An Image Processing Based Glass bottle Defect Detection System

Abu Salman Shaikat and Md. Mizanur Rahman and SuraiyaAkter and Mehbub Khan
Department of Mechatronics Engineering
World University of Bangladesh
Dhaka, Bangladesh
skt047@gmail.com, m92504@gmail.com, sarmin.suraiya15@gmail.com,
m.mehbub.k@gmail.com

Abstract

Glass defects are one of the main causes of production losses for glass bottle manufacturing industry. Many machines like, Evolution 12, Evolution 5, OLT AGR, MettlerToredo, and ISM Ranger is used to detect the defects of glass bottles in different sides. Some machines are responsible to detect the cracks and others are responsible to detect the bubbles. This paper introduces an intelligent glass defect detection system, where only one machine can detect the bubble and crack defects of glass bottles. This system is entirely controlled by the use of image processing techniques. Image processing helps for detecting the glass defects by using Haar Cascade method. These process held automatically by a camera and by the use of stepper motor, the glass bottle will rotate 360 degree and an entire bottle will check from the camera. After defecting the defect, the image will be captured and stored in the monitor. Finally, glass defect data s will be collected and prove the effectiveness of the proposed system. This system will support as an extremely effective glass bottle defect detection application.

Keywords
Image Processing, Glass bottle defects, Harr Cascade method, .net framework, Arduino uno, Stepper motor

1. Introduction

Glass bottle defect detection is a major issue for any glass industry. Most of the production losses are happened due to glass defects. For detecting different types of defects of glass industry, different machines are being used. Evolution 12, Evolution 5, OLT AGR, MettlerToredo, ISM Ranger machines are being used for glass bottle defect detection. Evolution 12, Evolution 5, OLT AGR, MettlerToredo, ISM Ranger machines are used for bubble detection, base and finish defect detection, bottle thickness detection and crack detection respectively. The machines are very costly and huge number of machines are being used, which is unnecessary. So, we introduced our proposed glass bottle defect detection machine for glass industry. Mainly, this will detect the defects on bubbles and cracks, which are the major issue for glass bottle defects.

Glass bottle manufacturing process is shown in figure 1. Firstly, raw materials are collected and then, moulding and mixing section is accountable for mould the glass with proper shape and mixing various components in proper ways. After that, melting down the glass bottles is occurred. Glass forming department is responsible for maintaining hot end processes. Press and blow method and blow and blow methods are used in hot end process to make the proper formation of bottles. Then annealing process is held, which guarantees the glass to be stronger by cooling down the temperature gradually. Then inspection and testing process is occurred, where the glass defects are being detected and cullet crushing is happened whenever the machines detect the defect bottles. These glasses is going to recycle again. After inspection, one worker will be accountable for see the defects. Defect less bottles will go to packing section and the bottles will be ready for shipping.

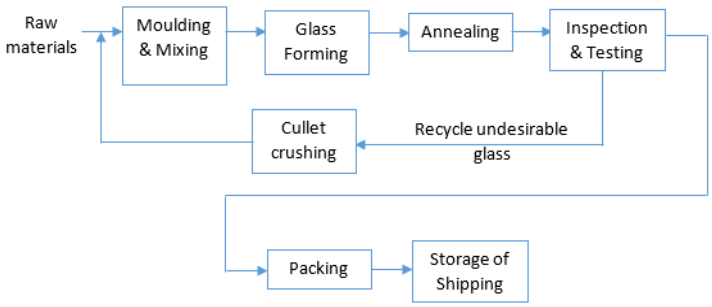

Figure 1: Glass bottle manufacturing process

In Bangladesh, most of the glass bottle manufacturing factories don't use glass bottle defect detection machines due to high cost. They are using workers mostly to detect the glass defects by eyes, which is mostly inaccurate. Sometimes, customers make complains for glass bottle defects, mainly for bubble and crack defects.

So, we proposed an image processing based glass bottle defect detection system (Jaina George et al.andZhang Yepeng et al.), which can detect bubble and crack defects of bottles. The entire cost estimation is very low according to normal defect detection machines.

