Machine Vision Based System For Inspection Of Flat Monocolour Coated Products

P.P. Rathi, Y.M. Lakhotia

Abstract: Quality related in-process inspection/verification is an essential part of quality control in manufacturing. Inspection in manufacturing includes measuring, examining, testing, or gauging one or more characteristics of a product or process and comparing the results with specified requirements to determine whether is the requirements are met for each characteristic by developing an automatic inspection system for inspection of products. Inspection is a process which requires the inspection of each individual unit or component received from a supplier to determine specification and quality compliance. Reliance on attribute visual inspection is nearly universal in the manufacturing industry, in general, to confirm the quality of parts prior to shipment. In this project, a conceptual model is proposed for inspection of visual defects using video processing. The model is capable of inspecting products and effort was made to make it cost-efficient. After a number of experiments performed it was found that the system is capable of producing only the accepted parts.

Keywords: Inspection, Visual Defects, Video processing.

I. INTRODUCTION

In today's era of automation, there are still many industries where the inspection is done manually. This type of inspection requires a large number of workers and a lot of time. There are times when workers get exhausted and tired while inspecting the products where there is mass production. Many times it is noted that many defective products are also sent for packing which cannot be detected by the naked eyes. To avoid all such problems and also to reduce and manpower for the only inspection, it's better to replace the system with automation which can save the time and also reject those products which have minute defects.

II. PROBLEMS WITH THE MANUAL INSPECTION

In the existing process, the inspection of flat monocolour coated products takes place manually, wherein the products are checked manually, by the workers on either side to check all the requirements of the products. Inspection and packaging section has 68 workers working in 3 shifts.

1. Average output = 1000 pieces/hour/person.
2. Volume is as per product size (eg. for J26 – 25,000 pieces and J14 – 40,000 pieces).
3. The product range is 300.

Depending upon the project model and specification, inspection is done for inside diameter, outside diameter, surface finish, etc. manually by the workers. The defective product is placed in separate bins.

The problems that were identified in the industry were as follows:-

1. Time-consuming**:** In the existing process of inspection, the operator is required to pick up a single product inspect it from both the side and if any defect is found then the product is kept in the recycle bin.
2. Labor-oriented**:** The observation of defects detection is based on the judgment of operators. The task is monotonous, repetitive and due to which there is a fatigue to the operators and ultimately results in high labor cost.

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III. LITERATURE SURVEY

3.1. The existing process of inspection

In the existing process, the inspection of flat monocolour coated products takes place manually, as seen in fig1, by the workers on either side to check all the requirements of the products needed by it [1].

Fig 1 *Manual inspection*

Since it was not possible to check each product manually from both the ends a new system was created.

3.2. Existing inspection station 1

In this inspection station, as shown in Fig2, the ergonomics factors are kept in consideration while designing the model. But the problems faced were that Circlips of diameter greater than 30mm can only be inspected. The accuracy of flipping is only 80 to 85%. Due to which many defected products were not been able to detect and also the system took a lot of space [1].

Fig: 2 *Inspection sation1*

3.3. Existing inspection station 2

In this inspection station, as shown in Fig3, the ergonomics factors were kept in consideration while designing the model and even considered that space required is less. The accuracy of flipping was about 85 to 90% [3].The problem faced was the position/space required for the vibratory bowl feeder was not available because it is seen coinciding with the second system as the length of the second conveyor is more than that of the first one.

Fig: 3 *Inspection station2*

IV. OVERVIEW OF MACHINE VISION SYSTEM

4.1. Definition and Application of Machine Vision Detection Technique

Machine vision technique is an interdisciplinary integrated subject. It is a newly developed technique for detection purpose. This detection process obtains defective objection information through the camera. Then, related image processing software in the computer will process, analyze and output required detection results [2]. This technique combines machinery, electronics, picture processing and computer technology, etc., multiple subjects and is widely applied to industry, biomedicine, robot navigation, military, aerospace, agriculture, and transportation, etc., fields.

4.2. Machine Vision Principle and System Composition

Machine vision system converts adoptive targets to image signal through machine vision products, transfers it to dedicated image processing system, and transforms into a digitized signal in line with pixel difference, luminance, and color, etc., information. Machine vision mainly utilizes a computer or robot to replace human eyes to identify, judge and detect objects, involving in image acquisition of objects, processing of target objects' image information, detection and identification of target objects [2]. Hardware parts of machine vision detection system mainly composed of a detecting instrument and a computer, including camera motion control system, image acquisition system, lighting system, detection workbench and support, etc..

