UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF VISION-BASED SYSTEM FOR PRODUCT CLASSIFICATION

This report submitted in accordance with requirement of the UniversitiTeknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Industrial Automation & Robotics)(Hons.)

by

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I hereby, declared this report entitled **"Development of Vision-Based System for Product Classification"** is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours. The member of the supervisory is as follow:

Supervisor:

……. Date:……..

(Mr. Ahmad Idil Bin Abdul Rahman)

Co-Supervisor:

…….. Date :……...

(Mr. Johar Akbar bin Mohamat Gani)

ABSTRAK

Projek ini akan difokuskan untuk pembangunan sistem visi. Ia adalah untuk membuat pemeriksaan ukuran air dan label pada air berkarbonat . Produk ini dipilih atas permintaan yang tinggi dalam pemeriksaan botol air yang berkualiti. Sistem visi biasanya digunakan oleh pengeluar untuk pemeriksaan visual. Pemeriksaan ini adalah untuk memeriksa ketepatan dimensi. Bahagian-bahagian ini diukur menggunakan kamera dan dikira menggunakan sistem pemprosesan gambar. Data yang terkumpul daripada sistem visi akan dianalisis dan sebarang kerosakkan pada ukuran air dan label akan dibuang. Fungsi yang penting dalam sistem ini adalah kebolehan untuk mengenalpasti dan menganalisis poduk di atas pita pengangkut barang. Sistem visi juga boleh merekod video dan memidahkan data yang terkumpul ke komputer. Kamera diletakkan di hadapan produk akhir untuk mengambil gambar produk dan dianalisis. Projek ini adalah untuk mengurangkan kos pengeluar dalam pemeriksaan akhir produk yang kebiasaannya menggunakan tenaga kerja manusia. Ia memerlukan masa yang lebih banyak untuk pekerja mengenalpasti sebarang kerosakan yang ada pada produk. Pekerja tidak dapat melakukan kerja berulang kali dalam tempoh yang panjang. Oleh itu ini adalah tujuan projek dimana untuk menyelesaikan masalah yang dihadapi. Projek ini juga untuk meningkatkan ketepatan pemeriksaan produk.

ABSTRACT

This project will be focusing on development of vision based system. It is demonstrate the inspection of water level and labelling error in soda-drink bottle.. The product was chosen due to need in high quality inspection. The vision system usually used by manufacturers for visual inspection. It is used to check parts for dimensional accuracy. These parts are measured using camera and calculated by using image processing program. The collected data from vision system will be analyzed and any defect on water level and labelling product will be exiled. The important function of the system is the ability to identify and analyze the product defect. The vision system also can record video and transfer the data to the computer. The camera installed in front of product to capture image and analyse it. The project is also to reduce the manufacturer's cost in product inspection that usually use human force to do it. It is consume more time for workers to inspect any defect contained in the product. Workers cannot do any repeated work for a long time so that this is one of the purpose of this project which is to solve this problem. It is also to increase the accuracy of the product inspection.

DEDICATION

To my beloved parents Mr. Sudirman bin Jumadi and Mrs. Napsiah Binti Othman, I want to confess my gratitude to them for all their love and sacrifice across my life. The sacrifice they had done really make me inspired and the main reason for me to stay strong until now. Their support and faith for my ability to achieve my ambition is not something that can be contradicted.

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LIST ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

GUI	-	GUIDE User Interface
UI	-	User Interface
V	-	Voltage
LED	-	Light-Emitting Diode
LCD	-	Liquid-Crystal Library

CHAPTER 1
INTRODUCTION

1.1 Background of Project

Quality control is a nodal point for today‟s industries. The desired level of quality in product is the main point for the manufacturer to achieve in order to maintain a high-quality end product when customer purchase it. This will be a big benefit and satisfaction to the consumers as they receive a high-quality products. The effective inspection in production process will reduce the production costs. Any wastages happened from the product will give a loss to the producer. Maximum exercise of obtainable resources will decrease wastage is one of the importance of a good quality control. Inspection costs is reduce as there is a vision system that can detect numerous type of defect repeatedly by just changing the programming code.

Vision is the ability to produce a good report of environment around it which is from any measurement that have been set in the programming code. Vision is including building of 3-D environment, conclusion from any surface properties as example of colour, texture and material of the product. Vision also including the object recognition and give a prediction about future state. A computer vision is also known as high-level process which is the input an attributes and the output is understanding. For example, computer vision is used in tracking moving objects.

1.2 Project Overview

This project will be focusing on development of vision based system which will be demonstrate for product inspection. This inspection will be try out with drinking water plastic bottle. This product was chosen due to need in high quality inspection and time consumption that need to be save by the manufacturer. This project will be focusing more on using the available programming software to create a programming code for inspection system and resulting a suitable program to be use for inspection of the product.

1.3 Problem Statement

In the industry nowadays, production increase as per day because of the high consumption need by user. It requires higher production number in a less time utilization. Longer time consumption will give a big impact to the manufacturer‟s profit. As increase in today‟s economic growth, there is no way for the manufacturer to take a longer time in their production which will give a big impact to their cost.