Yang Bao et al.used SFC technique to detect the glass defects, whereas Saban ÖZTÜRK et al.uses Biasfeed CNN method for detecting cracks. Some proposed their system, which can detect the bottom fault detection (Fu Li et al.,Chang-Hwan Oh et al and Julian Henderson) and Hui-Min Ma et al., ZongFang Yang et al and Yao-Nan Wanget al .can detect upper fault detection.

In this proposed work, it uses an Arduino, OpenCV and .net framework to monitor the glass bottle defects for a glass industry. A stepper motor is used to rotate the glass 360 degree, so that, camera can detect the defects of the entire bottles with the help of .net framework with Haar Cascade Algorithm and monitor the total system by OpenCV. Bubble and crack defects detection is made in this proposed work, which is one of the main advantages of this system with respect to other related researches.

2. Methodology

Figure 2 represents the block diagram of Image Processing Based Glass Bottle defect detection. Firstly, open the camera and then, open the glass bottle detection window (OpenCV). Secondly, turn on the camera by clicking Cam on in OpenCV. Then point the exact areas to detect the defects in OpenCV. Then put a number in Glass ID in OpenCV for capture image of bottle. After that, click start to start the stepper motor and looking for defect of bottles at the same time.

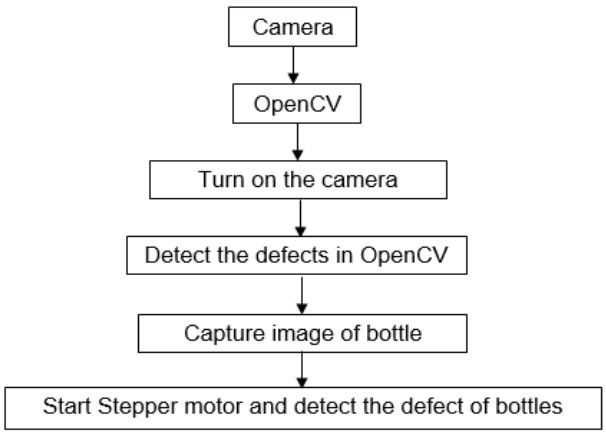

Figure 2: Block Diagram of Image Processing Based Glass Bottle defect detection

Figure 3 shows the mechanical design of Image Processing based glass bottle defect detection system, in which the dimensions are given.

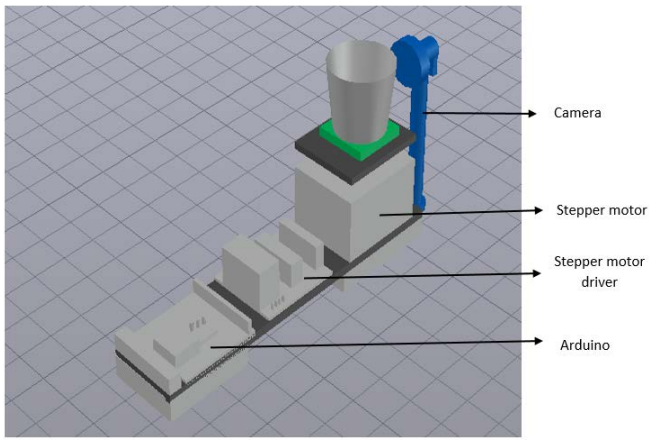

Figure 3: Mechanical Design of Image Processing Based Glass Bottle defect detection

Figure 4 shows the circuit diagram of Image Processing based glass bottle defect detection system in glass bottle manufacturing industry. Camera with usb connection is being neglected in electrical design. Stepper motor is connected with Arduino via stepper motor driver L298.

