

Object Sorting Using Image Processing

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Abstract— This project's primary goal is to clarify and streamline the process of putting various factory-made goods on a single conveyor for appropriate distribution and data logging in a random order. Software such as MATLAB can be used to process webcam images using image processing techniques in order to improve this process. The proper output is obtained in this project by applying color detection and image processing techniques to the captured image. The objective is to create a conveyor belt that will be essential to both large and small businesses for data logging, thereby lowering labor costs and the need for numerous conveyors. The system makes use of a conveyor belt with a motor, a product sorting mechanism, and a Webcam near the equipment. In order to know the product and its sequence, a webcam is positioned parallel to the assembly line and focused on the goods on the conveyors. A microcontroller receives the device's image-processed measurements and readings via wires for additional processing. A program that controls the conveyor belt's speed and direction uses code on the microcontroller and code in MATLAB to generate an output on the appropriate pins that the user has configured. This feature of Arduino and the MATLAB image processing toolbox has made it feasible. As a result, this study uses an industrial assembly line with image processing methodology.

Index Terms—Image processing, MATLAB, Conveyor Belt, Automatic Sorting, etc.

I. INTRODUCTION

Normally, sorting of the objects is done by manually. It consists of 4 integrated stations called distribution, testing, processing and handling. Old sorting method uses a set of inductive, capacitive and optical sensors do differentiate object color in the testing station. Handling is done by using a programmed manipulator. No vision capability exists in the system to improve its performance and flexibility. In this case, there is a possibility of minor error which will affect the accuracy in sorting. Also for huge systems, time and manpower required will very high. Automated systems can be used to remove such human errors and also it saves time and money.

Elementary conveyor belts were used since the 19th century. In 1892, Thomas Robins began a series of inventions relating to conveyor systems, which led to the development of a conveyor belt used for carrying coal, ores and other products. Recently conveyor belt systems are not only used in mining industries but also applied in cement industries, food factories, power plant, and production industries etc. So it is essential equipment for in house material transportation today.

A conveyor Belt is ultimate and widely used option in most of the manufacturing industrial applications where ever there is need for complete assembly line automation like chemical industries, bottling plant, food processing and packaging factories. The entire process from production to sort products for packaging is carried on a single conveyor belt and the processes are done in between, while they are moving. So here, one such conveyor belt application is explained. Determining real-time and highly accurate characteristics of small objects in a fast flowing stream would open new directions for industrial sorting processes.

This is the project to build a single conveyor belt for multiple objects in a random sequence, for its proper distribution and data logging. In this project efforts have been made to use a single assembly line for the classifying and sorting purpose of different objects using electronic systems, advanced sensors and image processing technique in MATLAB on the basis of physical and color characterization of each object. The project involves colour identification of an object which is done by a webcam acting as colour sensor which identifies the object's colour and sends the signal to the ATMEGA microcontroller. The microcontroller in response to the received signal; generates an appropriate control signal which is send to the circuit which drives the various motors and it also synchronizes the movement of the belt with the sorting mechanism. Based upon the color detected, the linear actuator pushes the object to the specified location. It aims in classifying and sorting the colored objects which are coming on conveyor belt by placing them in their respective pre-programmed place. The GUI based system helps to control and monitor the whole conveyor belt. With this it is possible to calculate the number of items with their respective colors and predefined weights which will make packaging much easier and controllable. Due to this only one conveyor is sufficient instead of many, thereby achieving high accuracy and speed in the work; while eliminating the monotonous work done by human.

II. LITERATURE REVIEW

Bhakti Basutkar, Piyush Kotwal, Krishna Sonawane, Dr. Shankar M Patil. April 2021|

The image processing rule for article color, from detection to sorting has been successfully applied in this paper. Through the utilization of sensor, the model effectively segregates various things. The sensing device handling system and the ability to choose the item and place it in the designated location serve a purpose. The first step in the sensing process is object detection and second one is recognition. [1]

Ahmad Jahanbakhshi a, Mohammad Momeny b, Majid Mahmoudi c, Petia Radeva d,2021

In this study, problem if carrot classification and waste control using improved convolutional neural network (CNN). The carrot having larger size so for image processing it is reduced accordingly to three sized pixels. For increasing marketability rate carrots were based on their appearance. CNN was able to classify the carrots by 99.43%. [2]

Santosh Kumar Sahoo, B.B.Choudhury ISSUE 11, NOVEMBER 2019. |

The author of this paper employed K-NN classification. To sort the defective bottle and defect free bottles These structures are effectively categorized as defective and defect free bottle by several artificial intelligence classifiers like K nearest neighbour, Artificial Neural Network, Support Vector Machine, Least Square Support Vector machine. The proposed LSSVM functional blocks effectively demonstrated as a best analytical tool with advanced classification rate of 96.35% for analysis. [3]

Aishwarya Rao, Rohith K, Harsha A. K. Karthik V. Desai, Praveena K. S. 2018.

