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Crop Disease Detection and Monitoring System

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Abstract*: Plants are liable to diseases that affect the growth of the plant, which successively affects the economy of the farmer. The symptoms of plant diseases are discernible in parts of a plant such as leaves, stem. Using an automatic disease detection system helps in early-stage detection and allows to treat the plant, thus preventing loss of crop. So, in our proposed system, we have introduced a crop disease detection and monitoring system. Disease detection is done using K-means clustering. Other subsystems include periodic monitoring of the temperature, humidity and soil moisture content. Based on the input of the soil moisture sensor, the motor is switched on and off for watering the plants. The actions taken are recorded and sent as a message to the farmer using the Wi-Fi Module.

***Keywords*: Disease Detection, Remote Control, Image Processing, Internet of Things**

I. INTRODUCTION

One of the important sectors of the Indian Economy is Agriculture. Employment to almost 50% of the country's workforce is provided by the Indian agriculture sector. Almost 70% of the population depends upon agriculture and 80% of the farmers are small-scale and/or marginal farmers. India produces almost 275 million tones of food grains, accounting for 16% GDP and 20% export. One of the reasons that disease detection in plants plays an important role in the agriculture field, is because there is almost a 50% of crop loss due to diseases in the plants and lack of proper monitoring.

In the early days, detection and cure of plant diseases were done by the expert person in the field. Monitoring of the diseases requires a tremendous amount of work and processing time. A large number of farmers use pesticides to protect the plants from diseases. These chemical pesticides used to cause more harm than good, as it harms other organisms that aid in agriculture. The overdose of pesticides can harm the crops as well as human beings.

Monitoring of plants and diseases at its initial stage is of utmost importance as it can prevent loss and allow us to act early. Identification and diagnosis of the disease can be done from the leaf itself.[1] Manual monitoring of diseases does not give the desired result, as observed using the naked eye is unreliable and increases the chances for misdiagnosis. It also requires an expert's attention which is time-consuming and expensive. Therefore, manual methods are ineffective. Automatic and instant detection of plant diseases is essential to detect the symptoms of diseases, in early stages, when they appear on the growing leaf of the plant. It is used to segment, extract features and classify the leaf based on its appearance. [2]. Border detection segmentation has been used in Orchid leaf disease detection in late 2014 [3]. A Robotic based Early crop disease detection has been tried by Sai Et al.,[4]. Other plant disease detection methods and survey of the same have been discussed in few research works [5-7].

This paper introduces a disease detection and monitoring unit. A MATLAB based subsystem is designed which focuses on scanning the diseased leaf and used image processing technique for accurate detection and identification of plant diseases. Watering the plants and applying the fertilizer are done automatically.[8] Other subsystems include monitoring of the temperature, humidity and moisture content in the soil. These subsystems measure the above factors and update the values in the server.

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II. PROPOSED SYSTEM

a. Block Diagram

In the proposed system, we find out the disease on some important features extracted from its leaf images.

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Experimental analyses were done on samples and the area of the infected region. Detection of plant diseases can be done using image processing. Disease detection is done by capturing and segmenting the image, extracting the classifying features and final classification.

Our project detects the plant diseases and also carries out the preliminary steps for disease recovery. It shows the percent of the affected area of the leaf. Our project has been designed in a way such that it sends messages to the user about every action taken such as disease detection and about soil dryness. In addition to this, soil moisture and temperature sensors are added and they are used to avoid the spreading of diseases due to change in climatic conditions. Through these sensors, this system can maintain the moisture of the land depending on the type of crop. If the values of moisture/temperature exceed the predefined range, the device enables auto medicine or water to the plants. Information regarding the plants, soil dryness, and motor operations are informed to the farmer through messages.

