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Review on Smart Agri-Robots

NARESH KUMAR B[1], VINAYAK T DESHPANDE[2], BHARATI[3]

[1] Senior Lecturer, Department of Mechanical engineering, GPT Raichur-DTE, Bangalore, India

[2] Senior Lecturer, Department of Mechanical engineering, GPT Hubli-DTE, Bangalore, India

[3] Senior Lecturer, Department of E&C engineering, GPT Bidar-DTE, Bangalore, India

Abstract

his article surveys the evolution of robotics research in the last half century as a response to the evolution of human social needs, from the industrial robotics that released the human operator from dangerous or risky tasks to the recent explosion of field and service robotics to assist the human. This article surveys traditional research topics in industrial robotics and mobile robotics and then expands on new trends in robotics research that focus more on the interaction between human and robot. The new trends in robotics research has been denominated service robotics because of their general goal of getting robots closer to human social needs, in India agriculture is the major backbone of most. And it has been noticed from decades that farms are in losses in one or another way so we have come with losses due to pest infection and deceases in various plant and discussed the use of robots as 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. 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: Robotics, Agri-Robo, image processing, pesticides spraying techniques, Monitoring, Automation.

Introduction

Agriculture is the most important sources of incomes in India. Agriculture alone constitutes about 22% of income in our country. 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 difficult task 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 yellowish spots, 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 colour of the affected area. 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. Here we detected the diseases by using Agri-Robo 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.

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

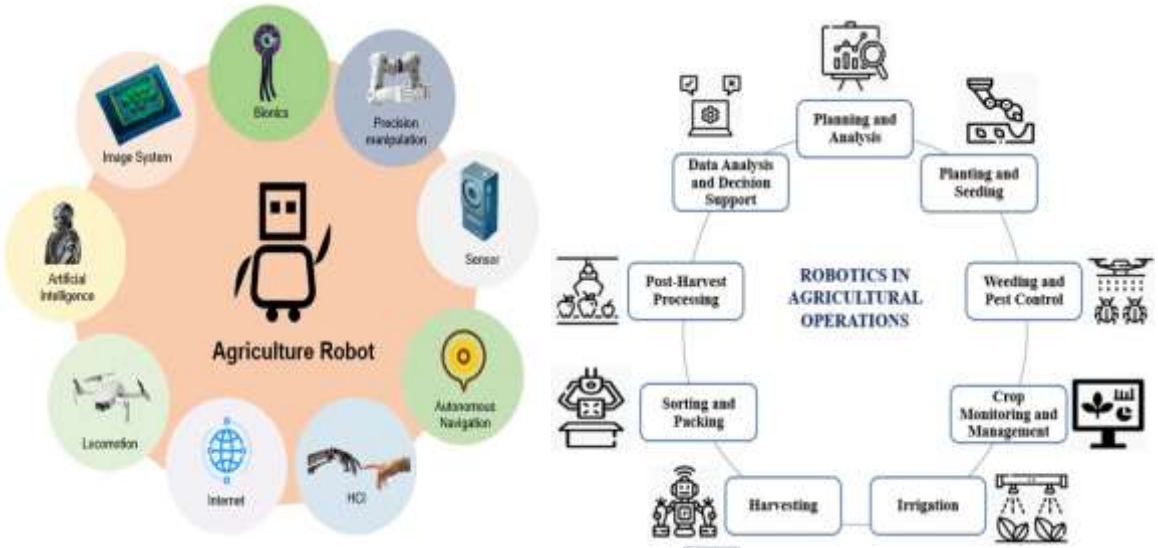

Fig.1. An Agriculture Robot with different application base and operations.

