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Design and Construction of Optical Sortex Machine

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Abstract - *For future development of automated sensor-based sorting in the mining industry, an improvement in the separation efficiency of the equipment is desirable. This could be achieved through a better understanding of the identification and separation aspects of the automated sorter. For automated sorters that undertake separation through the use of compressed air jets, the problem of poor separation efficiency has been linked with co-deflection losses. Co-deflection losses occur as particles meant to pass on to the 'accept' bin are co-deflected with the particles (which are to be deflected) meant to go to the 'reject' bin. To study co-deflection losses and suggest means of improving automated sorter separation efficiency, this research investigates the effects of particle size, shape, throughput, together with the proportion of particles (out of the total test batch) required to be deflected on separation efficiency. The effect of the air valve configuration on separation efficiency was also studied.*

***Key Words*: Raspberry pi, IR SENSOR, Co-deflection losses, efficiency,**

1. INTRODUCTION

Dimensions usually measurement of an object in length, width and height. The length, width, and height of the parcel box, there will be a multiplication program is used to obtain the result of volume. Therefore, contour-based object detection can be applied for automatic sorting system to measurement volume of an object in computer vision based. Color and size are the most important features for accurate classification and sorting of citrus. It is in this context that the field of automatic inspection and machine vision comes in to play the important role of quality control for agricultural products. Fruit size estimation is also helpful in planning packaging, transportation and marketing operations. Among the physical attributes of agricultural materials, volume, mass and projected areas are the most important ones in sizing systems

To study the probability of composite formation, it was necessary to measure the average area a particle occupies on the belt and use this information to determine the area of the belt that two or more particles would occupy. To ensure that the particles do not rest on top of each other approximately 1000 particles of each size and shape fraction was passed one-by-one over the automated sorter. The particle characteristics such as size and surface area were obtained from the image processing analyzer of the automated sorter.

2. HARDWARE DESCRIPTION

2.1 RASPBERRY PI

512 Mb with a nice black plastic case: The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It has the ability to interact with the outside world, and has been used in real time applications. This board is the central module of the whole embedded image capturing and processing system as given in figure. Its main parts include: main processing chip, memory, power supply HDMI Out, Ethernet port, USB ports and abundant global interfaces.

Fig -1: Raspberry pi module

The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation. The Raspberry Pi has a Broadcom BCM2835 system on a chip which includes an ARM1176JZF 700 MHz processor Video Core IV GPU and was originally shipped with 256 megabytes of RAM, later Upgraded to

512 MB. It does not include a built-in hard disk or solid-state drive, but Uses an SD card for booting and long-term storage.

2.1.1.1USB hub

A USB hub is a device that expands a single Universal Serial Bus (USB) port into several so that there are more ports available to connect devices to a host system. USB hubs are often built into equipment such as computers, keyboards, monitors, or printers. In order to connect additional devices to the RPi, you may want to obtain a USB hub, which will allow multiple devices to be used.

2.1.1.2 SD Card

The SD card is a key part of the Raspberry Pi, provides the initial storage for the Operating System and files. Storage can be extended through many types of USB connected peripherals. 32 GB SD card is used for this Project.

2.1.1.3 Power Supply

Raspberry Pi can work without the main connection by using power bank that can be connected to Pi using an USB cable. The unit uses a Micro USB connection to power itself (only the power pins are connected – so it will not transfer data over this connection). A standard modern phone charger with a micro- USB connector will do, but needs to produce at least 700mA at 5 volts.

2.1.1.4 GPIO

One powerful feature of the Raspberry Pi is the row of GPIO (general purpose input/output) pins along the edge of the board, next to the yellow video out socket.26 GPIO Header in Model A/B and 40 GPIO Header in Model B These pins are a physical interface between the Pi and the outside world. Out of 26, 8 are dedicated IO Lines, 2 are for UART, 4 are for SPI (+1 for Another Chip Select), and another 2 for the I2C Interface (Total 17 out of 26). These pins are a physical interface between the Pi and the outside world. Rest is Supply Rails.

Fig -2: GPIO Pin Diagram of raspberry pi

2.2 IR SENSOR

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

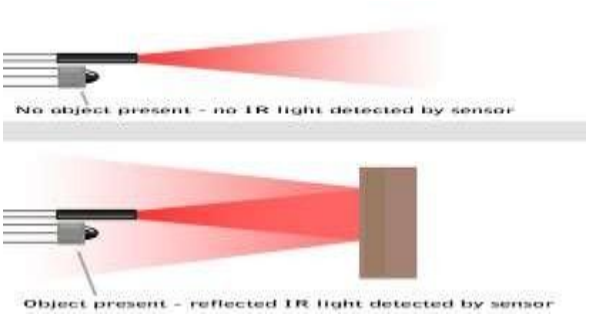

Fig-3: IR Sensor operational diagram

2.3 12v DC MOTOR

A DC motor in simple words is a device that converts direct current (electrical energy) into mechanical energy. It's of vital importance for the industry today.

Fig-4: outer assembly of dc motor

2.4 USB CAMERA

A simple Webcam setup consists of a digital camera attached to your computer, typically through the USB port. The camera part of the Webcam setup is just a digital camera -- there's really nothing special going on there.

