UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE STUDY OF MEASUREMENT ERROR IN VISION SYSTEM

This report was submitted in accordance with requirement of Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Industrial Electronics) with Honours

by

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2016

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **The Study of Measurement Error in Vision System**

SESI PENGAJIAN: **2016/2017 Semester 1**

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Industrial Electronics) with (Hons.). The member of the supervisory is as follow:

………………………………

(Project Supervisor)

ABSTRAK

Ralat boleh dijumpai dalam setiap perkara terutama sekali dalam bidang berkaitan dengan ukuran. Kepentingan ralat adalah untuk menganalisa sebarang kesilapan atau sebagai faktor berlaku nya kurang ketepatan. Di dalam bidang pemeriksaan, ralat boleh juga didefinisikan sebagai sesuatu yang boleh menjurus kepada salah jajaran dan juga membolehkan masalah timbul kemudian. Pemeriksaan diperlukan untuk memastikan semua peralatan dalam keadaan yang baik. Terdapat pelbagai jenis pemeriksaan, tetapi yang paling lazim adalah dengan menggunakan sistem penglihatan. Pemeriksaan menggunakan sistem ini juga boleh menimbulkan ralat. Dengan projek ini, ralat dalam pengukuran akan di bincangkan. Imej akan ditangkap menggunakan kamera. Dengan melakukan pemerhatian untuk perbezaan, imej akan ditangkap menggunakan julat ketinggian yang berbeza. Ketinggian yang di ambil ialah 5 cm, 10 cm, 15 cm, 20 cm dan 25 cm. Semua ralat yang diperoleh akan dianalisis sehingga keluaran ralat menjadi ralat yang boleh diterima untuk pemeriksaan.

ABSTRACT

Error could be found in every single thing especially in field related to measurement. The important of error is to analyse the faulty and also any non-accuracy factor. In inspection field, error could be defined as something that could lead to a misalignment and also gain some problem later. Inspection is needed to ensure all the equipment in a good condition. There is various type of inspection, but the most common is by using vision system. The inspection using this system also could lead to an error later. By doing this project, the error in measurement will be discussed. The image will be captured by using a camera. To observe the differences, the image will be captured within a different range. The range would be 5 cm, 10 cm, 15 cm, 20 cm and also 25 cm. All the error will be analysed until the output of error will be a significant error for inspection.

DEDICATION

First of all thank you Allah S.W.T for making me able to finish this project.
My biggest thanks is to the special persons in my life, my father, Mr.Abdul Razak
Bin Hj Mohamed and my mother Mrs.Faridah Binti Hj Mohd Tahir.

ACKNOWLEDGEMENT

I would like to express my gratitude to my supervisor, Mr.Khairul Anuar bin A.Rahman for all the knowledge and assisting me to finish this project. I also would like to thank you to my lectures in Fakulti Teknologi Kejuruteraan (FTK), my classmates and also my friends. I would gladly thanking both of my parents for giving me encourage and will to finish this project. I would also gratitude this thanks to my sister and also the families for all the support and help for me finishing this project. Biggest thanks to my friends, especially my BETE Kohort 3 classmate for all the help and knowledge for me.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

mm – Milimeter

cm – Centimeter

CCD – Charge Couple Device

CMOS – Complementary Metal Oxide Semiconductor

Dpi – Dots per Inch

MP – MegaPixels

CCM - Coordinate Measurement Machine

Ppi – Pixels per inch

DSP – Digital signal processing

HDR – High Definition Resolution

CHAPTER 1
INTRODUCTION

1.0   Introduction

This chapter provides an overview of the measurement error in vision system. The problem background and problem statement are described next. This is followed by research objectives and scope of the study involving the type of error in measurement. It will be focused on error related to vision system that could lead a less accurate inspection.

1.1   Background of Study

Inspection is one of the procedures in works related to accuracy and also measurements. There are various type of way to inspect some materials including using manual way or by using some optical method. Basically vision system could detect any misalignment of the product or materials, the corrosion and also the size of it. These types of inspection really need an accuracy reading and almost no-error result. But by using human vision, the error could occur and affect the accuracy result. Thus, this project is aiming on the error that could appear in measurement by using vision system. Other than naked eye error, this project also focusing to analyses the error by using the equipment like different type of camera and also different type of range from camera to object to decreasing an error.

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1.2   Problem Statement

The project ideas come up after some observation regarding to inspection. The multiple problems have been found especially the measurement error. This is because, the measurement taken are using human vision system. It could lead to misreading and also lack of accuracy. The inspection by human also could take some time and the workers will do the inspection in rush. The effect of this action is lack of accuracy and also wasting some time for some inspection. The result of this inspection are also different because the multiple ways on taking the measurement reading.

