UNIVERSITI TEKNIKAL MALAYSIA MELAKA

GLASS BOTTLE DEFECT DETECTION BY USING IMAGE PROCESSING TECHNIQUE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Robotic and Automation) (Hons)

By

AHMAD AIZAT BIN NOH
B051210163
911013-14-5303

FACULTY OF MANUFACTURING ENGINEERING

2015

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Glass Bottle Defect Detection by Using Image Processing Technique**

SESI PENGAJIAN: **2014/15 Semester 2**

Saya **AHMAD AIZAT BIN NOH**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (✓)

☐ SULIT   (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)

☐ TERHAD   (Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

☐ TIDAK TERHAD

Disahkan oleh:

_____   _____

Alamat Tetap:

9-1-2, Taman Abadi Indah, Jalan

3/109c, Off Jalan Klang Lama, 58100,

Kuala Lumpur

Cop Rasmi:

Tarikh: _____   Tarikh: _____

** Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitled "Glass Bottle Defect Detection by Using Image Processing Technique" is the result of my own research expect as cited in references.

Signature   :   ……………………………………………

Author's Name   :   ……………………………………………

Date   :   ……………………………………………

APPROVAL

The report has been submitted to Faculty of Manufacturing Engineering of UTeM to fulfill the needed for degree of Bachelor of Manufacturing Engineering (Robotic and Automation). The members of committee as follow:

………………………………

(Project Supervisor)

(Official Stamp & Date)

ABSTRAK

Penglihatan mesin adalah teknologi dan teknik yang telah dilaksanakan dalam sektor industri di seluruh dunia baru-baru ini. Teknologi ini adalah berdasarkan kepada imej di mana ia boleh digunakan pada situasi sebenar untuk menangkap imej seperti pemeriksaan, kawalan proses atau panduan robot dalam industri yang membolehkan proses itu berjalan lebih cepat, ketepatan yang tinggi, gerakan berulang-ulang yang baik dan selamat berbanding kerja yang dijalankan secara manual oleh manusia. Idea menggunakan teknologi penglihatan pada memeriksa botol kaca adalah untuk menggantikan teknologi semasa yang digunakan sistem mengesan fotoelektrik dengan mekanisme menyentuh dan pemusingan. Tujuan projek ini adalah untuk membina sistem penglihatan yang dapat mengesan lubang dan bulat badan botol. Kaedah yang digunakan untuk mengenal pasti objek itu berdasarkan hasil kerja penyelidik yang terdahulu. Dari pemetaan jurnal, kaedah pengesanan bucu telah digunakan untuk memeriksa sampel. Teknologi ini terdiri daripada perisian dan perkakasan, perisian yang digunakan untuk membina algoritma dipilih berdasarkan pengetahuan penulis dalam pengaturcaraan. Algoritma telah dibina dalam perisian MATLAB. Dengan menggunakan algoritma, parameter pengukuran dan analisis telah dijalankan untuk sampel. Daripada eksperimen ini, semua sampel kecacatan telah berjaya dikesan. Perkakasan telah mengenal pasti produk kecacatan itu dan menghasilkan bunyi sebagai isyarat untuk mengesan kecacatan. Untuk pembangunan masa depan, ia dicadangkan untuk mewujudkan jig untuk memegang sampel, menyesuaikan kedudukan lampu dan meningkatkan jenis pengesanan kecacatan.

ABSTRACT

Machine vision is the technology and technique that has been implemented in the industrial sectors all over the world recently. The technology is based on the image where it can be used for real time capture image application such as in inspection, process control or robot guidance in industry which allowing the process run faster, high accuracy, good repetitive motion and safe compared to human works output. The idea of applying the vision technology on inspecting the glass bottle is to replace the current technology that used the photoelectric detecting system with touching and rolling mechanism. The aim of this project was to build a vision system that can detect the hole and the body roundness of the bottle. The methods used to identify and classified the object was based on the former researcher works. From the journal mapping, the edge detection method was applied to inspect the sample. The technology consists of software and hardware, the software used for developing the algorithm was chosen based on the author's knowledge in programming. The algorithm has been developed in MatLab software. By using the algorithm, the parameter and measurement analysis have been performed to the sample. From this experiment, all of the defect samples have been successfully detect. The hardware had identified the defect product and produced sound as the signal to detect defection. For future development, it was suggested to create jig to hold the sample, adjust the lighting position and improve the type of defect detection.

DEDICATION

This dedication specially for my beloved family, to my parent Mr. Noh bin Ahmad and Mrs. Suzana binti Hashim who had supported me in morale and financial supports. To my brothers and sister, Ahmad Aidit, Ahmad Aiman, and Ain Najwa that inspired me. I also dedicated to my fellow friends of 4BMFA who had been encourage me to be strong in my study.

