Implementation and Realization of a Smart Electronic System in Post-Harvest Treatment of Fruits for Machine Vision Inspection

Yogitha. S [1], Savitha. S [2]
[1, 2] *Assistant Professors,Sri Shakthi Institute of Engineering and Technology, Coimbatore, Tamilnadu, India.*

Abstract

the scope of this project is to implement and realize the required preprocessing stage phase requirement in the post-harvest treatment of fruits as per industry norms. The treatment process involves in removing field soil, surface micro-organisms but also to remove fungicides, insecticides and other pesticides according to the agricultural board standards specifying maximum levels of these materials that may be retained on the fruit.

The PC based process measurement involves multi point temperature measurement and control, pH or conductivity measurement, motors control through AC drives, driving the contactors/ actuators and getting information from sensor & switches with auto/ manual features. The necessary electrically isolated Analog & Digital functional hardware blocks and application program codes have to be developed and realized for communicating with PC parallel & serial port for dynamic data exchange. The user friendly GUI interface facilities the operator for easy interaction with process through command buttons, monitoring & control of the various operation of the plant and records the data in real time in to the data grid and also stores in to database for future reference.

Keywords - *Parallel Port, grading, shorting, Image processing.*

I. INTRODUCTION

Most of the food processing industries in India employ manual labours for carrying our various process operations line with little scope for automation. The tailor made systems are not available off the shelf and have to be imported or custom built at a huge cost. Lots of manual interventions are required especially in the grading and sorting of fruits. Screening of good ones for quality and identifying defective ones by manual inspection is a difficult task and often fails because of human fatigueless. Fruits like mango, apple, orange etc., fetch more value in terms of export potential when they are screened for defects and graded as per required quality parameters.

Application of machine vision for quality inspection of fruits can solve many of the limitations related to the manual inspection. This has great potential for supplementing human labour for the visually intensive inspection work. Machine vision inspection involves determining the fruit quality by analyzing the images of the fruits. Machine vision based sorting system consists of a computer and video cameras to perceive fruit images, process their images, and make suitable inspection decisions.

Grading decisions required in many agricultural processes, which are otherwise difficult, can be taken up by machine vision. Machine vision can also be far more cost effective and sometimes is the only viable solution for higher throughput and/or hazardous conditions.

The machine vision inspection system essentially involves three main processes namely image acquisition, image processing and decision-making. Cameras under appropriate lighting conditions carry out image acquisition. The visual information is converted from analog to digital format. The acquired images are analyzed by image processing hardware and/or software to extract the required object features and quality parameters. Based on these results, a decision on the fruit quality is taken by software considering the end user's requirements. The end of result is in improving the product quality, as the defective ones are removed and the rest are graded and sorted based on image parameters and weight

II. LITERATURE SURVEY

Chandra Sekhar Nandi, Bipan tudu, Chiranjib koley [1] have proposed computer vision based system for automatic grading and sorting of agricultural products like mango, apple, orange etc. The automated system collect video image from the CCD camera placed on the top of a conveyer belt carrying mangoes, then it process the images in order to collects several relevant features which are sensitive to the maturity level of the mango. Finally the parameters of the individual classes are estimated using Gaussian Mixture Model for automatic grading and sorting.

Sachin Syal, Tanvi Mehta, Priya Darshni [2] proposed grading of jatropha fruit by Its Feature

Value Extraction Using Fuzzy Logics. This system is being implemented with the help of Image processing techniques. In order to evaluate the performance of the Intelligent system used for sorting of Jatropha fruit, the simulation is done with the help of Image processing tool in MATLAB software. For the display of results GUI is used. The GUI is used for the sorting to make the system more users friendly and the grading is done by using three grades A, B, C. This system will replace the human expert burden for grading of Jatropha and the results obtained show that system is quite stable and accurate.

S.Arivazhagan, R.Newlin Shebiah, S.Selva, Nidhyanandhan, L.Ganesan [3] mentioned in Fruit Recognition using Color and Texture Features journal paper.

Where the computer vision strategies used to recognize a fruit rely on four basic features which characterize the object: intensity, color, shape and texture.

This paper proposes an efficient fusion of color and texture features for fruit recognition. The recognition is done by the minimum distance classifier based upon the statistical and co-occurrence features derived from the Wavelet transformed sub-bands.

A.M. Lefcourt, P. Narayanan, U. Tasch, M.S. Kim, D. Reese, R. Rostamian, Y.M. Lo, [4] present research paper of "Orienting apples for imaging using their inertial properties and random apple loading" in ELSEVIER journal. In this study, the practical importance of initial loading conditions was tested using two different methods to randomly load apples onto a track.

