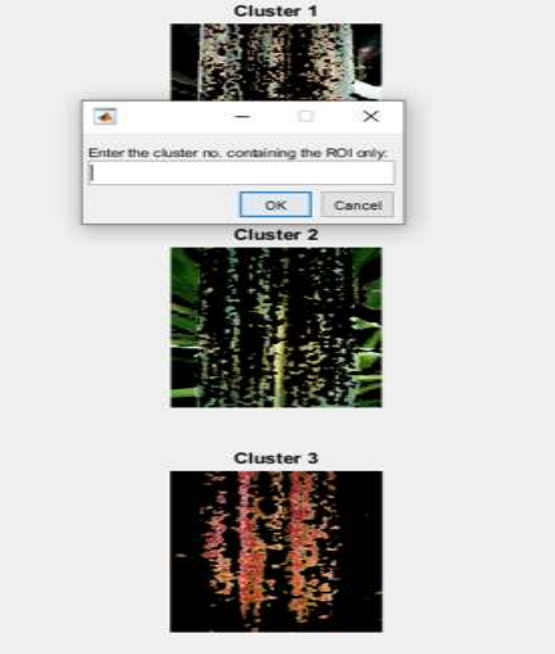

Fig.14 Disease Detecting Cluster Image of Sugarcane Leaf

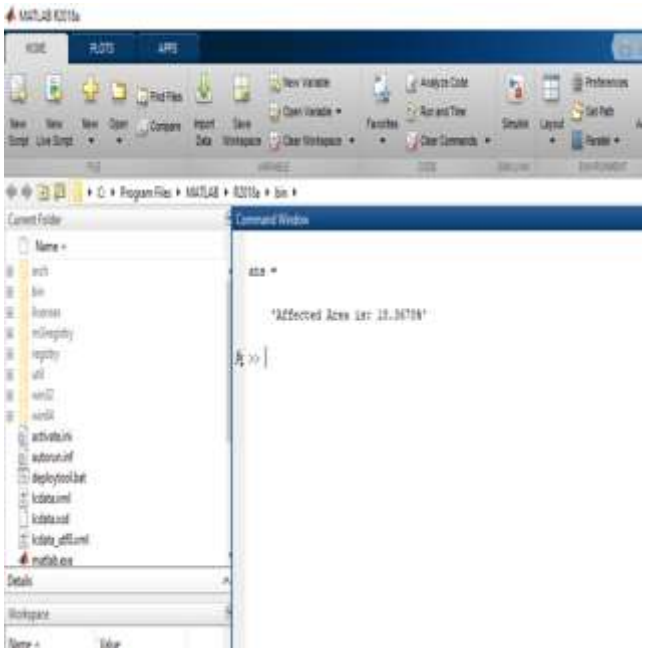

Fig.15 Disease Percentage Determined for Sugarcane Leaf

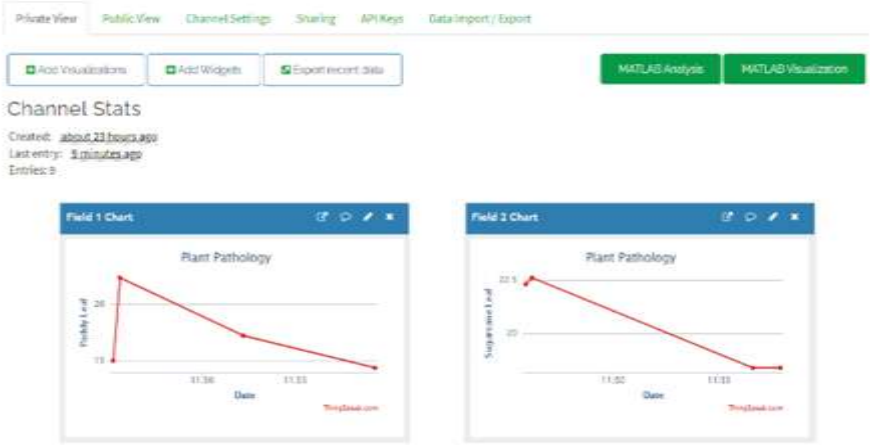

Fig.16 Think speak Output

VIII. CONCLUSION & DISCUSSION:

The main objective of this system is to identify the percentage of disease affected areas in paddy and sugarcane leaves by image processing techniques. The experimental results indicate the proposed approach is used to identify the disease affected areas with a little computational effort. By this method, the leaf diseases can be identified at a very initial stage and the necessary measures can be done at the field earlier. By this method, the nearby plants can be saved with will reduce a huge loss in the field.

By using IoT system the information of disease affected area are updated to the farmers frequently at a very minimal cost. To improve disease identification rate at various stages, the training samples can be increased with the optimal features given as input condition for disease identification and fertilization management of the crops.

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