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AUTOMATIC FRUIT SORTING AND QUALITY ANALYZER

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Abstract
Fruit is essential for sustenance and nourishment of life. The fruit sorting system gives us various information like shape, defect, color, size etc. In present days, the grading and classification is performed based on through experience and observations i.e. manually. Manual method is costly, slow and also lacks objectivity and reliability required in various competitive industries. In this project, system is designed for sorting and analyzing the quality of fruit and it is implemented through MATLAB. External inspection of the fruit is done through image processing. The system utilizes image-processing techniques and embedded system to analyze the quality and sort the fruits.

Keywords: Classification, Embedded system, Fruit, Grading, Image Processing, MATLAB, Quality.

1. Introduction

The quality of the fruits is important factor for the consumers and it becomes the requirement from the suppliers to provide fruits to their customers with high standards quality. Hence, in the past few years, fruit quality analyzer systems have established to fulfil the needs of the fruit processing industry. Apart from that, the process of fruits involves several steps that can generally be classified into grading, sorting, packaging, transporting and storage. In present era, the fruit grading and quality analyzer system is accomplished based on size, weight and color which are accessible in all fruit processing industries. The grading is considered as the most important step towards the high standard of quality of fruit. Still in India, the inspection i.e., grading of fruits is performed with the help of human experts. A lot of time is wasted in the fields for checking the quality of the fruits. Generally, fruits are graded manually which is an expensive and time-consuming process and labors shortage will affect to the operation during peak seasons. It has become very difficult to hire the person or train the person who are willing to handle the monotonous task for sorting the fruits. In the meanwhile, a cost effective and accurate grading can be performed with automated grading and quality analyzer system. Generally, the quality of the fruits depends on outer parameters such as size, color intensity, shape, surface appearances and inner parameters such as sugar contents, acid contents, but color and size are the most important factors for grading and sorting of fruits.

Computer machine vision and image processing play the important role in fruit grading system techniques and quality control in fruit processing industries. Horticulture and Agriculture plays the major role in economic development of India. In this paper, an economic and safe way is used to analyze the fruit quality which is based on size, shape and color. The most important physical property of fruit is size while color of fruit is visual property. Hence, classification of fruit is necessary in increasing market value and meeting quality standards. It is also helpful in marketing operations, transportation, planning and packaging. If the grading and classification of fruits is done through manually, then the process will be time consuming and sometimes it will cause error. The labors classify fruits based on shape, size, color, etc. if these quality measures are mapped into automated system then the work will be faster and error free. In this paper fruit sorting and quality analysis method based on computer machine vision and image processing technique has been proposed to improve the analyzing and sorting speed of fruits.

1.1 Objective

- To sort the fruits according to the quality of fruits.
- To increase the reliability of quality analysis of fruit.
- To reduce the manual work.
- To make system available for small scale industries in low cost.

2. Scheme of Implementation

Scheme of implementation is presented as follows.

2.1. Block Diagram

The Fig. 1. explains the detailed block diagram of Automatic Fruit Sorting and Quality Analyzer. It consist of various blocks like camera, MATLAB (PC), Food detecting, IR Sensor, LPC 2148 (ARM 7), LCD, Motor Driver- Conveyor belt, Motor for Moving Platform and Motor for Food separation.

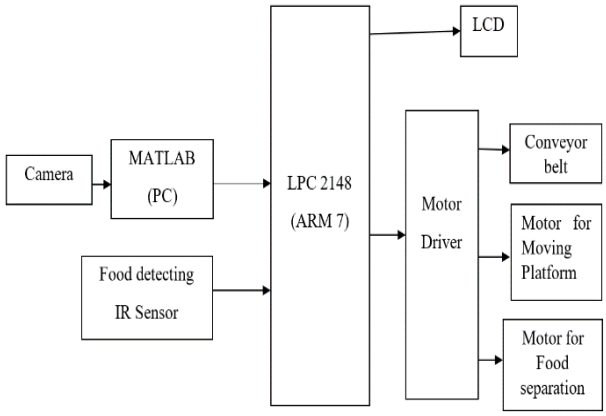

Fig. 1. Block diagram Of Automatic Fruit Sorting and Quality Analyzer

2.1.1. Camera

Digital camera systems, incorporating a variety of charge-coupled device (CCD) detector configurations, are by far the most common image capture technology employed in modern optical microscopy. Until recently, specialized conventional film cameras were generally used to record images observed in the microscope. This traditional method, relying on the photon-sensitivity of silver-based photographic film, involves temporary storage of a latent image in the form of photochemical reaction sites in the exposed film, which only becomes visible in the film emulsion layers after chemical processing (development). By using digital camera, we capture the color image. This image is used for data acquisition. Color calibration of CCD cameras is essential for color inspection systems based upon machine vision to provide accurate and consistent color measurements.

