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DESIGN OF VISION BASED INSPECTION SYSTEM FOR WASHERS

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ABSTRACT

Inspection is a quality evaluation technique which is most widely used in industries to obtain best quality products with specified requirements. Traditionally manual inspection may lead to loss of material, labour, time for production and inaccuracy in measurement. Thus automated inspection technique can be effectively implemented to overcome the above discussed aspects. This paper presents a brief explanation about implementing automated inspection technique in quality control process of washer using machine vision. The manufactured washers may have defect like variation in dimensions. Thus each washer is checked for perfectness in dimension using machine vision. Machine vision processes discussed in this paper include capturing of image of the washer, image processing, determination of area of washer material and actuation of ejector mechanism. By machine vision technique defective washers can be eliminated accurately and comparatively reduces the time for inspection.

Keywords: Automated inspection, Go and No-Go Gauge, Image processing, Machine vision

I INTRODUCTION

Inspection is a quality evaluation technique which is most widely used in industries [1]. Inspection is defined as the critical appraisal process which involves in measurement, examination, analysis and comparison of manufactured part. Inspection may be manual or automatic. Automated inspection includes the use of electrical, electronic and mechanical devices to reduce the workload on human and to increase the effectiveness of quality control. Thus it is viable to replace the manual inspection by automatic inspection method in order to increase accuracy and to decrease the inspection time. Automated inspection techniques are implemented for inspection of food products [2,3], textile fabrics [4,5], tile surface [6], biscuit colour [7] etc. Large scale production industries like washer manufacturing industry follow 'Batch inspection' using "Go/No-Go gauge". Batch inspection method involves in the random selection of a washer from a particular batch and it is subjected to inspection using Go/No-Go gauge. Go/No-Go gauge is a quality control tool which is used to result a state which should be either acceptable or the unacceptable. The Go/No-Go gauge for washer consists of two ends, in which an acceptable washer must pass through one end and should not be able to enter the other end. In traditional manual batch inspection, defect in a single product of the batch leads to the rejection of that particular batch as a whole and it will result in waste of material, labour and time for production. Thus to overcome the defects of manual batch inspection, automated inspection using machine vision can be implemented. Machine

vision is a technology used to provide imaging based automatic inspection and analysis. A machine vision system consists of one or more cameras, analog to digital converter, micro controller, conveyor and a pneumatic blower. As the manufacturing process gets completed, the washer gets collected one by one on top of the conveyor. The washer while reaching the view area of the camera, image of the washer is captured. The captured image can be converted into suitable digital form with the help of analog to digital converter. The converted digital image can be compared with the desired dimensions of washers. The washers with acceptable dimensions will be allowed to pass through. On the other hand the washers with defect will be recognised and the micro controller operates the pneumatic blower and it is eliminated from the conveyor.

II PROPOSED DESIGN

Design of this visual inspection technique is quite simple with an arrangement of a camera placed vertically over the path of conveyor which carries the part to be inspected. Inspection process includes the usage of back light technique in order to illuminate the part through the transparent conveyor. The light source will be in line with the camera as shown in figure below. The image that is captured by the camera is processed using image processing software using computers. The processed image is compared with the standard image of that size by using the same software. The end output data thus obtained as a result of comparison is fed as input to the micro controller. Elimination of defective part is achieved by use of pneumatic blower connected to the output terminal of the controller. Actuation of pneumatic blower depends on the comparison data which is given as input to the controller. The pneumatic blower should also be a controlled in such a way that its blowing effect should not affect the next coming washer.

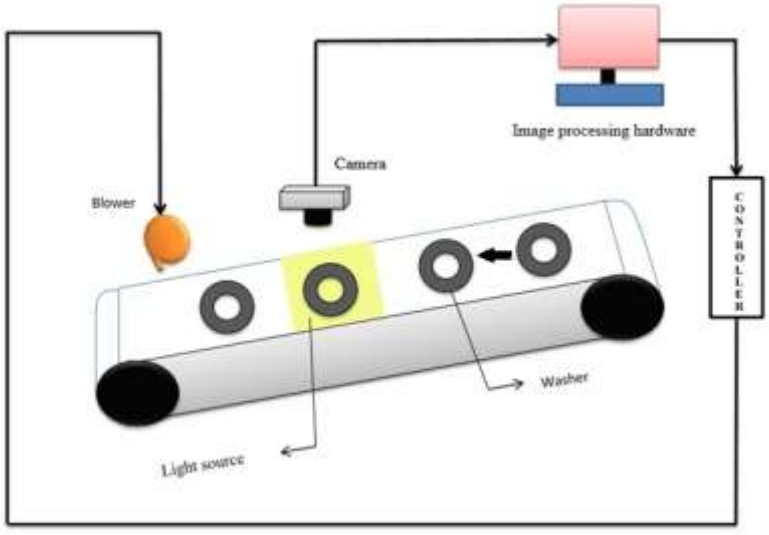

Fig.1. Design layout of the system

The following are the components of the proposed system:

- Camera
- Light source
- Transparent conveyor

- Image processing hardware
- Controller
- Pneumatic Blower

2.1 Camera

Camera is the most primary component of inspection technique which is used to record the still image of the constantly moving washer and then transmit it to the image processing hardware through cable. Camera is positioned at the top of the conveyor with its lens facing downwards as shown in Fig.1. The shutter speed of the camera relies on the speed of conveyor motor and the distance between two consecutive washers. High resolution cameras are used in order to increase the accuracy of the process.

