ENHANCED TECHNIQUE FOR SORTING AND GRADING THE FRUIT QUALITY USING MSP430 CONTROLLER

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ABSTRACT
This project presents fruit quality detection system. The system design considers some features that includes fruit colors and size, which increases accuracy for detection of fruits pixels. Gaussian Mixture Model (GMM) is used for background removal, for color classification Support Vector Machine (SVM) is used. At present, most existing fruit quality detecting and grading system have the disadvantage of low efficiency, low speed of grading, high cost and complexity. The existing system method for background removal is based on histogram approach which has the disadvantage of fruit pixels being removed if it occurs as a cluster. This drawback is removed in this paper by using a pixel wise classification method called GMM. Image processing offers solution for the automated fruit size grading to provide accurate, reliable, consistent and quantitative information apart from handling large volumes, which may not be achieved by employing the human graders. The hardware prototype also created by using MSP430 ultra low power microcontroller. It will have a good prospect of application in fruit quality detecting and grading areas.

KEYWORDS: *MSP430, IR sensor, Image Processing, Conveyor setup.*

I. INTRODUCTION

The naked eye observation of experts is the main approach adopted in practice for detection and identification of plant diseases. But, this requires continuous monitoring of experts which might be prohibitively expensive in large farms. Further, in some developing countries, farmers may have to go long distances to contact experts, this makes consulting experts too expensive and time consuming and moreover farmers are unaware of non-native diseases.

In order to improve the fruits' quality and production efficiency, to reduce labor intensity, it is necessary to research nondestructive automatic detection technology. Fruit nondestructive detection is the process of detecting fruits' inside and outside quality without any destructive, using some detecting technology to make evaluation according some standard rules. Nowadays, the quality of fruit shape, default, color and size and so on cannot evaluate on line by using traditional methods. With the development of image processing technology and computer software and hardware, it becomes more attractive to detect fruits' quality by using vision detecting technology. At present, most existing fruit quality detecting and grading system have the disadvantage of low efficiency, low speed of grading, high cost and complexity. So it is significant to develop high speed and low cost fruit size detecting and grading system.

Food and other biological products are valued by their appearance. Appearance is a major factor in the judgment of quality and human eye has historically done this. The color indicates parameters like ripeness, defects, damage etc. The quality decisions vary among the graders and often inconsistent. The adaptation of human eye to small changes in color and the effect of the background on the perceived color and color intensity are the main sources of error. There are many efforts is being made to establish the standard quality parameters for fresh produce and the instrumentations that meet these expectation. Employing non-destructive sensing techniques in fruits industry assure the quality and wholesomeness of fruit. This would increase consumer satisfaction and acceptance, and enhancing

industry competitiveness and profitability. Various non-destructive sensing techniques have been studied and implemented for predicting internal/external quality of fresh fruits.
Computer vision techniques have been shown to closely correlate with those from the visual assessment. Fruit size is one of the most important quality parameter analysis by consumer performance .i.e. consumer prefer fruits of equal weight uniform size for example people like yellow bananas, dark red apples, light green or dark black grapes, dark yellow loquat and yellow mango etc. The estimation mean of fruit size is important in meeting quality standard increasing marketing value monitoring growth. Fruit size estimation is also helpful in packing planning, transportation and marketing operation.
In this paper initial idea has been described in terms of fruit quality measurement with low power consumed hardware approach.

II. LITERATURE REVIEW

Hongshe Dang, Jinguo Song, Qin Guo [1] have proposed fruit size detecting and grading system based onimage processing. The system takes ARM9 as main processor and develops the fruits size detecting program using image processing algorithms on the QT/Embedded platform. Authors in [2] have proposed system which finds size of different fruits and accordingly different fruits can be sorted using fuzzy logic, here author proposed MATLAB for the features extraction and for making GUI. John B. Njoroge. Kazunori Ninomiya. Naoshi ondo and Hideki Toita [3] have developed an automated grading system using image processing where the focus is on the fruit's internal and external defects. The system consists of six CCD cameras. Two cameras are mounted on the top, two on the right and another two cameras mounted on the left of the fruit. X-ray imaging is used for inspecting the biological defects. Image processing is used to analyze the fruit's features; size, color, shape and the grade is determined based on the features. The developed system is built from a combination of advanced designs, expert fabrications and automatic mechanical control.

