IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 5, Issue 4, April 2016

Intelligent Autonomous Farming Robot with Plant Disease Detection using Image Processing

D. A. Shaikh[1], Ghorale Akshay G.[2], Chaudhari Prashant A.[3], Kale Parmeshwar L.[4]

Department of Electronics and Telecommunication Engineering, Pravara Rural Engineering College,

Loni, Rahata, Ahmednagar, India[1,2,3,4]

Abstract: Even though India is agricultural country lot of challenges are faced by farmer. Every year farmer experiences large losses due to pest infestation in crop & this in turn affect his lifestyle. These losses are basically due to discontinuous monitoring of farm, various diseases on crop and improper management of pesticides. Plant disease reduces product of farmer both in quality and quantity. So quick detection and identification of disease plant are of more importance. It also needs continuous monitoring of farm. To overcome above problem it is necessary to develop such system which continuously monitor the farm and detect the disease as quick as possible. In this paper we gave brief idea to solve this problem by continuously monitoring crops using 'Agri-Robo' and techniques called Image Processing. Image Processing give the good solution to above crisis. Image processing gives fast, automatic and accurate solution to user. We developed an agri-robo system to monitor crops and for identifications and monitoring of diseases & pesticides. This agri-robo not only detects disease but also spray pesticides to protect them from disease. The robot helps the farmer to take informed decision locally or allows connecting with other existing services. This agri-robo find diseases on various infected leafs. This system result in detection of cotton diseases and spray the pesticides of disease in proper amount when needed.

Keywords: Agri-robo, image processing for disease detection, pesticides spraying techniques**.**

I. INTRODUCTION

Agriculture is the most important sources of incomes in India [1]. Agriculture alone constitutes about 22% of income in our country [2]. India is a cultivated country and about 70% of the population depends on agriculture. Farmers have large range of diversity for selecting various suitable crops and finding the suitable pesticides for plant. Disease on plant leads to the significant reduction in both the quality and quantity of agricultural products.A solution to this issue is by spraying pesticides on crops only when need required and eliminate the crops which is affected by diseases. This required continuous monitoring of farm by farmer but this not possible by farmer due to various reason such as lack of proper guidance by expert at all points of time. This entire problem is solved by using agriculture robot which detect any disease immediately and prevent crops from excessive pesticides & insects. The agri-robot presented here helps the farmer to take decision locally or allows connecting with other existing services. Ordinary camera (webcam, mobile camera) is inserted in this system, to reduce the cost of the overall solution. Plant disease identification by continuous monitoring visually is very difficulttask and at the same time less accurate and can be done only in limited areas. Whereas if image processing technique is used for disease detection then it will take minimum efforts, minimum time and is more correctly. In plants, some general diseases are red and yellowishspots, and other is fungal, viral and bacterial diseases. Image processing is the technique which is used for measuring affected area of disease, and to determine the difference in the color of the affected area [3] [4] [5].Depending on impulsive differential expression, this system developed impulsive model of the disease management. Creating proper plan is the most effective for control pest and minimizing the diseases on crops [6].Monica Jhuria detects the disease using artificial neural network. Back propagation is used for training databases [7]. Zulkifli Bin Husin et al, in their paper [8], used the MATLAB for perform image processing. They used digital camera for acquisition of image and LABVIEW software is used for GUI. Mrunalini R. Badnakhe,Prashant R. Deshmukh uses Otsu threshold and the k-means clustering algorithm used for leaf segmentation [9]. Chunxia Zhang, Xiuqing Wang and XudongLi,uses FPGA for getting image, monitor and control of plant diseases [10]. ShantanuPhadikar and Jaya Sil uses pattern recognition techniques for identify infected part of the leaf [11]. Mohammed Ei – Helly uses image analysis with the Central Laboratory of Agricultural Expert System (CLASE) diagnostic model [12]. RakeshKaundal [13] support vector machines for weather based prediction models of crop diseases; H. Al-Hiary find out airborne hyper-spectral imagery & the red edge method [14].Paul Boissard work on early pest detection in greenhouse plant, To facilitate viable plant pest control an automatic pest recognition system using k-means clustering in combination with a correspondence filter is investigated [15]. In our design we detected the diseases by using agrirobo and MATLAB software. By using this system we maintained regular surveillance over a large field of crops. Such a system automatically detects the various diseases and after detection is complete is automatically spray the pesticides.