2.2 Light Source

Light source used here is light emitting diode placed below the transparent conveyor as shown in Fig.1 in line with the camera. White LED light is used to illuminate the part. White LED has many advantages over cold light or fluorescent tubes, which makes them ideal for most machine vision technique. LEDs provide uniform and constant light with less expense and have longer life of over 1,00,000 hours.

2.3 Transparent Conveyor

Conveyors are used to move object from one place to another in production line. Conveyor belt which is used in this method should be transparent in order to illuminate the washer image. The speed of the conveyor motor should be optimum so that there is a little time gap between the consecutive inspection and rejection.

2.4 Image Processing Hardware

Image processing hardware is nothing but a computer in which the image processing software is installed to it. The image processing software enables the comparison of image of the part to be inspected with the standard part image in terms of pixel areas. Data thus obtained after comparison is fed to the controller.

2.5 Controller

Controller forms the heart of this automatic inspection technique. They are used to control the action of entire system by means of program that is already stored in ROM (read only memory). By the nature of data obtained from the computer it controls the actuation of blower.

2.6 Pneumatic Blower

A blower is nothing but a pneumatic valve actuated by a solenoid. It is connected to the output terminal of the controller. The solenoid is actuated only if the inspected part does not match the standard part.

III IMAGE PROCESSING ALGORITHM

For the purpose of obtaining the standard dimensions, a washer with perfect dimensions is placed in the field of view of the camera. Backlighting technique is used to capture the image using a camera, which involves in the usage of light source placed under the transparent conveyor. Thus when the washer reaches the view area, the washer blocks the light and appears dark whereas the region which is not covered by the washer will allow the light to be received by the camera and appears bright. The captured image will be converted into gray scale image in which the colours will appear in different intensities of gray. Now the gray scale image will be converted into binary image. In binary image the region allowing the light will appear white and the washer material area which blocks the light will appear black. For the purpose of calculation of area of the washer, the

binary image is complemented which will convert the washer material region into white and the remaining to black. Now the area of the white region is determined and it is stored in the memory as the reference range (36,000 to 40,000). The various images obtained during the process is shown in Fig. 2.

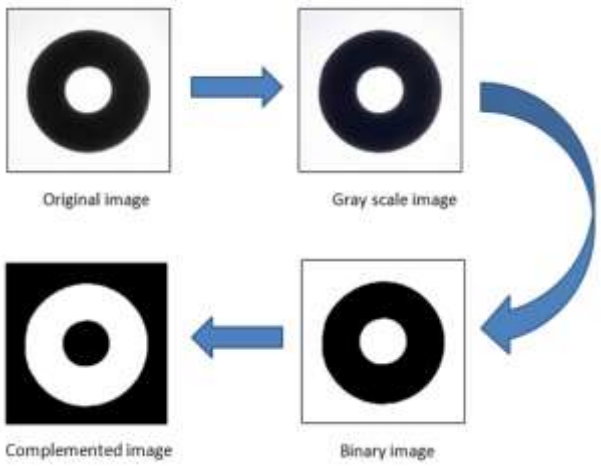

Fig.2. Various images obtained during processing

IV WORKING ALGORITHM

After the manufacturing process, the washers get collected one by one on the conveyor. The washer while reaching the field of view of the camera, the controller triggers the camera to capture the image. The captured image is processed by image processor using the above explained image processing algorithm which results in the determination of washer material area from the complemented image. The determined area of the washer is compared with the reference value using 'if-else' conditional statement. The washers within the reference range (36,000 to 40,000) will be allowed to pass through. If in case the controller detects a washer which fails to possess area within the reference range, the controller triggers the blower which results in the elimination of that particular washer from the conveyor. Further, the washer with lesser area than the reference can be eliminated from the main conveyor and can be collected in different conveyor. Similarly the washer with greater area can be eliminated and collected in another conveyor. Thus only the washers with acceptable dimensions will pass the inspection.

V CONCLUSION

This paper discusses the design of an inspection system for washers. This system uses simple 2D vision algorithm to inspect the dimensions of the washer. The algorithm was tested and was found to be an effective replacement for Go and No-Go Gauges used in industries. Machine vision technique when implemented in large scale manufacturing industry following batch production, it will eliminate the risk of rejection of whole batch of final product and improve the quality and effectiveness of inspection.

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