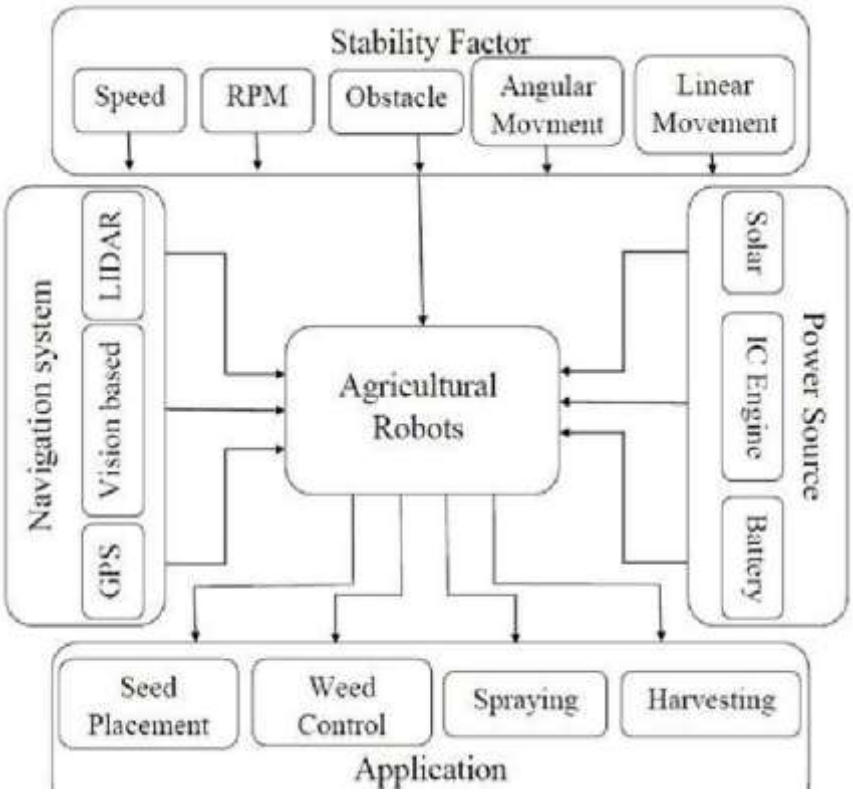

Fig.2. shows Power Supply Stability Navigation and Application of Agri-Robo.

II. THE 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 increase 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 is then converted into binary codes and transfer through RF module and given it to the microcontroller unit.