3. SYSTEM ARCHITECTURE

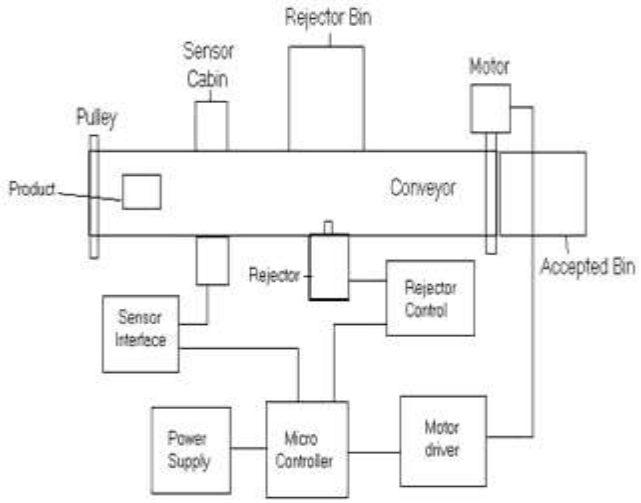

Fig-5: CONCEPTUAL DIAGRAM

3.1 System Overview

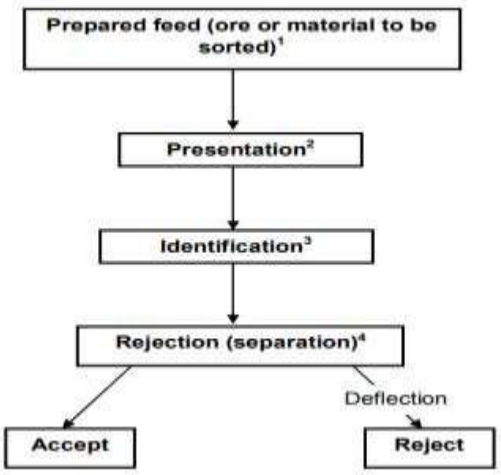

Fig-6: system overview

3.2 Image Processing

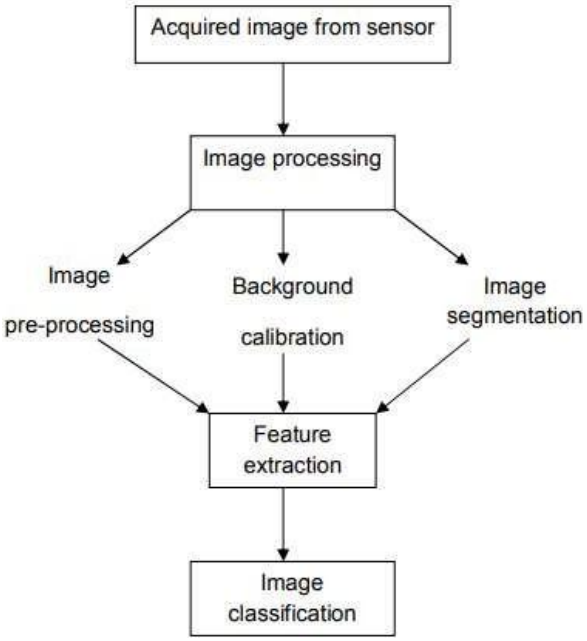

Fig-7: image processing

4. WORKING

The object recognition is based on colour characteristics hence individual particles must be distinguishable from the background. The background ideally should contrast the particles to aid identification. To acquire an image a portion of the belt is scanned).

The acquired image undergoes image processing procedures such as image segmentation and filtering. Image segmentation involves determining the edges of the observed image utilising an algorithm that identifies sharp changes in colour or grey levels of neighbouring pixels using this information to segment the image Image filtering involves smoothening edges of the image after segmentation utilising algorithms. During image filtering the pixel classes can be accentuated or attenuated.

5. ALGORITHM

 Step1: Start

 Step2: Initialize ports

 Step3: Initialize ADC

 Step4: Initialize LCD

 Step5: Display project name

 Step6: Enter into while loop(o/p =high)

 Step7: Read ADC

 Step8: Compute the object dimension through IR sensor

 Step9: send it to microcontroller through ADC

 Step10: microcontroller reads data and compares with initial design dimensions

 Step11: also compares the required colour and comperes with object

 Step12: if both required dimensions and object dimensions are same then it accepts the object

 Step13: if both required colour and object colour are same then it accepts the object

 Step14: If both above conditions do not satisfy it will reject the object

 Step15: it will display the reject on led

 Step16: sends command to rejecter motor through motor driver to initialize

 Step17: rejecter motor starts and pushes out the wrong object through the line

 Step18: this object will be pushed away and fell into rejecter bin

 Step19: Display the new objects status

 Step20: system ends and comes to initial position to check next object.

6. CONCLUSION

The tests indicate that separation efficiency decreases with an increase in throughput and decrease in size. For finer sizes (< 10mm) the separation efficiency was lower than for coarser sizes (-20+15mm). The decrease in separation efficiency can be explained by the ‘touching’ of sample particles to form composites as the particles are transported for sorting. These composites lead to the inadvertent deflection of ‘accept’ with ‘deflect’ particles being deflected by the compressed air jets.

The effect of shape on separation efficiency indicates that cubic shaped particles generally produce a higher separation efficiency. Valve sensitivity was also identified to be an important separation efficiency factor. Solenoid valves which have lower overall energise and de-energising times would be of advantage as the amount of co-deflections would be reduced.

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