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Implementation of Farming Robot for Various Agricultural Applications

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Abstract: The recognition of plant leaf disease is a very important factor to prevent serious outbreak. If these diseases are not detected in time then these may cause several losses. Insects are also affecting the leaves. Traditionally farmer visually checks the disease if this is not treated on time, and then it causes several losses. Excessive use of pesticides for plant treatment increases the cost and environmental pollution, so their use must be minimized. The diseases on the cotton are basic issue which makes the sharp decrease in the production of cotton. So the study of interest is the leaf rather than whole cotton plant. About 80-90% of diseases occur on the cotton leaves are like Alternaria, Cercospora, Red spot, white spot and Yellow spot etc. The solution for the mentioned problem is to design robot for performing different farming work like identify the diseases on crop, suggest the pesticide for that disease, and spray the pesticides on crop. By utilizing farming robot, the excessive use of pesticides can be saved & the labor cost is reduces. The farmers health is protected from pesticides.

Keywords: Agriculture Image Processing, Beagle Bone Black, PIC Micro controller, Crop Leaf Image.

I. INTRODUCTION

India is an agricultural nation; where in around seventy percentage of the population depends on agriculture. However, the development of these plants for optimum yield and quality product is highly technical. Cotton," The White Gold" or the "King of Fibers" enjoys a pre -eminent status among all cash crops in the country and is the principal raw material for flourishing textile industry. It provides livelihood to about sixty five million people and is an important agricultural commodity providing remunerative income to millions of farmers both in created and creating nations. Each issue has an importance. When any condition occurs then farmers become aware about the pest, then they can take correct action and control the situation, but if farmers does not have correct knowledge, then identification of any pests can be incorrect. Most important it may lead to serious problems to crops. The diagnostician must have very good observation skills, and he/she also needs to be a good detective. It is important to keep an open mind until all of the facts related to the problem can be collected. The possibility of multiple causal factors must be considered. Therefore, disease is one of the most important aspects of a plant pathologist's training. Without proper identification of the disease and the disease-causing agent, disease control measures can be a waste of time and money and can lead to further plant losses. Proper disease diagnosis is therefore vital. Otherwise, they may approach to any agricultural specialists who give them suggestion regarding detection of diseases and increase the crop productivity. But, usually they may face situations like: Sometimes they have to go long distances for approaching the expert. Sometimes the expert may not be in a position to prompt the farmer with the accessible data and knowledge.

I.1 Different types of Diseases on Cotton Leaves
The diseases on the cotton leaves are named as,
A) Bacterial disease: e.g. Bacterial Blight, Crown Gall.
B)Fungal disease: e.g. Anthracnose, Leaf Spot.
C)Viral disease: e.g. Leaf Curl, Leaf Crumple, Leaf Roll.
Some of the cotton leaf diseases and medicines presently known are given explained below.

1.1.1Alternaria Spot Disease on leaf cotton
Fig.1 shows the Alternaria Spot Disease on Leaf Cotton.

Fig -1: Alternaria Leaf Spot [Ref.5]

This disease arises due to potassium lack. Leaf demonstrates brown necrotic Neorotic tissues turn a sooty black color due to prolific sporulation by the fungus spots.

1.1.2Cercospra Leaf Spot Disease on Cotton
Fig.2 shows the Cercospralesf spot disease on cotton.

Fig -2: Cercospra Leaf Spot [Ref.5]

Red dot marks on the leaves which expand in diameter to about 2-3 cm. Irregular brown lesions, often surrounded by chlorotic tissues.

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1.1.3Red Leaf Spot Disease on Cotton
Following fig.3 shows the red leaf spot disease on cotton.

Fig -3: Red Leaf spot [Ref.5]

Nutritional deficiency symptoms – Nitrogen content below 3% in leaf. Decrease in minimum temperature below 15^0C lead to the formation of anthocyn in pigment in the leaf.
All these diseases can damage th cotton crops.

Cotton Disease Recognition System:
Diseases on the cotton plant decreases efficiency of the cotton production. The image processing technique is used for detecting diseases on cotton leaves early and accurately. Following fig.4 shows the block diagram of cotton disease recognition system.

