PLANT MONITORING USING IMAGE PROCESSING, RASPBERRY PI & IOT

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Abstract - *In India, 70% of its people are in the Agriculture sector. The remaining 30% of people are an inseparable part of this field. Because from agriculture, we get various raw materials and especially crops, which serve as a staple food for people. But The crops and plantations get destroyed mainly due to two major reasons, first reason is destruction by natural calamities such as flood, earthquake, drought, famine, etc. and second reason is the destruction by the pathogens.98% of the destruction is caused by the pathogens and 2% of the destruction happens due to natural calamities. So the need for the plant disease detection was felt. The traditional methods were inaccurate and not effective. So various researches in this field lead to inclusion of image processing for accurate detection of disease by using plant leaf. Various spots, patterns on plant leaf are useful in detecting the disease. Further advancement was use of digital image processing for more accurate results. On referring various reputed IEEE, international conference and international journal papers regarding this field, it was found that none of these suggest remedy for curing the plant disease.*

Key Words*: component; formatting; style; styling;*

1. INTRODUCTION

In India, Farmers have a great diversity of crops. Various pathogens are present in the environment which severely affects the crops and the soil in which the plant is planted, thereby affecting the production of crops .Various disease are observed on the plants and crops .The main identification of the affected plant or crop are its leaves. The various coloured spots and patterns on the leaf are very useful in detecting the disease. The past scenario for plant disease detection involved direct eye observation, remembering the particular set of disease as per the climate, season etc. These methods were indeed inaccurate and very time consuming. The current methods of plant disease detection involved various laboratory tests, skilled people, well equipped laboratories etc. These things are not available everywhere especially in remote areas. The method which I am implementing insures the automatic detection of crops. The very first implementation of plant disease detection using image processing was done by shen weizheng, wu yachun, Chen

zhanliang and Wei hongda in their paper [9].The method which I am implementing makes use of digital image processing for plant disease detection.

2. LITERATURE SURVEY

Let's have a brief overview of the various papers, which I have referred for implementation of my project. The usage of image processing technology for plant disease degree grading eliminates the subjectivity of traditional classification methods and human-induced errors. Thus the estimation credibility is improved and accurate data are provided for disease studies. The method is also convenient, which simply needs computers, digital cameras with the Combination of necessary software programs to realize for the disease batch grading. The accurate detection and classification of the plant disease is very important for the successful cultivation of the crop and this can be done by using image processing. The basic steps for disease detection using image processing include image acquisition, image pre processing, feature extraction, detection and classification of plant disease. Enhanced images have high quality and clarity than the original image. Colour image have primary colors red, green and blue. It is difficult to implement the application using RGB because of its range. Hence they convert RGB to grey images. Detection of plant disease through some automatic technique is beneficial as it reduces a large work of monitoring in big farms of crops and at very early stage itself detects the symptoms of the disease. They have presented a survey on various classification techniques. Abdul hallis et al in their paper, have used MATLAB for feature extraction and image recognition. Here digital camera is used for image capturing. Mrunalini and Prashant. R.Deshmukh Compares Otsu threshold and the K means clustering algorithm for infected leaf analysis. The clarity of k means clustering is more accurate than other method. J.K.Patil in his paper describes the possible approach for extraction of low level image features like color and texture. Anand kulkarni in his paper discusses the Gabor filter and ANN for feature extraction and classification respectively . Haiguang Wang in his paper stresses on the principal component analysis. PCA could reduce the dimensions of the obtained data under the premise of retaining the total data information, reduce the

nod .of neurons in the input layer and increase the speed of neural networks. Maintaining the Integrity of the Specifications

3. STEPS FOR PLANT DISEASE DETECTION

3.1 IMAGE ACQUISITION

The images of the plant leaf can be acquired using two ways. First way is to capture image using the external camera, here we have used iball web camera and second way is to get the image from the email etc. The input image is converted to color space.
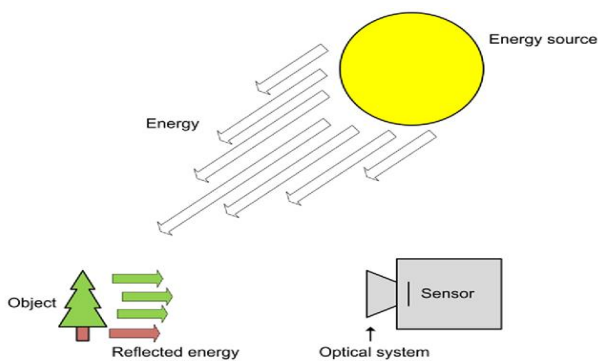

