Monitor and Quality Control for Automatic Production Line System

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Abstract - *Manufactured products need to control the process and quality control before marketing the product. Machine vision systems are widely used today in the manufacturing industry for inspection and sorting application. High-productivity industries can't be standardization of all the pieces produced and therefore can't be revelation errors in production as well as increase the error rate.*

The major objective of this research is to design and to implement a machine vision system for monitoring, and to proposed a non- touch real time control system for measuring dimensions finished pieces using vision technique. Most automated system contain an error for the production of cutting the proportion of manufacturers, the error possible cause complete system failure depends on the piece manufacturer. Non-matching pieces to the manufacturing specifications of the required probable cause failure of system design, so the control on the production line control system by camera and sensor system to get a piece matching the specification of manufacturing.

The system requires programming linking sensors and camera. A web camera (HD-3000) used to capture an image of piece and process this image in matlab software (V.R2014b). Ultrasonic sensor used to measure height of piece. Each part of the electronic circuit has special work that done for processing signal . The processed done by different ways as image processing for image that taken by camera. programming in c language for the signal in Arduino ,all that connect together to process signals. The results measurement by ultrasonic sensor for the height of product pieces that the average percentage error was 2.7 %. The vision system will have high precision, that the smaller of the standard deviation is 0.411 with testing 35 pieces.

***Key Words*: Machine vision, Quality control , Monitoring, Image processing, Matlab etc (Minimum 5 to 8 key words)…**

1.INTRODUCTION

The stability of the production process and whose control technologies, one of the major topics for the quality of the product. Therefore fast measurement technique plays an important role. An effective quality control process identifies specifications to which the product or service must conform in order to be of value to the consumer once the standards are established and then a system must be designed to ensure that the product or service conforms to these standards. Precision's production is one of the problems that are not easily controlled, The quality control of products is a process for part to match the required specifications of design with real product. Most automated production line systems utilized manually quality control . This way may be some of product passes without match required specification, because it done by people. The objective of this work was to build an engineering solution to proposed a non- touch real time control system for measuring dimensions finished pieces, by developing image analysis algorithms for estimation of the quality of automatic system. There are many recent research dealing with machine vision, Such as, Salimiazar et.al (2013)[1]have presented the image processing procedures for determination and comparison of the moldboard blades wear and chisel tines that have presented the image processing procedures for determination and comparison of the moldboard blades wear and chisel tines. Zakaria et.al (2012)[2] discussed the used vision machine as style recognition application, threshold used way that called Otsu for acquire the image that binary. The filter median is limited impurity also Sobell worker is discovering the boundaries. To remove unwanted edge pixels used thinning method where the pixels may contend for the factor assessment process. The way records 85% accuracy. Blasco *et.al* (2009)[3] discussed that machine vision-based system has been developed to classify the topics that reaches line in four classes, and work was to construct an Engineering solution to automatic sorting of Satsuma segments by evolving image analysis algorithms to the on-line appreciation of the quality of mandarin segments. These systems automatically recognize pieces of skin and other raw material, showed tests of the machine able correctly classify 93.2% of sound segments. SHI and ZHOU (2009)[4] have provided a brief survey of emerging methodologies for tackling various issues in quality control and improvement for multistage systems including modeling, analysis, monitoring, diagnosis, control, inspection and design optimization. The success of the framework for multistage systems in quality control of multistage manufacturing systems will certainly stimulate the extension of this methodology to other systems and fields. Golnabi and Asadpour (2007)[5]discuss the functions that expect From a vision machine are the exploitation and imposition of the environmental constraint of a scene, the capturing of the images, analysis of those captured images, recognition of certain objects and features within each image, and the initiation of subsequent actions in order to accept or reject the corresponding objects. Abouelela *et.al* (2004)[6]describe Quality control that is one of the basic issues in textile industry. Analysis of texture content in digital images plays an important role in the automated visual inspection of textile images to detect their defects.

2. Proposed System

(Fig.1) and (Fig.2) show the diagram and image of the proposed vision system respectively. It consists of two parts: hardware and software. The hardware consists of vision system that is designed to capture images of Piece product to calculate the dimension of the pieces, and the software was developed to analysis to captured images using MATLAB for image processing.