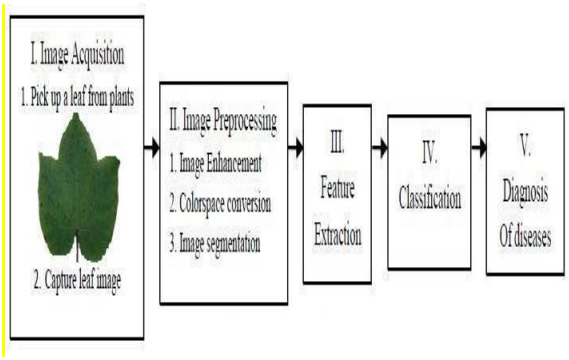

Fig -4: Block Diagram of Cotton Disease Recognition System.

Image Acquisition: For capturing the rich details of cotton leaf patterns, an acquisition system should have a minimum resolution of 512 X 512 pixels in frame.
Image Preprocessing: Here initially preprocessing the input image using histogram equalization is applied to increase the contrast in low contrast image.
Feature Extraction: In this, Color feature variance is used for matching the train image features to database images.
Leaf Segmentation: For detection of internal and external boundaries of the cotton leaf, use K-mean clustering algorithm technique.
Leaf Recognition: Before actual recognition process of cotton leaf image, the disease spot is located using color feature technique. Finally recognition is performed using neural-network to recognize the diseases.

II. PROPOSED SYSTEM

For farming robot requires all framework. Hence Beagle Bone Black and PIC Micro controller are used to perform mechanical operation.

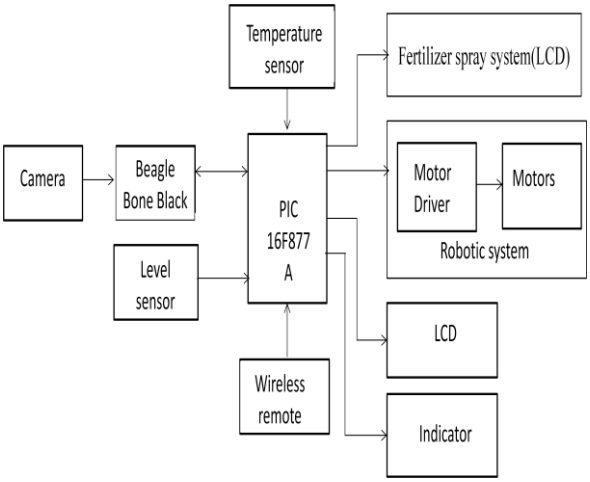

Fig5: Block Diagram of Proposed System

A. Block Diagram Description
a. Camera
It is used for take an image of crops; it is directly connected to the Beagle bone. There are two ways to connect camera to beagle bone black. First one is USB camera and second is camera module of Beagle bone.
b. Temperature Sensor
Temperature sensor is utilized to sense the environment temperature. We have used a Temperature sensor called LM35.
c. LCD Display
Lampex, 16*2, Backlit facility LCD is used in a project to visualize the output of the application. We have used 16x2 LCD which indicates 16 columns and 2 rows. Total 32 characters we can display on 16x2 LCD. It can also used in a project to display the pesticide name to be spray on the crops. Thus LCD plays a vital role in a project to see the output and it also display the status of fertilizer tank that is tank is empty or not.
d. Motor Diver
An L293d motor driver IC is used to control motors in robotics. Motor driver act as an interface between controller and the motors in the robotics. Motor driver are primarily used in autonomous robotics only. Also the controller operates at low voltages and requires a small amount of current to operate while the motors require a relative higher voltages and current. Thus current cannot be supplied to the motors from the controller.
e. Fertilizer Spraying system
Fertilizer spraying system is used to spray the fertilizer on crop. By using this system we cover large area in less fertilizer. When the fertilizer tank is empty then these systems activates the indicator and also show the status of tank on display.
f. Beagle Bone Black
The Beagle Bone Black is the latest addition to the beagle board.org family and like its predecessors. It also offers access to many of the interfaces and allows for the use of add-on boards Called capes, to add many different combinations of features. Beagle Bone Black is manufactured and warranted by Circuit co LLC in Richardson Texas for the benefit of the community and its supporters. In addition, Circuit co provides the RMA support for the Beagle Bone Black.