ACKNOWLEDGEMENT

Praise to Allah for willing giving me the opportunity to complete this Final Year Project (FYP). As for my supervisor from Universiti Teknikal Malaysia Melaka, Mr. Ruzaidi Bin Zamri. I would like to express an appreciation for his ideas, guidance, encouragement and professionally giving constant support in ensuring this project possible and run smoothly as per planning schedule. I thanked for his patient and kindness to help me in completing my report.

Not forgotten for all lecturers and staffs of Manufacturing Engineering Department, UTeM. I very much appreciate for their comments to improve my project when I'm studying here. Sincerely thanks to them for their excellent corporation, supports and inspiration during this project. I am very lucky to have such a helpful colleagues and I never felt left out in any situation.

Last but not least I also would like to extend my thankfulness to the most precious persons in my life, my parent for all their moral support, financial support and also to my friends for never ending reminding me to always be honest and trustworthy during my study here.

TABLE OF CONTENT

vi

© Universiti Teknikal Malaysia Melaka

© Universiti Teknikal Malaysia Melaka

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND SYMBOLS

GUI	-	Graphical user interface
CCD camera	-	Charge-couples device camera
LED	-	Light emitting diode
%	-	Percent
$\geq$	-	More than or same

CHAPTER 1
INTRODUCTION

.

1.1   Background of study

Recently, technology has evolved to the new stage and changed the character of manufacturing industry. In the past, manufacturing and the fabrication process were all done by manually and operated by a human. Since the computer and technology has been applied in the industry, automation has turn the competitive beneficial in today"s manufacturing. The benefit for the companies who applied automation in their companies enables the companies to mass produce of products with the high speed, repeatability and better quality output. This also makes the automation as the factor that determine the strong competitive between the companies in the manufacturing industry whether the each companies can hold in the storm of competitiveness.   Automation study are emphasizes on the capability, productiveness, quality and reliability, also focusing on systems that operate independently, often in structured environments over extended periods and on the explicit structuring of such environments.(Goldberg, 2012).

There are many application of automation in the industry. One of the applications of automation system is inspection system. According to the Cambridge dictionaries, the word inspection means the act of looking at something carefully to check its quality or condition. Inspection is a part of quality control where in this process it requires to test the products to uncover defects and the management will make the decision whether to allow or deny the product inspected. The quality control is aim for preventing the defects from occurs whether detecting the defects. It also ensures the economic production of products of uniform quality acceptable to

the customer. Quality control has a very their own benefit such as increased the productivity for example poka yoke, a mechanism that use to help an equipment operator avoid mistake. By increasing the productivity, it also increases the profit of the company by reducing the rejection and repair of the product.

In manufacturing industry, the inspection system is developed as an application to identify the defects occurs on the product and if the defects is recognize then it must be sort into another path for correction or rejection, this may increase the quality of the production system. Inspection system is divided into two which is manual system and automated system. Before the automated system is develop, people are the one who use to do manual system of the product by following the procedure. The manual system is a system that relies on the action of people which would increase the possibly human error to occur. An error is defined as "An action that unintentionally departs from an expected behavior" and it"s mostly done by human. The system also operated in low speed because human response is slow than automated system and this may slow the productivity of the product. Human tend to make an error because human need to be trained to gain an experience and sometimes error can be happen, this may cause the output result inaccurate.

For the present time, the automated inspection system is using a computer and technology has improved the manual system. The automated system has reduced the labor cost and human error by reducing the number of human in line. The automated inspection system is transform into the advanced technique by using machine vision. Previously, the work on sorting and inspection of the product been conduct manually using human inspection (with eye), which the job was repetitive, bored and need to stay sharp for a long period that may lead to human error. With the vision technique, the same work can be done faster, accurate, repetition, safe and adaptability.(Prabuwono, Sulaiman, Hamdan, & Hasniaty, 2006).

The automated system can do work fast because the system can process the information than human being. It also can do the repetitive work without getting tired and fell bored due to continuous power supply, compare to human that may fail to finish the job properly if getting tired. Using automated system also increase the safety of the worker by placing in the dangerous area like the space or power plant. The accuracy of automated system is beyond human because with a vision system applied on the machine, it can stay sharp and focus to detect and identified item with a quick response. According to Tai-shan, Xu-huai, Hong-min, & Jia-wei, (2012), by using machine vision system it can do online detection where the product is inspect on the real time environment without need of touching the detecting product. The system can run with high speed, good accuracy and good flexibility in automatic detection product detection.

This project is about on how to detect defect glass bottle and sent a warning signal if the glass bottle defect is identify. Liu & Wang, (2008) state that there are various kinds of glass bottle products that been produce for food and drink container. For example, the production output of beer in China in 2007 has surpassed 39 million tons and the majority of the beer is canned with glass bottle. Therefore, inspection is required in order to maintain the quality of high demand production but in many cases the work inspection is usually done by manual and will increase the labor cost also the inspection quality also low.