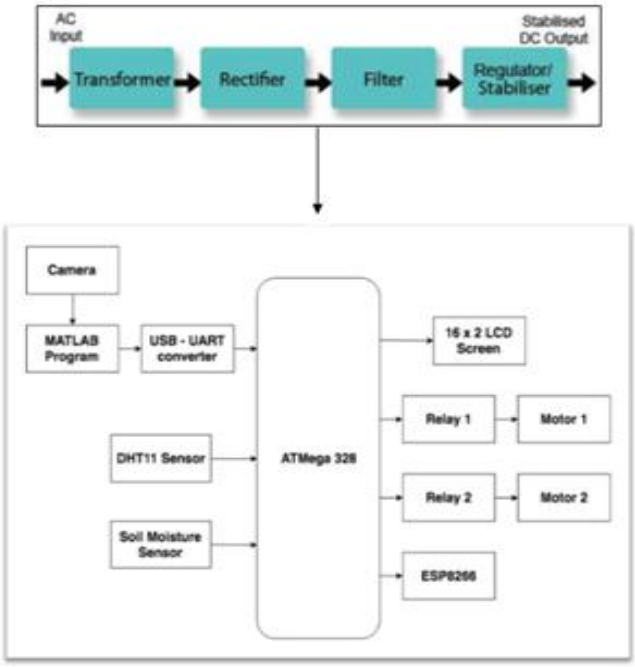

Fig 1. Block Diagram of Detection

The diagram in Figure 1 shows the overall block diagram of the research. It consists of a power supply unit, ATMega-328, DHT 11 sensor, Soil sensor, 16x2 LCD Module, Relays and 30MP camera, USB to Serial Converter. Various algorithms including K-means clustering are used for accurate diagnosis of the disease.

b. Flow Chart

In this section we discuss the Flow chart of the proposed system as in Figure 2.

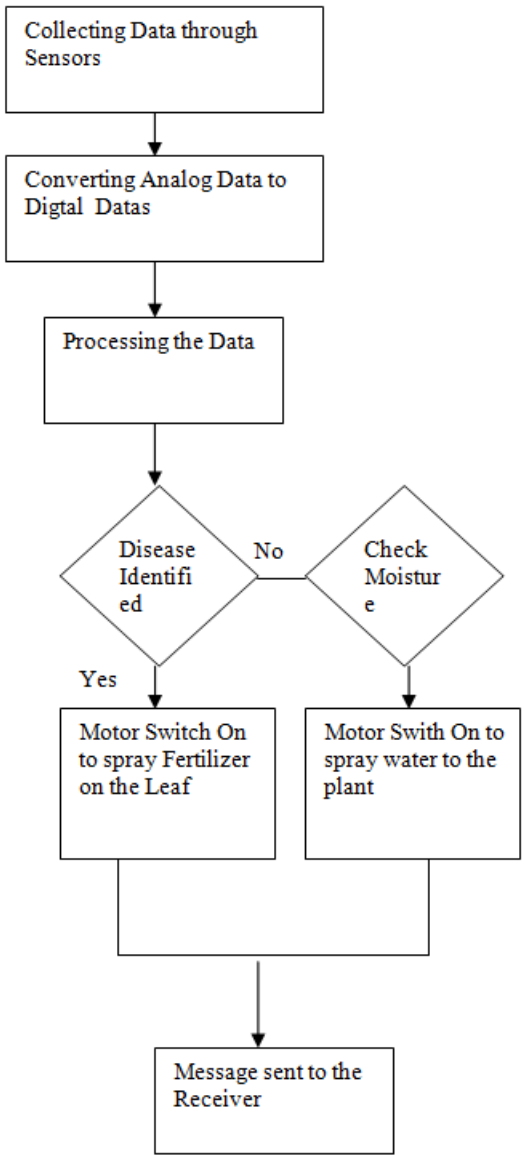

Fig 2. Flow Chart

III. HARDWARE REQUIREMENTS

A. *ATMega 328*:

ATMega-328 microcontrollers can be programmed for various applications. A 2A power jack is used to power the ATMega 328. In this project, the ATMega-328 microcontroller is used for the overall control and interfacing of the various components. The inputs from the sensors and the disease detection program are fed to the controller. Based on the program, the outputs are given to the LCD, drivers and the Wi-Fi module are given accordingly. The program is uploaded to the chip using AVR Studio.

B. USB to Serial Converter:

The USB to Serial Converter is used for converting the serial data obtained from the program for disease detection and processes it into a serial format for further processing.

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C. *Relay*:

A relay has a control system and a controlled system (also called output circuit or output contactor). The control system is used to control the devices. In simple words, it acts as a switch to control a circuit using high current by a low current signal. In this circuit, the relay is used to supply a uniform power to the two motors.

D. *DHT11 Sensor*:

DHT11 Temperature and Humidity sensor detects the temperature and humidity of the surroundings and gives a calibrated digital signal. It is used to measure the temperature and humidity of the farm and its surroundings. The data is sent to the LCD screen via the microcontroller. It is also sent to the server from the microcontroller through the Wi-Fi module.

