

Counting Items In A Package In A Conveyor System Using Camera

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Abstract- This paper is about the Industrial Project using Raspberry Pi SBC for counting items in a package and verifying the right number of items are in the package when the package is placed in the Conveyor for the final packing process in the Packing Industry. The purpose of this project is to eliminate the time taken for checking the count of items in the package in Industries that are dealing with a large number of items per package, which consumes a lot of time during the packing process. This project uses Computer Vision by placing a camera facing the conveyor, where the package arrives for checking. A photo is taken for the process while the package is moving in the conveyor. At a few distances from the camera point, a servo actuated sliding lever is placed to direct the defective package to the other side of the conveyor. So that the Industry persons can collect the defective package. The result of every package that crossed the checking area will be stored in the database as a CSV file for later viewing of packaging details and analysis.

Keywords- Industrial Automation, Conveyors, Counting items, Computer Vision in Industry, storing in Database, Industrial Automation using Raspberry Pi, Industrial Computer Vision using Raspberry Pi

I. INTRODUCTION

In many packing industries, packing items of required count is the crucial part. Most Industries prefer manpower to verify the package before leaving the Industry. Which at times is time-consuming and inaccurate. Industrial Automation is what can be best apt for such places. Computer Vision in Industrial Automation gives an upper hand in achieving accuracy in Industrial Automation. Introducing Computer Vision for counting in packaging Industries can interpret faster than the conventional man labor. In this project, a Camera is placed above the conveyor, at a spot where the package has to be checked. A photo is taken for the process while the package is moving in the conveyor. The Computer Vision process is done using Raspberry Pi SBC to detect if the package is defective or not. At a few distances from the camera point, a servo actuated sliding lever is placed to direct the defective package to the other side of the conveyor. So that the Industry persons can collect the defective package. The data about each package that crossed

the camera is stored in the database as a CSV file. A database is created for each day and for each time a package crosses the camera along with timestamp data. This Computer Vision method can also be used to classify different objects of different sizes.

II. DIAGRAM AND COMPONENTS USED

DIAGRAM:

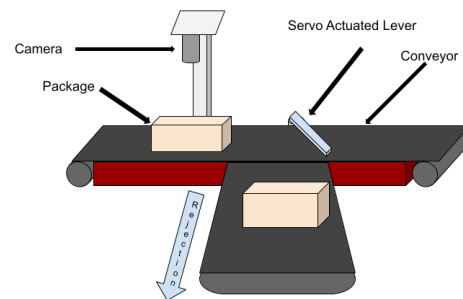


Figure.1.

COMPONENTS USED:

- Camera (8MP, 1080p)
- Raspberry Pi 4 SBC
- Conveyor system
- Servo Motor with Lever attached
- Stand for positioning the Camera

III. WORKING CONCEPT

This project consists of three working stages, Computer Vision, Conveyor and Servo actuated lever, Database collection. For this project prototype, I have used two types of Nails, 1 inch and half-inch Nails.

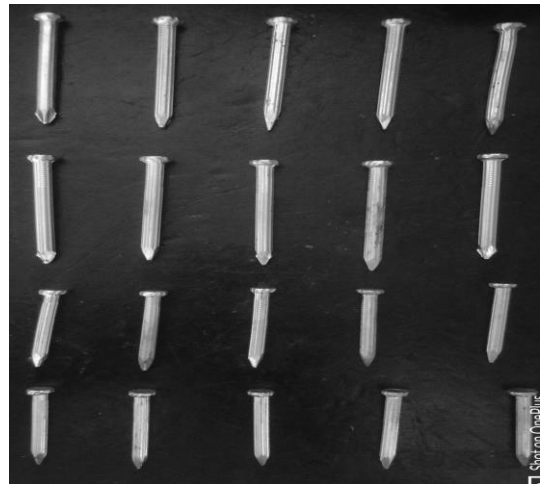
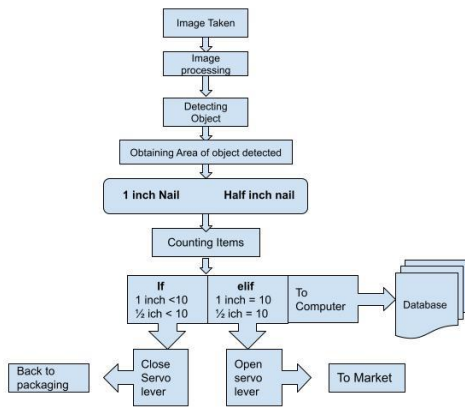


