



**ANTHROPOMETRY OF UTeM FKP MALE STUDENTS:
COMPARISON USING MOTION CAPTURE CAMERA AND
TRADITIONAL ANTHROPOMETRIC METHOD**

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

by

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2017

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: ANTHROPOMETRY OF UTeM FKP MALE STUDENTS: COMPARISON USING MOTION CAPTURE CAMERA AND TRADITIONAL ANTHROPOMETRIC METHOD

SESI PENGAJIAN: 2016/17 Semester 2

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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 (Engineering Management) (Hons). The members of the supervisory committee are as follow:

.....
(DR. NADIAH BINTI AHMAD)

ABSTRAK

Kajian antropometri merupakan salah satu cabang tertua dalam pengajian ergonomik dimana tujuannya adalah untuk mengkaji tentang saiz tubuh badan manusia. Antara kaedah yang biasa digunakan dalam proses pengukuran ialah dengan cara manual ataupun dikenali sebagai antropometri tradisional. Jika dibandingkan dengan negara Asia yang lain, Malaysia masih ketinggalan dalam membangunkan pengkalan data antropometri negara sendiri. Para penyelidik di Malaysia juga masih lagi bergantung pada pengukuran antropometri tradisional. Terdapat banyak faktor penting yang menyumbang masalah dalam antropometri tradisional antaranya ialah pengenalan tempat penandaan, kedudukan alat, dan sentuhan tekanan yang diberikan oleh alat pengukuran semasa proses pengukuran. Oleh sebab yang demikian, adalah penting bagi penulis mencadangkan teknik pengukuran yang kurang megenakan tekanan sentuhan terhadap responden. Matlamat kajian ini adalah untuk memperkenalkan kaedah baru bagi tujuan mengukur antropometri iaitu dengan menggunakan kamera pengesan pergerakan sekaligus membangunkan pengkalann data antropometri untuk pelajar lelaki FKP, UTeM. Kesahihan data yang diperoleh kamera pengesan pergerakan haruslah diperiksa sama ada ia mencapai piawai yang ditetapkan oleh kaedah pengukuran tradisional. Adalah menjadi keperluan untuk mengetahui tahap dan keupayaan kamera pengesan pergerakan sebelum memutuskan bahagian tubuh mana yang boleh dan mampu diukur. Banyak bacaan dan rujukan telah dibuat oleh penulis bagi mendalami bidang antropometri dan juga sedikit sebanyak tentang kamera pengesan pergerakan. Pengkalan data antropometri yang berjaya dibangunkan boleh digunakan dalam mengurangkan ketidak sepadanan data antara pelajar dan juga persekitaran pembelajaran mereka.

ABSTRACT

Anthropometric study is one of the oldest branch of study in ergonomics where it serves a purpose in study of proportion and size for human body. One of the common method used in anthropometric measurement is traditional measurement or direct measurement. However, Malaysia is still behind compared to other Asian country in development of national anthropometric database. In addition, researchers in Malaysia are still rely in traditional anthropometric measurement. There are several important factor that contribute to problem in traditional anthropometric such posture, identification of landmarks, instrument position and orientations, and pressure exerted due to measuring equipment. In view of the fact that the difficulties of obtaining human anthropometry, it becomes necessary to propose method which has less contact perform on respondent. This study aims to propose new anthropometric measurement method using motion capture camera method, hence develop database for UTeM FKP male population. Validity and reliability of data obtain from the motion capture camera need to be check whether it achieve the ‘gold standard’ set by traditional anthropometric measurement. It is important to know the capability of the motion capture camera before deciding on human body dimension that need to be measured. Lot of referencing from the literature review has been made referred to help author to understand more on anthropometric and motion capture camera. Anthropometric data for UTeM FKP male students that has successfully been constructed can be utilized to eliminate or minimize mismatch between student and their study environments.

DEDICATION

To my beloved family member
my beloved father, Zainuddin Bin Abdul Majid
my appreciated mother, Che Kamariah Binti Dolah
and my adored sisters Nur Fatimah Binti Zainuddin and Nur Farahana Binti
Zainuddin
for giving me moral support, money, cooperation, encouragement and also
understanding along this project.