III. CREATION OF GENERALIZED BLOCK

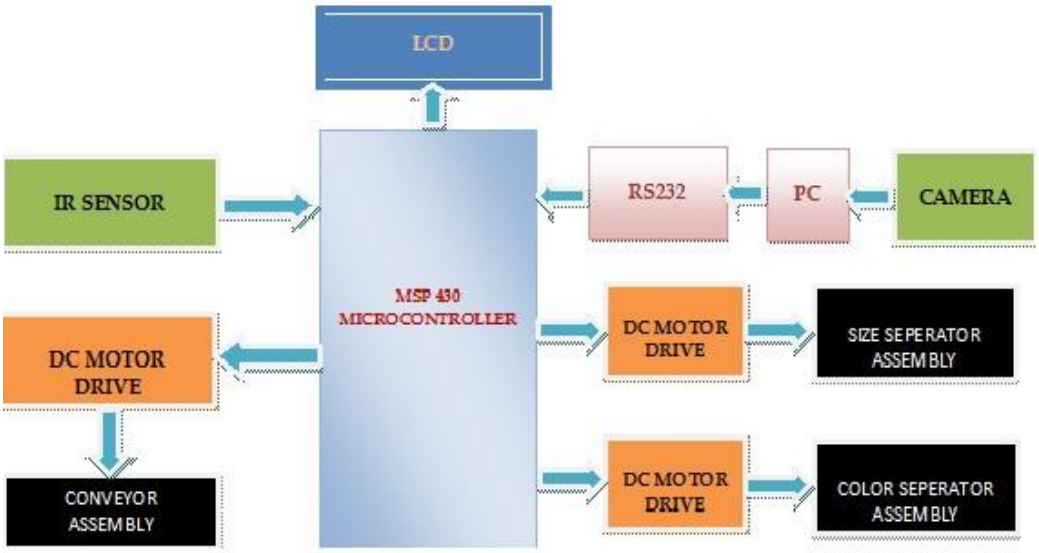

Figure 1: Block Diagram

Building the block diagram for an idea is necessary part in order to examine the overall operations of the defined solutions. In this it describes image and size (IR) as an input and dc motor, conveyor and display unit as an output. The above figure 1 shows the block of the project.
This automated system is designed to overcome the problems of manual techniques. Here the hardware model is designed which contains conveyor system, grading assembly which contains three plates to which DC motor is connected, digital camera, IR sensor, MSP430 microcontroller, LCD display on field and grading assembly.

IV. MSP430 MICRO CONTROLLER

The Texas InstrumentsMSP430 family of ultra-low power microcontrollers consists of several devices featuring different sets of peripherals targeted for various applications. The architecture, combined with five low-power modes, is optimized to achieve extended battery life in portable measurement applications. The device features a powerful 16-bit RISC CPU, 16-bit registers, and constant generators that contribute to maximum code efficiency. The calibrated digitally controlled oscillator (DCO) allows wake-up from low-power modes to active mode in less than 1 μs. The MSP430F23x/24x (1)/2410 series are microcontroller configurations with two built-in 16-bit timers, a fast 12-bit A/D converter (not MSP430F24x1), a comparator, four (two in MSP430F23x) universal serial communication interface (USCI) modules, and up to 48 I/O pins. The MSP430F24x1 devices are identical to the MSP430F24x devices, with the exception that the ADC12 module is not implemented. The MSP430F23x devices are identical to theMSP430F24x devices, with the exception that a reduced Timer B, one USCI module, and less RAM is integrated.

3.1. Features

- Low Supply-Voltage Range, 1.8 V to 3.6 V
- Ultra-Low Power Consumption:
  - Active Mode: 270 μA at 1 MHz, 2.2 V
  - Standby Mode (VLO): 0.3 μA
  - Off Mode (RAM Retention): 0.1 μA Ultra-Fast Wake-Up From Standby Mode in Less Than 1 μs
- 16-Bit RISC Architecture, 62.5-ns Instruction Cycle Time
- 12-Bit Analog-to-Digital (A/D) Converter With Internal Reference, Sample-and-Hold, and Auto scan Feature
- 16-Bit Timer A With Three Capture/Compare Registers
- 16-Bit Timer B With Seven Capture/Compare-With-Shadow Registers
- MSP430F247, F2471 - 32KB+256B Flash Memory, 4KB RAM
- Available in 64-Pin QFP and 64-Pin QFN Packages

V. IMAGE PROCESSING

The scopes of objective are to develop a complete system to undergo color detection before quality analysis and grading of the fruits by digital image. The whole system will be undergoes real time analysis as possible submission.

The image could be captured using a regular digital camera. Here we have used for capturing image the iball twist cam which is CMOS based camera. The system arrangement is done as shown below the basic aim is to obtaining the fruit's features. The system consists of several steps like feature extraction, sorting and grading. As proposed in [1], to avoid shadow, two annular lights are used to supply well- distributed light. The black background color in image is easier to extract the fruit edge characters later. So the background is set black in whole process of image capture. The light and camera location is as shown in Figure 2.