Figure.3.Grayscale image of Image taken

A. Computer Vision

The Computer Vision part of this project is done using the OpenCV library. The items are detected by converting the image taken in RGB color format to Binary format and adjusting its Threshold value.

The Grayscale Image has pixel values ranging from 0 to 255. In which the value 0 represents the black color and the value 255 represents the white color of the pixel. And the values between these two values are the color shade between white and black which are gray shades.



Figure.2.Image taken by the camera

```
cv2.threshold(gray_scale_image,80,255,cv2.THRESH_BINARY)
```

The above code is used to do that conversion.

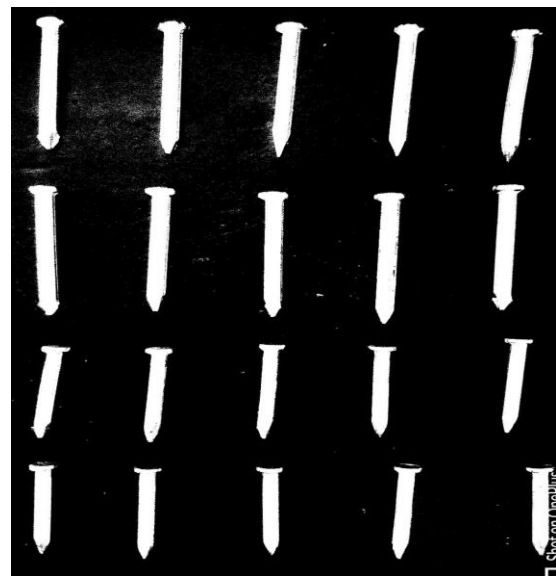


Figure.4.Binary Format of the image taken

The first step to identify the objects in a package is to differentiate them from the background. In Figure.2 the Nails have to be differentiated from their background. So this image is converted from RGB format to Grayscale first.

From Figure.4 the Nails are differentiated from their background, so the item detection becomes easier.

```
cv2.cvtColor(frame,cv2.COLOR_BGR2GRAY)
```

The above code is used to convert the image to Grayscale.

Now, using the Contour method, the white areas are detected and its areas are obtained.

```
area = cv2.contourArea(i)
```

Now to differentiate the nails based on size, the area obtained from the contour area is used. From Figure.4 the 1 inch Nails have an average area value and so for the half-inch Nails.

In this case, the average area of 1-inch nails is above 60000 pixels. And for half-inch nails, it is between 40000 and 60000.

This condition can be used to classify the different types of items in the package. So that the count for different items which differ by size can also be determined. For this project, 20 pieces are set as the default count for the package. 10 pieces of 1 inch Nails and 10 pieces of half-inch Nails.

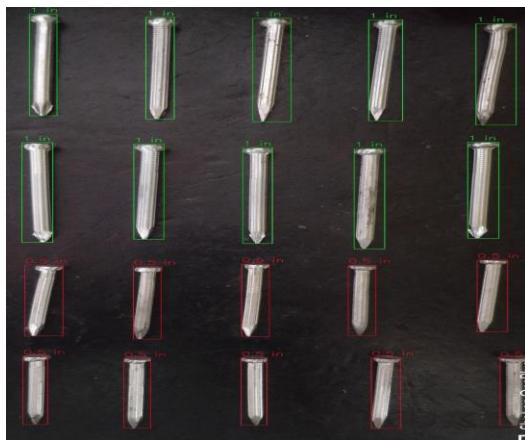


Figure.5.Output Image

In Figure.5 the Nails enclosed by Green color Boxes are the 1 inch Nail and the Red Boxes are the half-inch Nails. The number of boxes created is counted to find the number of items present in each category. Here, since the default count matches the output, this package is sent out to the market. Similarly to find the package with the insufficient count, the same process is followed.