2.1.2. MATLAB

MATLAB is widely used in all areas of applied mathematics, in education and research at universities, and in the industry. MATLAB stands for MATrix LABoratory and the software is built up around vectors and matrices. This makes the software particularly useful for linear algebra but MATLAB is also a great tool for solving algebraic and differential equations and for numerical integration. MATLAB has powerful graphic tools and can produce nice pictures in both 2D and 3D. It is also a programming language, and is one of the easiest programming languages for writing mathematical programs. MATLAB also has some tool boxes useful for signal processing, image processing, optimization, etc. In image processing we perform various operation on an image, i.e. conversion of image from RGB to Gray for edge detection etc.

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming environment. Furthermore, MATLAB is a modern programming language environment: it has sophisticated data structures, contains built-in editing and debugging tools, and supports object-oriented programming. These factors make MATLAB an excellent tool for teaching and research. MATLAB has many advantages compared to conventional computer languages (e.g., C, FORTRAN) for solving technical problems. MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. The software package has been commercially available since 1984 and is now considered as a standard tool at most universities and industries worldwide.

2.1.3. ARM 7

ARM7 is most successful and widely used processor family in embedded system applications. This enables the companies to develop their own processors compliant with the ARM instruction set architecture. The ARM (Advanced RISC Machine) has launched several processors which have different features as well as the different cores for a wide variety of applications. The first ARM architecture design has 26-bit processors, but now it reached to 64-bit processors. The general expansion of ARM products cannot be categorized on some particular information. But ARM products can be understood based on its architecture. The standard ARM series processors available in the market are starting from ARM7 to ARM11. These processors have several features like cache, Data Tightly Coupled memory, MPU, MMU, etc. Some of the widely known ARM processor series are ARM926EJ-S, ARM7TDMI, and ARM11 MP Core.

2.1.4. Motor Driver

A motor driver is a little current amplifier; the function of motor drivers is to take a low-current control signal and then turn it into a higher-current signal that can drive a motor. Motor driver is required for rotating Conveyor belt, Platform motor and Food separating motor. Motor driver circuit takes input from ARM 7.

2.1.5. Conveyor Belt

A conveyor belt is the carrying medium of a belt conveyor system (often shortened to belt conveyor). A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with an endless loop of carrying medium—the conveyor belt—that rotates

about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, overburden and more. Here we are using conveyor belt for passing the fruit from conveyor belt to platform motor.

2.1.6. Motor for Moving Platform

Fruit is placed on platform motor. Then camera will capture the front side image of fruit and by rotating platform by 180° the back side of image is captured. Then these are send to MATLAB for processing.

2.1.7. Motor for Food Separation

Images are processed in term of size, shape and color. By analyzing such parameter the quality of fruit is decided. If fruit is good it is pass to the right side and if not it is pass to the left side with the help if food separating motor. The process will continue for analyzing the fruit and sorting of fruit.

2.1.8. LCD

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

LCDs are used in a wide range of applications including LCD televisions, computer monitors, instrument panels, aircraft cockpit displays, and indoor and outdoor signage. Small LCD screens are common in portable consumer devices such as digital cameras, watches, calculators, and mobile telephones, including smartphones. Here the use of LCD display is for showing the status of working.

