Raspberry Pi based Intelligent Autonomous Farming Robot with plant health indication using Image Processing

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Abstract : Agriculture is a most important and ancient occupation in India. As an economy of India is based on agricultural production, utmost care of food production is necessary. Virus, fungus and bacteria such pest causes infection to plants with loss in quantity and quality production. Because of that large amount of loss in production. Hence proper care of plants is necessary for same. This paper presents an overview of Raspberry Pi based Intelligent Autonomous Farming Robot using Image Processing methods to detect various plant diseases. Farming Robot provides more efficient ways to detect diseases caused by fungus, bacteria or virus on plants. Mere observations by eyes to detect diseases are not accurate. Overdose of pesticides causes harmful chronic diseases on human beings. Nowadays due to spraying of pesticides on crop framers suffer from many chronic diseases that even caused death of farmer. Excess use also damages plants nutrient quality. It results in huge loss of production to farmer. Hence use of Raspberry Pi based Intelligent Autonomous Farming Robot using Image Processing methods to detect and classify diseases in agricultural applications is helpful.

***IndexTerms* - Image processing; Raspberry Pi; Open CV.**

I. INTRODUCTION

Agriculture is an ancient career. It performs a crucial role in our daily existence. Food is basic need of all people. To distribute meals among massive population desires proper amount of manufacturing. In India huge variety of populace lives in rural areas where livelihood of humans relies upon totally on agriculture. Accordingly Indian economic system on the whole relies upon on agriculture. Hence increasing first-rate production has grown to be necessary every day.

Monitoring of crop/vegetation and their control from early degree is crucial. It consists of numbers of obligations like preparation of soil, seeding, including manure and fertilizer, irrigation, ailment detection, spraying pesticides, harvesting and garage [1]. Among these spraying proper amount of pesticides needs to be taken proper care. Pesticides are used to attract, seduce and break pests subsequently known as crop protection product. Pesticides are prepared by using dangerous chemicals or every so often by using organic strategies to kill pests, weeds or infections on plant.

India is a cultivated country and approximately 70% of the populace depends on agriculture. Farmers have massive range of variety for choosing diverse suitable vegetation and finding the suitable pesticides for plant. Disorder on plant results in the large reduction in both the satisfactory and quantity of agricultural merchandise. The studies of plant ailment confer with the research of visually observable patterns at the plant life. Tracking of fitness and sickness on plant performs an vital role in a success cultivation of vegetation within the farm. In early days, the monitoring and analysis of plant diseases have been finished manually by using the information individual in that field. This call for first rate amount of work and additionally calls for excessive processing time. The photograph processing techniques can be used within the plant sickness detection. In maximum of the cases sickness symptoms are seen on the leaves, stem and fruit.

Today various means are available to increase yield in production and reduce human efforts. Technologies have been vastly developed and spread in all fields including agriculture. One of the inventions is agricultural Robot. Agricultural robot is an agricultural robot used for performing various agricultural tasks. It performs all sorts of agricultural tasks. This reduces human efforts, increases yield and decreases cost of labor. Due to which one gets healthy food

II. LITERATURE SURVEY

The surveys of various papers that have contributes, Basavaraj Anami proposed colour and edge histogram comparison for plant leaf color and edge matching [3]. Mila nikolova proposed colour image processing for use fast hue range parameters of histogram matching [4]. Kumthekar proposed more number of video key frame extraction by using image processing [5]. Raman maini proposed study and comparison different image Edge Detection Techniques Senthil kumar proposed image capturing using Raspberry Pi controller with NOIR camera module [6].Suvita vani proposed SSH (Secure Socket Shell) connection for interface of GSMwith Raspberry Pi.

The surveys of various papers that have contributes various problems of farmer facing crop damage, image processing on plant using different methods, edge histogram, parameters of histogram matching.