Figure.6.Camera Image of Insufficient package

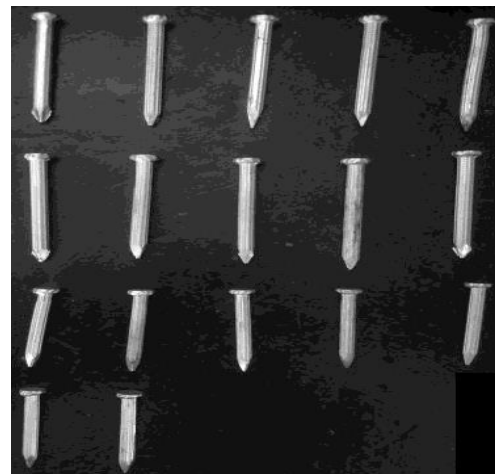


Figure.7.Grayscale image of the insufficient package

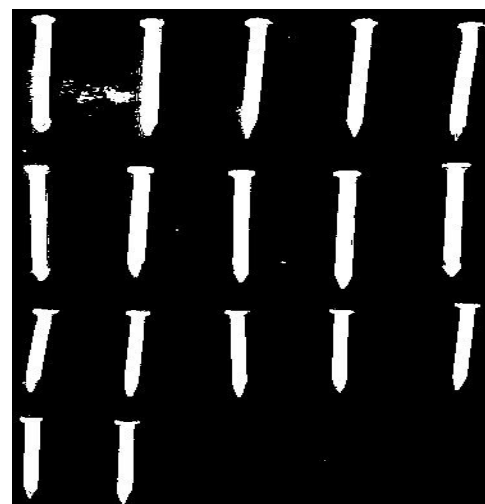


Figure.8.Binary Image of Insufficient package

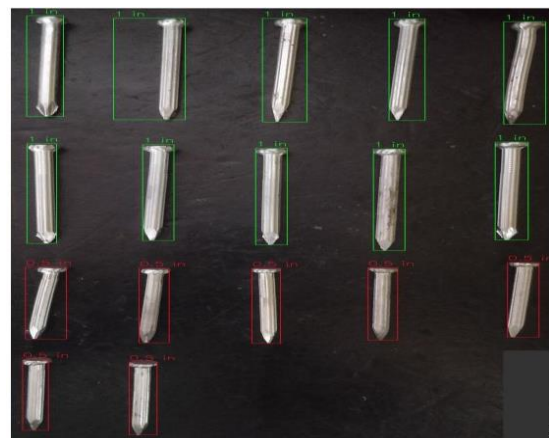


Figure.9.Output Image

B. Conveyor and Servo actuated lever

After the Computer Vision part comes the most crucial part of this project, Servo actuated a lever to slide the package to the adjacent conveyor to carry away defective packages which have insufficient item count. The servo has

two jobs. If the count is equal to the default count that has been set for each package, then the servo stays open. So that the package goes straight to the outlet. Else if the count is less than the default count that has been set for each package, then the servo stays closed at an angle to the conveyor. So that the package slides to the adjacent conveyor to carry it back to the packaging section.