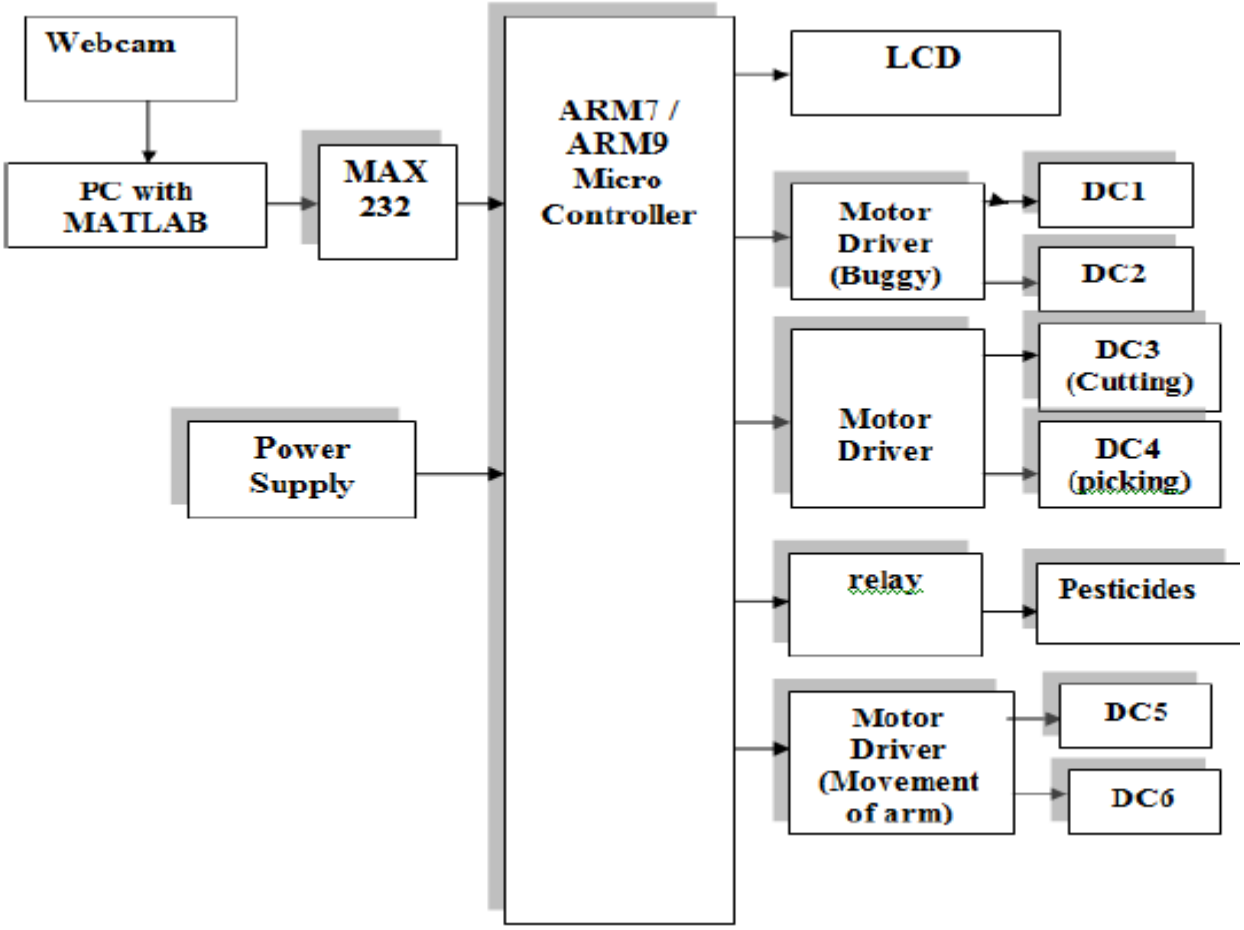

Fig.3. System Architecture

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. THE AGRIROBOT

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

Fig.4. Agri-Robo

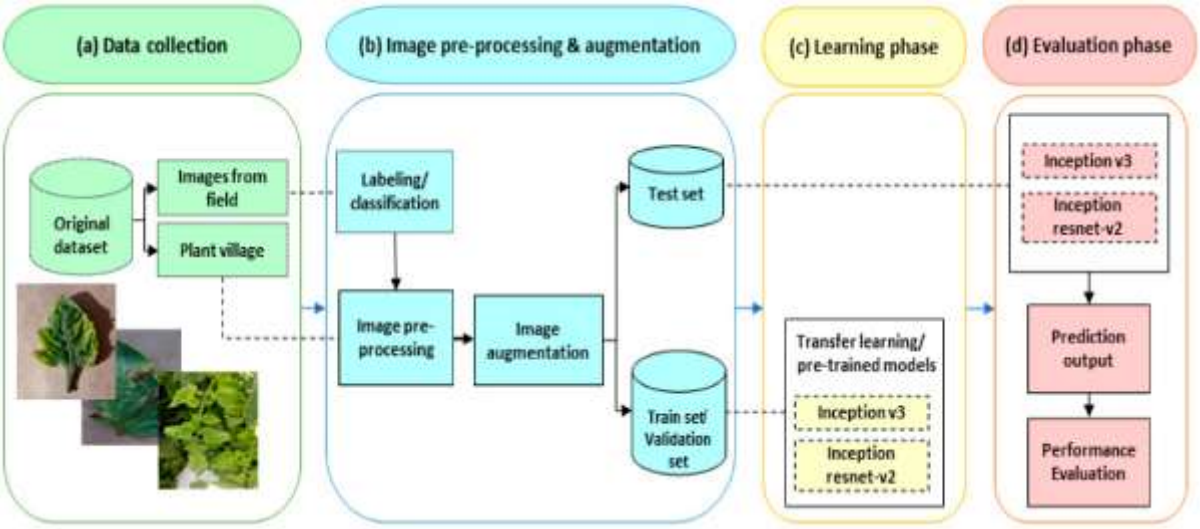

Fig.5. shows an example of smart detection of tomato leaf disease

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. STEPS 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:

1. first starts with Loading the images
2. Enhancement of the loaded images with detecting edges and shapes
3.start and enhanced images are Transferred as the input image from RGB to LAB pattern

4. next comes the Masking of green-pixels
5. and leads to Removal of masked green pixels
6. Image segmentation
7. feature extraction

In image processing, MATLAB contain tools require for image processing which covers all color space transformation Input color images have primary colors green, 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* represents Lightness this component represents the colors positive on the green-red axis a negative value indicates green while positive value indicates the red.

A* represents the colors position on the green- red axis. A negative value indicates green while a positive value indicates the yellow.

B* represents the colors position on the blue- yellow axis. A negative value indicates blue while a positive value indicates the red.

Convert image to L*a*b* color space
C form 2lab = make form(srgb2lab);
LAB = apply form (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,. These both file are compared with each other and corresponding disease is detected.

