THREE-DIMENSIONAL ANTHROPOMETRY STUDY WITH 3D CAS AND CATIA SOFTWARE MEASUREMENT ON HUMAN'S HEAD

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in fulfilment of the requirements for the degree of
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DECLARATION

I declare that this Choose an item. entitled "THREE-DIMENSIONAL ANTHROPOMETRY STUDY WITH 3D CAS AND CATIA SOFTWARE MEASUREMENT ON HUMAN HEAD" is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Date : **18 JANUARY 2022**

APPROVAL

I hereby declare that I have checked this thesis and, in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Manufacturing Engineering Technology with Honours.

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DEDICATION

I dedicate this project to God Almighty my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding. He has been the source of my strength throughout this program and on His wings only have I soared. I also dedicate this work to my father, Mother and my supervisor who has encouraged me all the way and whose encouragement has made sure that I give it all it takes to finish that which I have started. To my friends who have been affected in every way possible by this quest. Thank you. My love for you all can never be quantified. God bless you.

ABSTRACT

Anthropometrics is the study of the human body's measurements. Traditionally, this has been done by using simple equipment like tape measure or callipers to take measurement on the body surface, such as circumferences and widths. By using 3D body scanners, body measurement technology can be non-contact, instantaneous, and accurate. However, how each scanner establishes benchmarks and performs measurements must be determined to achieve standardization of data collection. The purpose of this study is to collect, compare the conventional and 3D method and also to analyse the data gathered form manual and 3D CAS method using statistical analysis. The experiment was done with 10 male and 10 female respondent. During the experiment anthropometer equipment were used for manual and Catia software used for 3D measurement in the experiment. From the data collected, the calculation and analysis between percentiles, mean and standard deviation was done. The outcome of this thesis has able to differentiate the method of measurement and the problem encounter. Last but not this study has concluded with several improvements for further study by taking measurement using software and manual measurements.

ABSTRAK

Antropometrik ialah kajian tentang ukuran badan manusia. Secara tradisinya, ini telah dilakukan dengan menggunakan peralatan mudah seperti pita pengukur atau kaliper untuk mengambil ukuran pada permukaan badan, seperti lilitan dan lebar. Dengan menggunakan pengimbas badan 3D, teknologi pengukuran badan boleh menjadi bukan sentuhan, serta-merta dan tepat. Walau bagaimanapun, cara setiap pengimbas menetapkan tanda aras dan melakukan pengukuran mesti ditentukan untuk mencapai penyeragaman pengumpulan data. Tujuan kajian ini adalah untuk mengumpul, membandingkan kaedah konvensional dan 3D dan juga menganalisis data yang dikumpul secara manual dan kaedah 3D CAS menggunakan analisis statistik. Eksperimen dilakukan dengan 10 responden lelaki dan 10 perempuan. Semasa eksperimen, peralatan antropometer digunakan untuk manual dan perisian Catia digunakan untuk pengukuran 3D dalam eksperimen. Daripada data yang dikumpul, pengiraan dan analisis antara persentil, min dan sisihan piawai telah dilakukan. Hasil daripada tesis ini telah dapat membezakan kaedah pengukuran dan masalah yang dihadapi. Akhir sekali kajian ini telah diakhiri dengan beberapa penambahbaikan untuk kajian lanjutan dengan mengambil ukuran menggunakan perisian dan pengukuran manual.

ACKNOWLEDGEMENTS

I would like to express my bottomless appreciation to all those who provided me the chance to complete this report. A special recognition I give to our final year project supervisor, En Mohd Fa'iz bin Wahid, whose contribution in stimulating recommendation and inspiration, helped me to coordinate my project especially in writing this report and conducting the experiment.

Furthermore, I would also like to acknowledge with much appreciation the crucial role of lab assistants who gave the permission to use all required equipment and the necessary materials to complete the task measurement. A special thanks goes to my final year team mate who help me to conduct and gave suggestion during the experiment. Last but not least, many thanks go to the all the respondent whose have invested his full effort in guiding the team in achieving the goal. I have to appreciate the guidance given by other supervisor as well as the panels.

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P – Percentile

n - Number of values in the data set

M = Mean (average).

K = Factor related to normal distribution on (Z tables).

S = Standard deviation.