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h. Wireless Remote

A wireless radio frequency (RF) transmitter and receiver can be easily made using HT12D Decoder, HT12E Encoder and ASK RF Module. Radio Frequency (RF) transmission is stronger and reliable than Infrared (IR) transmission due to following reasons:

- Radio Frequency signals can travel longer distances than Infrared.
- Only line of sight communication is possible through Infrared while radiofrequency signals can be transmitted even when there are obstacles.

B. System Flow Chart

a. Disease Detection

Fig 6 shows the flow chart for disease detection and fertilizer suggestion. First take the image of crop then make image processing on that image, after that check work done signal if it is high then show the disease name and fertilizer name on display else repeat the process of image capturing and image processing. Fig 7 shows the flow chart for fertilizer spraying system, first fill the fertilizer in robot tank after that check the status of temperature sensor if it is above set point then spraying system is stop else continue the spraying.

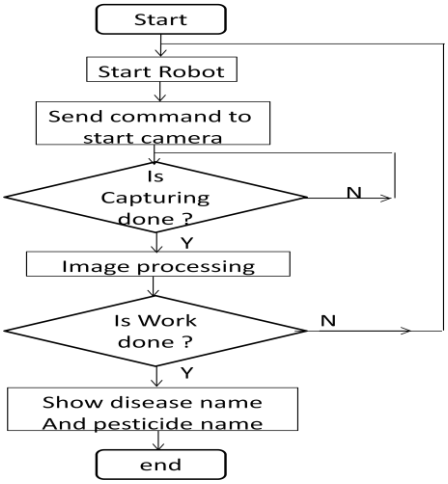

Fig6: Disease detection

b. Fertilizer Spray System

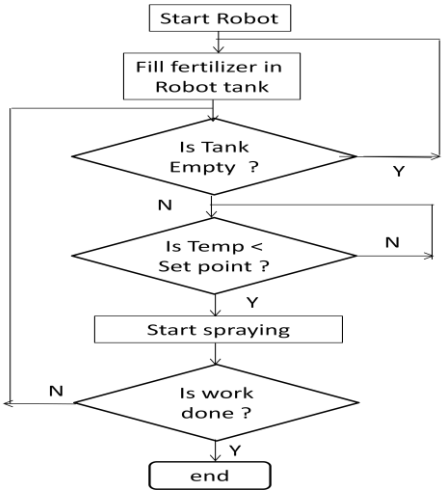

Fig 7: Fertilizer spray system

III. WORKING MODEL

Fig 8 show the physical structure of farming robot, robot structure is partitioned into three segments, first embedded section, second battery section and third fertilizer tank section. Operations of robot are controlled by using PIC16F877A microcontroller. DC motors are used for robotic operation where motors are drive through L293D IC. PIC gives the signal to theL293D, according to that signal L293D IC gives the signal to the DC motor. 12v battery is used for providing the supply voltage to the PIC Micro controller, Beagle bone and DC motors.

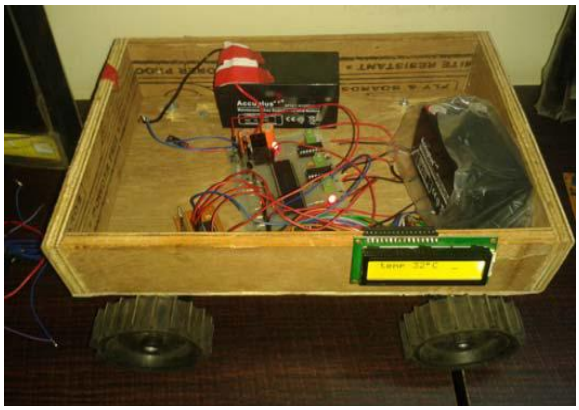

Fig 8: Farming robot

IV. TEST RESULT

The Fig.9 the startup message shown by system gives the indication for start of system.