1.2   Problem statement

This project proposed on how to improve the inspection process regarding the product in the production line, where the product is the glass bottle need to be inspected before it going to be package. Currently, the technology been apply in the industry was a photoelectric detecting system with touching and rolling mechanism. This system has big disadvantages because the mechanical system if used too often, it can be wear easily and also the systems are complexes. This project applies the machine vision technology for inspection on the glass bottle to identify the defects occurs during shaping process. By using the vision technology, it allows inspecting

the glass bottle just using one method only to replace both mechanisms and identify the parameter without need of touching and rolling on the product.

1.3　Objective

There are two objectives during conducting the project:

i.　To build vision system that can detect the hole and body roundness of the glass bottle.

ii.　To develop Matlab coding which can classify the circle and pixel measurement of the glass bottle.

1.4　Scope

The scope of this paper is focuses on how to detect an object and give signal after detecting a defect glass bottle by using image processing technique. The object that is use in this project is glass bottle. The object is inspect on a static position only. The parameter uses to inspect the product are based on the shape and the dimension of the object. The system only detects the roundness (outer circle) and the hole (inner circle) of the glass bottle. The software use to create coding by using MatLab software.

1.5   Report Structure

This report is divided to three major chapters which are introduction, literature review and methodology. As for report structure, each chapter will be explained.

Here are some short reviews in subsequent chapters. Chapter 1 will be divided into five categories which are background of study, problem statement, objective and scope. Firstly, in background will discussed about the general idea about the project. Next, is problem statement which explains the current issues that need to be addressed before solving the problem. Next, the objective is set to achieve the goal of the. Lastly, the scope will explain the range of the project based on the student capabilities. As for report structure, each chapter will be explained.

Chapter 2 will discuss on literature review which focusing on the previous project details, analysis and study related information for this particular project. This chapter also will review the critical points of current knowledge which include any point of view from previous researcher and their findings that contribute to a particular topic.

Chapter 3 will discussed about the methodology used to fulfil the objective and the scope of the project. In this chapter will include flow chart which illustrates the project progress from the beginning through the end of the project. It will be some explanation regarding a process of making the project.

Chapter 4 will discussed the results obtained through the experiments that have been designed in methodology.

Lastly, Chapter 5 will be discussed the outcome of the project from the beginning until the end.

CHAPTER 2
LITERATURE REVIEW

2.1   Introduction

In this chapter, it will show all the relevant overview of the method that will be used in order to achieve the objective. The detail review of vision system that currently develops in industry will be showed in this chapter where all of the information from different kind of sources such as the journal, reference book, internet, and others will be used. All the information are used to design the methodology in chapter three, that chapter will focused on the design and development of the system in vision machine.

2.2   Production process glass bottle

In general, the production of glass bottle is required to go through four major stages, which are: melting, pressing, blowing and annealing. The largest process that influences the production of glass bottle is during pressing process because in this process where the bottle is being shaped into the desired designed. This is a typical stage for many glass forming processes, which is being carried out when the glass is sufficiently hot. The glass then been melted in the (the melting stage) gobs of a hot glass (of about 1100°C) then delivered to one of the process units of a cluster. These units work synchronously to transform gobs of glass into a final product. First a gob is transformed into a preform, the so-called parison, which is then blown into its final shape, a glass bottle. (Konstantin Y. Laevsky.2003).
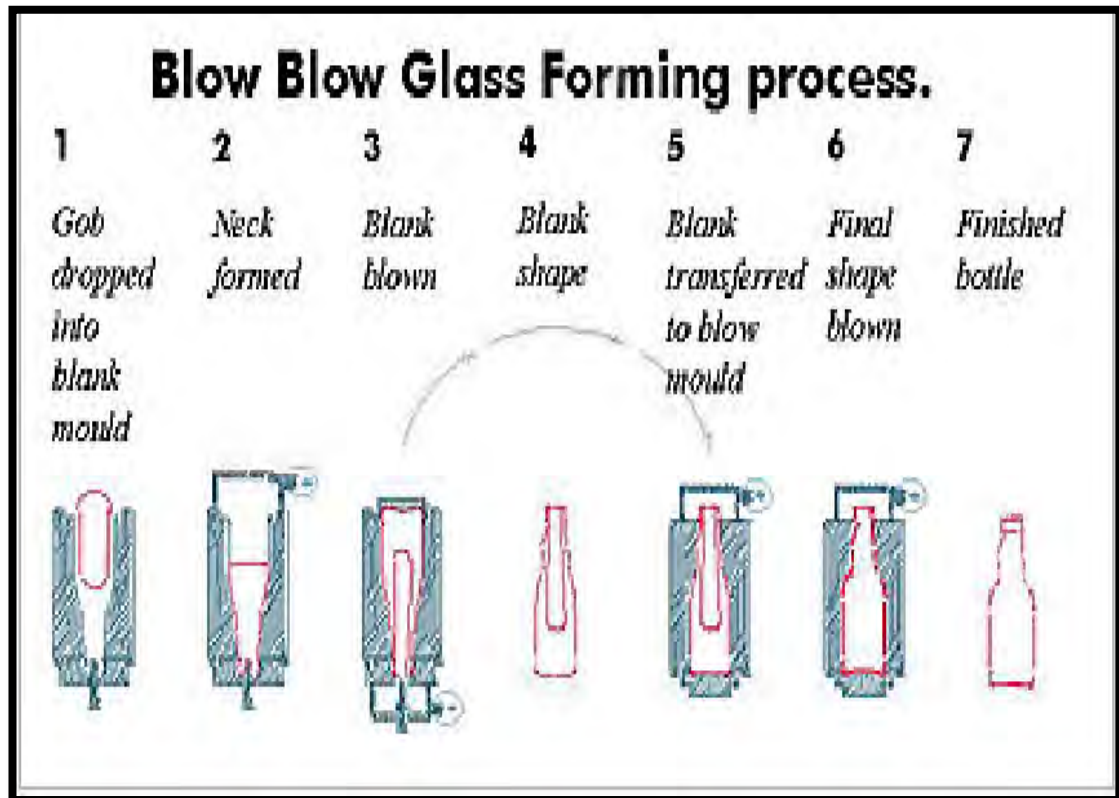
Figure 2.1: Glass forming process (Source: Ty Nant Spring Water (2014). Retrieved from
http://www.tynant.com/main.aspx?pID=39-0)