V. SPRAYING TECHNIQUES

In this 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. Spraying Techniques These motor are used to take the corresponding pesticides in the injection when rotate in clockwise direction. When dc motor rotates 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. Using Mat lab software

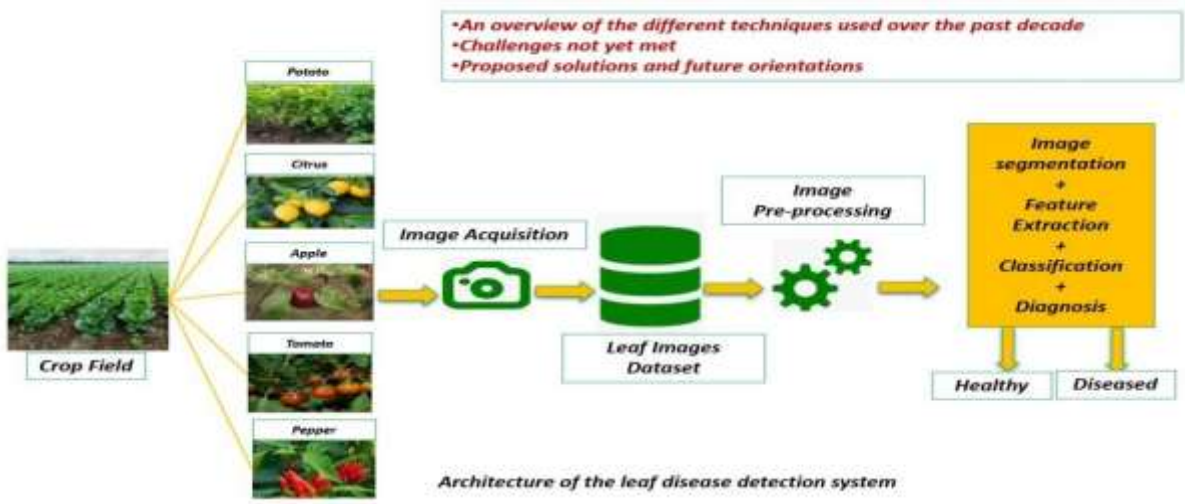

Fig. shows the leaf disease detection system

Fig. shows the tomato plant leaves

Thus from the above figures we can notice the Agri robots effectively process the image and take the Remedial actions in order to save the plants and give good yield.

Benefits of Agricultural Robotics in Crop Monitoring and Management

The integration of agricultural robotics in crop monitoring and management brings several benefits to farmers and the agricultural industry:

1. Improved Efficiency: Agricultural robots automate labour-intensive tasks, reducing the time and effort required for crop monitoring and management. They can cover large farmland areas efficiently, collecting data and performing actions precisely and quickly.
2. Increased Yield and Quality: By providing real-time data on crop health, pests, and nutrient levels, agricultural robots help optimise crop management practises. This leads to increased crop yield and improved quality, ensuring farmers can maximise their harvest and meet market demands.
3. Resource Optimisation: With precise data on soil moisture, nutrient levels, and pest infestations, farmers can optimise water, fertilisers, and pesticides. This reduces resource waste, minimises environmental impact, and contributes to sustainable farming practises.
4. Early Disease and Pest Detection: Timely detection of diseases and pests allows for swift intervention, preventing the spread of infections and minimising crop losses. Agricultural robots enable early identification, improve disease management, and reduce reliance on broad-spectrum pesticides.
5. Data-Driven Decision Making: The data collected by agricultural robots provides farmers with valuable insights into crop health, growth patterns, and environmental conditions. This data-driven approach allows farmers to make informed decisions, adjust farming strategies, and implement targeted interventions for better crop management.

CONCLUSION

Agricultural robotics has emerged as a game-changer in modern farming practises. With technological advancements, including robotics, automation, and AI, the agricultural industry is leveraging these innovations to enhance crop monitoring and management. Crop monitoring and management are critical aspects of modern agriculture. Agricultural robots play a vital role by providing accurate and real-time data on crop health, soil conditions, and pest infestations. The integration of agricultural robotics in crop monitoring and management brings several benefits to farmers and the agricultural industry. The case study demonstrates the effectiveness of agricultural robotics in crop monitoring and management by harnessing the power of agricultural robotics, farmers can achieve better crop yields, enhance crop quality, and adopt more sustainable farming practises. The case study serves the potential of agricultural robotics to revolutionize the agricultural industry.

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