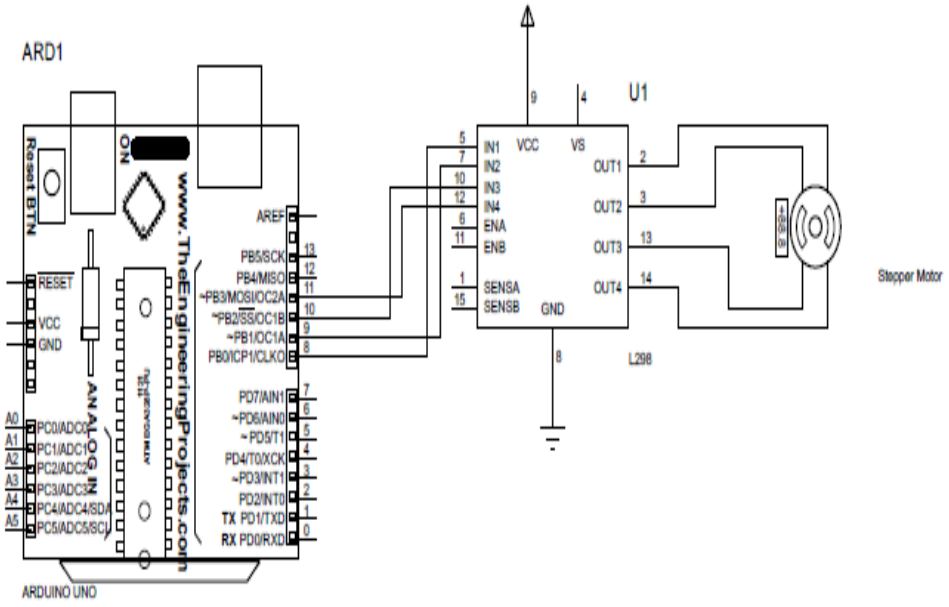

Figure 4: Electrical Design of Image Processing Based Glass Bottle defect detection

Figure 5 shows the flow chart of Image Processing Based Glass Bottle defect detection system. Firstly, then system starts. Then, apply image processing using OpenCV with Haar Cascade Method. After that, stepper motor starts to rotate to detect the entire defects. If the glass defect is detected, then OpenCV will show “Crack detected”. Otherwise, it will show “No Crack Detected”. In both cases, it will capture the image of glass bottles.

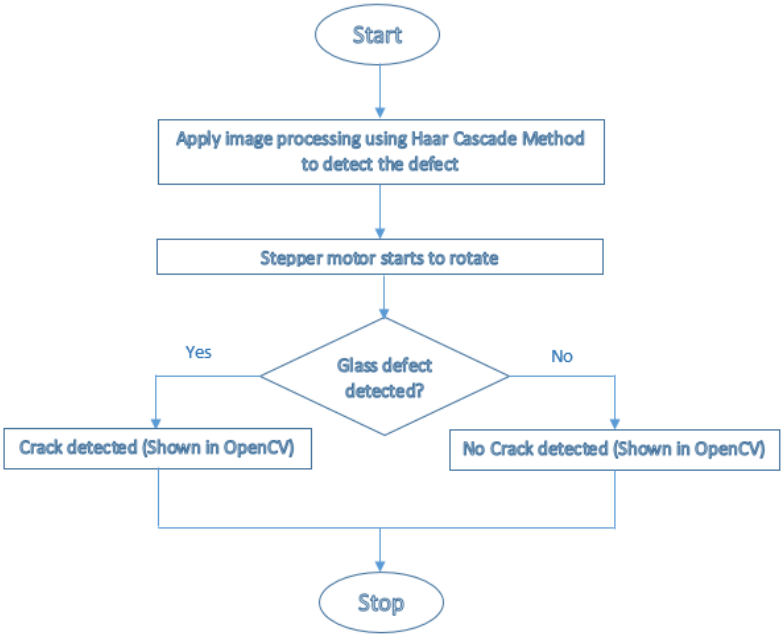

Figure 5: Flow Chart of Image Processing Based Glass Bottle defect detection

3. Results and Discussion

In this glass bottle defect detection system, Arduino is connected with Stepper motor via Stepper motor driver. Camera is connected to usb port of PC, which is operated with .net framework. Experimental setup is given in Figure 6.