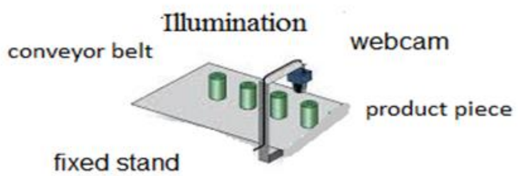

Fig-1: Diagram showing the elements of the vision system.

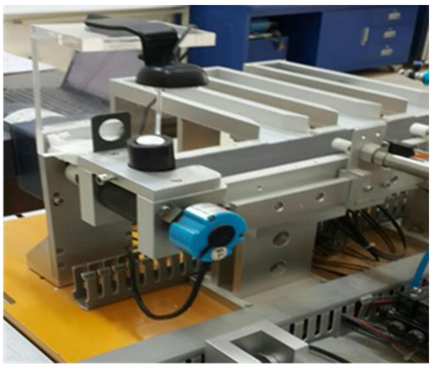

Fig-2: the elements of the vision system.

2.1 System hardware

The hardware system consists of five main items:

- Webcam (HD_3000) digital camera with resolution of 1280 x 720 pixels. (Fig.3)
- LED illumination source.
- Two Ultrasonic sensors: first sensor to define position of the piece and second sensor to measure height of the piece. (fig.4)
- Two Arduino to control on electronic circuit.
- Lenovo personal computer (PC) with MATLAB program for image processing as software.

Fig-3: (HD-3000) Webcam

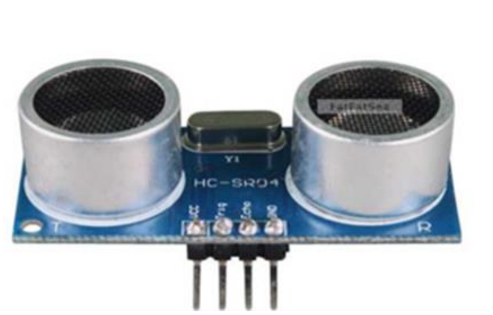

Fig-4: Ultrasonic sensor

A camera is fixed vertically above of the product piece by stand that is design fixed to capture accurate image for any piece comes from automatic product line system.

2.2 System Software

The developed software is fully written using MATLAB (version 2014b) as a 64-bit application and it is ready to run on any Windows environment. The image of the piece that needed to be measured is opened by the software, then matlab processing the image that capture to calculate the diameter. (Fig.5)

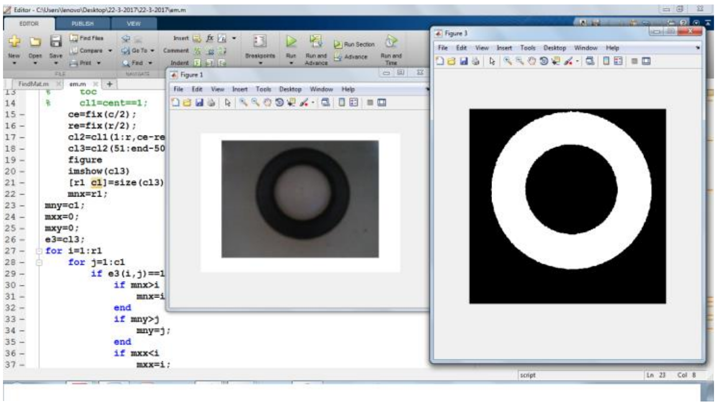

Fig-5: Main interface of software developed

2.2.1 Image acquisition and analysis

All the image analysis software was programmed in C language. The acquisition of the images is triggered by pulses received from an ultrasonic sensor attached to conveyor belt and connected to Arduino port. Camera is triggered as the belt and sensor work. This design makes the acquisition of the image independent from the speed of belt. Each piece was captured one time and transferred to the PC using USB cable to be processed in matlab as shown in (Fig.6).

