



**The Measurement of Human Face Characteristic Using Image Processing
Technique for The Anthropometric Database**

This report is submitted in accordance with requirement of the University Teknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Hons.)



by

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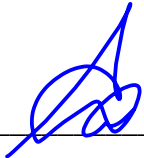
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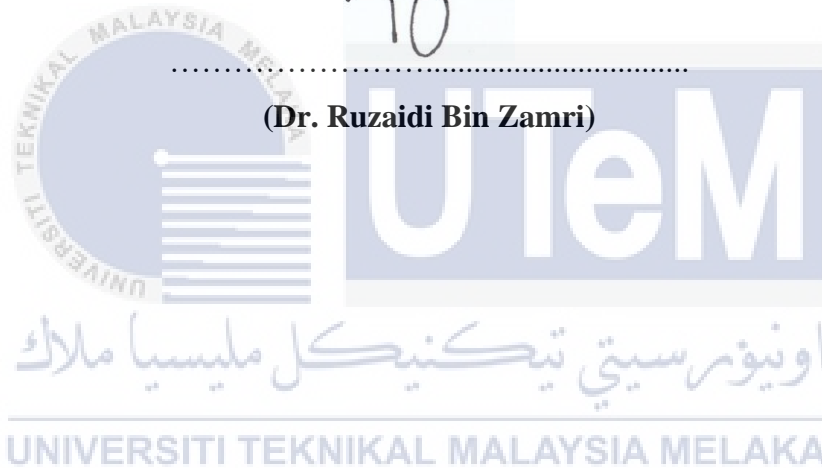


APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirement for Degree of Manufacturing Engineering (Hons). The member of the supervisory committee is as follow:



(Dr. Ruzaidi Bin Zamri)



ABSTRAK

Pengukuran telah digunakan secara meluas dalam banyak industri seperti pertanian, perubatan, pembinaan dan pakaian sejak pengukuran manual dicipta. Dalam pembuatan, ketepatan yang tinggi dan dimensi yang tepat diperlukan untuk menghasilkan produk. Walau bagaimanapun, pengukuran manual tidak memenuhi keperluan kerana ketepatannya yang rendah. Oleh kerana permintaan yang tinggi dalam ketepatan dan masa yang lebih pendek yang diambil dalam era moden, terdapat banyak penyelidikan dan kajian telah dilakukan dalam mengemaskini pangkalan data semasa. Pengukuran manual digantikan secara beransur-ansur dengan kaedah pengukuran yang lebih maju seperti pengukuran penglihatan pada masa kini. Dalam industri pembuatan, data antropometrik adalah penting untuk mereka mereka bentuk produk ergonomik. Ini kerana penggunaannya melebar dalam industri ketenteraan dan pakaian. Oleh itu, objektif utama projek ini adalah untuk membangunkan sistem pengukuran visi untuk mengukur ciri-ciri wajah manusia. Gabungan perkakasan dan sistem perisian boleh mengautomatiskan proses pengukuran ciri-ciri wajah manusia.

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ABSTRACT

Measuring has been widely used in many industries such as agricultural, medical, construction and apparel since the origin of manual measurement. In manufacturing, high accuracy and precise dimension are required to produce the product. However, manual measurement is not fulfilling the requirement because of its low accuracy. Because of the high demand in accuracy and shorter time taken in modern era, there are many research and study has been done in updating the current database. Manual measurement gradually replaced by advance measuring method such as vision measurement in nowadays. In manufacturing industry, the anthropometric data is essential to design ergonomic product. This is because its usage widened in military and apparel industry. Thus, the main objective of this project is to develop a vision measurement system to measure human face characteristic. The combination of hardware and software system can automate the measuring process of human face characteristic. Hardware system consists of camera, a controller and a laptop while software system refer to the programming developing system. Generally, the code the coding for the well-developed vision measurement system will not reveal. Besides, the python programming language will be used for demonstration in this research project.

DEDICATION

TO MY FAMILY,

Leong Chee Keong, Leong Pui Ting, Leong Chun How, Tai Sam Thai and all of my family members.

For their supports and love throughout my life

TO MY HONOURED SUPERVISOR,

Dr. Ruzaidi Bin Zamri

For his advice, support, motivation, patience, and care throughout this project

Thank you so much.