Thank You So Much and Love You All Forever

ACKNOWLEDGEMENT

"In the name of Allah, Most Gracious, Most Merciful"

First of all, I would like express my gratefulness to Allah SWT because of his grace and merciful, I have managed to complete my final year project successfully without difficulty.

I would like to thank you my supervisor Dr Nadiah Binti Ahmad for her guide and time that she had spent with me. Not to forget Dr Seri Rahayu Binti Kamat and Madam Ruzy Haryati Binti Hambali as lecturers that help me a lot to complete this project. I believed that I could not accomplish this final year project successfully without their guidance and help.

On the other hand, I also need to thanks my family members especially my father, Zainuddin Bin Abdul Majid and my mother, Che Kamariah Binti Dollah giving me encouragements and supports. These motivations have driven me through a lot of hardships all times. Need to be mention, I want to thank you all of my friends that help me a lot in this project.

Finally, I would like to thank all respondents and everybody who was contribute to this final year project report, as well as expressing my apology that I could not mention personally each one of you.

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LIST OF ABBREVIATIONS

1D	-	One Dimensional
2D	-	Two Dimensional
3D	-	Three Dimensional
4D	-	Four Dimensional
CAD	-	Computer Aided Design
CAM	-	Computer Aided Manufacturing
FKP	-	Fakulti Kejuruteraan Pembuatan
MAD	-	Mean Absolute Deviation
MCC	-	Motion Capture Camera
REM	-	Relative Error Magnitude
TA	-	Traditional Anthropometric
UTeM	-	Universiti Teknikal Malaysia Melaka

CHAPTER 1

INTRODUCTION

This chapter gives a brief introduction to the project background based on anthropometry measures for FKP male students using motion capture camera method and developing anthropometric database for UTeM FKP male students. In addition, the problem statement, the aims and objectives of the study, the research scope, rationale of the project as well as the thesis organization are also presented in this chapter.

1.1 Project Background

Malaysia is one of multicultural country located at the South East Asia. It has known as the fast growth economy competing with its neighbours Indonesia, Singapore, Thailand and Brunei. Based on the statistic provided by Department of Statistics Malaysia (2016) stated that the current population of Malaysia is 31 million. With the current number of population, it is important for a developed country like Malaysia to have its own anthropometric database for its own people. Anthropometry measures are measurement of human body. It is measurement for of each visible part of human body from head to toe. Anthropometric data continues to be treated as the very basic core of ergonomics in an effort to resolve the challenges of fitting people to machine (Mohamad *et al.*, 2013; Wang *et al.*, 1999). It can be used in ergonomics to specify the physical dimensions of workspaces, workstations, and equipment as well as applied to product design. Meanwhile, ergonomics is analysis or study of people along with their relationship utilizing environment close to them (Ryan, 2007). Simple

analogy can be used to represent the function of anthropometric toward ergonomics. For example, a chair with the dimension that fit the user anthropometric data such the popliteal height can be considered an ergonomic chair. Anthropometric data upon the whole population is important in ergonomics to specify the physical measurements of workstation, tool, equipment, outfit and furniture to match the person and also to prevent physical mismatch involving the dimensions of compartment or equipment with the appropriate user dimensions. It is undeniable that all industry from primary, manufacturing and service industry will get the beneficial from ergonomic study. Unfortunately, there is insufficient written documents of Malaysian anthropometric data (Hassan *et al.*, 2015). In addition, the lack of Malaysian anthropometry database lead to a problem where no complete Malaysian adult can be referred and need to rely on data from other Asian country such Japan and Korea where this might lead to slight differences between actual size of Malaysian population (Karmegam *et al.*, 2011) In attain a proper databases of anthropometry of Malaysian, researches had been done with common use of method which by traditional anthropometric approach. By far, there is no documentation for highly sophisticated method such as camera, motion camera, 3D scanner and other computer mechanism used for Malaysian human measurement whilst there is a rising passion for overcoming the constraints of direct anthropometry via the use of computer based technique (Julielynn *et al.*, 2008). Thus, to fully exploit this potential, the anthropometry measures using motion capture camera has been used in order to determine the comparison of validity and reliability of data obtained using traditional and motion capture camera method. Therefore, this research aims to compare the validity and reliability of motion capture camera and the traditional anthropometric as well to construct the anthropometry databases of FKP male students using motion capture camera method.