Fig.(3-1) image acquisation

3.2 IMAGE PRE-PROCESSING

To remove the noise in the image, different pre processing techniques are considered such as image clipping for obtaining the concerned area by cropping; image smoothing is done to reduce in the obtained image by using the smoothing filter. Image enhancement is done to increase the contrast.
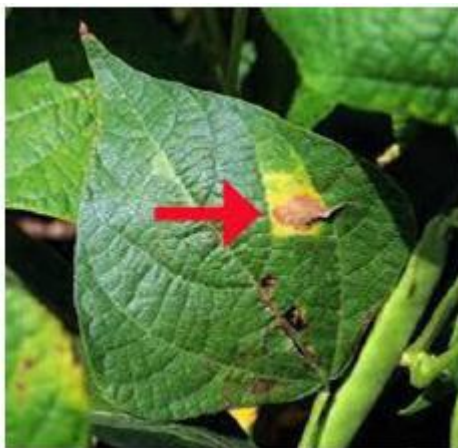

Fig.(3-2) image cropping example
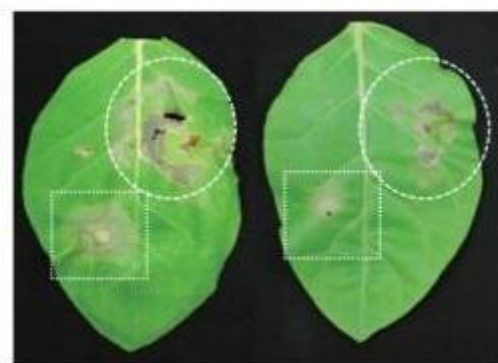

Fig.(3-3) image smoothing

Fig.(3-4) enhanced image of leaf

3.3 IMAGE SEGMENTATION

Segmentation means partitioning of images into various part of the same feature or having some similarity. The segmentation can be done using Otsu's method, K means clustering, converting RGB to HSI model etc. The K means clustering is used for classification of the object based on a set of the features into K no. of classes. The classification of the object is done by minimizing the sum of the square of the distance between the object and the corresponding cluster.
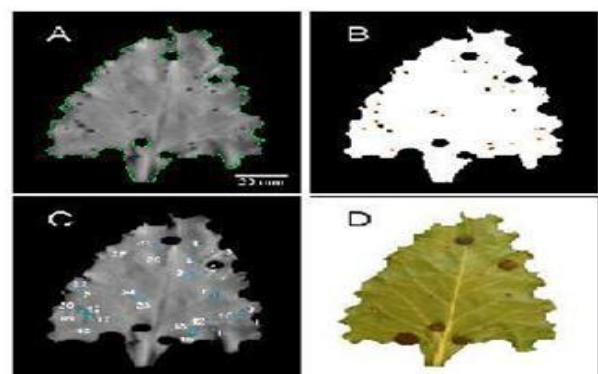

Fig.(3-5) image segmentation

3.4 FEATURE EXTRACTION

Feature extraction plays an important role for identification of an object. In many application of image processing, feature extraction is used. T he features which can be used in plant disease detection. In paper [3], Monica jhuria et al considers color, texture and Morphology as a feature for disease detection. They have found that morphological result gives better result than the other features. Texture means how the color is distributed in the image, the roughness, hardness of the image. It can also be used for the detection of infected plant areas. Color, texture, morphology, etc. are the features which can be used in plant disease detection. In my project for feature extraction, we have converted the image to grey scale. The image which is in the color space is converted into grey image using,