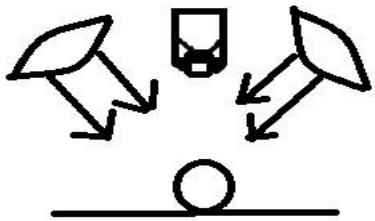

Figure 2 : Conveyor

For grading using first choice camera position is adjusted in such a way that for capturing live image of a fruit the camera is continuously scanning the conveyor belt in video mode, when conveyor stops as fruit is detected by IR system camera can capture top view image of fruit. The black background

color in image is easier to extract the fruit edge characters later [1] so black color is used for the conveyor system. The captured image is given as an input to the MATLAB software which extracts (detects) color and size of a fruit, this data is transferred to MSP430based system by using RS232 and com port and accordingly control action is taken place, later conveyor starts and Then fruit is collected in main plate of grading assembly. If fruit is red color (as detected by MATLAB) then the main plate is moving anticlockwise and accordingly the fruit is collected in lower plate 1, now depending on the size of fruit(as detected by MATLAB) it can be graded as a small or big fruit. If fruit is of big size the lower plate 1 will be moving anticlockwise and if fruit is of small size the lower plate 1 will be moving clockwise, Similarly, if fruit is of green color (as detected by MATLAB) then the main plate is moving clockwise and accordingly the fruit is collected in lower plate 2, now depending on the size of fruit (as detected by MATLAB) it can be graded as a small or big fruit. If fruit is of big size the lower plate 2 will be moving anticlockwise and if fruit is of big size the lower plate 2 will be moving clockwise.

4.1. Flow of Process

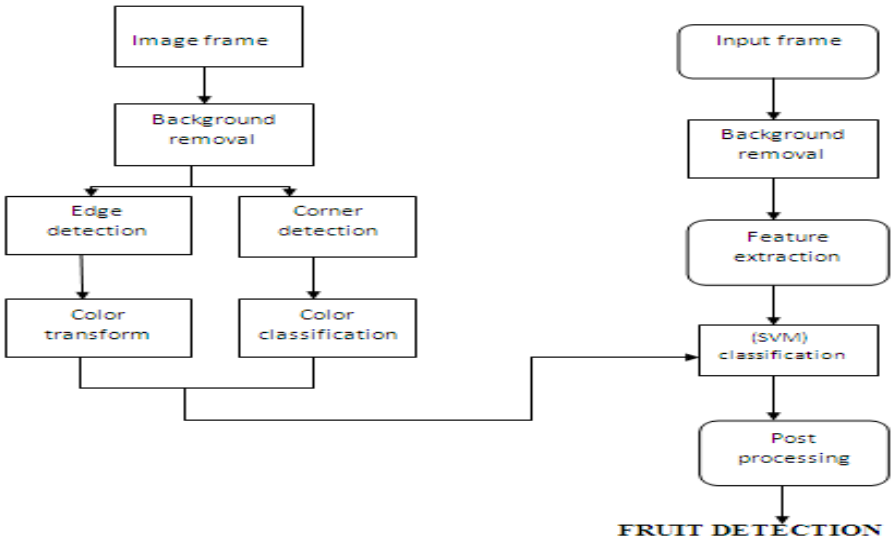

Figure 3 : Flow Chart

The process of fruit quality monitoring is as follows

- Color detection
- Edge detection
- Color grading
- Fruit grading

VI. RESULTS AND DISCUSSION

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.

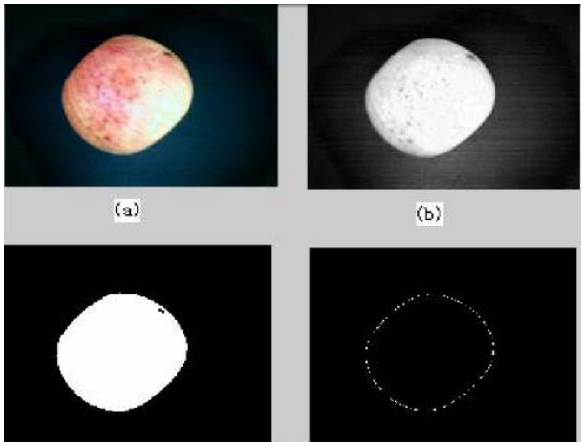

Figure 3: The processing fruit image. (a) the original image;(b)gray image;(c)diversion image;(d)tracking edge

The proposed work is related to rgb2grayscale color quantities which is analysis a digital images of a guava, and orange fruit using the help of digital computer system separately, human vision system and image acquisition system to measure quality standard level by color recognition of visual external surface of different sizes of fruits. Where skin appearance, sun light, atmospheric conversion/changes impact on fruit quality measurements to analysis digital images of same dimension that may be un-ripe, partially ripe, ripe or fully ripe (ready to eat) and also be an over ripe fruit (bad fruit) may as in Fig. 4.