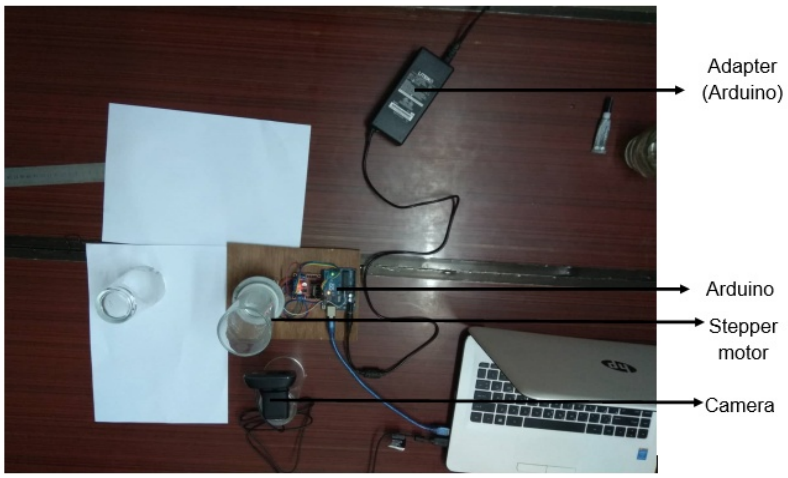

Figure 6: Experimental setup of Image Processing Based Glass Bottle defect detection

When the defect is detected in glass bottles, then it shows “Crack detected” in OpenCV, which is shown in Figure 7. And the captured image is shown in Figure 8.

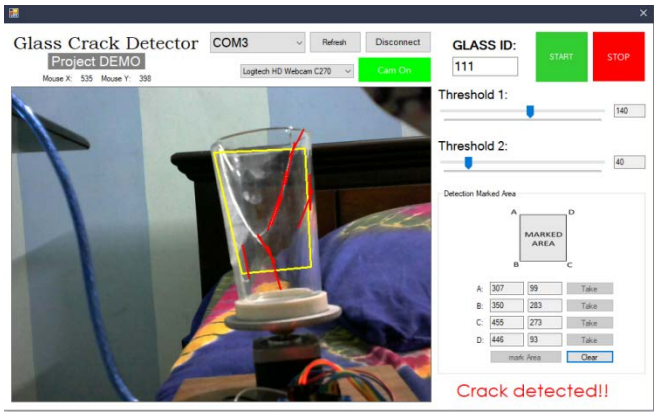

Figure 7: OpenCV detects the crack in glass bottle

Figure 8: Captured Image in OpenCV, which detects the crack and bubble of glass bottle

When the defect is not detected in glass bottles, then it shows “No crack detected” in OpenCV, which is shown in Figure 9. And the captured image is shown in Figure 10.

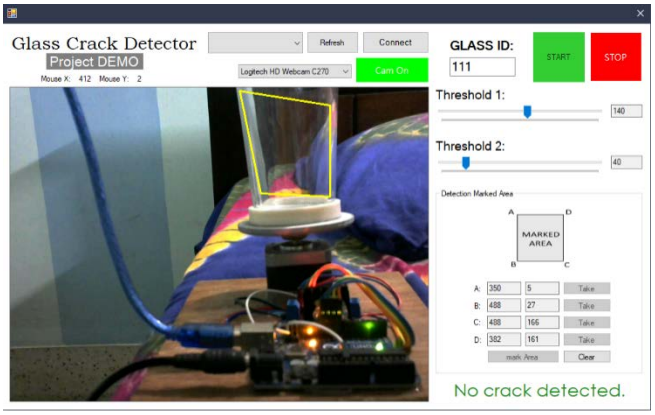

Figure 10: OpenCV detects no defects in glass bottle

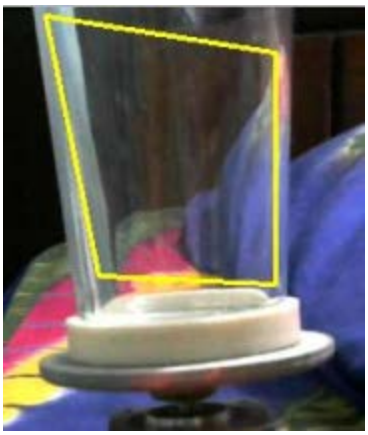

Figure 11: Captured Image in OpenCV, which can't detect any defect of glass bottle

4. Conclusion

In this proposed work, the real time defect detection is successfully established. Real time monitoring of the process has been achieved. The process for different defects has been checked. The image can be taken from OpenCV window. The OpenCV safety features are also observed. All the wiring are set up with safety solution. This project is done for glass bottle manufacturing industry. This work can also be used in plastic bottle industry. This work can be carried out as an reliable glass bottle defect detection system for glass bottle manufacturing industries. However, number of total defect bottles can be shown in OpenCV window.