$$F(x) = 0.2989*R + 0.5876*G + 0.114.*B.$$

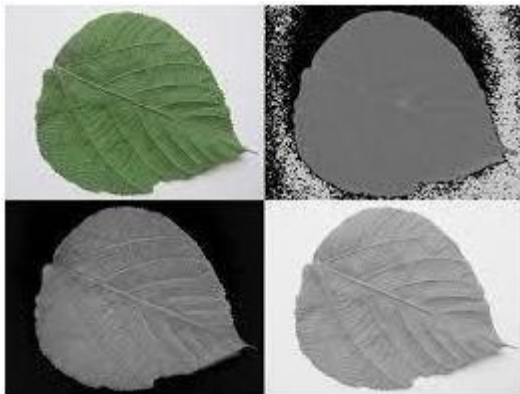Fig. (3-6) Feature extraction

3.5 CLASSIFICATIONS

For the classification and the detection, we have used SVM (support vector machine) with .mat file. The SVM is the supervised learning model with associated learning algorithm that analyzes data used for classification and regression analysis. A SVM constructs a hyper plane or a set of hyper planes in a high or infinite dimensional space which can be used for classification, regression or other tasks. Intuitively, a good separation is achieved by the hyper plane that has the largest distance to the nearest training-data point of any class (so-called functional margin), since in general the larger the margin the lower the generalization error of the classifier. The.mat file store the various features of the affected leaf.

4. BASIC TYPES OF PLANT FAMILIES

4.1 MONOCOT FAMILY PLANT

These type plants have one seed leaf. The vein structures of Monocot family plants are parallel and straight   wheat, ginger, corn, rice, millet.

4.2 DICOT FAMILY PLANT

These type plants have two seed leaves. The vein structures of Dicot family plants are nested and complex structure. Cotton, potatoes, tomatoes, beans, honeysuckle, roses.

5. FRUIT SIZE DETECTING AND GRADING
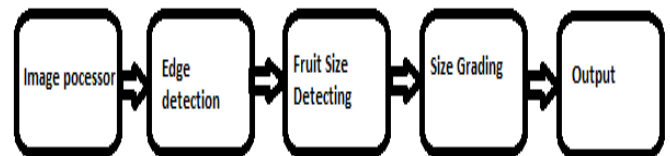
5.1 PROCESSING FLOW

Fig (5-1) fruit image size detection and grading

Take apple as the processing example, according to, the apple size is its diameter, which is the longest distance in the apple's cross section. So the detecting program is focused on how to calculate the diameter in an apple side view image. The fruit image size detecting and grading processing flow.

5.2 COLOR DETECTION

In the process of fruit color is detected according toRGB values; here fruits are sorted according to color and size. So for e.g. two fruits are considered say tomato having red color and guava having green color, so in this step work is going to find out color of a fruit by using RGB values of an image taken from the camera, this image can be processed by using MATLAB software and accordingly color can be detected i.e. green or red.

Color detection algorithm:

1) Start
2) Read the input color image using imread function.
3) Read the input pixel of color image in three different planes (RGB) and store it into three variable r, g, and b.
4) Read the small region of fruit to detect color of fruit.
5) Store in different variable r1, g1, b1.
6) Calculate the mean of r1, g1, b1 and store into variable r2, g2, b2.

7) Compare the value with threshold.
8) If g2>threshold, Color detected is green.
9) If r2>threshold, Color detected is Red.
10) End.

5.3 EDGE DETECTION

Once color is detected, there is a need to find out size of a fruit. The size of circular shaped fruit is its diameter. The edge extraction is key factor for size detecting. After gray image, the most powerful edge-detection method that finds edge is the canny method.

The Canny method differs from the other edge-detection methods in that it uses two different thresholds (to Detect strong and weak edges) and includes the weak edges in the output only if they are connected to strong edges. This method is therefore less likely than the others to be fooled by noise, and more likely to detect true weak edges.

5.4 FRUIT SIZE DETECTING ALGORITHM

In order to calculate this diameter, the fruit's natural symmetry is considered, so the fruit size detecting algorithm based on its symmetry mainly contains two parts: finding the center coordinates of fruit's shape in image and finding fruit's axis in image . The algorithm is described as follows:

Finding the center coordinate of fruit's shape in image: The center coordinate can be easily calculated once finding the edge sequence points. Suppose the finding edge sequence point is q (x_i, y_i), i=1, n. the center coordinates of fruit's shape is (c_x, c_y).
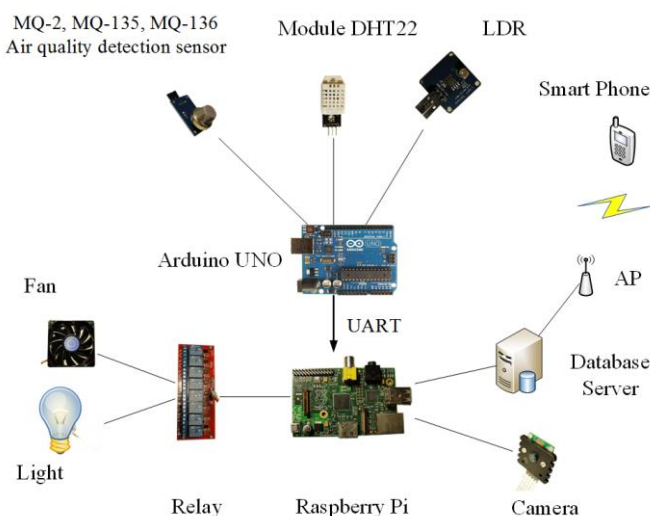
6. PLANT MONITORING SYSTEM OVERVIEW