DOI 10.17148/IJARCCE.2016.54248

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The Section 2 discusses system architecture, Section 3 consist information about disease detection technique image processing, and Section 4 describe pesticide management.

II. PROPOSED SYSTEM

Agri-robo is a robot made for agricultural purposes. It reduces the effort of farmers in addition to increasing the speed and accuracy of the work. It does various functions that involve spraying. And they increases agricultural production to increase product and increases accuracy in application and enhance working safety. We developed a robot system to manage crops and for identifications and monitoring of crops diseases & pesticides. In our system the captured images from camera processed by using image processing technique, the processed result are then converted into binary codes and transfer through RF module and given it to the microcontroller unit.

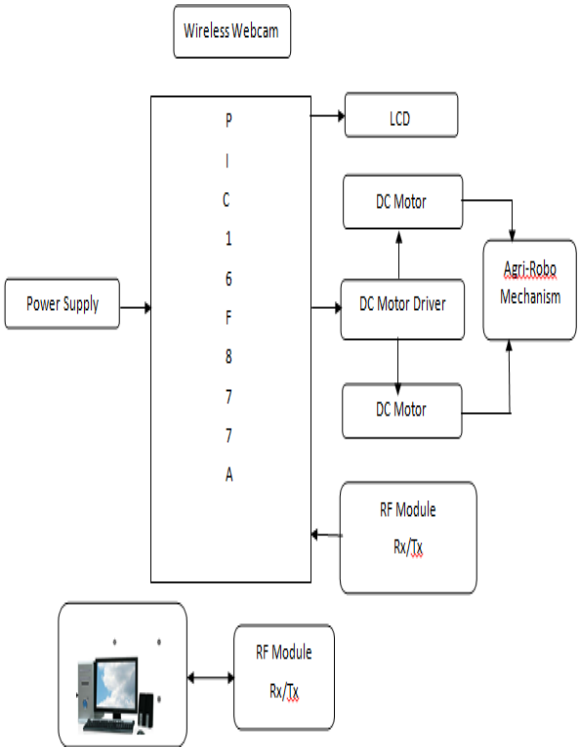

Fig 1 System Architecture

The microcontroller unit is programmed to control the agri-robo. To mix the pest in tank DC motors are used. Some dc motor used to spray the pesticide by using sprayer. The control of spraying mechanism is done by the microcontroller unit. The spraying system contain a tank for keeping the pesticides, a sprayer and DC motor to direct the robot to spray the pesticides in desired spray area. The DC motors are electronically controlled by microcontroller with the help of L293D driver which receives input signals from RF module on the underside of the robot. By receiving the signal, DC motor is turned on and off to enable selective spraying of pesticides on plants. There are three pests in injection mechanism that are taken into tank by DC motor for mixing of pesticides within the tank. Some DC motors help to spray the required pesticides on particular disease which is detected using image processing techniques.

III. AGRIROBOT

Here we proposed aagri-Robo which capture the leaf images in real time and detect and classify infection in particular field. For this, we use MATLAB software to run the disease detection algorithms on pc.

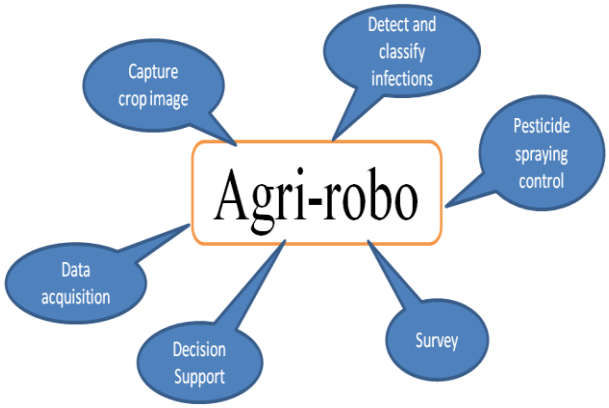

Fig.1. Agri-robo

The Robot also have injection mechanism, hence it is completely autonomous robot. These systems consist of camera placed on robotic car. This robot is made in such a way that it can move around the farm in space, in space between two row of crops and camera take the images of plant. The camera is connected to PC wirelessly on which main process of disease detection is run.. PC is connected to robot through RF module for wireless control of agri-robo from certain distance. After the detection of disease a spraying system which is designed on robot automatically spray the pesticides in proper amount and where it required.