III. BLOCK DIAGRAM OF SYSTEM

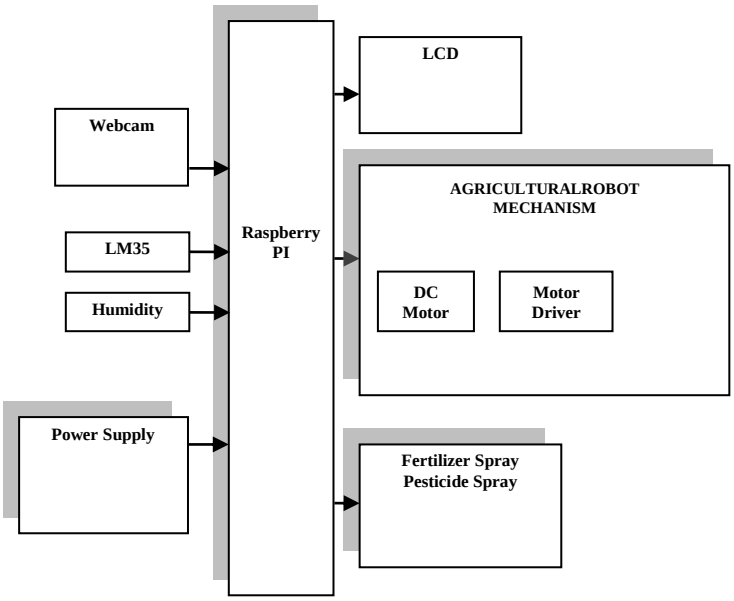

FIG.1. GENERAL BLOCK DIAGRAM OF FARMING ROBOT.

Farming Robot Mechanism

Today various means are available to increase yield in production and reduce human efforts. Technologies have been vastly developed and spread in all fields including agriculture.

One of the inventions is agricultural Robot. Agrobot or agricultural robot or Agrobot is an agricultural robot used for performing various agricultural tasks. It performs all sorts of agricultural tasks from seeding to spraying pesticides. This reduces human efforts, increases yield and decreases cost of labor. Due to which one gets healthy food .Thus Farming Robot is boon to farmers and society. Fig.1. shows general block diagram of Farming Robot.

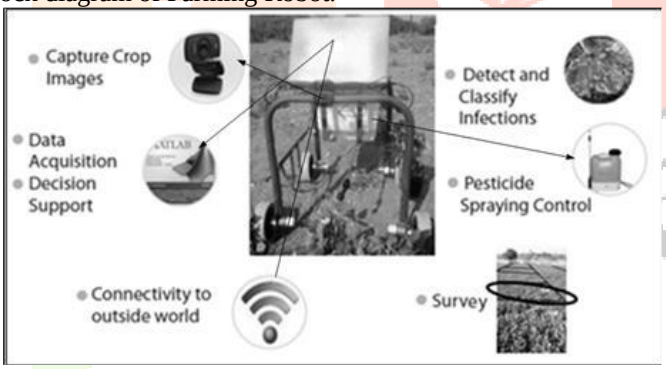

FIG.2. SCHEMATIC DIAGRAM OF FARMING ROBOT [2].

B. Hardware Mechanism

1. Webcam

Input to the machine is given through Webcam. It takes snap shots or video of plant and for similarly system is send to controller/processor. Resolution of webcam is 640*480 and up to 30 Megapixel can be used.

2. Power Supply or Battery

The power supply or battery can be used to operate Farming robot.12V is required to drive DC motor and for controller it depends on which processor/controller is used. Hence 12V battery is used to drive DC motor [7].

3. Raspberry PI

The Raspberry Pi controller is a credit card sized computer that interface with camera, Audio and video device and some electronic devices like GSM, XBEE etc. It's like a mini personal computer that can be used for games and data processing. It is a ARMv7 Quad Core Processor. The board consists of in build memory for 1GB RAM to access large powerful applications. Raspberry Pi controller consists of 4 USB ports for connect devices, 1 HDMI port for video output display, Ethernet port for network connections, and input power supply for controller is 3.3v.

4. DC Motor Driver (L293D)

To drive a DC motor, we have used DC motor driver called L293D [1]. It is monolithic, high voltage and high current device. It has four channel drivers which are assembled in a16 lead plastic package [1]. For heat sink it has 4 centered pin connected together.

5. DC Motor

To actually drive the application like wheel in robot, DC motors are used. These DC motors work on 12V [1] and needs motor driver L293D. One L293D drive 1or 2 DC motors [1].

6. LM35

Temperature sensor is used to sense the temperature. In this method we have used a Temperature sensor referred to as LM35. LM35 can experience the temperature of the ecosystem around it or the temperature of any machine to which it is connected [5].

7. Humidity Sensor

Humidity sensor is an analog sensor and offers the output into form of analog signal [3]. That analog signal is given to ADC with the intention to convert it into virtual shape. Once transformed into analog form, the microcontrollers can method the digital humidity signal as in keeping with the required software.

8. Relay with driver unit

Relay is an electromagnetic switch; consist of a coil, 1 common terminal, 1 normally closed terminal, and one normally open terminal. Relays allow one circuit to switch a second circuit, which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

C. Image Processing

1. Pre-processing

Pre-processing images commonly involve removing circumstance noise of low frequency and, adjust the intensity of the individual pixel of images, removing speculations, and masking portions of images.