1.3   Objectives

a) To detect error in image taken by various camera
b) To compared the captured images using the different range
c) To observe the range that suitable for inspection and reduce an error

1.4   Scope

The scopes for this project are to detect the error in inspection in vision system by using MATLAB. For this project, the captured images by two types of camera which is need to be compared with the exact reading of the object to find the error. This process then repeated by using the different range of the camera which is 5cm, 10cm, 15cm, 20cm and 25cm. The entire image will be captured between these ranges to get the comparison. All the related measurement error that occurred in vision system will be observed. Then, the error will be analyzed to find any solution to reduce it.

1.5   Summary

This report is consists with 5 chapters. Chapter 1 were including the overview of measurement error introduction of this project, research background, problem statement, objective and scope of the study based on the research of measurement

error. Chapter 2 provides a literature review based on everything related to measurement error and also vision system. The topics related on the type of error, inspection by using vision system, and also general topics of image processing. Chapter 3 shows a methodology of this research in detail to achieve the objectives successfully. It consist a flowchart of this project and all the details information from chapter 2. Chapter 4 will be the result and analysis of this project. Chapter 5 is the last chapter as it will conclude this project along with the recommendation for improving this project.

CHAPTER 2
LITERATURE REVIEW

2.0   Introduction

This literature review is the summarization works related on the research on measurement error in vision system. Most of the information related is taken from journal, books, article, and also the relevant website. The background and definition of image processing, measurement, error and also vision system will be covered in this chapter. It also will summarize the usability of the hardware and research information that important to this project. Other than that, this chapter will discussed and summarize some past related research done with measurement error as well as inspection in vision system.

2.1   Image Processing

Basavaprasad B, Ravi M (2014) stated that image processing is a method of transforming the image into a digital type and performs some actions on it. This process is important to get an upgraded pictures/images and collecting some useful data from it. The mathematically type of image processing can be determined with the process of two dimensional image by the computer. The result of the image processing can be either the picture, or characteristics or even the quality equivalent to the image itself.

Image processing can be described as digital image processing. This digital image then has been through the process to digitize the image. This process is to ensure the image is digitized form. It is because the processing images need the images to be in that type. The first step of this process is the image need to be transformed to an analogue sign then been sweep to the output. The image processing is nearly attached to the vision and also graphics of the computer. There are various types of the applications such as image enhancement, restoration, compression, character recognition, and also signature verification.

Huiyu Zhou, Jiahua Wu and all (2010) purpose that applied computer algorithm is a process of the technology in digital image processing. This process outcome will be images and also the properties of the original images. Basically, the digital image processing has been applied in robotics system, remote control sensing, photography, medical imaging and also forensics field.

The red, green and blue values are the colourful images that give the almost exactly information in dimensional compared to grey colour. These three colours is the basic colour to produce the colour in the real world. Image processing is a way for human to get the high quality level of image of the specific characteristic from the original images. Subsequent process is the process of removing the object from background. It has 3 level which is low level, mid-level and also high level. Low level example is the image enhancement which is a process equivalent to the primitive operation. The mid-level is a process involving the image division and also objects categorization. The last one is the high level which is the process that is considered to find definite thing that compatible with the pre-requisite mark.

2.2   Vision System

There are huge difference occurred between the picture that been captured and the image that been seen by human eye. This human vision system can defined the image that can be process with computer. Human vision systems are divided into two

parts which is the eye and also the brain. The eye works as a camera while the brain would process all the image processing.

Different people would have different type of image process by the brain. It is because human eye are not same with each other. This is why; the error could occur when doing some inspection by using naked eye. Human visual system contains the eye that work like an image sensor or camera, an optic nerve that will work like a transmission line and also the brain that will process the entire image like a computer.

Wei Huang, Radovan K (2011) proposed that there are laser based visions systems that are used for welding process. Welding is a complicated process where the quality of the weld could be influenced by various types of parameters especially the final weld. Thus, to inspect whether the weld quality this type of vision system are been used. This type of inspection was created on the principle of laser triangulations. From this process, the geometrical characteristics of the weld can be acquired.

Thus, the human vision system focusing on human naked eye for inspection and also images processing while the laser based vision system are suitable for welding process that can't be watch directly using human vision system. Other than these two types, there is another one type of vision system which is machine vision system.

M.Jalili, H.Dehgan and friend (2013) mentioned that machine vision system is the modern type of inspection to examine the product. In industrial field especially on production area, the dimensional inspection is one of the important things. This type of vision system is quite expensive compared to others and it also faces some difficulty with dimensional inspection. For production process, human vision is not a suitable type of quality control.