V. AUTOMATION OF THE EXISTING UNIT

The proposed automated system is as shown in fig 4; there is two conveyor system with the flipping arrangement between them for the purpose of flipping the object and guiding it to next conveyor system. For monitoring the object the cameras are mounted on the systems. When the objects move in the range of the camera, it is processed through raspberryPi and if the defect is detected the electrical signal is generated and send to the actuator which then ejects the object in the bin. If the object is found free of defects then it is passed on next conveyor system with the help of flipping arrangement where it would be checked for the opposite side. If the defects are found on that side then it would be ejected, if its defect-free then it would be sent for the further processing.

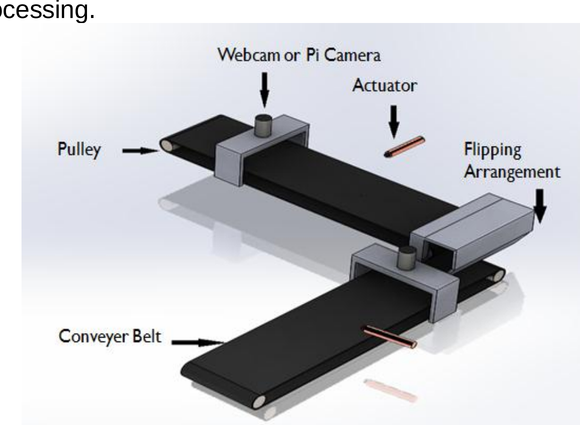

Fig: 4 *proposed conveyor system*

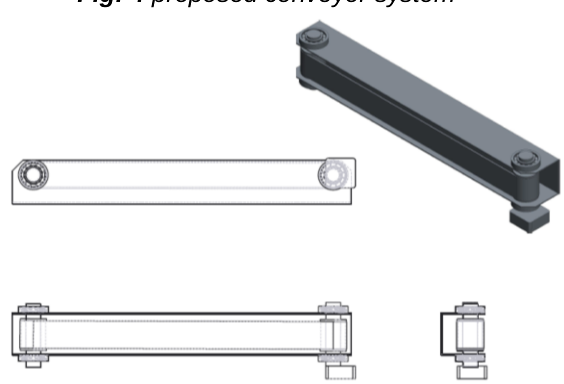

Fig 5: *3-D model of the single system*

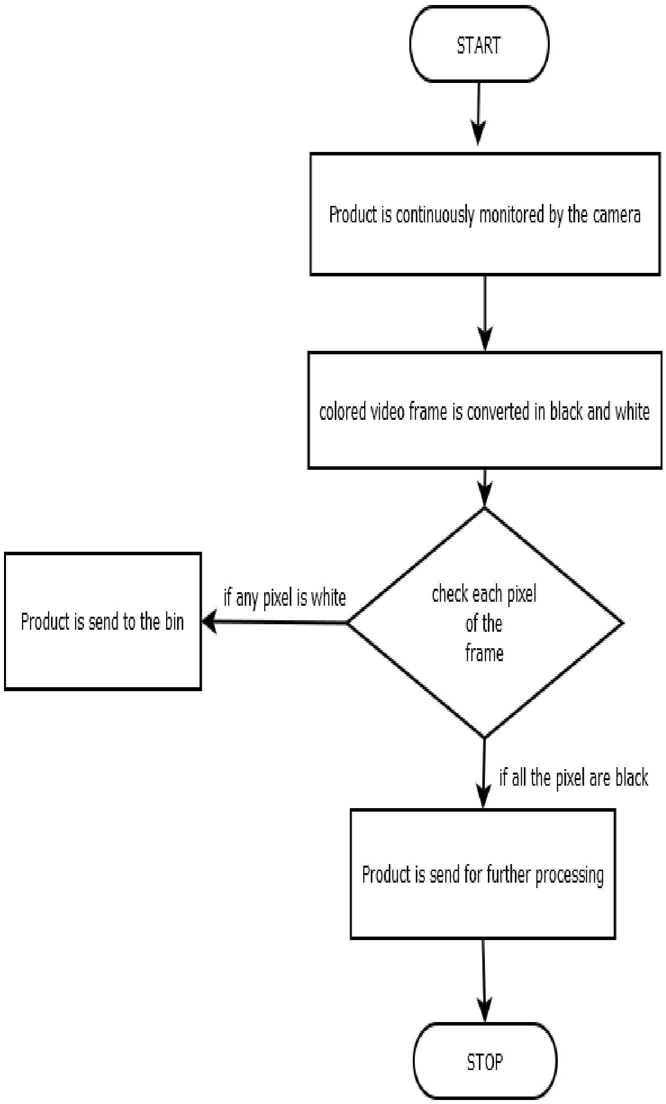

Fig: 5 *Algorithm of the proposed model*

The algorithm of our automated system is described in Fig 7 in such a way that, as the object moves in front of the camera through conveyor system, the camera captures the video frame and converts it into the black and white video frame. This means that the whole frame appears black and only the defect remains white in color. Then every single pixel of the frame is being checked, if any of the single pixels appears white and is detected by the camera then a signal is sent to the solenoidal ejector, which will then eject that product.