References

Yang Baoet al., Image Identification of Glass Defects Based on Non-negative Matrix Factorization and Sparse Representation Classification, 2012 24th Chinese Control and Decision Conference (CCDC), 2012, pp.3225-3229.

Saban ÖZTÜRKet al., Novel BiasFeed Cellular Neural Network Model for Glass Defect Inspection", CoDIT'16 - April 6-8, 2016, Malta, pp.366-371.

Fu Li et al.., The Method for Glass Bottle Defects Detecting Based on machine vision, 2017 29th Chinese Control and Decision Conference (CCDC), 2017, pp.7618-7621.

Chang-Hwan Ohet al., Detecting Low-Contrast Defect Regions on Glasses Using Highly Robust Model-Fitting Estimator, IEEE Conference, International Conference on Control, Automation and Systems 2007 Oct. 17-20, 2007 in COEX, Seoul, Korea, pp.2138-2141.

Hui-Min Maet al., A Glass Bottle Defect Detection System Without Touching, Proceeding of the First International Conference on Machine Learning and Cybernetics, Beijing, 4-5 November 2002, pp.628-632.

Jaina George et al., Automatic Defect Detection Inspectacles And Glass Bottles Based On Fuzzy C Means Clustering, International Conference on Current Trends in Engineering and Technology, ICCTET'13, 2013, pp. 8-12.

Zhang Yepeng et al., Application of Digital Image Process Technology to the Mouth of Beer Bottle Defect Inspection", IEEE Conference, The Eighth International Conference on Electronic Measurement and Instruments, ICEMI'2007, vol. 2, pp.905-908.

Julian Henderson,Research on Surface Defect Detection Algorithm of Tube-type Bottle Based on Machine Vision", IEEE Conference, 2017, 10th International Conference on Intelligent Computation Technology and Automation, 2017, pp.114-117.

ZongFang Yanget al., Vial Bottle Mouth Defect Detection Based on Machine Vision, Proceeding of the 2015 IEEE International Conference on Information and Automation Lijiang, China, August 2015, pp.2638-2642.

Yao-Nan Wanget al.,A Bottle Finish Inspect Method Based on Fuzzy Support Vector Machines and Wavelet Transform", Proceedings of the Fourth International Conference on Machine Learning and Cybernetics, Guangzhou, 18-21 August 2005, pp.4588-4592.

Biographies

Abu Salman Shaikatis a Lecturer in Department of Mechatronics Engineering at the World University of Bangladesh, Dhaka, Bangladesh. He earned his B.Sc. in Electrical and Electronics Engineering from Ahsanullah University of Science and Technology, M.Eng.degree in Mechatronics Engineering from Asian Institute of

Technology. He worked at Bangkok Glass Public Company Limited as a Production Engineer, AIT Extension, IT and Engineering Unit as a Service Provider and Dowla Consultants and Engineering Limited as an Electrical Design Engineer. His research interest includes Automation, Robotics, Artificial Intelligence, Product Design and Development, Control System, Image Processing and Deep Learning.

Md. Mizanur Rahman is chartered Energy Engineer who is now working as an Associate Professor under World University of Bangladesh. He also worked as a Research Assistant, a Research Engineer, and a consultant in the Renewable Energy Technology in Asia (RETs in Asia) project at KUET and AIT until 2004, December. After that, he moved as a Program Support Specialist under a NGO named BRAC Bangladesh. He was joined as Assistant Manager in the Rural Power Company Ltd (RPCL) in February 2006 and continued until July 2007. He started PhD on Natural Draft Chimney at UniversitiMalaysia Sabah from July 2007. He was worked as a lecturer in the TAS institute of Oil and Gas from July 2009 and continue until August 2012 then moved Universiti Malaysia Sabah as Senior Lecturer.

SuraiyaAkteris currentlystudying in Department of Mechatronics Engineering at World University of Bangladesh.

Mehbub Khanis currentlyworking with Confidence Power Limited as Trainee Engineer. He studied in Department of Mechatronics Engineering at World University of Bangladesh.