There are limitations such as the time taken, expensive wage, and also could perform some error. Thus, the semi-automatic tools like Coordinate Measurement Machine (CCM) is been used. This CCM can inspect and measured the dimension with pointing the probe at some point. CCM might be precise but it still need human energy to ensure it inspect totally true. Human need to move the start point and it can't move

by itself. This CCM is also having weakness with limitations of moving and also the heavy parts near CCM.

2.3   Measurement Error

Michael K (2010) proposed that error in measurement is not a mistakes but it is must in every type of related to measurement. The data taken is needed to be compared, so any error in measurement could be observed.

Zhou W, Alan C, Bovik and all (2010) stated that digital images can produce an error during acquisition, processing, compressing, transmitting and also when store the image. All if this error could lead to a disturbance of image quality. The objective image quality metric are important because it can be used to monitoring and adjusting the image quality.

Basically, on human understanding about error is something that has been wrong. But, in science world, 'error' gives the meaning of uncertainty that come with every measurement. There is no measurement that would be a perfect measurement even when something is carefully measured. The way to prevent is by trying to make less error and make it as small as possible. By observing error in science field, it is important to handle and interpret the data and results. This is including the type of measurement applied, the method of testing and finding out the error and also the correct way to handle the error. There are two major types of error which is precision and accuracy. Precision usually will be related to random error while the accuracy is a specific and systematic error especially in calibration.

There are three main sources of the error which is reading error, random error and also systematic error. Reading error is the error that occurred by when using some kind of measuring equipment and also time measurement. The equipment with scale such as a ruler, analogue voltmeter callipers had been used to measure. Not only analogue equipment, the one with digital display also could lead to the error such as digital multi-meter and such. There is also error that involving with time. Not only the error when reading the time but also the error that will happen when someone starts or

stop the watch to take the time. Next is random error. This random error is referring to the value that randomly spreading from one measurement to next that caused by random fluctuations in measured value.

The precision of the experiment would be affected with this type of error. Lastly is the systematic error. This systematic error is the error that will occur in every measurement from a given quantity. It could be caused by some part of the experiment, some error in calibrating and also flawed when measuring some equipment or instrument. Different from random error, this systematic error will affect the accuracy in measurement. This type of error is hard to detect because the source of error are hard to found.

F.C Campbell (2013) mentioned that calibration is one of important things that related to measurement. If the calibration is wrong or not been done well, all the measurement later could be wrong too. This will affect all the production if it had been used in industry. The measurement error that been traced using human vision then need to be inspect and solve the error. There are some disturbance that often unnoticed, such as the humidity, air pressure and also temperature. The people who need to do the inspection should aware of this condition so the source of error can be found.

2.4   Inspection by Using Vision System

Judi E. See (2012) stated that visual inspection is also important in industries. This is because all the production done will be examined by for the quality control.

The product will be decided after it been inspect visually either it will be sent back to manufacturer after detecting some error or it will be delivered to the customer if it come out with no error. Some of the modern production will be criticize the inspection because of the unproductive type of inspection. But with the vision of zero-error type of manufacturing, both inspection and quality control are started from the beginning not only started at the end of the process. It clearly increase the manufacturing this recent years.

Jean Watson (2012) mentioned that majority of the inspection for the aircraft structures are using visual inspection. Not only for aircraft, had the power plants also used the visual type of inspection. Inspection is not a perfect including the visual inspection. It will be some error especially with human vision.

The usage of automated devices also will not guarantee the perfect inspection. Basically, visual inspection is the method to inspect with naked eye and also supported by various equipment such as sensing mechanism. The visual inspection is a decent method used in aircraft maintenance that can reveal an assorted type of disruptions. The basic inspections by using human eye are to test the large area of the aircraft build.

The inspections that need a supported aid especially optical aided are for a small part or area of the aircraft. This inspection as also includes the usage of magnifiers and bore-scopes as an aided. There are four type of level in visual inspection in aircraft and also large scale of equipment which is walk around, general, detailed and special detail. For walk around level, the inspection is a basic check that only observed generally to check any error from ground level and also ensure the general condition and safety. Second is general level. This level is focusing on detecting the damage, error, failure and a not good condition.

It will be done through the openings and hatch of the exterior and also the interior. The third one is the detailed visual inspection. This level of inspection is an absolute visual check through the definite area or system to determine the defect failure or even the inconsistency. The inspection aids also should be used in this level.

There are also some procedure needs to be followed especially on surface preparation and also elaborate access. The last one is special detailed level. This special detailed inspection is a thoroughly examination on a particular equipment, installation to determine the failure, damage and also the inconsistency. It will be applied with a specialized aid and also method. For this level, the equipment might need to be detached and also cleaning process may be compulsory.