Implementation on Tomato Cutter Robot using Image Processing and Raspberry PI

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ABSTRACT: Promoting digital farming might be the answer for current challenges in the agriculture industry by employing a robot to provide continuous information of its deployed area and gives the right analysis in many aspects of farming. The fruit to be picked is red and yellow tomatoes. The objective of this study is to set the initial project in creating a series of robots applied in agricultural to realize the idea of digital farming. The novelty of this study is that this method is simple, and image processing is kept simple to accommodate processors limited computation resources. The robot designed is customized according to the size of the tomato tree and tomato.

Keywords: agriculture robot, circuilar Hough Transform, color filter, Arduino Raspberry Pi.

1. INTRODUCTION

Promoting digital farming might be the answer for current challenges in the agriculture industry, such as the lack of young people interest in this industry, ever-growing population that demands more food stock, and the requirement in keeping the quality and quantity checked all the times. Digital farming or automatic farming is a method in applying automation in every aspect of farming, starting from seeding to harvesting the agriculture product.

Employing a robot is considered building a digital farming project. The robot can provide continuous information about the farm or area where it is deployed, and gives the right analysis in many aspects of farming. All the type of robot is possible to be a farming robot, such as a drone can spray pesticide effectively. A robot can be a great help during harvesting since it can monitor the field continuously and pick the product at the right time based on the input criteria. Arm robot manipulator and the mobile robot can be employed as a harvesting robot. However, for picking motion during harvesting time, arm robot manipulator is the perfect one for the job since it has an arm that can be customized to pick or grab any objects. To ensure the effectiveness during harvesting, the robot needs eye to detect, track, cut, and grab the agricultural product. As electronics components needed to build a robot are getting cheaper, everyone can build their robot, including equipping the robot with a good camera. Camera size is also getting smaller that it can be attached to the robot without adding significant weight to it. There are two types of camera application on arm robot manipulator; eye in hand and eye to hand. Eye in hand is where the camera attached to the robot, and eye to hand or time of flight camera is where the camera is attached elsewhere. Both methods have their advantages and disadvantages. The eye in hand has a more natural function as an eye, however, is prone to occlusion.

Camera application needs image processing to differentiate the object to be grabbed/picked with the background; therefore, the robot knows which one to cut and grab, and which ones to ignore, for example, it is essential that robot understand the fruit location relative to vegetation. Another necessary sensor is a proximity sensor to make the robot get a sense of distance between it and the fruit. This paper discusses the pilot project of employing robot as a harvesting robot. The fruit to be picked is tomatoes, both green and red tomatoes. The robot is equipped with servo motors as the actuators, microcontroller ATMega as the main controller, Raspberry Pi to process the image, PI camera attached to the end-effector, and proximity sensor to give the distance information between the robot and fruit. To show the effectiveness of proposed method, the prototype robot harvests the fruit by cutting its branch; the fruit considered in this study is red and green tomatoes. The objective of this study is to set the initial project in creating a series of robots applied in agricultural to realize the idea of digital farming. The novelty of this study is that this method is simple, and image processing is kept simple to accommodate processors limited computation resources.

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. PROPOSED SYSTEM

Tomato is one of the main vegetables consumed by humans for its antioxidant content, vitamins (A, B1, B2, B6, C, and E), and minerals such as potassium, magnesium, manganese, zinc, copper, sodium, iron, and calcium. This fruit provides health benefits in the prevention of chronic diseases such as cancer, osteoporosis, and cataracts. One of the main indicators that allow knowing the internal composition of the tomato is its degree of maturity. This paper discusses the pilot project of employing robot as a harvesting robot. The fruit to be located is red and green tomatoes with appropriate size.

System consists of Raspberry pi, Arduino along with camera module, motors and motor driver circuits shown in fig 2.. Camera captures video continuously, Raspberry Pi converts real time input video into frame and then perform circle Hough Transform on image to detect shape of tomato. If tomato circular then it is considered as tomato is ripe. Then color filter is applied on tomato image to detect color of tomato shown in figure 1.

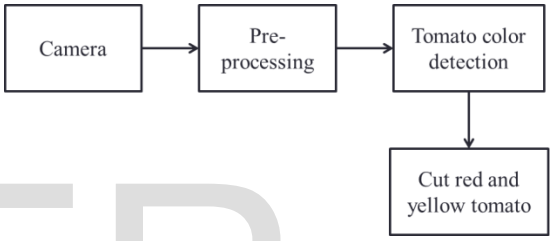

Fig.1 Block diagram of video processing

The video captured from the camera. For the image processing purpose opencv library is used which allows image processing operations in python. Image is pre-processed to de-noise it, extract region of interest from image and extract features. Classify the color of tomato into green, yellow and red.