This project proposes a robotic arm that sorts objects based on colour and shape. It gives an easy and cheaper way to implement an autonomous object sorting system. By using this system, the human intervention and manual work in production and distribution areas can be minimized. [4]

Rahul Soans, Pradyumna G. R. Conference paper: May 2018. |

In this paper, they describe a visual technique that was developed in the recent period to separate products. The object-sorting module was created and trained to take camera-taken images into consideration. Additionally, the Raspberry Pi, which generates code using the Python scripting language, was used to test the essential components needed for sorting things, such as the conveyer belt and actuators. [5]

Seokhoon Jeong, Yong- Min Lee and Sangjoon Lee, 2017.

In this paper, machine sends the 6-year-old ginseng classification results to an industrial plant server that stores the daily classification results, monitors this classification standing, and effectively performs production management. The ginseng classification is performed using image process on the premise of criteria like calculable weight and analysed form pattern. we have a tendency to considered many applicable algorithms for ginseng classification, and compared the 3 algorithms SVM [6]

Jakhfer Alikhanov1, Stanislav M. Penchev2, Tsvetelina D. Georgieva2 Aidar Moldazhanov1, Zhandos Shynybay1, Plamen I. Daskalov2, 2017

In this paper the indirect technique for egg sorting, using image process, includes the subsequent main steps: egg image acquisition, using acceptable machine vision system; image analysis, using acceptable image procedures for calculation of egg geometric parameters; applied mathematics methods for determinative the connection between egg weight and its geometric parameters; mathematical model for determining the egg weight, using one among the geometric parameters; check of the accuracy of projected indirect approach for egg sorting.[7]

Vishnu r. kale, V. a. Kulkarni, Proceedings of 3rd IRAJ International Conference, 5th January 2014.

In this work, a parallel and independent channel structure is used to create a fully functional sorter machine in order to boost overall turnout and produce an expected outcome. The project will work with success. The first step in the sensing process is object detection and second one is recognition. The system will successfully perform handling station task, particularly decide and place mechanism with facilitate of detector. Thus, an economical Mechatronics system may be designed using the best ideas and economical result may be observed. [8]

Prof. D. B. Rane, Gunjal Sagar S., Nikam Devendra V., Shaikh Jameer U. International Journal of Emerging Technology and Advanced Engineering, Issue 2, February 2015.

With the help of the roboarm and the image processing software MATLAB, the sorting machine successfully sorts the objects in this paper based on their colours. The USB digital camera is an eye fixed of the system that captures the important time image of the objects. The smart quality object continues to move on the conveyer and finally drops into the object carrier system while the roboarm picks up the faulty quality object and places it in a designated location. [9]

III. METHODOLOGY

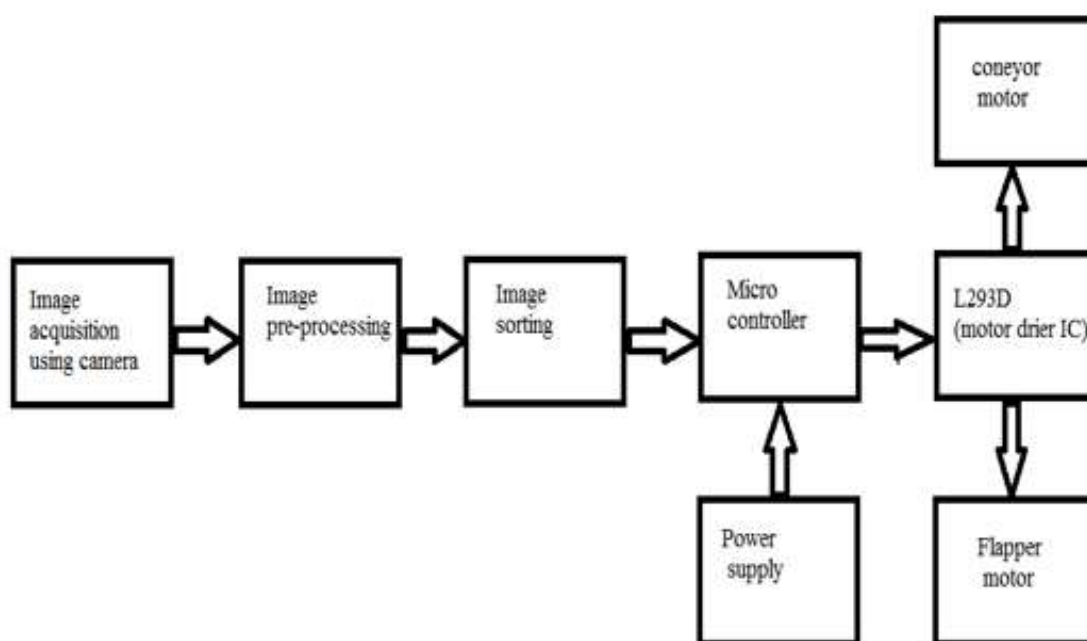


Fig.1 Block Diagram

1. Image Acquisition

To start with when the object on the conveyor is detected by the camera, image is captured by the camera and is sent to the MATLAB workspace. The input image obtained from the webcam cannot be directly given for processing. Pre-processing is done on the image such as thresholding. Then only object image is converted in binary format. This final threshold image of object is now ready for processing.