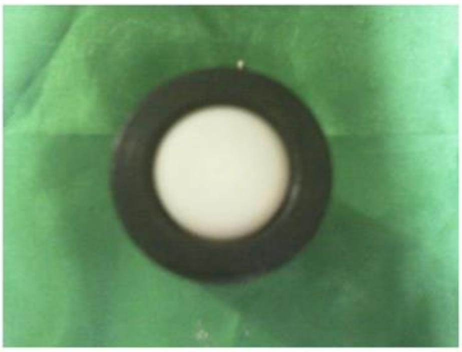

Fig-6: Loaded image in the MATLAB

Then converted to the gray scale image to reduce the algorithm operation time and convert the image to binary image (Black & Wight), as shown in (fig.7).

Binary image=im2bw (image, level);

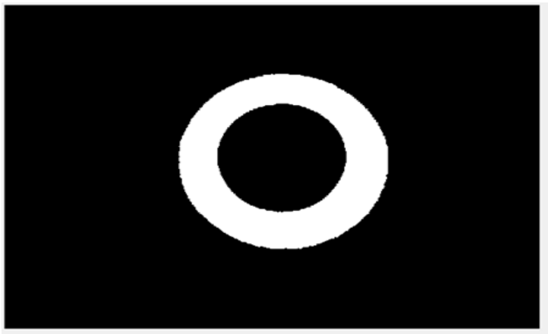

Fig-7: binary image

After that cut the part that needed to be measure the diameter from the original image, and convert this image into an array of numbers.

The image was gradient in Y direction to find the change in the intensity from the white to the black to find the edge of the piece, and at the same time find the change in intensity in direction X.

Special comment was written to scan the first row to find the first white pixel in the image, and then scan the second row to locate the second white pixel. This procedure was repeated to detect all the white pixels that lie in the image. These pixels were represented by the contour the diameter of the piece. The diameter calculated in pixel and convert to millimeter by these relationships.

