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Development of an Automated Fruit Sorting Machine Using an Embedded System

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ABSTRACT: The design, development and performance evaluation of the automated fruit sorting machine was carried out using an embedded system (Arduino based) to serve as a time saving, low energy consuming and cost effective alternative for sorting and grading fruit for both home and commercial applications. The device is constructed to sort different varieties of fruit, which includes mango, orange, lemon, udala (Agbalumo or African star apple), apple, tomato etc. Sorting are carried out based on the difference in the wavelength of the color of a ripe fruit to that of an unripe or defective. This are made possible by the use of color detection module, an open source operating system interfaced with an android remote application and a mechanical system. In the end, the test result shows that the machine system has a 90% accuracy for sorting fruits that are either ripe or unripe/defective. Hence, this paper will provide the needed guidance for color error detection for fruit sorting and play a significant role in quality assurance and process automation.

KEYWORDS: Arduino Uno R3 Microcontroller, Conveyor, LCD, Vibration Sensor, Color Sensor, ATMEGA328

I.INTRODUCTION

India is an agricultural nation. Automation of fruit sorting industry is one of the important milestones in this market. Farmers and distributors do conventional quality inspection and hand microntroller king to sort and grade food products. But these conventional methods has many drawbacks like time consuming, monotonous, slow and inconsistent etc. so automation in this area has greater advantage in terms of efficiency, accuracy, consistency etc. Computer vision systems provide rapid, economic, hygienic, consistent and objective assessment. Agriculturally efficient countries like Israel and Australia have manifested active use of this modern technology and it needs to be inoculated to Indian Fruit Industry. The targeted beneficiaries from this project include farmers, Indian in particular, who can't afford cost of today's fruit processing facilities. This project aims at developing a fruit sorting and packaging facility that can be established at very root level itself which will be economical, compact, fast, and accurate and of more justice to farmers. If every farmer can set up own outlet facility for fruit distributing he will be more self-reliant and free of unwelcome expenses incurred in putting fruits at distribution facilities, transport from farm to market. This project is optimized for inspection and sorting of fruit Indian Lemon (Citrus Limon) only. The algorithm can be reconstructed with simple changes for another fruits. Scope of research in this segment is not inclusive of causes and remedies of these defects; it is limited only to the understanding of external appearances of lemon-skin. Various kinds of skin diseases are found in Indian Lemon Species, depending on weather conditions and region of plantation. Still some of the most prevalent Lemon Skin Diseases are alternaria rot, anthracnose and bacterial blast (common defects of fruits, Agriculture and Natural Resources, University of California). The cull lemon frequency varies depending upon the nature of disease. For example, Bacterial Blast affects lemon production more extensively and more defected lemons can be found in a batch, as compared to alternaria rot disease. This project is limited for inspection of the defect Bacterial Blast only.

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II.EXISTING SYSTEM

Sorting is a process in which two or more objects of similar, yet different characteristics are arranged in a systematic order. This is generally carry through manually or by using sensors in automation. Here a highly automated system is proposed which uses Arduino UNO for detecting the presence of objects and their color and allows only those objects which are of desired color to pass through conveyor belt and deselect those colored objects which are unpleasant away from the belt. A linear actuator is activated by passing a high signal when the color is undesirable which push off the objects to deselect them. This is carried out using 'C' code which Arduino UNO supports.IOT based colored products sorting machine widely used in candy industry, food industry (grain, fruit) and mining industry. In candy industry using this can differentiate the candies according to their color. In grain industry using this can differentiate the grains based on their color. In Diamond and mining industry, segregates the precious stones according to their color. This machine arranges the items in particular order as required, so physical work is not needed. Improves automation and decreases the man work. This machine puts forward the mechanism to sort and display the color of the product. We are implementing this machine in an effective way, using color sensor (TCS 3200), Arduino nano, servo motors and LCD display. In many packaging industries, color object counting and sorting is the major task that needs to be done at final dispatch section. Manual sorting is the tradition approach that preferred by industries. In this approach, visual inspection performed by human operators. This traditional approach is tedious, time-consuming, slow and non-consistent. Therefore the efforts are made to design and implementation of automatic technique to determine color of object, color based object counting and sorting using image processing technique. In implemented system, image of a colored object which is rolling over a conveyer belt has been captured using suitable image acquisition device. Using image processing technique, the color of an object which may be red, green or blue has been determined. Once the color of an object is determined, implemented system will automatically count and sort the objects as per its color. The algorithm for object color determination, color based object counting has been developed in MATLAB and object sorting assembly has been designed using Microcontroller circuitry.

