Implementation of Horticulture Crop Disease Detection System

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Abstract:An important aspect of moving towards agricultural sustainability is the management of crops during its growth stages which involves monitoring, classifying & identification of nutrient deficiency, crop diseases and controlled use of pesticides & fertilizers. Crop production rate reduces drastically due to the crop diseases. Also, the main challenge is to reduce and precisely utilize the pesticides and fertilizers in agriculture and engage more natural manuring for improved crop quality. Here, in this project a ground-based agricultural robot is being made which detects, classifies and predicts the crop diseases in its early stages and provides necessary measures of spraying the appropriate pesticides according to the classified disease types. To classify the crop disease, image captured by Arducam OV2640 robot will be processed and segmented using different image processing techniques. Here, to predict the infected region of crop field we have used Wireless Sensor Networks which monitors the soil temperature and moisture. Depending upon the data received from sensor node we will predict the particular region where the Agrobot needs to go and spray pesticide.

Keywords – Agricultural robot, Pesticide sprayer, Wireless Sensor Network, Image Processing.

I. INTRODUCTION

Agriculture is the backbone of Indian economy, with more than 65% of the population dependent on it. Agricultural and its allied sectors like forestry and fisheries employs more than 50% of total workforce of India and contributes nearly 17-18% to country's GDP (gross domestic product), according to Economic Survey of India 2018.Today, India ranks second worldwide in farm output. Agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India. Food security, nutritional security, profitability and sustainability are the main principles of present and future agricultural development[1].

The Agrobot presented here is an all-terrain robot to be tested extensively in cotton fields using different experimental image sizes with resolutions of 1600x1200 pixels and 1024x768 pixels. Large resolution is used for wide images and the results have been demonstrated. The robot helps the farmer to take informed decision locally or allows connecting with other existing services (for example, upload the pictures for expert opinion).

Figure 1: Wireless Robot for Capturing Live Images of crops

II. PROPOSED SYSTEM

The functional block diagram of our Agrobot is shown in Figure.2

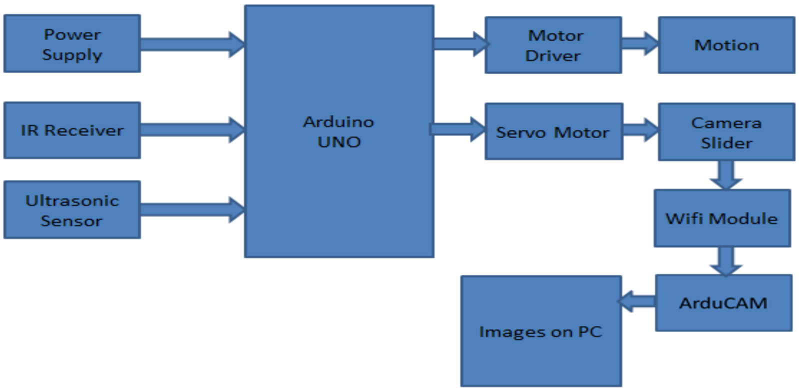

Figure 2:Block Diagram of Agrobot

From Figure.2 we can say that main purpose of this agrobot is capture the live images of crop and this using the Wi-fi module the same image can be seen by the remote user. Then the user can command this agrobot to spray the necessary pesticide. Since it is wireless agrobot, wireless communication with agrobot is done IR receiver and the remote control. The microcontroller(Arduino Uno) is programmed to perform necessary action when IR receiver receives any signal from remote control.When Agrobot is far from user Line of Sight then to crop damage of crop or to avoid any obstacle ultrasonic sensor have been used. Thus whenever an obstacle is detected the ultrasonic will measure the distance and will turn automaticaaly in the direction opposite to obstacle. Main power supply to this Agrobot is given by 12V battery which is can be recharged using Solar Panels. To capture the images of crops which are grown upto certain heights we have added a vertical slider on our Agrobot so that camera can be adjusted in vertical direction so that user can see clear images of crop leaves. Then all crop images are stored in dataset of MATLAB GUI which we have implemented to perform image processing of acquired images and detect whether crops are suffering from any kind disaease, Once disease detected the user can send signal Agrobot to spray the pesticide over the affected crop and further spreading of disease among the crops is stopped.The flowchart for image processing of crop leaves[2] is shown in Figure.3