VI. PROBLEMS FACED

6.1 BELT SURFACE AND FRAME

The color of the belt and frame were kept in consideration as the system was detecting white defects. As shown in fig 16, as the frame of the conveyor system is white in color, the result will always show the desired product as defective.

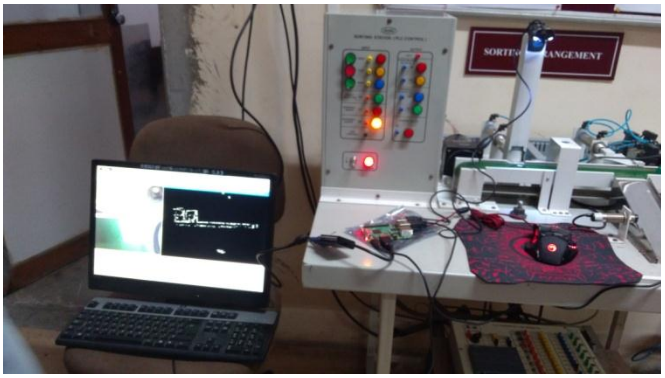

Fig: 16 *White colors of the frame*

6.2 LIGHT DEPENDENT

The surface of the belt should not be glossy since it is reflecting the light and the System was light dependent due to which false detection had taken place. As shown in fig 17, the light is reflecting from the surface so if any desired product is kept then also it would detect it as a defective one.

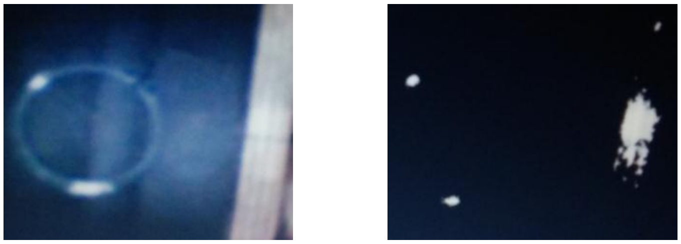

Fig: 17 *Glossy and White detection*

VII. SOLUTIONS FOR THE ABOVE PROBLEMS

7.1 FIXED COLOR OF THE BELT AND FRAME

The belt and surface coating of the frame should be matt finish and should be black in color (dark color). So that the problem which was faced due to the color of the belt and frame has been solved.

7.2 ADAPTIVE THRESHOLDING

Adaptive thresholding typically takes a grayscale or color image as input and, in the simplest implementation, outputs a binary image representing the segmentation. For each pixel in the image, a threshold has to be calculated. The system became independent of light through the method of adaptive thresholding and the desired result has been obtained.

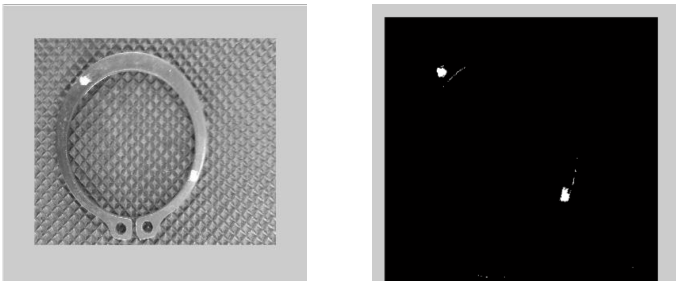

Fig: 8 *Defective Circlips*

VIII. CONCLUSION

The above project report proposes a Machine vision-based system to eliminate the defective product. The model is equipped with a conveyor belt system which is driven by a DC motor. A camera and an ejector is being mounted on the system which is connected with the raspberry pi which takes the input from the camera then process it if any defect is detected then an output signal is being sent to the ejector. Hence, this system is capable of detecting 1000 of defects in an hour.

IX. RESULT

After fabrication of the model, it was tested and experimented and the results that we got were:

9.1 Desired Products

9.2 Defective Products

X. REFERENCES

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