Processes involved in Image Pre-Processing are:

1) Image Acquisition
2) Noise Removal
3) Color Masking

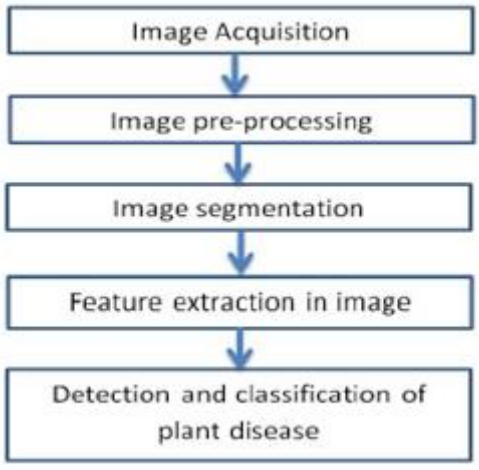

Fig.3. Basic steps for plant disease detection And classification [3]

1) Image acquisition

In this image acquisition technique Web Camera is interfaced with Raspberry Pi controller in the 5 feet distance of the field. When the Dry peanut leaves and worm affected leaves is present in a particular field which can be captured by using this Web Camera in a period of time.

2) Noise removal

Noise reduction uses important role for segmentation and feature detection methods because noise affects the true image data and pixel values. In order to avoid this problem to remove noise thus, uses the clear appearance of true image and removes adjacent pixel noises in this project to remove noise using fast, nonlocal means de-noising method. In this method input query images of background noise is removed. Each neighborhood pixels are surrounded by window size and then noise is removed.

3) Color masking

In this color masking mask the all colors except for the required true image color. Therefore, in this technique need to change the color spaces.

2. Algorithm

There are 150 number of color space conversion techniques available in image processing. HSV color space is mostly used in open computer vision compared to RGB color space because RGB color space varies in illumination levels. HSV means Hue-Saturation-Value, In this Hue represent the color. Saturation denotes the grayness, so that saturation value is zero means image is

grayscale (or) dull image. For HSV, Hue range is [0,179], and [0,255] for both saturation and value. In different type of software uses varies the HSV values, therefore need to normalize the images after converting the BGR to HSV color space. Depending upon this HSV values we are extract the different color images. In corresponding green color HSV value to extract the green color image alone, except the all other colors of query images using Bit wise AND operation

IV. OVERALL FLOW OF THE SYSTEM

1) Start
2) Initialize WEBCAM (Driver, Preference, Resolution (640 x 480))
3) Take photo in RGB colour space
4) Start video
5) Open a preview window (640 x 480)

"A"

6) Move the Robot buggy by 5 seconds and stop (Next plant)
7) Get a snapshot from webcam
8) Store in current directory
9) Apply **RGB to HSV** function to the RGB image (for green component)
10) Take out the Hue component of image by comparing it with look up table for green colour, Store it in I1 matrix Take out the Saturation component of image by comparing it with look up table for green colour, Store it in I2 matrix
11) Take out the ABS value component of image by comparing it with look up table for green colour, Store it in I3 matrix
I=I1 x I2 x I3
12) Apply median filter
13) Dilate the image
14) Take out Image properties (Leaf area)
15) Find the connected components for Plant Colour
16) Calculate the pixel count of all Leaf Colour areas
17) Calculate the total pixel count of image
18) Is Height Colour pixel count > set total area (70%)? Y→
19) Display Healthy→ "A"
20) N→ Display Reduced height → Spray fertilizer for 5 sec →"**A".**

V. RESULT

The proposed system is "RASPBERRY PI BASED INTELLIGENT AUTONOMOUS FARMING ROBOT", by using this proposed system we are able get the result quick and accurate results.

Raspberry Pi based Intelligent Autonomous Farming Robot using Image Processing methods to detect various plant diseases. Image processing provides more efficient ways to detect diseases caused by fungus, bacteria or virus on plants. Observations by eyes to detect diseases are accurate.

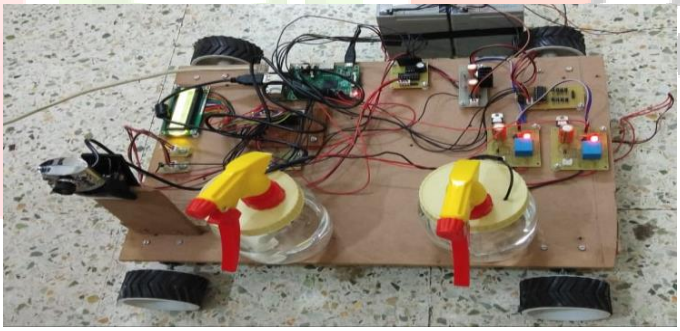

Fig.4. Setup

The above Figure shows the setup of the Proposed System. In this LCD, DC Motor, Humidity Sensor and Temperature Sensor are connected to the Raspberry Pi through connector.