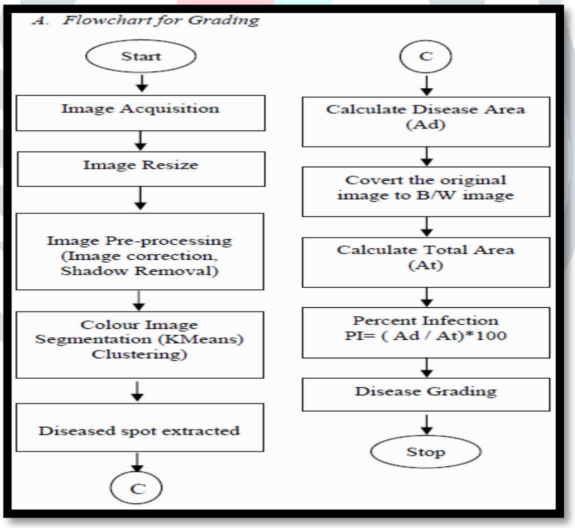

Figure.3: Flowchart for Image Processing

Once the image is acquired from Agrobot, then it uploaded to our MATLAB GUI and all received are resized so that the colour matrix size for all images would be of same size. Now in low light condion, images captured may not be of good quality so enhance these images constrast streching techniques is used which makes brighter pixel level more brighter. Then using k-mean clustering[3] we create three cluster which contains the following data:

- Cluster 1 separate the foreground and background of image.
- Cluster 2 contains only the green part of the leaves.
- Cluster 3 contains only brown part of leaves.

Now, the user should select the cluster 3 to check whether crop is defected or helathy. After this we calculate the total amount arae of leaf which is defected as shown in the flowchart and now we check the accuracy of result predicted by ruuning disease detection loop for 500 iteration and calcutae percentage by taking ratio of no.of times the result is true to no. of iterations. Then depending upon the disease detected the user can spray pesticed on the desired crop and this operation can be performed by pressign the button on the remote controller.

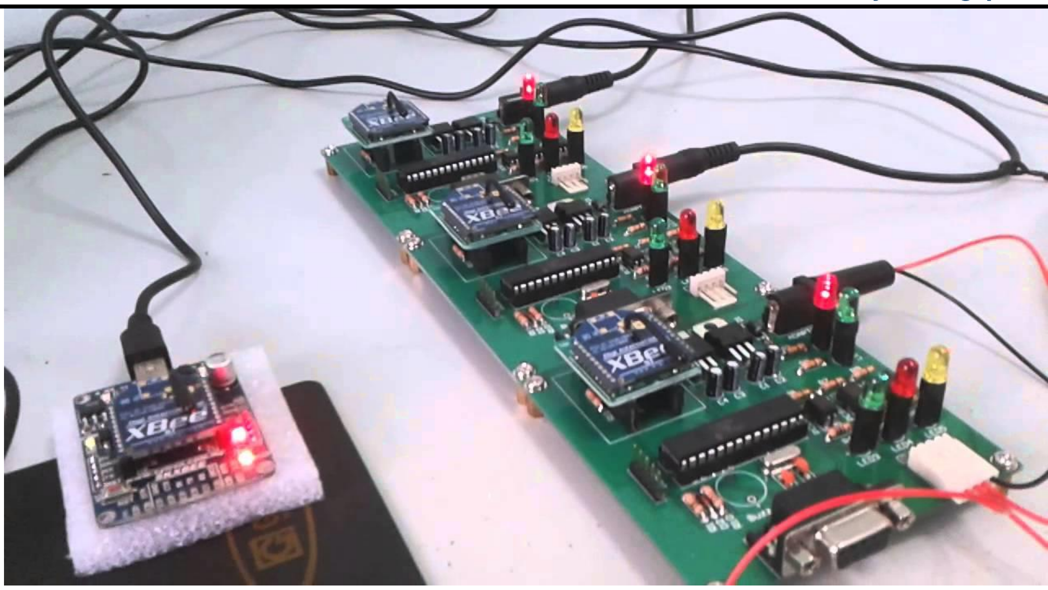

Figure 4: WSN using ZigBee S2C module

We cannot let our Agrobot to randomly roam in the field can keep on capturing the live image cause power consumption will be very high. So as solution to this problem we need to find the particular region of interest within the field and to do this; in our proposed systema Wireless Sensor Network[6] which will have four sensor nodes where each sensor node comprise of Arduino Uno as microcontroller and ADC unit, DHT22 to measure soil temperature and moisture value and ZigBee S2c module for transmitting the sensed data to the remote user at base station. The DHT22 senses the soil temperature, moisture and this data is then given to the ADC unit of the Arduino Uno which converts the sensor value into its corresponding digital format. Then the data given to ZigBee for transmission. Here ZigBee connected to each sensor node are configured as Router so that even if one of the link fails then corresponding node can transmit it data using different communication link. We deployed our WSN in star topology so that we all data can reach to user end within 2 hops only. The base station ZigBee is configured as Co-ordinator whose main function is to establish links with all nodes, allocate necessary resources, start/end communication of data. In both cases Zigbee works as Full Function Device(FFD) which they can perform all set of function that are defined by IEEE 802.15.4 standards.