Fig (6-1) monitoring system

Shown in figure , components of the automatic plant monitoring system on Raspberry Pi Model-B and Arduino Uno are demonstrated. The system can notify using a real-time alarming system to smart phones reporting such as the current and daily highest/lowest temperature, humidity, and weather quality of the farm surroundings. Users can also control the filter fan switches and customize the notification system to the smart phone.

7. MONITOURIN SYSTEM METHODOLOGY

7.1 RASPBERRY PI

Raspberry Pi is a small computer board working on the Linux operating system which connects to a computer monitor, keyboard, and mouse. Raspberry Pi can be applied to a electronic structure and programming network work, it can also serve as a personal computer and Apache Webserver, MySQL could be installed in the board.

A GPIO pin can be used as either a digital input or a digital output, and both operate at 3.3V. Unlike the Arduino, the Raspberry Pi which does not have any analog inputs. For that you must use an external analog-to-digital converter(ADC) or connect the Pi to an interface board must be used.

7.2 ARDUINO

Arduino is an open-source microcontroller compatible with developed platforms. The controller appears not to be expensive and uses low electrical power, 5.5 volts. C and C++ were employed for this development. Arduino can connect to a computer via the Universal Serial Bus (USB) and perform with compatible connected accessories in both analog signal and digital signal. The Arduino is a microcontroller platform, mounted on a board that plugs easily into most computers. It allows the user to program the onboard Atmega chip to do various things with programming language, in programs called sketches.

7.3 HUMIDITY SENSOR MODULE

Environmental conditions directly affect animal livelihood contributing to some chronic epidemics such as Bird Flu and Hand Foot and Mouth Disease. Therefore, DHT22 is use as a censor for measuring temperature (for both Fahrenheit and Celsius value) and humidity. The measurement unit will be demonstrated in a digital signal form.

7.4 GAS SENSOR MODULE

The module works as a Air Quality Detection Gas Sensor, this is sensitive to gas dangerous to human, applied to measure NH3, NOx, Alchohol, Benzene, CO, and CO2. The module is also used for controlling weather conditions and air cleaners in buildings. The measurement unit is presented in a analog signal.

In this research, three censor forms were used, consisting of MQ-2, MQ-135, and MQ-136 because of its gas measurement differences.

7.5 PHOTOSENSITIVE SENSOR MODULE (LDR)

A light sensor was used for measurement of light intensity especially for naked eye light, its unit is called Lux . Light Dependent Resistor (LDR) is a light sensitive resistance changing electronic resistance when there is a light incidence, called Photo Resistor or Photo Conductor. The resistor was made from Semiconductor, Cadmium Sulfide (Cds) or Cadmium Selenide (CdSe). These two substances are semiconductors coated in a ceramic sheet as a base.