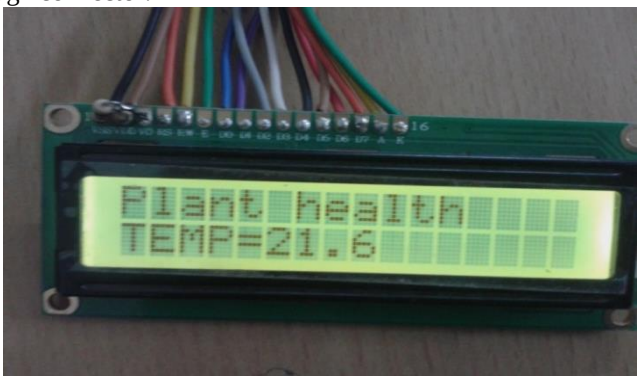

Fig.5. LCD display showing Name of System.

In the above Figure the LCD shows the name of project and temperature sense by the temperature sensor LM35. The Temperature and Humidity affects the health of plants.

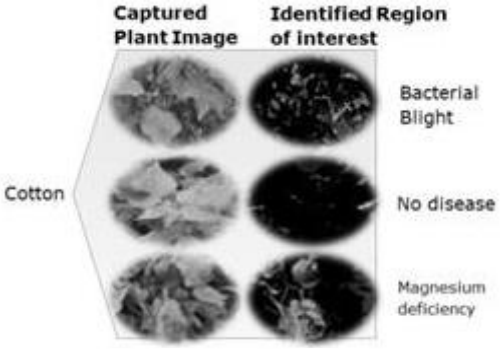

Fig.7. Identified Cluster for different images in cotton[2]

For cotton plantations, bacterial blight and magnesium deficiency are used for classification. The test is conducted to study the challenges that need to be addressed during a real time run as well as to have a preliminary estimate of the algorithm accuracy. The cotton crop data is a random multiple sample section of the field and is used for the further analysis. An accuracy of 90+ % is obtained for cotton diseases detection.

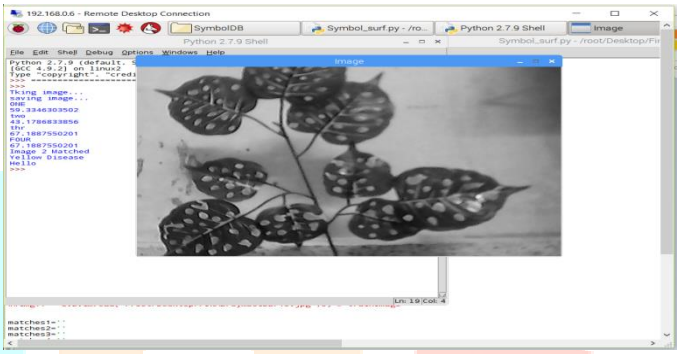

Fig.8. Disease Detected.

In the above Fig.8 the yellow disease on the cotton plant is detected by comparing with the healthy plant.

The experimental results are calculated in figure 9. In this Normal growth and no disease detected is a normal healthy plant, Abnormal growth means plant with reduced height, Disease 1 means yellow disease detected, Disease 2 means black disease detected as we consider here two diseases and abnormal growth plant. Total shows the no. of plants evaluated.

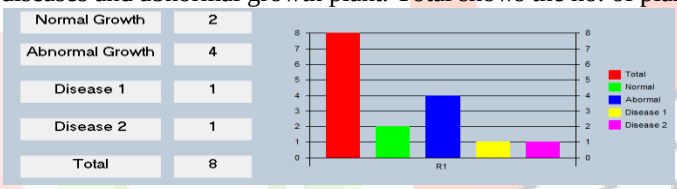

Fig.9. Experimental Results

VI. CONCLUSION

For proper and successful cultivation of crops it is necessary to detect diseases accurately. Hence from above discussions it can be seen that Raspberry Pi based Intelligent Autonomous Farming Robot with plant health indication using Image Processing have proved useful in all means. We can accurately detect and classify diseases on various plants using all above techniques. Hence these techniques have potential to be use in Farming Robot system.

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