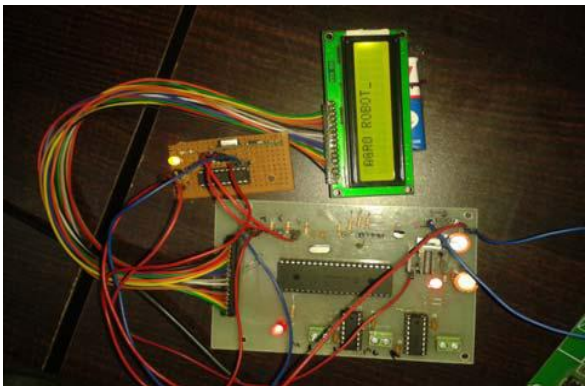

Fig 9: startup message shown by system

The fig.10 shows the environment temperature on LCD.

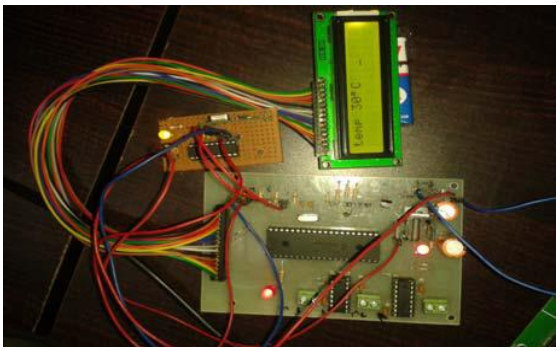

Fig 10: Environment temperature

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The fig.11 shows the yellow spot disease detected.

Fig 11: Yellow spot disease detected

The fig.12 shows the white spot disease detected. In that two windows present but only white spot is detected by system there is no yellow spot on input image.

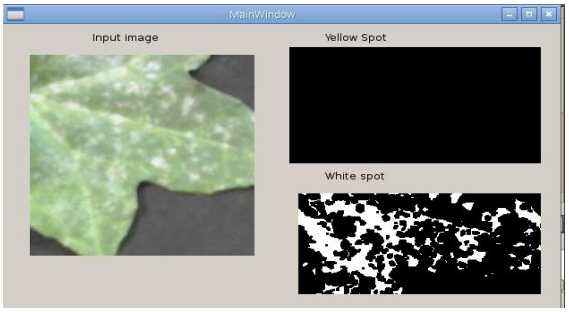

Fig 12: White spot disease detected

The following fig.13 shows the no disease detected. In input image there is no any spot or disease is present so system shows no disease detected.

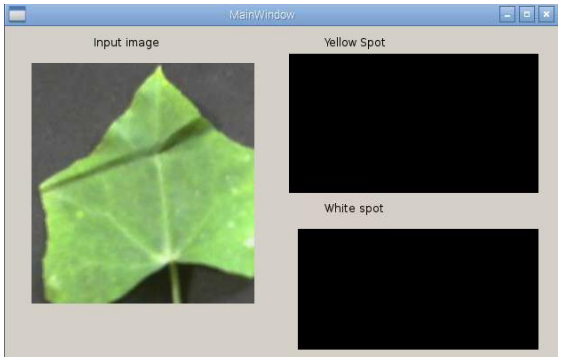

Fig 13: No disease detected

The following fig.14 shows the status of fertilizer tank. How many tanks should be selected, how much pesticide should be taken. This information is shown in fig.14.

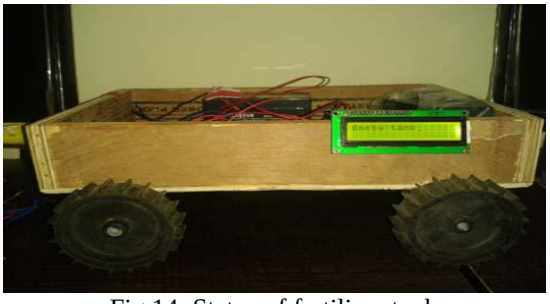

Fig 14: Status of fertilizer tank

CONCLUSIONS

Leaf diseases in plant are the most prevalent diseases which appear as spots on the leaves.
The leaf disease can restrict plant growth, resulting in reduced yields and loss of vigor, healthy plants can tolerate considerable injury.
By using image processing we can find out the type of the disease and according to that disease, the system can spray the pesticides on crop through farming robot. By using farming robot we give the accurate treatment to the crop and maintain the crop healthy and increase the production. Main advantage of farming robot is to save the pesticide cost, labor cost and avoid the direct contact of farmer with pesticide.

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