$$\frac{h}{a} = 0.0885$$

where
h: piece diameter in mm.
a:piece image diameter in pixel

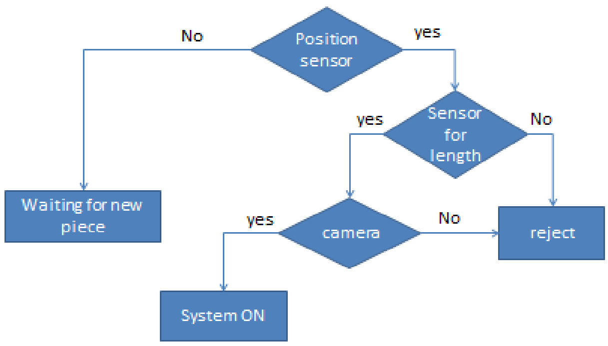

Fig-8: principle work of system

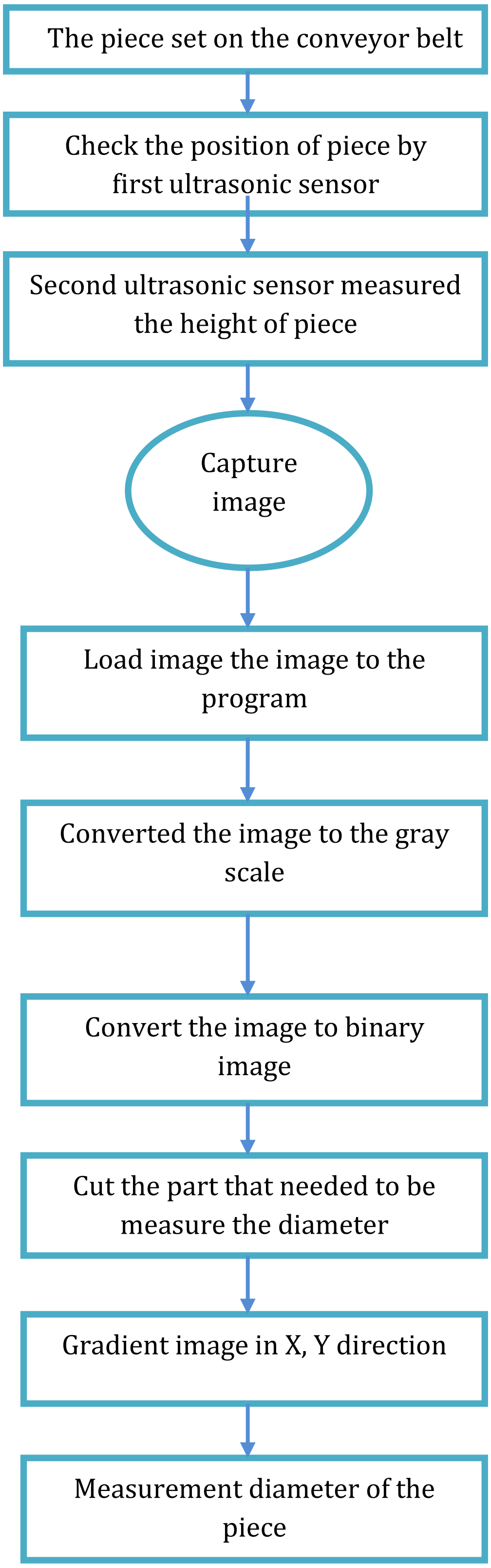

Fig-9: Flow chart of final procedure

3. Result and discussion

The first ultrasonic sensor used to locating position of piece, the position determined when the piece set on conveyor belt. The sensor send wave from trigger pin collides with piece and echo to echo pin that controller y Arduino. If the piece put on a distance 5 centimeter or less than sensor will be sent signal to second ultrasonic sensor, The second sensor work and begin measured height of piece. The ultrasonic ranging sensor provides 2cm to 400cm with a ranging accuracy that can reach up to 3mm.and The second ultrasonic sensor pins connected to Arduino, It used to measured height of the piece with permeability ±0.6, The table1 shown the result measured for sensor.

Table-1: Result of measurement height of the piece from sensor and error ratio

The Standard height of the piece (cm)	The height of the piece from sensor (cm)	The error
4	4.4	0.4
3.95	4.49	0.54
3.9	4.52	0.62
4	4.49	0.49
4.1	4.61	0.51
4	4.11	0.11
4	4.33	0.33
4	4.52	0.52
4	4.56	0.56
4	4.23	0.23
4	4.49	0.49
4	4.11	0.11
4	4.52	0.52
4.1	4.61	0.51
4	4.52	0.52
4	4.49	0.49
4	4.33	0.33
4	4.23	0.23
4	4.56	0.56
3.9	4.11	0.21
4	4.43	0.43
4	4.61	0.61
4	4.61	0.61
4	4.49	0.49
4	4.52	0.52
4	4.49	0.49
4	4.11	0.11

In the table 2 shown the result of diameter and error ratio for each piece set on conveyor, apply the Matlab M-file to find the diameter of pieces. Based on the experiment conducted, the pixel to mm ratio can be calculated using equation ($\frac{h}{a} = 0.0885$), it can convert the pixel unit to millimeter (mm) unit. The maximum error 0.896, this ratio is good for using a webcam added the effect of lighting sometimes. The background of image effect on the counting the pixels if have the same color of pieces. The resolution of webcam is 720p affected on accuracy of image, it less comparing with the digital camera that have high resolution, but webcam lowest price and gave good accuracy with low resolution.

Table-2: the result of diameter and error ratio

Diameter in pixel	Diameter in millimeter	Error
363	32.125	0.875
374.6	33.152	0.152
374.5	33.143	0.143
373.5	33.055	0.055
375.5	33.232	0.232
374.5	33.143	0.143
379.5	33.586	0.586
379	33.542	0.542
379	33.542	0.542
378.5	33.497	0.497
378.5	33.497	0.497
377	33.365	0.365
370	32.745	0.255
371	32.834	0.166
371	32.834	0.166
371.5	32.878	0.122
378.5	33.497	0.497
378.5	33.497	0.497
380.5	33.674	0.674
382	33.807	0.807
382	33.807	0.807

4 CONCLUSIONS

The best height of piece required for each sample is determined by the system by using the ultrasonic sensor, with error 0.5. The machine vision can be applied to the industries since this system has high precision which can be defined as the stander deviation and High accuracy the can calculated as the difference between machine vision and measurement, with error ratio 2%, also The mean of a diameter of pieces is 33.4 mm and the standard deviation for the data is 0.411. The time for system running is good and acceptable in the industrial application.

For more accurate results of the machine vision method, the specimen placed perpendicular to the lens in order to avoid some errors such as a shadow caused by lighting system during the experiment.

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