After completed all 4 major stages, the glass bottle required to go for quality
control process where in this stage, the product will be inspected according to their
dimension and shape so the defect product could be sort to another place for
recovery.

2.3   Defect on glass bottle

A good glass bottle is when the product is pass the quality control line without causing any difficulty and proceeds to next process which is packaging process. There are many type of defects that can occur during the production process and some of it is beyond the control of operator and the largest number occur either in the feeder or machine operation. (Glass container defects – Causes & Remedies (1967), section 1, pp.1).

In this project, the inspection on the glass bottle is only based on the diameter of the hole and roundness of the glass bottle because it going to replace both inspection mechanisms rolling and touching on the glass bottle.

This project covered only the general defect of the glass bottle, such as:

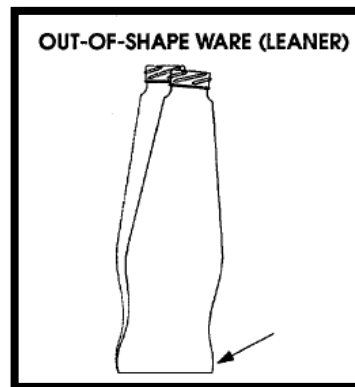### 2.3.1   Out of shape ware (leaner)

Figure 2.2: Out of shape ware
(Glass container defects – Causes & Remedies (1967), section 7, pp.136)

This glass bottle is not stable due to bottom not being level. If no action taken on this type of defect, it may affect the other process like filling and labeling. There are 4 causes of this type of defect, firstly at the feeder section where the glass is too hot. Secondly, the machine setup and operation where the product does not have enough

time to be cool down, where the machine speed is too high, the product not hanging in the takeout long enough and blow mold cycle too short. Thirdly, the mold equipment is incorrect shape of the blow and blank design of the mold. Lastly, the conveyor there is incorrect cooling over the deadplate. (Glass container defects – Causes & Remedies (1967), section 7, pp.136-137)

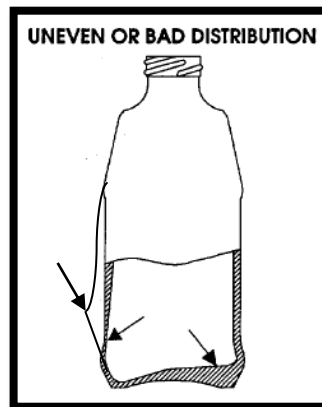## 2.3.2   Uneven or bad distribution

Figure 2.3: Uneven shape

(Glass container defects – Causes &Remedies (1967), section 7, pp.138)

This type of defect occurs because of uneven wall thickness on the glass bottle due to three causes. Firstly, on the feeder part where there is incorrect glass temperature setting and uneven gob temperature. Secondly, there was error at machine setup and operation where there are uneven cooling of blank molds, machine speed too low, incorrect timing of gob delivery and excessive blank cooling. Lastly, the mold equipment also affects the uneven shape off the product with blank design unsuitable and incorrect plunger design. (Glass container defects – Causes &Remedies (1967), section 7, pp.138)