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LIST OF ABBREVIATIONS

BC	-	Before Christ
OpenCV	-	Open-source computer version
UAV	-	Unmanned Aerial Vehicle
BSD	-	Berkeley Software Distribution
CT	-	Computed Tomography
MRI	-	Magnetic resonance imaging
GMM	-	Generalized Method of Moments
2D	-	2-Dimensional
3D	-	3-Dimensional
FYP	-	Final year project
IEEE	-	Institute of electrical and electronics engineers
SD	-	Secure digital
HDMI	-	High-definition multimedia interface
USB	-	Universal serial bus
Wi-fi	-	Wireless fidelity
OS	-	Operating system
SL	-	Single language
HDD	-	Hard disk drive
CPU	-	Central processing unit
RAM	-	Random access memory
LAN	-	Local area network
FHD	-	Full High Definition
SL	-	Single language
BLE	-	Bluetooth low energy
LED	-	Light emitting diode

STD	-	Standard deviation
LOA	-	Limit of agreement
BOM	-	Bill of material
ECM	-	Environmental conscious manufacturing
LLL	-	Long life learning
BE	-	Basic Entrepreneurship



CHAPTER 1

INTRODUCTION

The introduction of this project means to elaborate the main idea of the project. This chapter explains the significant of the study in image processing technique. It introduces the title, background, problem statement, objective, the significance, and the scope that are going to be focused on this final year project.

1.1 Background of Project

Measurement systems are used to measure parameter or characteristic of an object. The parameter or characteristic includes dimension, value, and shape of an object. It is wide used in many industries such as manufacturing, construction, engineering, medical and apparel. Measuring was created in 3rd millennium BC. At that time, lifestyle of human began to change from as groups formed permanent settlements and tended crops. Also, the “Barter System”, a system which use money note for trading has been used to replace the exchange system. The moderate change in trading system all around the world has stimulated the growth of measurement system to a more precise and increasingly diverse set of fields. The first measurement method created during the Egyptians time when Royal Cubit (Figure 1.1) was use as today’s length measurement. Nowadays, the science of measurement term is called metrology. It establishes the common unit which are closely related to human activities. Those common units are diameter, length and volume. In metric, the SI units of length is meter and can be convert to millimetre, centimetre and even English unit, inch.

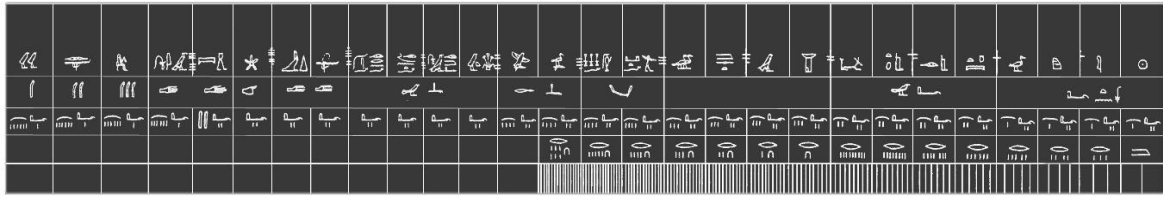


Figure 1.1 shows Royal Cubit.

To investigate a various of human's aspects in the present and past societies, an anthropologist studies the practice of anthropology. Human body measurement is collected to update the anthropometric data. The data is useful in various industries such as apparel, manufacturing and academic research.

The technology nowadays is growing very fast, the manual measurement is no longer preferred and replaced by vision measurement. Two-dimensional (2D) photogrammetry was served as the primary sources for craniofacial measurement data to cover the inaccuracy of direct anthropometry and it was then transformed to three-dimensional (3D) imaging technique such as laser surface scanner and stereo photogrammetry for craniofacial investigation (Weinberg et al., 2004). Vision sensing and image processing combined with machine visual identification technology has been widely used in automation industry because of its fast speed and high accuracy (Min, 2015). To use algorithm to measure the parameters of an object, the hardware system must consist of computer and camera module. The computer used to transfer an image or video from the camera and then using algorithms to measure the subject parameter or track the motion of an object in the image. Real time effect measurement can be made with the method of photogrammetry and digital image processing.

Jing Min mentioned that a new detection technology using machine vision can replace traditional techniques of measurement (Min, 2015). Currently, vision measurement is the most effective method to measure the parameters of an object in automation industry due to its shortest time taken and high accuracy. It is very useful in anthropometric and clinical categories. For example, digital image processing technique used to measure the torsion from eye multitemporal based on the eye image.

1.2 Problem Statement

The method of measuring 3 selective parts of human face, which are width of human face, distance from tips of forehead to chin and the distances between eyebrows is still using Vernier calliper (Figure 1.2) or digital calliper (Figure 1.3). It is not surprised that every single measurement is subject to uncertainty (Fruggiero et al., 2017). There are many types of errors occurred proven by previous research stated that direct measurement is not reliable. According to the authors of Fundamentals of Dimensional Metrology book, calliper is difficult to follow Abbe's Law to achieve high accuracy because there are always errors (Hannaford, n.d.). Errors appears with the reason of the untreated experimental measuring apparatus intervals (Krechmer, 2018). In measurement, risk of human error is associated with operator error which includes physical and mental stress state that led to observational error and wrong formal procedures as well as response options (Fruggiero et al., 2017). Reading the calliper requires good eyesight and skill to avoid misreading (Hannaford, n.d.). The manufacturers can only manipulate the error to minimum, but they cannot eliminate the error.