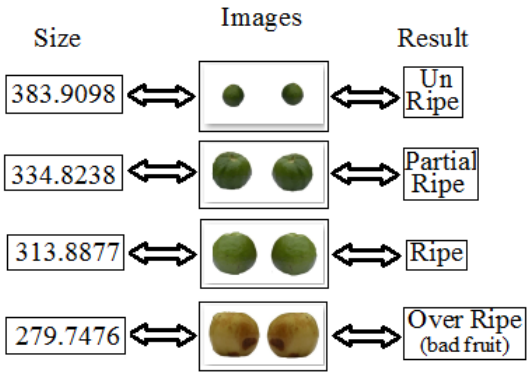

Figure: 4 Show as the result sample after implementation of guava fruit.

VII. CONCLUSION

The initiated system is a demo version. In future, for the great volum of production the number of web cameras and length of conveyor system can be changed according to our needs. This paper 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 the advantage of gray scale image is taken into account, which are less effected to the external environment changes as well as beneficial for finding the size of a fruit. Further MATLAB coding will be identified for different images of fruit in order to improve the efficiency.

VIII. FUTURE WORK

The other parameters like size, shape, hardness, softness, day light, day temperature, colorization can also be included in this project for future extension. These parameters will play valuable role for quality analysis process, further this research work can be used for grading and sorting of fruits for agricultural products with the help of digital images (any format) which involve image analysis, visual examination and inspection of color. The embedded grading system has the advantage of high accuracy of grading, high speed and low cost.

REFERENCES

[1] H. Sardar, "Quality Analysis in grayscale color using visual appearance of a guava fruit," International Journal of Engineering Sciences, pp. 46-56, 2013.
[2] Ananthi, S. Vishnu Varthini, Detection And Classification Of Plant Leaf Diseases International Journal of Research in Engineering & Applied Sciences, Volume 2, Issue 2 (February 2012) ISSN: 2249-3905
[3] Harshavardhan G. Naganur, Sanjeev S. Sannakki, Vijay SRajpurohit, Arunkumar R, "Fruits Sorting and Grading usingFuzzy Logic," International Journal of Advanced Research inComputer Engineering & Technology (IJARCET) Volume 1,Issue 6, August 2012,pp 117-122.
[4] H. Sardar, "Color Based Quality Analysis of Fruits for Automatic Grading," in Proc. International Conference on Reliability, Infocom Technologies and Optimization (ICRITO 2013), Noida sector-125, Uttar pardesh, India, 2013, pp. 190-197.
[5] H. Sardar, "A role of computer system for comparative analysis using image processing to promote agriculture business," International Journal of Engineering Research & Technology, vol. 1, no. 9, 2012.
[6] A. Fakhri, A. Nasir, M. N. A. Rahman, and A R. Mamat, "A study of image processing in agriculture application under high performance computing environment," International Journal of Computer Science and Telecommunications, vol. 3, no. 8, pp. 16-24, August 2012.
[7] H.Al-Hiary, S. Bani-Ahmad, M.Reyalat, M.Braik and Z.AlRahamneh, Fast and Accurate Detection and Classification of Plant Diseases,International Journal of Computer. Applications (0975-8887), Volume 17-No.1.March 2011
[8] Hongshe Dang, Jinguo Song, Qin Guo, "A Fruit Size Detecting and Grading System Based on Image Processing," 2010 Second International Conference on Intelligent Human-Machine Systems and Cybernetics,pp83-86.
[9] Wong Bing Yit, Nur Badariah Ahmad Mustafa, ZaipatimahAli, Syed Khaleel Ahmed, Zainul Abidin Md Sharrif, "Design and Development of a Fully Automated Consumer-based Wireless Communication System For Fruit Grading", ISCIT 2009 , pp 364-369.
[10] John B. Njoroge. Kazunori Ninomiya. Naoshi Kondo andHideki Toita, "Automated Fruit Grading System using ImageProcessing," The Society of Instrument and Control Engineers(SICE2002), Osaka, Japan, August 2002, pp 1346-1351.
[11] J. V. Frances, J. Calpe, E. Soria, M. Martinez, A. Rosado, A.J.Serrano, J. Calleja, M. Diaz, "Application of ARMA modeling to the improvement of weight estimations in fruit sorting and grading machinery," IEEE 2000, pp 3666-3669

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