2. Camera

The camera used in this case will be overhead camera, it will take the snapshot of the object for colour sensing purpose. The image captured by the camera will be processed by image processing using matlab.

3. Image Processing

The objects are sorted on the basis of color and predetermined shape. To identify the color, firstly the image is converted into gray format and then thresholding is done. After thresholding color components are extracted and the image is converted into black and white format which is called as binary format. Find region properties & bounding box and the color are identified.

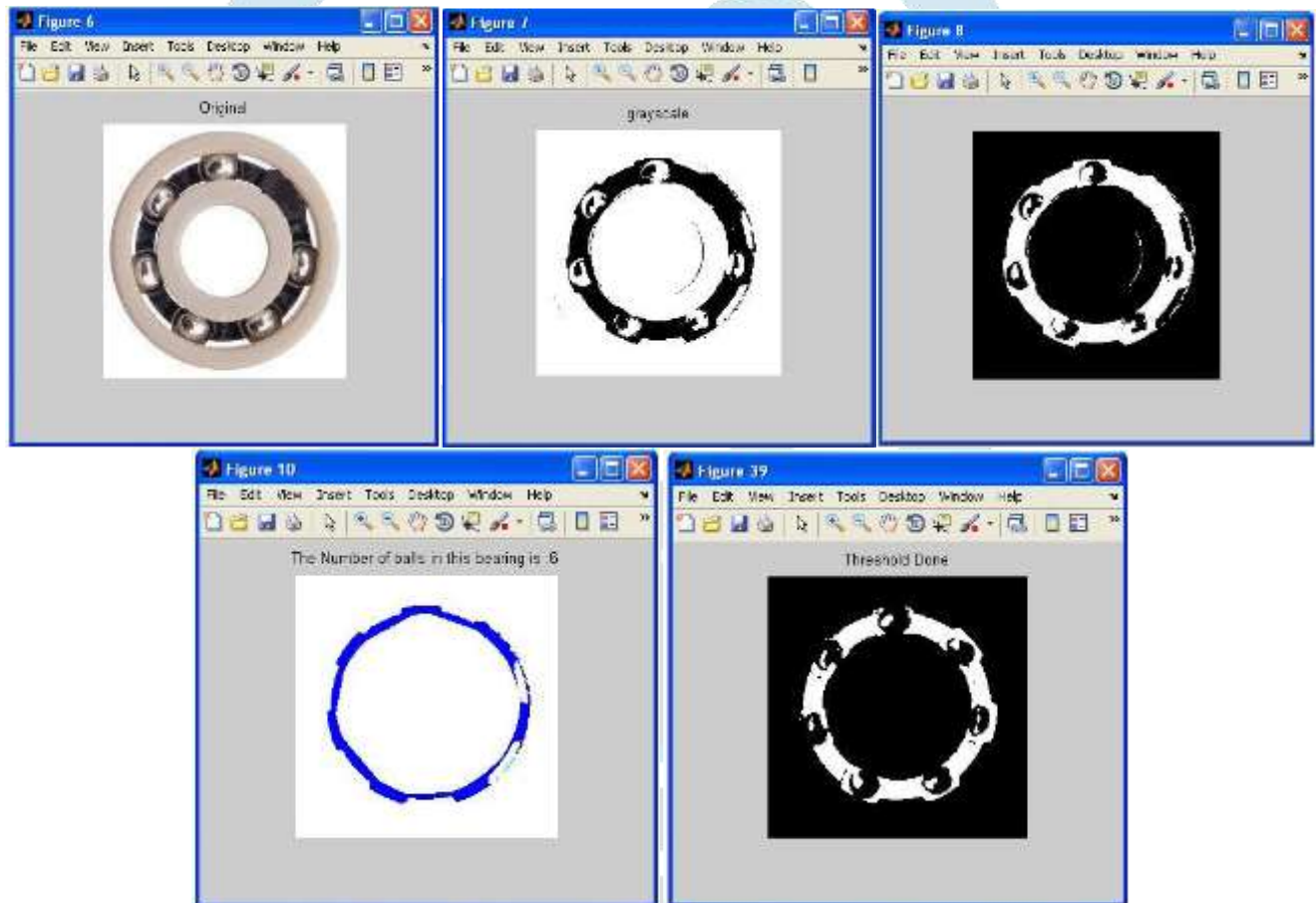


Fig. 2 Image Processing

4. Sorting Mechanism

The sorting mechanism consists of a linear actuator, servo motors and a conveyor assembly. After identifying the color with predetermined size, command will be sent to direct the linear actuator through COM port of the computer via the development board. Conveyor assembly is in OFF state for this period. According to the size and colour the servo motors with help of linear actuator places the objects in their specified place.