1.2 Problem Statement

From the literature reviews and previous study, several researches has been done on anthropometric data around the globe. For Asian country like China and Japan had took a lead in the anthropometric study where large number of respondent is used

in their study which more than 10,000 people (Mohamad *et al.*, 2013). Apart from it, south East Asia country like Singapore, Indonesia, Philippine and Thailand had made their own research for the anthropometric data for their own population (Chuan *et al.*, 2010; Klamklay *et al.*, 2008; Del Prado-Lu, 2007). It is important to know that even the anthropometric data collected is within the Asian population itself has significant different between the certain body parts measured (Lin *et al.*, 2004). In Malaysia, there is limited amount of anthropometric data for Malaysian population especially among the young adults' population and children (Karmegam *et al.*, 2011). Lack of these data will contribute to other problems that relate to human and machine intervention, lower productivity, fatigue, accident, discomfort and biomechanical stress are common effect of mismatch between human body dimension and machine or equipment dimensions (Mandahawi *et al.*, 2008). In the context of learning environment or institution, researchers around the world suggested the necessity of ergonomically designed school furniture to suit student needs in order to ensure comfort (Biswas *et al.*, 2014; Panagiotopoulou *et al.*, 2004; Hubbard & Ph, 1999). Recent study from local universities also show that there are several mismatch between the anthropometric measure among student and furniture provided in classroom (Aminian & Romli, 2012). Hence, it is important for UTeM as a public university to have its own anthropometric data for their students.

Traditional or manual anthropometric measurement has been used since 1870 where the early aim is to find measurement of average man (Simmons & Istook, 2003). Nowadays, there are lot of another method available for anthropometric study such photography, body scanning and linear dimension method (Johansson & Åström, 2004). In Malaysia, most of researcher are depending on traditional anthropometric measurement. Only few that rely on photographic method such used of anthropometric grid (Hassan *et al.*, 2015). Figure 1.1 show statistic on method used by previous researcher on their study.

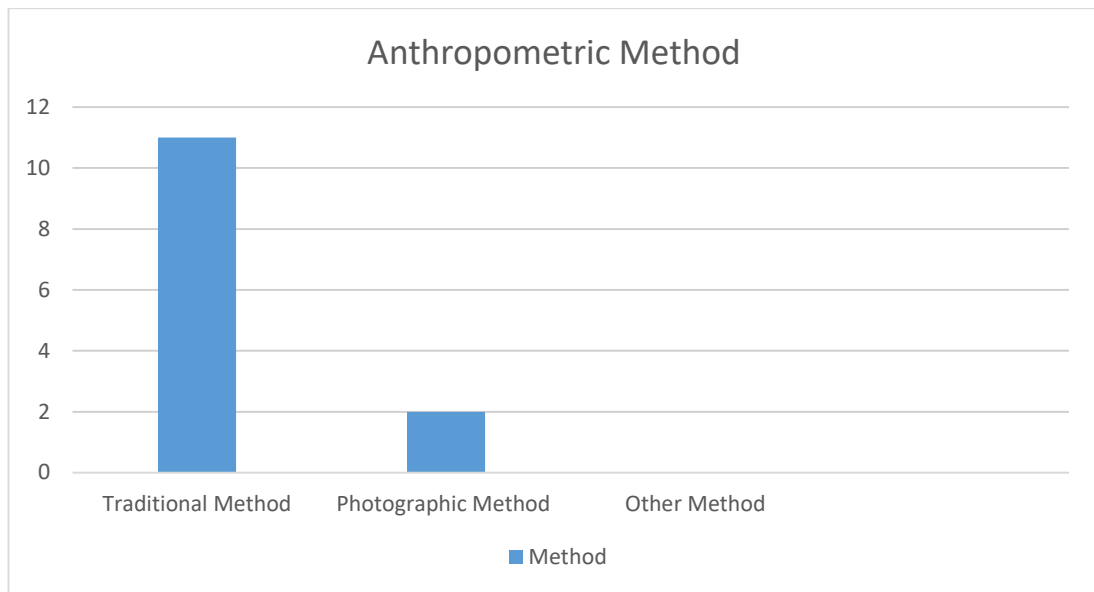


Figure 1.1: Graph of previous study done with comparison of method used by the researcher. (Hassan *et al.*, 2015) (Dawal *et al.*, 2012) (Karmegam *et al.*, 2011) (M.Y *et al.*, 2009) (Karmegam *et al.*, 2011) (Mohamad *et al.*, 2016) (A.Suhaila, 2014) (Rashid *et al.*, 2008) (Mohamad *et al.*, 2013) (Nazif *et al.*, 2011) (Azuan *et al.*, 2010) (Moy *et al.*, 2015) (Rashid *et al.*, 2008).