Replicate tests indicated that successful orientation at rates of about 80% for Red and Golden Delicious cultivar apples was random, and that only 5% of the apples exhibited undesirable loading condition and orientation.

Results suggest that a commercially viable orientation system could be developed by recycling apples that are not oriented during imaging, and that it should be possible to improve single-pass orientation rates by addressing track compliance and loading velocity issues.

In this proposed system focus for small scale industry can also able to use fruit shorting machine vision technology on order to increase the efficiency in cost effective manner. Where in this simple programming technique as well as interfacing by the normal PC can able to handle normal workers in industries.

III. PROPOSED SYSTEM

The proposed scheme for a real time machine vision inspection system based on diameter and weight fruit sorter makes use of distributed network architecture to interface the field IO devices and camera inspection system to the computer system through Gigi LAN environment in a flexible way. To develop the state of art technology in-house as per the industrial end user requirement in compliance with the international/Indian standards pertaining to grading and sorting. The criterion for the indigenous product to be developed should be cost effective, reliable without compromising the quality aspect and measurement accuracies.

The system employs the recent version of window operating platform and the application program will be conceived as an open platform for image processing, functional under the latest version of Visual Studio. The concept of object oriented programming will be implemented in the software development so that the functionality will be modular, can be evolve and avoids the obsolescence of its design program codes or phasing out of components.

The system should caters to the expectation in performance mainly in the processing speed of captured dynamic image signals in real time, accuracy of measurement and precision which is the basic of a proposed low cost architecture. The objective is to knock off the expensive imported PC add-on card and the glue logic boards and to develop the indigenous hardware. The isolated output power channels meets the industrial standard for driving the high power solenoid valves with power management control and the isolated input channel accepts the signals from the field sensors.

Fruit classification is made according to their diameter and disturbing the fruits to the programmed or grated outlet at a maximum fruit rate of 5 to 10 fruits per second per conveyor belt approximately. The existing technology evolved from year 2000 to 2012 on apple and mango sorting with expensive hardware setup cannot be reused and does not support the recent version of windows operating system, the latest visual studio environment and the preferred hardware for high throughput rate by the industry.

IV. BLOCK DIAGRAM OF PROPOSED SYSTEM

The following block diagram is the typical block diagram of the proposed system.

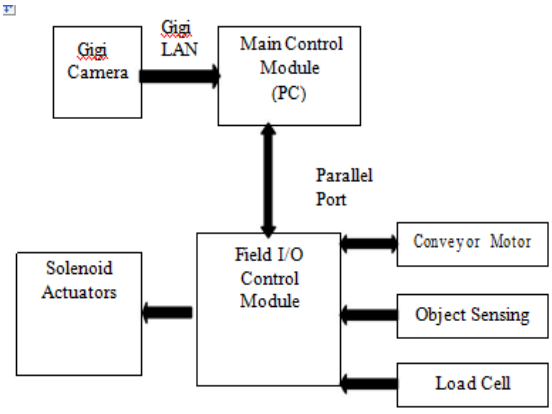

Fig 1: Real time machine vision inspection system

In block diagram of proposed system mentioned that the PC is the main control of the system. Where camera input is given to the PC through the Gigi LAN environment for high speed data transmission.

In order to communicate the PC with the field machine devices the Field I/O module is used through the parallel port. Where the conveyor motor have the bidirectional communication in order to measure the speed as well as the control the speed of the conveyor system. And load cell is used to measure weight of the each fruit and corresponding data fed to the PC for through the Field I/O module for the sorting process. The following table shows the load cell specification.

TABLE 1: Load Cell Specification

Menu	Configuration	Setting
Com Port	RS485	115Kb, 8, 1, 0
Mode	2 wire/ 4 wire	4 wire
Filter	FIR/IIR	FIR
Filter Type	-----	Low pass
Frequency	1 Hz to 20Hz	10Hz
Trigger	Local/ External	External
Address	0 to 64	31

The following Fig 2 is the Internal Diagram of Load Cell. Which is used for the measuring the weight of the fruits. It should capable of measure the 4-5 fruits per second as well as corresponding data should be transfer to the data base to store the information. And then the corresponding solenoid actuator's to be operated to collect the fruits by the bins according to weight based.

