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Automatic Object Sorter System Using Opencv And Neural Network

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ABSTRACT-Several Industries manufacture various products in this modern world in order to satisfy different expectations and achievements of the mankind. Most of the industries manufacture different products belonging to the same category at the same unit. These products would have the need to be separated at some point like before packaging and supplying. Especially industries manufacturing machine tools, produce tools of different kinds and they all gather at some point for cooling or any other process and have to be sorted out before packing. So, this system facilitates such industries in easy way of separation of these objects using vision systems and object recognition.

Keywords: Actuator, DNN, Neural Network, OpenCV , Sorting

1. INTRODUCTION

In this fast-moving modern world, automation is essential in all industrial processes. Sorting is a significant process which is necessary in all industries. Automated sorting process is fast, error-free and cost-effective. Object classification can be done by different ways. Classification based on size proves to be the best.

Problem Statement

Across the world, in many semi-automated and automated industries, still man power and knowledge are required for classifying the manufactured objects. It involves more time and money and also few errors that are unavoidable. Manufactured objects need perfect sorting before or after one process or another like cooling, packaging, etc.

Objectives

To fully automate the product sorting process. To identify and avoid faulty objects in the process. To recognize and classify objects correctly and accurately irrespective of their size, shape and color.

2. METHODOLOGY

This system is designed for separating objects based on their dimension and size using computer vision. The objects of different sizes would be passed across vision sensors (cameras) that are being controlled by a microcontroller which has been programmed to classify the objects according to the dimensions that were fed. Classified objects are diverted

to different lanes or paths with the help of motors which are also controlled by the micro controller.

Flowchart

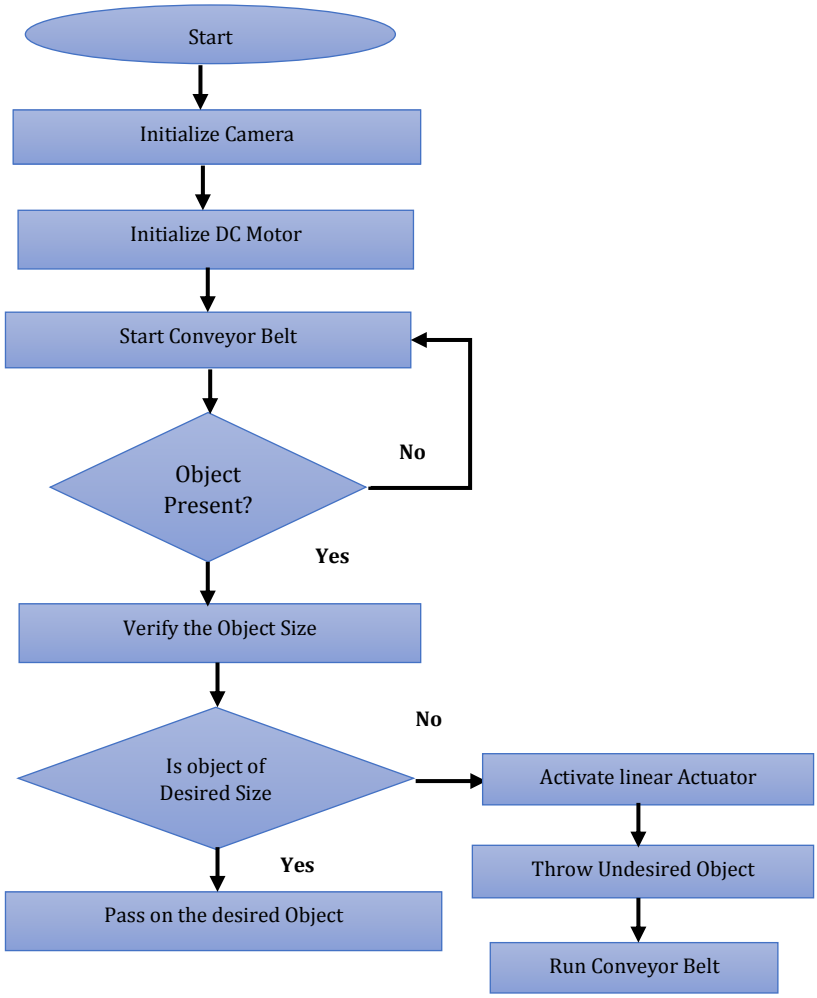

Figure 1: Flowchart demonstration of the process

The flowchart clearly portrays the process flow of object identification. It demonstrates the processes that occur when the object is desired or undesired as well.

Model

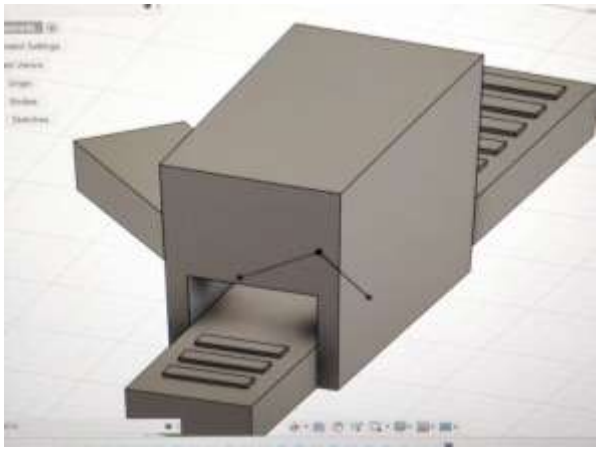

Figure 2: Initial 3D Model Using Solid Works

The design and modelling part of the system were done using the Solid Works software. The dimensions of the model in Figure 2 are: The conveyor belt is of thickness 200mm, length is as per the industrial requirement and the width is around 750mm. The cuboidal part is 800mm thick, 1200mm long and 850mm wide (approximately).