Some of the features of Xbee S2C modules are:

- Range (indoor) = 200ft.
- Range (Line of Sight) = 6000ft.
- Transmission Frequency = 2.4GHz - 2.5GHz.
- No. of channels: 16 in direct sequence.
- Data rate = 250 Kbps.
- Transmit Power = 2mW(normal mode).
- Operating Temperature = 0ºC - 80ºC.

As we know that main problem of WSN is very high-power consumption so to improve the efficiency of our system all Zigbee modules are operated in hold mode which means that sensor mode will transmit data after a defined interval of time and for rest of time interval they will remain sleep condition.

Once all the sensed data is transmitted successfully the Co-ordinator ZigBee will receive it and can will displayed in XCTU software. Here all nodes including Co-ordinator are in doing communication with each other using API frames. Since all frame arrive at Co-ordinator in random manner, so in-order identify which sensor node has transmitted data we have assigned each sensor node an ID which is received at base station along with the sensed data. While receiving the data, we also need to visualize it and do this we have used serial communication between remote user's PC and Co-ordinator ZigBee and all the received is stored in Excel Sheet with following parameter:

- With Date & Time of received packet.
- ID of each sensor node.
- Temperature sensed by each node.
- Moisture % sensed by each node.

The generation of Excel sheet is an automatic procedure as soon as data is received by base station all data are stored in a excel sheet.Once data is stored, so we need to classify this data according to ID of each node so as find out the latest value of soil temperature, moisture of particular region of field and this done using MATLAB GUI. After finding the latest values of soil parameters, make prediction like growth rate of crop in that region of field or crop may be more prone to any kind fungal, bacterial attacks. After finding the region of interest we can Agrobot to that region for capturing images and spraying pesticides.

III. RESULTS

To perform real-time testing of our proposed system we have implemented an Agrobot as shown in Figure 5. We have tested our Agrobot in small garden areas and observed the following results:

- Range of IR Receiver = 25m.
- Range of Arducam OV2640 camera = 369m.

Figure 5:Agrobot with Pesticide Sprayer.

Some of the sample images taken using Arducam OV2640 are shown in Figure 6 shown below:

Figure 6: Sample Shots using Arducam OV2640

Once these images are captured, they are uploaded to our MATLAB GUI where it is processed to detect whether crops by affected by any disease or not. Sample photo along with its processing and disease detection in our MATLAB GUI is shown in Figure 7 below:

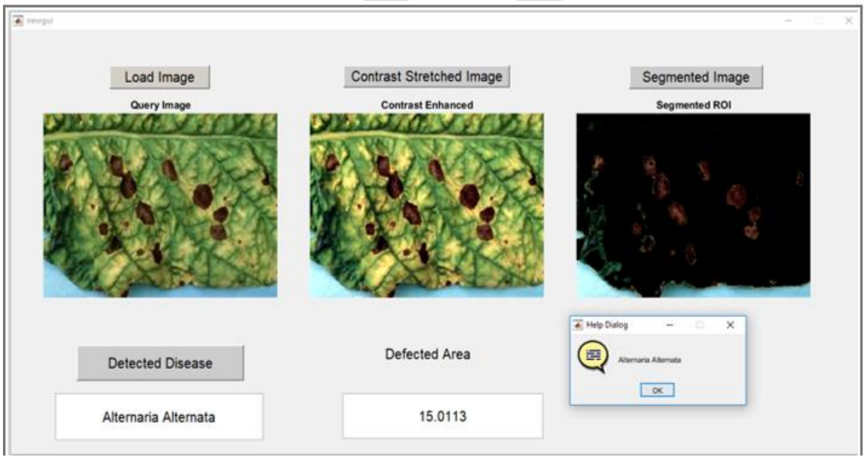

Figure 7: MATLAB GUI

IV. CONCLUSION

Our proposedAgrobot can go to the remote areas of the field without damaging the crops and can capture images in low-light condition whose quality can be further improved using MATLAB GUI. After processing the image, the crop disease detection in their early stages serves the farming community to improve their crop productivity by correctly classifying the disease type being occurred.The system is developed to detect common crops disease like Bacterial Blight, Antharacnose etc.

With the help SVM Classifier in MATLAB GUI, accuracy of each disease detected is found out to be 95%. Hence our system classify disease and would suggest farmers to spray pesticide on the affected crops.

The further work which can be done on this project is by adding theMachine Learning approach can be applied to the different image processing algorithms used in the classification and identification of crop diseases, here, in the implemented pesticide sprayer we don't have any control on the required amount of spraying used. So controlled spraying can be using this prototype, In MATLAB GUI while the images are processed currently we have to manually select the cluster to identify the defected area of the crop, also the crop images captured from the Arducam which are transferred to the PC via Wifi Module needs to be manually uploaded to the MATLAB GUI for further image processing.This intervention needs to be removed and automatic uploaded and cluster selection needs to be done.

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