By referring to Figure 1.1, only 2 researchers out of 13 researchers used photographic method while others still rely on traditional anthropometric. Beside of this two methods, there are no other method has been documented in Malaysia. It is such a well-known undeniable fact that the effective use of computer mechanism may result in much more accurate result (Mohamad *et al.*, 2013). However, these computer mechanism method namely linear dimension and body scanning are still unavailable or not being documented in Malaysia. Moreover, many factors get involved in play while in the measurement of human subjects, which can lead to the emergence of various forms of error. Several of the important sources include posture, identification of landmarks, instrument position and orientations, and pressure exerted due to measuring equipment (Amro, 2012). As a result of the difficulties of obtaining human anthropometry, it becomes necessary to propose method that has less contact perform on respondent. Hence, this research intends to propose a method using motion capture camera while comparing and evaluate the validity and reliability of motion capture camera method over the traditional measurement method. The outcome of this study is a useful input that will assist designer and administration in designing and choosing

specifically fit products and equipment to use on the UTeM young adult population in the framework of ergonomically designed human-machine interaction.

1.3 Objectives

The objectives of this research study are:

- a. To identify and study the anthropometric body dimension suitable for motion capture camera method.
- b. To compare the validity and reliability of data obtained from motion capture camera and traditional anthropometric.
- c. To measure the anthropometric using motion capture camera.
- d. To develop the database of anthropometric for male FKP UTeM population.

1.4 Scope of the Project

This study mainly focuses on validity and reliability of data obtain from motion capture camera method and measurement of anthropometry data of male FKP UTeM population where 50 human body measurements will be taken for 60 respondents. It is to be note that samples chosen is sample of convenience. Due to financial constraints and necessary resources had limited participation from bigger number of young population. Despite that fact required to state that the chosen participants include of 3 main ethnics. However, as consequences of lack relationship between anthropometry and number of ethnics differences in Malaysia and other issue like ethical issue caused this research is mainly concentrate on male gender only. Participant for this study will be randomly selected from student in Fakulti Kejuruteraan Pembuatan (FKP) at Universiti Teknikal Malaysia Melaka (UTeM) in Melaka, Malaysia. To represent young adult population age range of respondent will be in between 20 to 25 years old. Due to the sample is sample of convenience and sample chosen will represent male FKP UTeM population. As being mention before two methods will be used in this

research, which is traditional anthropometric and motion capture camera method to take the measurements and undergone validity and reliability test. Tools used in traditional anthropometric method consist of a large Anthropometer set, small Anthropometer set, set of Myotape Body Tape Measure, standard measuring tape, and anthropometric survey form. The survey form will contain some basic information of the respondent such name, age, height and weight. For motion capture camera method, 3 set of Vicon motion capture camera, 1 calibration stick, markers, calibration stick and computer needed to complete the measurement process. All participants are required to wear light clothing when the measurement is taken. All measurement will be taken in Ergonomics Lab located at Fakulti Kejuruteraan Pembuatan in UTeM.

1.5 Rational of the research

Validated data extracted from the camera motion capture can be used for further anthropometric study. Once the data has been confirming valid and reliable, thus this method has been trust to take measurement of the anthropometric. Anthropometric data that has been collected can be used to eliminate or minimize mismatch that occur between student and study environment. A suitable matching of machine requirements with the human capabilities is basically vital for optimum performance of almost any human-machine systems. Consequently, all designers should incorporate the anthropometry awareness in the design to prevent long term health problem onto the user in order to ensure comfort and safety.

1.6 Planning and Execution

In this project, Gantt chart is constructed to list all the related task and reallocate time to finish the respective task from the beginning until the end of the project including dated of report submission. This project schedule is presented in Appendix A.