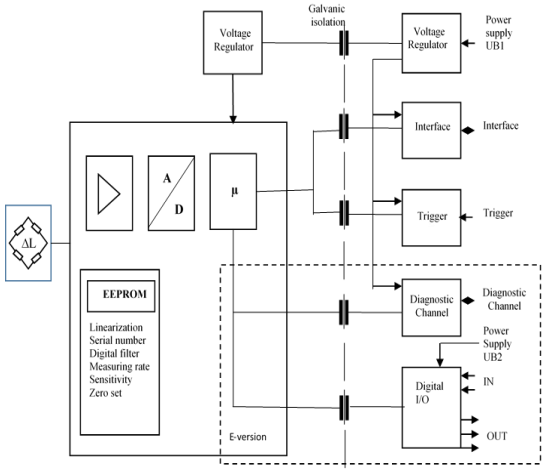

Fig 2: Internal Diagram of Load Cell

The following table 2 shows the Static Weight Measurement and accuracy.

TABLE 2: Static Weight Measurement and Accuracy

Sl.No	Specimen Weight	Load-cell Output	Accuracy %	
			BFC	AFC
1.	0	0	0	0
2.	198	197	0.5	0.01
3.	395	394	0.25	0.01
4.	588	589	0.17	0.01
5.	785	786	0.13	0.01
6.	1029	1030	0.10	0.01
7.	1277	1278	0.08	0.01
8.	1577	1576	0.06	0.01
9.	1821	1820	0.05	0.01
10.	2069	2067	0.01	0.01
11.	2365	2363	0.08	0.02

IV. IMAGE PROCESSING

Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop console and graphical user interface applications along with Windows Forms or WPF applications, web sites, web applications, and web services in both native code together with managed code for all platforms supported by Microsoft Windows, Windows Mobile, Windows CE, .NET Framework, .NET Compact Framework and Microsoft Silver light.

Visual Studio includes a code editor supporting IntelliSense as well as code refactoring. The integrated debugger works both as a source-level debugger and a machine-level debugger. Other built-in tools include a forms designer for building GUI applications, web designer, class designer, and database schema designer. It accepts plug-ins that enhance the functionality at almost every level—including adding support for source-control systems and adding new toolsets like editors and visual designers for domain-specific languages or toolsets for other aspects of the software development lifecycle

Visual Studio supports different programming languages by means of language services, which allow the code editor and debugger to support nearly any programming language, provided a language-specific service exists. Built-in languages include C/C++, VB.NET , C# , and F#. Support for other languages such as M, Python, and Ruby among others is available via language services installed separately. It also supports XML/XSLT, HTML/XHTML, JavaScript and CSS. Individual language-specific versions of Visual Studio also exist which provide more limited language services to the user: Microsoft Visual Basic, Visual J#, Visual C#, and Visual C++.

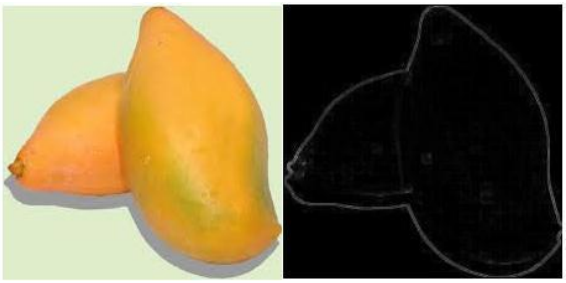

Figure 3: Edge Detection

The following figure 3 shows the typical edge detection of fruit. This edge detection is done by visual studio 10 .NET Frame work in order to measure the size of fruit. By using different filters in image processing for fruits shorting is possible with use of OpenCV different DLL function

VI. RESULT AND DISCUSSION

The proposed scheme for a real time machine vision inspection system based on diameter and weight fruit sorter makes use of distributed network architecture to interface the field IO devices and camera inspection system to the computer system through Gigi LAN environment in a flexible way. Where the parallel port interface is used to communicate the I/O data's between the computer to real field environmental plays major role for control the actuators, motor, conveyor, etc., The criterion for the indigenous product to be developed should be cost effective, reliable without compromising the quality aspect and measurement accuracies. Visual studio (version 2010).NET Frame work software programming is used for the parallel port programming.

VII. CONCLUSION AND FUTURE SCOPE

The grading and sorting of the fruits based on external parameters namely colour, size and shape .The images of the fruits were grabbed, features extracted and necessary operations were performed. All the processes were implemented by distributed network architecture to interface the camera unit to a computer system through GigE LAN environment. The fruits were classified into different grades on the basis of combination of the parameters mentioned above. This application runs under VC++ platform.

Future work that can be implemented in this project is, we can extend the single line mission vision inspection into multi line camera inspection. Since it employs distributed network architecture with additional suits of hardware and software modules. And we can increase the fruits quantity in scanning section. We can implement this in other fields by changing simple software and hardware.

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