E. Soil Moisture Sensor:

A soil moisture sensor is used to measure the quantity of water present in a material, like soil. The soil moisture sensor is made of two probes that aid in measuring the moisture content. It is done by passing a current through the probes, which passes it through the soil and measures the resistance of the soil. This allows calculating the amount of water present in it. The soil moisture sensor senses the moisture content and sends it to the microcontroller. Based on the program, if the moisture content is low, it sends an alert to the chip and the motor is switched on automatically for irrigation. A message is also sent stating that the moisture content is low and that it has been irrigated.

F. 16 x 2 LCD Module:

A 16x2 LCD is used to display 16 characters in 2 lines. In this research, the LCD Module is used to display the sensor values measured and any other action taken as shown in Figure 3.

G. ESP8266 WI-FI Module:

The ESP8266 Wi-Fi Module sends the data using the TCP/IP protocol stack method. This is used to give control of the Wi-Fi network to the micro-controller to enable the sending of data. The ESP8266 Wi-Fi Module is an integral part of the designed system. It uploads every reading which is taken and every action which has been performed to the server. The data can also be viewed in the server, which is used for storing every reading and action performed by the project. It also allows for remote control of the two motors.

Fig 3. LCD Monitor displaying the sensor values

IV. RESULT AND DISCUSSION

Plant Disease Identification System which is composed of four modules

1. Image acquisition Module
2. Image Conversion Module
3. Clustering
4. Classification Module.

1. The Image acquisition module contains all the images required for training the system. The images are loaded in a database and linked to the MATLAB program. The image is captured using a webcam and loaded onto the program dialog box.

2. In the next module, the captured image is converted to 256x256 size to avoid any irregularities in the size of the image. It is then converted from RGB to grayscale to HSI scale. This is done using the Otsu Algorithm and gray threshold algorithm.

3. Then, the distance of the RGB nodes is calculated and the image is divided into 3 clusters based on the distance. This is done by calculating the threshold value for the trained image. This helps the system to extract the feature of the image. This is done with the help of K-Means Clustering. K-Means Clustering, an unsupervised machine learning algorithm, calculates the distance from each detected node to determine if the leaf is healthy or diseased.

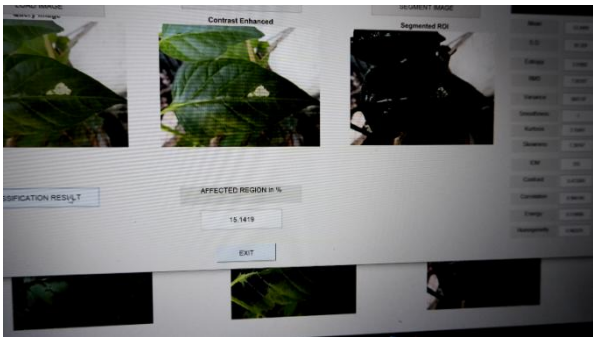

Fig 4. Disease Detection Program showing the values

4. Based on this, the system concludes classifying the test image as diseased or healthy. This is the final step. This is done with the help of the libraries fed to the project. For this project, we have collected leaf samples of some of the major diseases that affect plants. The libraries include leaf samples for Alternaria Alternata, Anthracnose, Bacterial Blight and Cercospora Leaf Spot.

Further, in Figure 4, there is a program for informing the farmers of the actions taken. This program is present in the microcontroller.

Fig 5. Image of the messages received

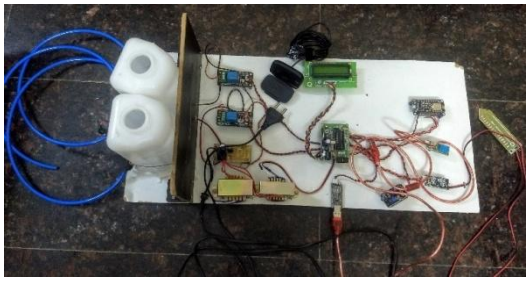

Fig 6. Model of the Detection System

The water motor is switched on automatically if the moisture content is too low and the fertilizer motor is switched on if a disease is detected from the image of the leaf. These are displayed on the LCD module. The steps taken are also sent as text messages to the farmer. All the data are also updated to the server. The data from the server can be extracted and used to analyze patterns based on the data from the sensors as shown in Figure 5. The entire model of the detection system is shown in Figure 6.

V. CONCLUSION

Agriculture is the major occupation in our country. Now, farmers are facing a lot of troubles. The integration of technology and agriculture is needed now more than the past era. Our research has taken up the focus to ease the troubles of the farmers by monitoring the farm for any changes and taking the required action. It also allows the farmer to automatically detect the disease that is present on the farm and saves valuable time, off the farmer's work.

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