Figure 1.2: Vernier caliper.

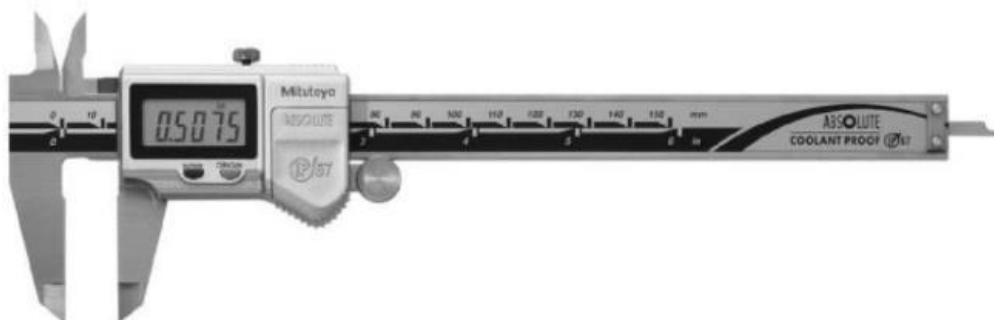


Figure 1.3: Digital Vernier caliper.

Besides, proceeding a measurement using calliper is very time consuming. The low accuracy and long-time taken are the reason why the manual measurement system needs to be improved in 21st Century. Therefore, that is a need to demonstrate automation in measurement.

1.3 Objective

1. To develop an image processing coding for human face using python computer language.
2. To compare vision sensor measurement method with manual measurement method in term of time consumption and accuracy.

1.4 Scope of research

The image processing technique using python is the scope of this study. To develop an algorithm that can measure human face characteristic, python is one of the most suitable computer programming language. OpenCV library is one that will be using the most frequently.

This research focuses on vision sensor measurement of the width of human face, distance from tips of forehead to chin and the distances between eyebrows. This research on human body measurement can contribute towards the ergonomics and anthropometric especially in collecting human body measurement data.

All the data measurement are taken from Malaysian of different race and gender, aged 18-30. The data measurement collected for analysis and comparison between vision sensor measurement and manual measurement.

1.5 Significant of study

The algorithm can measure human face in a few seconds and the measurements are taken accurately. By using the programmed algorithm, the data of measurement can be stored in hard disk and uploaded on Anthropometric Database. All those advantages can strengthen the shortage manual measurement method in term of accuracy and time consumption.

The system can also be used to enable automated image processing capabilities. Through machine learning and Big Data analytics, the designer can recognize the standard sizing of certain group of user.

1.6 Summary

This research consists of 2 parts which are background of study in research and output. The background of study in research is written in chapter 1,2,3 while output result and analysis are written in chapter 4 and 5.

The first part focus on investigates and looking for previous similar research or information to generate the idea on how to construct system workflow. It is a continuous process. All that information is extracted from journal paper, newspaper and book which are recognized in the standard. Purpose of carried out this thesis can be justified with a strong solving method and the scope of thesis can be figured out. In Chapter 1, the background, problem statement, objective and scope and significant of study are discussed. The chapter 2 is Literature review. The previous research on how to similar problem has been dig out used as reference. Methodology which illustrates the procedure of thesis in the form of workflow and Gantt chart.

The second part discuss the raw Malaysian sample result obtain using two different method, vision sensor measurement and manual measurement. The result will be analyzed and compared before make conclusion. There will be 50 samples data measurement of human face characteristic will be collected. In Chapter 4, Result and Discussion explains the result obtained with description, graphs and pictures are attached. In Chapter 5, Conclusion

and Recommendation outline the result of the research and conclude this research with some valuable recommendation to support future research.



CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will be discussed about this final year project title from past research and studies. It will then elaborate and analyses the findings and information regarding this project to gain more understanding and constructing the methodology.

2.2 Digital Image Processing Technique

Digital image processing uses computer algorithm to perform image processing on images to improve the quality of the image by removing noise and other unwanted pixels and to obtain more information on the image. There are fundamental steps in digital image processing. These steps are image acquisition, image enhancement, image restoration, Colour image processing, wavelets and multi resolution processing, compression, morphological processing, segmentation, representation and description, object recognition (Yogamangalam & Karthikeyan, 2013). A study shows these methods can shorten the time taken (Sarikan et al., 2017).

The acquisition of digital images can be obtained by fracture imager, digital camera, UAV (unmanned aerial vehicle) and smartphone. The hardware function of popular smartphone has been able to meet the digital image acquisition. But most of the equipment, such as fracture imager, digital camera, UAV, has not the complete network communication function, and no appropriate on-line quality monitoring methods (Ni et al., 2020).

Segmentation is the first step to carry out object measurement in the image. It is also defined as the primary important step of low-level vision (Tolias & Panas, 1993).