7.6 HARDWARE CONNECTION

The Raspberry Pi and Arduino were connected via UART. The connection was a serial communication as Full Duplex since there was two-ways that data could be transmitted via pin TX and RX. A direct connection between the Raspberry Pi and Arduino was prohibited, because of its electrical potential differences, which is 3.3 volts for the Raspberry Pi and 5 volts for the Arduino. Bi-directional Logic Level Converter should be used to separate them. A connection between a camera and Raspberry Pi by applying Common System Interface (CSI) serves as a point to point connection, providing a fast data transmission and low energy consumption. MJPG-Streamer is a basic program command copying data from a single input to multiple outputs. A photo could be presented in a network system accessing from a web browser on a computer. In this study, a photo from a camera would be taken to demonstrate on a smart phone. All sensors would be connected via Board Arduino and the data would be transmitted from UART to Board Raspberry Pi. Raspberry Pi works as a controller of a ventilator, notifying a working condition to the smart phone and served as a data sender to store in a server computer.
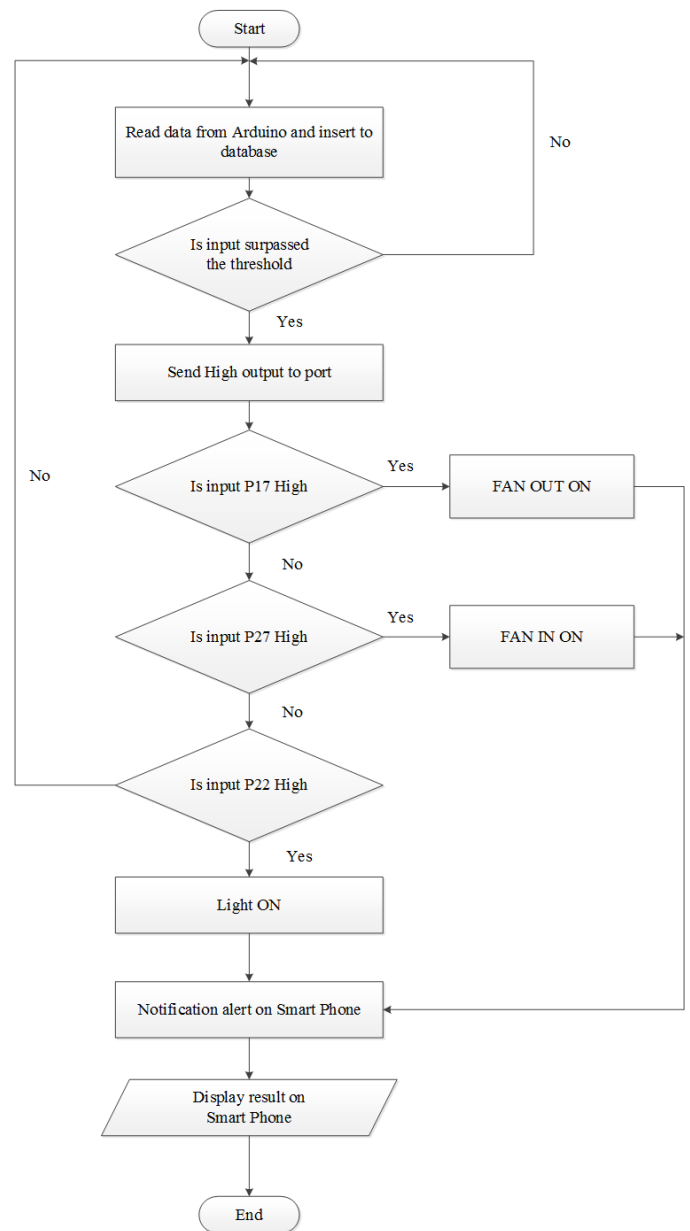
7.7 SOFTWARE

Fig (7-1) Flowchart of programming in Raspberry Pi

A connection between Raspberry Pi and smart phones was investigated in this study. Programming of a communication between a server and a client consisted of two perspectives. The Raspberry Pi would check whether there was any connected clients, if so, a mutual data transmission would be done. By doing this, an application would send the data via Socket referring to IP Address and Port in Transport Layer using TCP protocol.

Python programming is applied for the development of Raspberry Pi. Python would read the Arduino signal value via UART and then collect the obtained signal to the

database for processing. If the value surpassed threshold, the over signal would be sent to GPIO pins to aware the analog signal.

3. CONCLUSIONS

The accurate detection and classification of the plant disease is very important for the successful cultivation of the crops, this can be done using digital image processing. In this project, the detection as wells the remedy for curing it is achieved. This project utilizes GSM so as to send the message to every kind of mobile handset. This project utilizes various image processing techniques which provide accurate results.

The proposed system is a demo version, so for a large scale production the number of cameras and length of conveyor system can be modified. This work presents new integrated techniques for sorting and grading of different fruits. Generally image capture is a big challenge as there is a chance of high uncertainty due to the external lighting conditions, so we are taking the advantage of gray scale image which are less effected to the external environment changes as well as beneficial for finding size of a fruit. Same way while collecting fruit from conveyor system by a main plate there is variation in the weight measurement of a fruit so further design can be modified so fruits can be collected stably. Speed and efficiency of a system can be further improved by using ARM9 or ARM11 processor for the same purpose.

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