2.2. Flow Chart

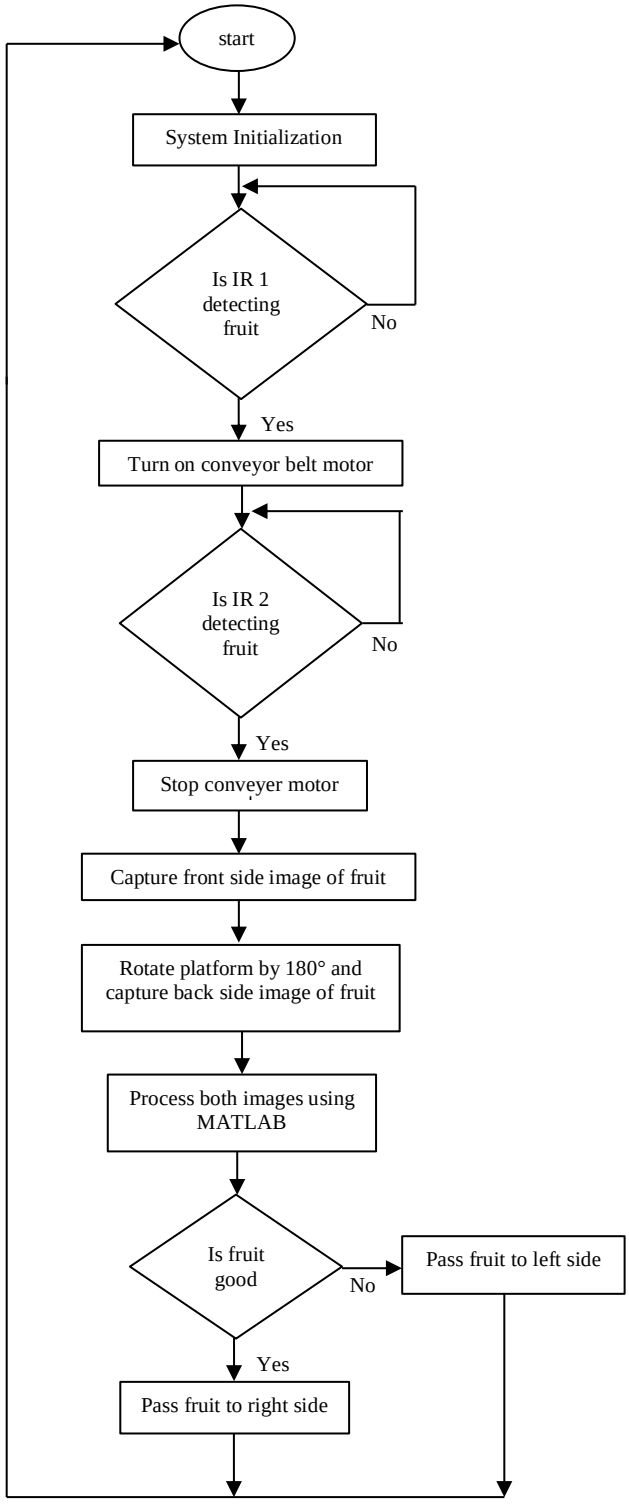

Fig. 2. Flow Chart

2.3. Working

When CCD captures the images of fruit, then IR 1 will check whether there is input coming or not and detect the fruit. As the fruit is detected then conveyor motor will turn on. Then for taking the images/snapshot of fruit the conveyor belt should stop, hence IR 2 will detect the fruit on platform motor and stop the conveyor belt motor. Then

camera will capture the front side image of fruit and by rotating platform by 180° the back side of image is captured.

Then these are send to MATLAB for processing. Images are processed in term of size, shape and color. By analyzing such parameter, the quality of fruit is decided. If fruit is good it is pass to the right side and if not, it is pass to the left side. The process will continue for analyzing the fruit and sorting of fruit.

3. Result

3.1 Hardware Implementation

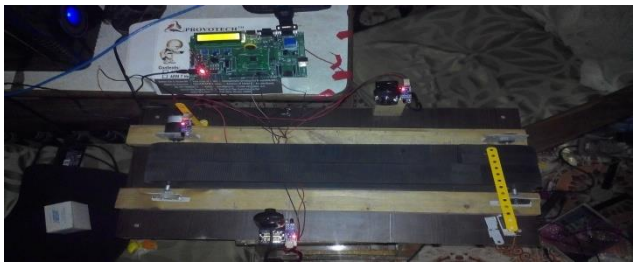

Fig. 3. Hardware module of the system

ARM7 processor will control all the process of the system. It controls all the actions of conveyer belt. Then fruit is placed on platform motor. Then camera will capture the front side image of fruit and by rotating platform by 180° the back side of image is captured. Then these are send to MATLAB for processing.

3.2 Software Result

Conversion of a color image into a grayscale image inclusive of salient features is a complicated process. The converted grayscale image may lose contrasts, sharpness, shadow, and structure of the color image. To preserve contrasts, sharpness, shadow, and structure of the color image a new algorithm has proposed. To convert the color image into grayscale image the new algorithm performs RGB approximation, reduction, and addition of chrominance and luminance. The grayscale images generated using the algorithm in the experiment confirms that the algorithm has preserved the salient features of the color image such as contrasts, sharpness, shadow, and image structure

Fig. 4. RGB Image of an Orange

The RGB image of an orange is shown in Fig. 3. The conversion of RGB image into the gray scale is done here is shown in Fig. 4. While detecting the defect on fruit surface the RGB value of fruit is converted into gray value with the help of MATLAB tool. As the gray value give the image value in count accordance with white and black. When the system will count the value of white part 1 then the fruit is good and when it will count white part more than 1 then the fruit is not good.

Fig. 5. Gray Scale Image of an Orange

These are the expected results of the system.

4. Conclusion

There are some manual methods are available for fruit sorting and quality analyzer. In this paper, the system has been proposed to automate this process using an image processing technique. This technique will help to improve the analyzing and sorting speed of fruits. This system also consists of an embedded system which improves the speed of working which helps to save the time, efforts and will gives better accuracy than manual sorting. This proposed system gives a cost-effective solution for small scale industries as well as large scale industries i.e., food beverage companies, agriculture etc.

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