After detecting color of tomato, Raspberry Pi sends information about tomato color and shape to Arduino as output. Arduino compares input from limit switches and Rpi. Limit switches convey Arduino whether it has to continue operation or stop in its way.

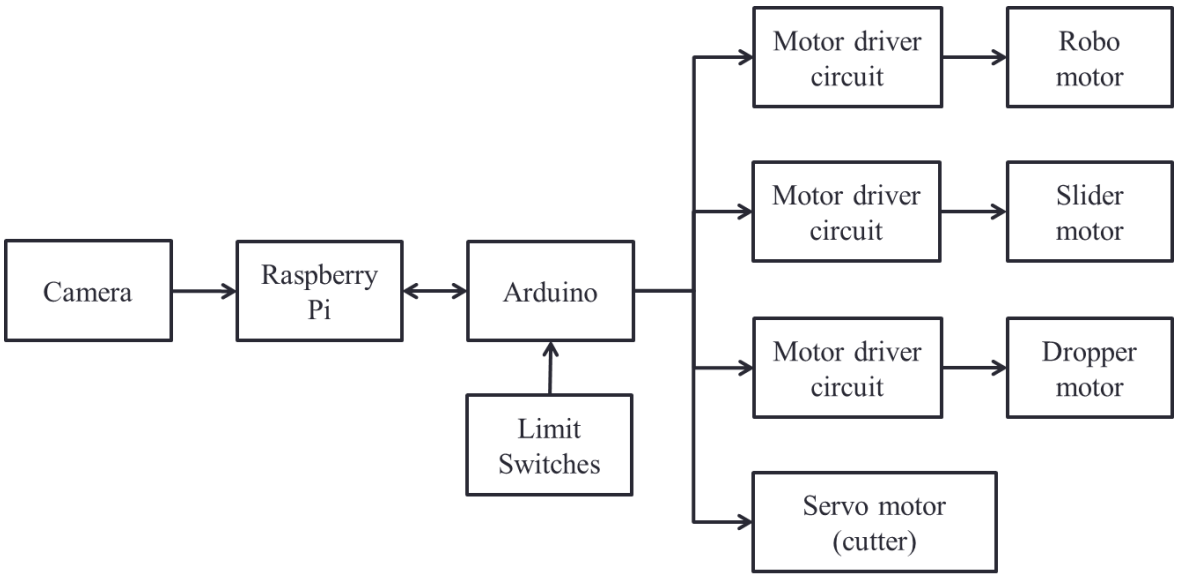

Fig 2 block diagram of proposed system

When limit switch input allows its to continue operation, Arduino command motor as follows:

- If tomato is red color
  - Command Robo motor to go close to tomato
  - Servo motor to cut tomato
  - Dropper motor to drop tomato in slider
  - Slider motor to drop tomato in box2
- If tomato is yellow
  - Command Robo motor to go close to tomato
  - Servo motor to cut tomato
  - Dropper motor to drop tomato in slider
  - Slider motor to drop tomato in box1
- If tomato is green

Command robo motor to move forward

Complete flow of system and image processing is shown in fig 3

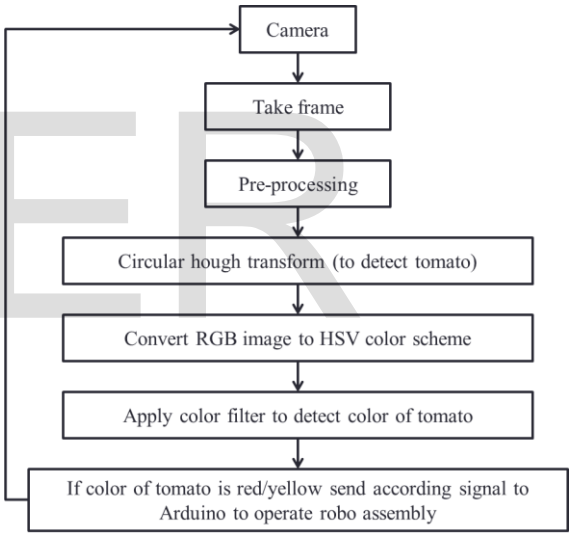

Fig 3 flowchart of proposed system

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4. CONCLUSION

This paper presents a pilot project of tomato harvesting robot. Therefore, the robot designed is customized according to the size of the tomato tree and tomato. The video captured from the camera is sent to Raspberry Pi which converts real time input video into frame. For the image processing purpose opencv library is used which allows image processing operations in python. Image is pre-processed to de-noise it, extract region of interest from image and then circle Hough Transform on image is applied to detect shape of tomato. The color filter is applied on tomato image to detect color of tomato. After detecting color of tomato, Raspberry Pi sends information about tomato color and shape to Arduino as output. Arduino commands robot mechanism to cut and placed yellow and red tomatoes in different partitions. If tomato is green system will simply go forward without cutting it.