IV. ALGORITHM FOR DISEASE DETECTION USING IMAGE PROCESSING

An efficient and speedy image processing algorithms was developed using MATLAB software. The first phase of algorithms deals with separation of healthy crop from affected one latter phase of algorithms concentrates on finding the disease on crop.
The steps required in image processing system:

- Load the images
- Enhancement
- Transfer the input image from RGB to LAB pattern
- Masking of green-pixels
- Removal of masked green pixels
- Image segmentation
- feature extraction

In image processing, sometimes we have to convert the image from one colour space to other. MATLAB contain tools require for image processing which covers all colourr space transformation.

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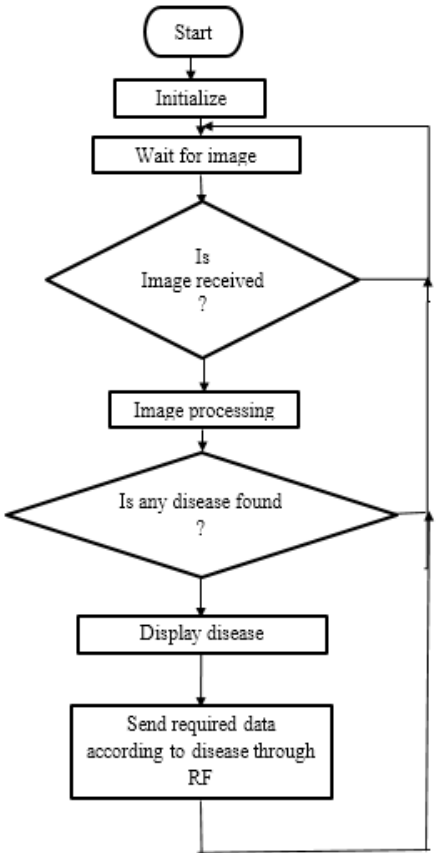

Fig 2 Flowchart of algorithm steps following in image processing

Input color images have primary colorsgreen, blue and red. It is not possible to implement the applications using RGB because of their range i.e. 0 to 255. Hence they convert the RGB images into the LAB images. LAB consist of L*, a* and b* layers. L* represent brightness represent degree of redness- greenish. B*represent degree of yellowish bluish.

Convert image to L*a*b* color space
Cform 2lab = makecform(srgb2lab);
LAB = applycform(RGB, cform2lab);

In masking process green pixel are find out and given out the zero pixel value. Some threshold value is set for detection of disease. The pixel having value less than threshold are set to zero and if it has high value then set to one. In segmentation part of leave having same features are divided into number of segment.The diseased part is then segmented into a number of small segment of same size. segments are obtained by segmentation process. The size of the segment must be selected in such a way that the proper information is not lost.From the above steps, the diseased part of the crop is find out. Not all segments consist useful quantity of information. Hence the patches which contain more than fifty percent of the useful information are taken as for the further analysis. If the image is in RGB form converts it into grey colour form with the help of following equation,

$$G(x) = 0.2989*R + 0.5870*G + 0.114.*B$$

After segmentation the infected region various features are extracted to describe the infected region. Colour, texture and shape based features are normally used for region description. Final stage in disease detection is classification. It identifies a rule according to selected features and assigning each disease to any one the predetermined classes.Once the feature extraction was complete, two files were obtained.

They were: (i) Training texture feature data, and (ii) Test texture feature data. A software routine was written in MATLAB that would take in .mat files representing the training and test data, train the classifier using the train files, and then use the test file to perform the classification task on the test data. Consequently, a MATLAB routine would load all the data files (training and test data files) and make modifications to the data according to the proposed model chosen. These both file are compared with each other and corresponding disease is detected.How we can detect the disease is explained by the above flowchart.

V. SPRAYING TECHNIQUES

In our system the captured images from camera processed in PC using image processing technique and the detection of disease is done and corresponding signal is given to the microcontroller unit. In the microcontroller unit C language coding is used for programming to control the robot. According to disease the injection mechanism work. Injection mechanism consists of three injections along with dc motor connection.