Other than that, manufacturers need to maintain the quality of the product also in order to ensure low expenses. In order to ensure a high quality product, inspection need to be done before the product is being pack and send to the seller. A high-quality product need to be inspect thoroughly without any unnoticed defect. If there is any ignored defect, it will become bigger as the product reach to the customer. Of course it will give a loss.

Inspection also need to be done repeatedly and production usually done 24-hour operation. The product examination still done by workers. As we all know, human source is different than technologies. There are so much weakness and high expenses needed to pay workers. Human can not do the same work repeatedly for a long time and the vision of human is also limited sometimes different than machine.

During the soft drink production process, there are many testing parts which are, water level measurement, label detection, perfection of plastic bottle that may not always 100% such as dent, absence of bottle cap and leakage. Too many testing parts also a disadvantage for a human to do it repeatedly. A human vision is different than machine which can not stand for a long time and easy to get bored.

Some production using the artificial detection giving a result in production order becoming slow but the manual labour stronger and easy to cause instability. Artificial detection also lacks in some specific parts detection. This type of detection also usually scanning technique which will give a reason to less accurate defect recognition of product.

So, the problem statement that become the reason to the outcome of the idea in this project is:

- Higher production number that need in a less time utilization.
- Maintaining high quality but manufacturer need low expenses.
- Repeatedly inspection that need to be done and 24-hour operation which a human worker can not catch up.
- Numerous number of testing parts that will easily for a human vision tired to it.
- Artificial detection giving a slow production and instability in detecting defects.

1.4 Objectives

An achievement to gain all the objectives is actually the real yardstick to a triumphant project. These objective is actually to oblige to the expansion of this project. The objectives is :

- To develop a vision-based system integrated with hardware and software system.
- To develop a vision-based system that can detect defect in soft-drink bottle.
- To increase the accuracy in vision based system for defect inspection.

1.5 Scopes

a) Vision System

- This system is only use for soft drink plastic bottle – small size (21cm height and radius of 3 cm).
- This inspection will detect any defect that occur at the plastic bottle only.

b) Camera

- The camera used in this project is chosen based on the application and budget expense.
- The camera will only use to obtain pictures which will be process by the image processing software.

c) Product

- Only one type of product is selected to be use in the project which is soft drink plastic bottle.
- The vision based system will only focusing on inspection of water level and labelling of the bottle.
- The size of plastic bottle is only small size because to be suitable use for learning purpose model.

d) Programming Image Processing Software

- The image processing software is selected to be use comparing the obtained processed picture with the original image.
- The program also for the defect inspection on product only.

CHAPTER 2
LITERATURE REVIEW

2.1 Vision System

Vision system is also referred as machine vision or robot vision. This term described many ways to be used for machine detect the real physical world. It is used currently to monitor the industrial manufacturing which become more popular. This is because with the today‟s environment which become more modern and automated. To achieve the high standard of quality control, there is increase of vision system‟s popularity. Mostly vision system is used in monitoring defects happened on products. It make vision system plays an important role in industry.

The popularity of vision systems increase because of the ability of the system to mimic the human vision system. The optical sensor and electronic processor is the main part which acts like eyes and brain. These sensor and electronic processor are working together to interpret all the visual information they got same like human vision which eyes plays as sensor role and brain is electronic processor part. Sensor and processor also filtering all the useless information. This reduces the processing necessities and a well-designed machine vision can make decision based on the required information very quickly.

To filter the information, it is begins with matching the vision system to all the requirements that have been set by the programming. Just as human who can adjust their surrounding situations by enlarging their eyes to look more precise on that particular object, machine vision also need to be flexible as the manufacturing quality is very high. Developing in variety application and specific techniques can

enable the system to increase the speed and accuracy standards demanded by the manufacturers.

Sense only along a line which is one-dimensional sensors is the elementary type of vision system. The sensor is the best when function used to detect any presence or absence of an object. The simplicity of this system resulting limited application. This type of system cannot differentiate between objects. It is fail to identified any two different-shaped products. So any, difference happened at the product, this type of system halt to detect it. The limited applications of this system make the outcome is popular for any specific applications and it is low cost.

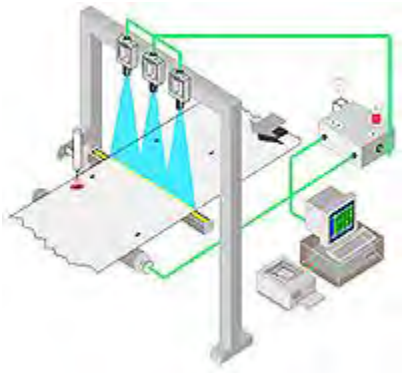

Figure 2.0 : Example of Vision System

Two-dimensional system is more advanced in sensing requirements and the most common type in responsible of detections two-dimensionally. This type of system can be found in photograph which any details in the scene are recorded. It is also very good to decide based on the picture. Shape is use by most vision system as interpreting an object. Proper illumination and high-efficiency of computer processing is the main important subject. To make the object‟s shape more noticeable, lighting from behind is more straightforward. Any flying object also can be detect if the illumination same as silhouette effect. The texture surface reflectivity also define the characteristics of the object. Enable the system to distinct between different surface finish as example, painted and unpainted objects. Colour or colour pattern can associate with determine feature. Spectroscopic is colour sensing which

have in two-dimension system can cued to make decisions. This system able to make complex analysis and multi-colour labels checking. (Wayman,2005)