Figure.10.Servo Actuated Lever opens

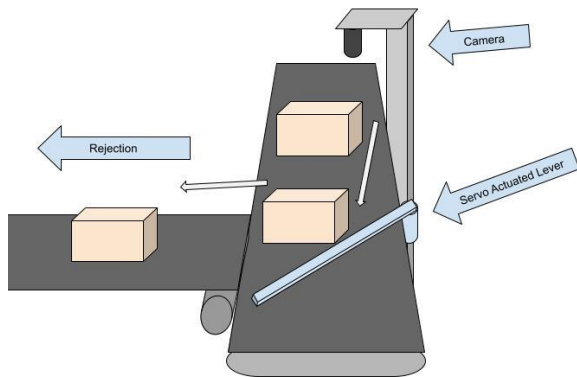


Figure.11.Servo Actuated Lever Closes

The time by the package to reach the servo is calculated from the distance between the camera spot and the servo actuated lever and the speed of the conveyor. So that the servo is actuated at the right time when the package reaches the servo actuator.

Time is taken = Distance between the camera and the Servo actuator / Speed of the Conveyor

C. Database collection

When the package crosses the camera, the result of each package that crosses is saved in the local database. Periodically it can be uploaded to the cloud so that it can be viewed anywhere for data analysis. The process of saving is done using the Pandas library. The database is uploaded to cloud storage like Google Firebase.

	A	B	C	D	E	F
1	Time	one in	half in	Total	Result	
2	2021-10-02 21:21:48.726763	10	10	20	ok	
3	2021-10-02 21:22:04.974127	10	10	20	ok	
4	2021-10-02 21:28:03.178859	10	10	20	ok	
5	2021-10-02 21:28:15.859250	10	10	20	ok	
6	2021-10-02 21:28:23.730547	10	10	20	ok	
7	2021-10-02 21:28:27.506030	10	10	20	ok	
8	2021-10-02 21:28:30.723250	10	10	20	ok	
9	2021-10-02 21:28:33.888516	10	10	20	ok	
10	2021-10-02 21:29:17.706331	10	7	17	rej	
11	2021-10-02 21:29:32.080136	10	10	20	ok	
12	2021-10-02 21:29:36.295880	10	10	20	ok	
13	2021-10-02 21:29:39.521294	10	10	20	ok	
14	2021-10-02 21:29:48.646707	10	7	17	rej	
15	2021-10-02 21:29:52.012050	10	7	17	rej	
16	2021-10-02 21:30:03.389138	10	10	20	ok	
17	2021-10-02 21:30:05.672497	10	10	20	ok	
18	2021-10-02 21:30:08.297181	10	10	20	ok	
19						

Figure.12.Database stored as CSV file

Time	one in	half in	Total	Result
2021-10-02 21:21:48.726763	10	10	20	ok
2021-10-02 21:22:04.974127	10	10	20	ok
2021-10-02 21:28:03.178859	10	10	20	ok
2021-10-02 21:28:15.859250	10	10	20	ok
2021-10-02 21:28:23.730547	10	10	20	ok
2021-10-02 21:28:27.506030	10	10	20	ok
2021-10-02 21:28:30.723250	10	10	20	ok
2021-10-02 21:28:33.888516	10	10	20	ok
2021-10-02 21:29:17.706331	10	7	17	rej
2021-10-02 21:29:32.080136	10	10	20	ok
2021-10-02 21:29:36.295880	10	10	20	ok
2021-10-02 21:29:39.521294	10	10	20	ok
2021-10-02 21:29:48.646707	10	7	17	rej
2021-10-02 21:29:52.012050	10	7	17	rej
2021-10-02 21:30:03.389138	10	10	20	ok
2021-10-02 21:30:05.672497	10	10	20	ok
2021-10-02 21:30:08.297181	10	10	20	ok

Figure.13.Database View

IV. CONCLUSION

Industrial Automation can be enhanced by the use of Computer Vision and Data Analysis. Nowadays, Industries are in the pursuit of evolving to Industrial Automation which reduces time consumption, errors and Increases Efficiency and Accuracy. This project can be a part of that evolution. It reduces human errors and time consumption. Thus increasing the production rate. Since it uses the Computer Vision method, it can interpret faster than the conventional man labor with great accuracy.

The item counting process has great accuracy when Computer Vision is used. In this project, the images were taken in real-time and tested with industrial applications. It showed better efficiency and accuracy in counting the items in a package.

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