5. MATLAB

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.

6. Microcontroller

The ATmega328 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the Atmega 328 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

7. Conveyor Belt

The conveyor motor receives power and signal from the central supply through rectifier and control circuit. The control circuit consisting of a potentiometer will allow the user to manually control the speed of conveyor belt by the regulatory knob. Polyester is used as a belt material. A conveyor belt consists of two or more pulleys, with a continuous loop of material - the conveyor belt - that rotates about them.

As shown in our block diagram our system proposes a hi-tech vision system for sorting bottles without cap or labels from conveyor line. Here we use hi speed cameras which captures continuous images of bottles and this images are been processed using MATLAB real-time. As soon as the bottle without cap or label is detected the controlling signals are send from Pc to controller to control the flapper in two different direction using predefined angle of rotation.

IV. RESULT AND DISCUSSIONS

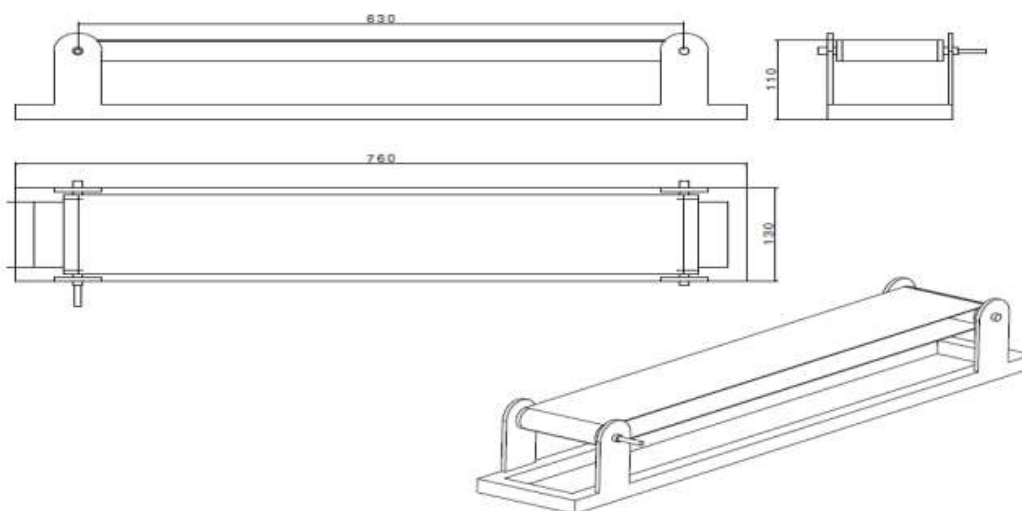


Fig. 3 Design of the System

The conveyor system designed will only be efficient when it achieves higher degree of accuracy and its output is very close to the expected result. The initialization delay of the microcontroller in the beginning is expected and can be tolerated up to 4 seconds. The Conveyor system is designed in an efficient way and expecting to work normally with provided power supply. The Matlab code has the option to modify the industrial and product parameters and can be recalibrated.



Fig.4 Result

First we recognize the object through webcam, then we convert that object or that taken picture into grayscale image, and that gray scale image is represented in fig. 4 For filtering purpose we are using the median filter, after converting the captured image into the gray scale image we are filtering that image through median filter for removal of noise present in the captured image. Fig. 4 shows the filtered image of gray scale image. After filtering the gray scale image, we are converting filtered image into the binary image for the red object recognition. In binary image it only recognizes the edges of the red object.

After filtering, converting the image into binary image we got the original filtered image with noise removal using median filter. The detected image is as shown in Fig.4. in this image we are detecting the boundary region of the object. If the object having x axes greater than 20 and y axes is greater than 30 then the object showing to camera is recognizing it as object to be captured.

V. CONCLUSION

The Code is generated using MATLAB image processing in conjunction with Arduino. The whole process is documented in the theory sections. There are no more limits but your imagination. One can begin to explore the more advanced functionality that the MATLAB-Arduino platform offers to understand as one progress further and further.

It was a valuable experience in making the project design, implementation, and testing of a system that involved digital components. More time was available for the circuit design and implementation, which was able to go through several designs before an acceptable one was reached. Ultimately the system accomplished its primary goal of motor speed control in a clear way.

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