III.PROPOSED METHOD

When the light falls on the product it is reflected back to the color sensor. As mentioned before, color sensor TCS230 has 4 color filters for green, red, blue and black (no color), which is opted by its select pins. Filters are selected by the program saved in the microcontroller. Frequency output from color sensor depends on the color of the object as well as the select pin configuration input from microcontroller. Select pin can select one of the four photo diode filters which can give output according to the color of the object. When there is no object in front of sensor it produces an output of 330Hz range frequency and when there is an object it produces an output frequency of 7-14 KHz. The microcontroller can find the frequency of the output from TCS230 by counting falling or rising edge of sensor given to its TOCK1 pin using pre-scalar settings set by option register configuration. The pre-scalar was set for 1:16 arrangement and the time for counting is 50ms. Hence MICRONTROLLER counts the frequency using its timer at the rate of one increment for sixteen falling edges of input frequency given to TOCK1. When there is no object in front of sensor it produces an output of 330Hz range frequency. Hence we set a break down value of 32H for deciding whether there is an object on the conveyor belt or not. Therefore the MICRONTROLLER can only proceed to the next step after checking this condition. If there is an object the sensor produces an output frequency which is proportional to the color of the object and the selected photo diode configuration in such a way that it provides maximum frequency for the respective color to the respective photo diode. Hence sensor gives maximum frequency for red colored object when red filter is selected, and in the same way other colored object are also sensed by corresponding filters. Frequency received during each filter selection is counted and saved to separate registers and these values are examined for taking the greater one, in order to identify the color of the object. The second DC motor is in contact with another conveyor belt, on which a container is placed. The container has three sections; first section for Green, middle for Black, and third for Red. According to the color, the container will be moved in forward or backward direction by the conveyor belt, which is made possible by connecting the DC motor to L293D hybrid IC. The products will finally fall to the corresponding sections in the container.

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Block Diagram

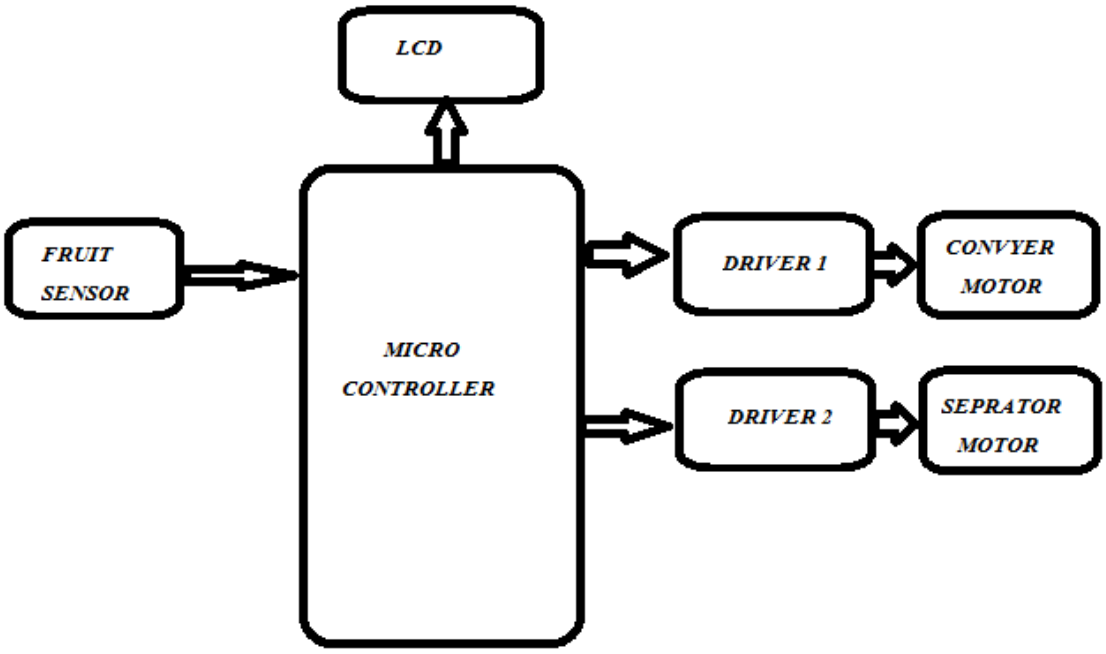

Fig 1. Block Diagram of Proposed Method

Arduino is a computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU (LGPL) or the (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, kits.