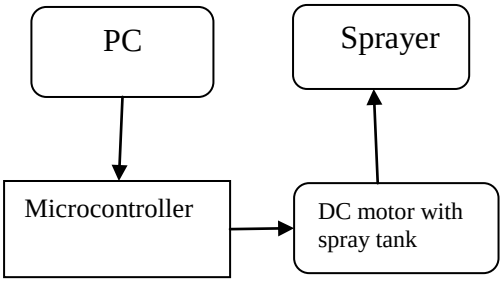

Fig.4. Spraying Techniques

These motor are used to take the corresponding pesticides in the injection when rotate in clockwise direction. When dc motor rotate in counter clockwise direction corresponding pesticides mix with water in tank.

Pesticides spraying are done through sprinkler motor. The control of spraying mechanism is done by the microcontroller unit. The DC motors are electronically controlled by microcontroller which receives input signals from RF module on the underside of the robot. By receiving the signal, DC motor is turned on and off to enable selective spraying of pesticides on plants. In this way DC motors help to spray the required pesticides on particular disease which is detected using image processing techniques.

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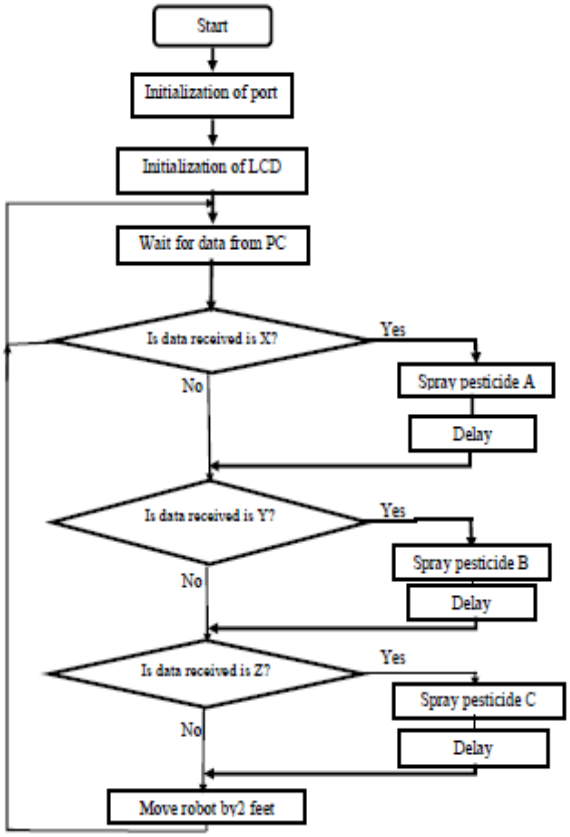

Fig.5. System Flowchart

VI. RESULTS

We apply all the steps of image processing in MATLAB on input samples. When the disease leaves are given as input data that result in detection of corresponding disease as shown in following table and corresponding pesticides is spread.

TABLE I RESULT TABLE

Input image sample	Detection of disease	Pesticides that have to spread
Leaf of infected disease I 	Alternaria Alternata	Pesticides (chlorothalonil, maneb, macozeb, or a copper-based fungicide, such as Bordeaux mixture, copper hydroxide, copper sulfate, or copper oxychloride sulfate.) is spread
Leaf of infected disease III 	Bacterial Blight	Pesticide(Pseudomonas fluorescensand BacillusSubtilis) is spread
Leaf without disease 	Healthy leaf	None of pesticides is spread

VII. CONCLUSION

The detection and classification of the plant disease is very important for the successful cultivation of crop and this can be done using agri-robo.It is used to find the plant diseases which can be identified at early stage or the initial stage.It can also spray the pesticides on the proper location, infected area only. Based on the result obtained from the algorithms, a decision can be taken as which type of pesticides should be sprayed. This prevents unnecessary spraying of any type of pesticides on crops.This paper discussed various techniques to detect the disease part of the plant. Agriculture robot is detecting the diseases along with a controlled spraying of pesticides. In future work, this can be extended to sprays the requisite pesticide, and can have Wi-Fi connectivity for necessary expert support.

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