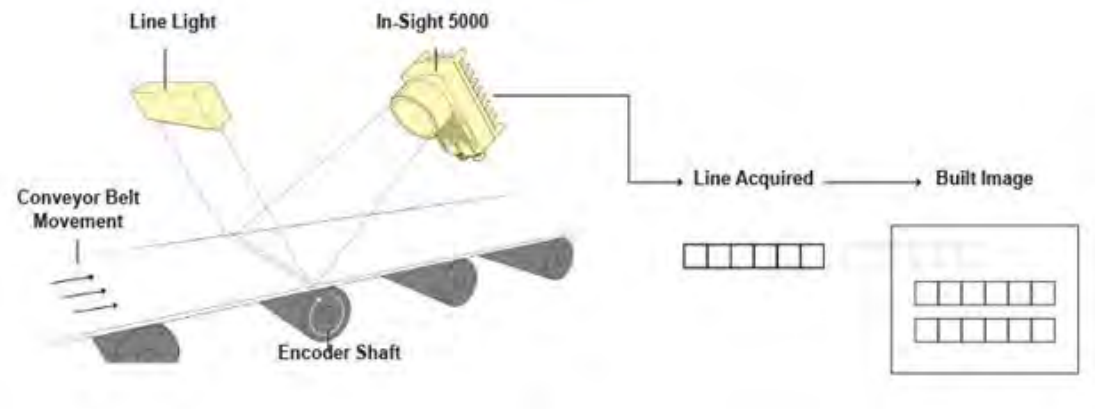

Figure 2.1 : Line scan techniques in 2D image one line at a time

Three-dimensional system is also known as the most advanced vision system which use acquisition and interpretation information. The most modern illumination and processing techniques come out with riveting results. The shape of the object can be identified by scanners to tolerances of distance. The object orientation such as checking of subtle deformations and forming detailed surface maps also can be identified. (Wayman, 2005)

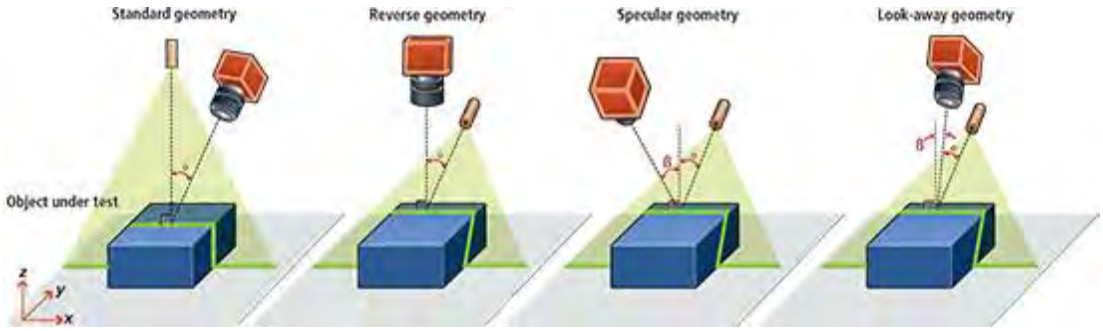

Figure 2.2 : Example of techniques in 3-D system

2.1.1 Human Vision vs. Machine Vision

Human eye is also known as one of the organ that reacts to light and pressure. The eye able to result vision and able to detect any moving object, colour and three-dimensional picture. Eye also one of the most complex organ in the body and nowadays technology known as machine vision develop by the scientist are trying to mimic this human‟s organ. But eye is still the best shape of vision system. The similarities that have between the human eye and machine vision can be found even though there is limitation in the machine vision system.

In human eye, the pupil and iris is act as image sensor. It is located behind the cornea. Iris function as diaphragm which same as shutter on a camera. It controls the amount of light that enters through the pupil which acts like a black hole at the centre of the iris. Muscles in iris is contracting when required more light but reduce it when too much light enable it to protect inside the light. The pupil is enlarged and tighten responds to changes in lighting (©VisionWeb,2010). In vision system, there is sensor. Sensor is electronic device which function to detects and responds to the input that been set from its environment. The input has to be specific such as light, heat or motion based on what have been set. After the input has been detected, the output is always converted for human-readable data. Usually in vision system, they use motion sensor which detect energy that break in the path. Infrared transmission also common sensor use in vision system. This infrared transmission is energy between region of electromagnetic radiation spectrum which the wavelengths is longer than visible light but still shorter than radio waves. (Margaret Rouse, 2000-2017)

Retina focuses as image transfer medium in human eyes. It is a form of thin layer tissue that lines along the back of the eyes. The location is near