IV.SIMULATION RESULTS

Amplifying a digital signal, switching a large amount of power with a small operating power. Some special cases are: A telegraph relay, repeating a weak signal received at the end of a long wire Controlling a high-voltage circuit with a low-voltage signal, as in some types of modems or audio amplifiers

STEP:1

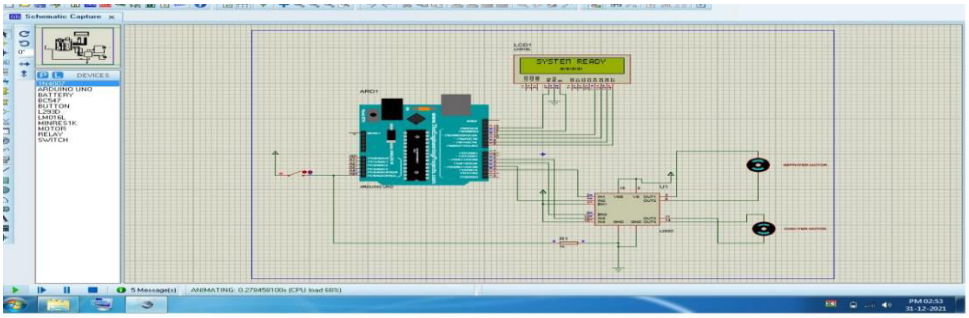

Fig 2. Simulation for Fruit Detecting

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STEP:2

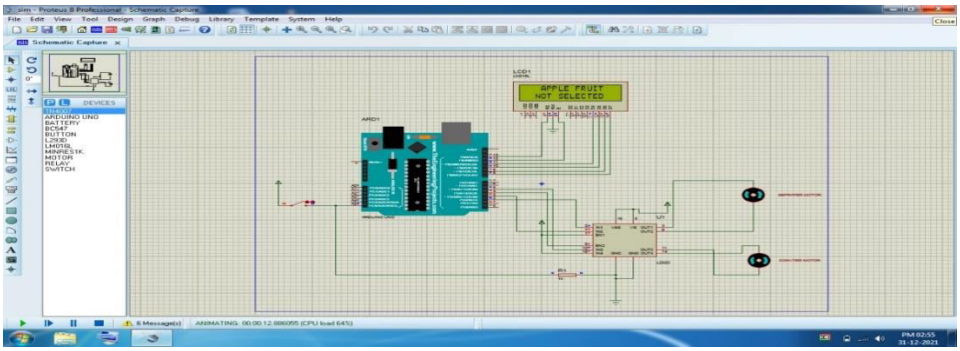

Fig 3. Drive Motor Processing

V.HARDWARE INSTALLATION AND RESULT

Fig 4. Hardware Implementation

Amplifying a digital signal, switching a large amount of power with a small operating power. Some special cases are: A telegraph relay, repeating a weak signal received at the end of a long wire Controlling a high-voltage circuit with a low-voltage signal, as in some types of modems or audio amplifiers. Initially the color sensors, which are connected with microcontroller units, sends the signal to the controller. According to the color of the for Some of the results obtained from the color sensor for different ripening stages of fruits are connected with microcontroller unit, sends the signal to the controller according to the color of the fruits for under 20% frequency scaling.

VI.CONCLUSION

The objective of this project was to develop an embedded system with quality control and process automation for sorting fruits either ripe, unripe or defective. The developed system has proven to be simple, efficient and user friendly, as all components worked properly in line with the designed specification. The developed system has a machine performance accuracy that is near 100% and an error margin is less than 0.9%. The developed system hasa robotic arm with some degree of freedom in order to microntroller and place the ripe, unripe or defective fruits at the designated bowl for ensuring the smooth processing operation. The possible outcome of this machine is an automated system based on color error detection technique that will encourage and enhance quality production of products. Similarly, Local industries having tight budgetary constraints can also benefit from this outcome by implementing this automated sorting system. This work will also provide a guidance for adopting automated color error detection based system to sort defective or unripe fruits from good or ripe ones.

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