Conveyor Speed

Belt Speed is given by the formula S=D x RPM x 0.2618 x 1.021 fpm (fpm – feet per minute). Where, D = Diameter of driver pulley in inches, RPM = Revolution Per Minute of Driver Pulley. Generally, for separation purposes industries imply a conveyor speed of 65 fpm. So, we also imply a speed of 65fpm for our sorter system as it is suited for the dimensions we chose earlier.

Sorting Method 1 (Using OpenCV)

Sample Collection

With the help of the system's camera, images of the desired objects are captured at all possible angles and orientations. The captured images are fed into the cascade trainer. 1200 images have been captured and feed. The images have been categorized into positive and negative samples. The positive samples are the images of the desired object. A total count of 600 positive samples of a single desired object have been fed and trained. For negative samples, a combination of 600 different images of the undesired objects have been taken and trained in all possible orientations.

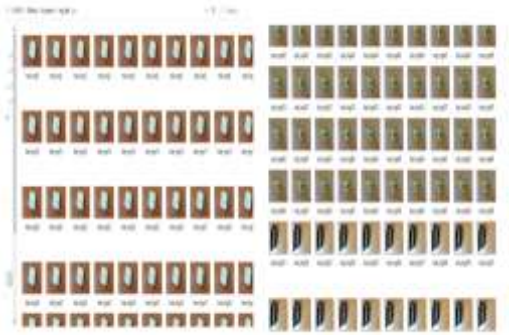

Figure 3: Positive and Negative Samples Collected

Training Process

In the simulation process, every sample has been studied and inspected. As a result, the trainer software is able to correctly identify and recognize the objects placed in front of the device camera, neglecting the undesired objects placed among the desired ones.

Figure 4: An Overview of the training process

Sorting Method 2 (Using Neural Network)

Neural Networks have recently shown excellent performances on image classification tasks. As we move towards more complete image understanding, the necessity of more precise and detailed object recognition becomes crucial. DNNs show major differences from traditional approaches for classification. First, they are deep architectures that have the capacity to learn more complex models than shallow ones. Neural networks (NNs) can be considered as composition models in which the nodes are more generic and less interpretable than the above models. Applications of NNs to vision problems are actually old, with Convolutional NNs being the most prominent example. In recent years, these models emerged as highly successful on large-scale image classification tasks in the form of DNNs.

3. RESULTS

Method 1:

This method proved to be very effective for separation of both dissimilar objects and very similar objects.

a. Dissimilar Objects: The system is able to identify the desired object that we need from our given set of dissimilar objects. At the same time, we can also change the scale, area, brightness and neighborhood, i.e., calibration.

Figure 5: Results of Method 1 in case of Dissimilar Objects

b. Very similar Objects: For detection among similar objects, we used two adapters which are slightly of the same size and color, which varies only in dimension, that too a minimal variation. In such cases, the system was able to identify the desired object based on its dimension.

Figure 6: Results of Method 1 in case of Very similar Objects

Method 2:

In this method utilization of Neural Networks proved to be more helpful and accurate in the process of object detection. This method is a rather faster one and the training process also takes only a minimal period of time compared to the previous method. This method was performed only to detect and recognize very similar kind of objects.

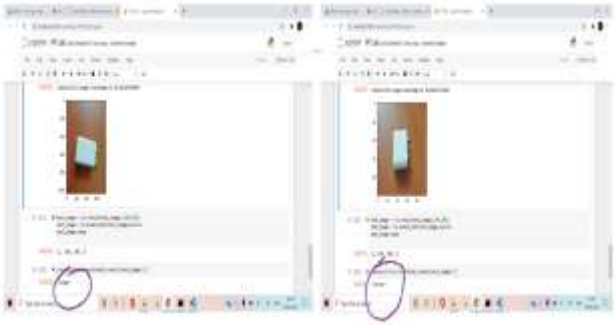

Figure 7: Results of Method 2 in case of very similar objects

4. FINAL DESIGN OF THE SYSTEM

The final design of the system was made on Sketchup Software. The Figure 8 shows the complete design of the model. Objects entering and leaving through conveyor belts can be seen. The center part consists of the vision sensor which segregates the input objects as programmed.

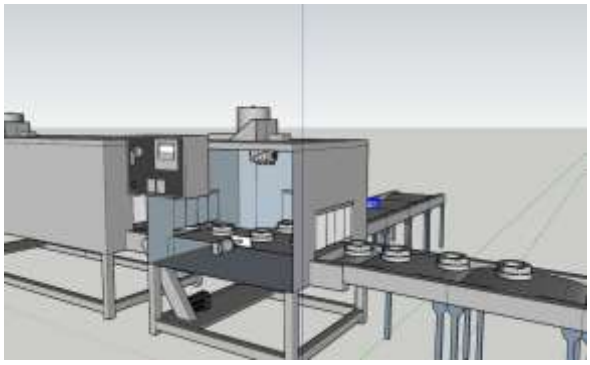

Figure 8: Final Design of the System

5. CONCLUSION

Automation is an emerging sector of investment in all kinds of industries across the world. Every industrial process is being automatized for various beneficiaries such as improved production, greater accuracy and also to eliminate the possible errors made by the human operators. Sorting the manufactured goods is an important step in every industrial process and it could be done in an efficient, error-free way with the help of the proposed system. A flawless segregation process avoids customer complaints and also avoids the work of checking and reorganizing the packed products for the workers. The proposed system is suitable for all kinds of small scale as well as larger industries who produce similar goods that are in need of separation. This is a cost-efficient and an advanced way to sort out or identify objects based on the requirements.

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