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CHAPTER 1

INTRODUCTION

1.1 Background

Anthropometrics is the study of the human body's measurements. Traditionally, this has been done by using simple equipment like tape measure or calipers to take measurement on the body surface, such as circumferences and widths. Surface anthropometry in three dimensions (3D), research can be extended primarily to 3D shape and morphology of tissues primarily outside the human body. The collection, indexing, transmission, storage, retrieval, questioning, and analysis of body size, form, and area, as well as their changes during growth and development to adulthood, are all part of this process. While 3D anthropometry surface surveying is relatively new, anthropometric surveying using traditional tools, such as calipers and tape measures, is not. Recorded studies of the human form date back to ancient times. Since at least the 17th century1, researchers have attempted to measure the human body for physical characteristics such as weight, height, and center of mass. Martin recorded 'standard' body measurement methods in a notebook in 1928.2 (Jones & Rioux, 1997)

1.2 Problem Statement

In this anthropocentric world, the size and shape of human beings influences many design decisions. Size and shape and human are also important to some aspects of medicine where surgical procedures, prosthetic design and reconstructive procedure all depends on precise design and the regeneration process is both point and fit body parts and their replacements. (Deason, 1997)

The manual measuring takes a lengthy time when using typical instruments to measure each portion of the human body. It possible to make a human error measuring the straight measurement of human face such as the eyes, eyes, mouth, other parts. In some cases, this will result in inaccurate measurements. It is also required more time consuming and close contact. As a result, the method of using digital 3D photo, such as cameras, has various flaws such as images created by the camera not being as obvious as the lens used is not quite right. Besides, the visual measuring of 3D data, which is also limited where the images are evaluated and inserted into the program.

1.3 Research Objective

The main two objective to overcome the problem statement above for this project is:

- To collect and compare the measurements data between conventional and 3D CAS method.
- To analyse and form the data gathered from both conventional (manual) and 3D CAS method using statistical analysis.

1.4 Scope of Research

Generally, the project was focus on the linear measurement of the head anthropometric method. The key objective of this study was to make major changes, mainly relevant to the estimation of the human body. The scope of this project is:

- The experiment was conduct at University Technical Melaka Malaysia, ergonomic laboratory.

- The study was involved of measuring 19 parameters of the linear measurement of the facial anthropometry.

- This study was conducted with a group of male and female respondents with the age range of 19 years – 25 years.

- The measurement taken by manual and 3D measurement with special devise such as Kinect camera to compare the methods of measurement by the equipment's.

- The analysis conducted in between the Catia Software, 3D CAS Anthropometry and the manually method.

- The calculation both of manual and 3D measurement average to get the differences and average data gather to get the percentile.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Anthropometry is the science of measuring the human body in a systematic way. Physical anthropologists first created anthropometry in the 19th century as a method for studying human diversity and evolution in contemporary and extinct groups. This anthropometric measure has traditionally been used to link ethnic, cultural, and psychological traits to physical characteristics. Specifically, anthropomorphic measurements involve the dimensions such as height, weight, surface area, and volume, the structure of sitting and standing height, shoulder and hip width, arm/leg length, and neck circumference, as well as components such as percentage of body fat, moisture content, and lean body mass of humans. (Biologydictionary.net Editors., 2017)

2.2 Traditional Anthropometry

In Conventional anthropometric the assurance of human parts measurements can accomplish by utilizing scope of gadgets. Richer has used callipers since 1890, when he first started using them, a standard arrangement of anthropometric equipment has been utilized. Straightforward, speedy, generally non-intrusive apparatuses incorporate weighing scales to decide weight, estimating tapes to quantify boundaries, direct body part measurements, anthropometers to gauge tallness, different cross over widths and profundities of the body, spreading callipers additionally quantify widths and profundities of the body, sliding compasses to quantify brief distances, like the button, ears or hands, and head spanners to quantify the stature

of the head (Löffler-Wirth et al., 2016). Traditional strategies decrease the convoluted state of human bodies to a progression of basic size evaluation and inferred wellbeing records, for example, the weight list (BMI), the abdomen hip-proportion (WHR) and midsection by-height0.5 proportion (WHT.5R)(Thelwell et al., 2020). With these customary techniques for gathering anthropometric information, the estimating cycle is tedious, costly and prone to blunders. Additionally, conventional strategies require the individual being estimated to embrace normalized stances are endorsed when are taken and to keep up them during the estimation cycle. These standard estimating stances, characterized in ISO 7250, depend the investigations a few creators, for example, Kroemer and Kroemer (Kroemer et al., 2010) who clarify the standard strategy for estimating a subject exhaustively. The essential estimating stance is alluded as "anatomical situation", which the member's body put in characterized, straight, upstanding stance, with the body portions at either 180, 0, or 90 degrees to one another. The head situated at Frankfurt plane; with the students similar flat level and the absolute bottom of right circle is in like manner adjusted evenly.

2.3 Anthropometric Measuring Tools

The body parts are measured with anthropometric tools. There are basic components of anthropometric such as anthropometer, personal scale, calliper, sliding calliper, metric tape and many more. These are accurate, standardized originates mechanism to calculate the height, length, width and parameter. (Kopecký, 2014)

2.3.1 Anthropometer

The tools shown in figures below are to measure vertical dimension of the human body part. These tools made up of aluminium square profiles and double-sided measuring system

with reading scale ranging from 50 to 2,133mm. It was designed to measure solely the vertical dimensions of human body part. A spirit level may be included in the anthropometer to guarantee that it is perpendicular. (Kopecký, 2014)

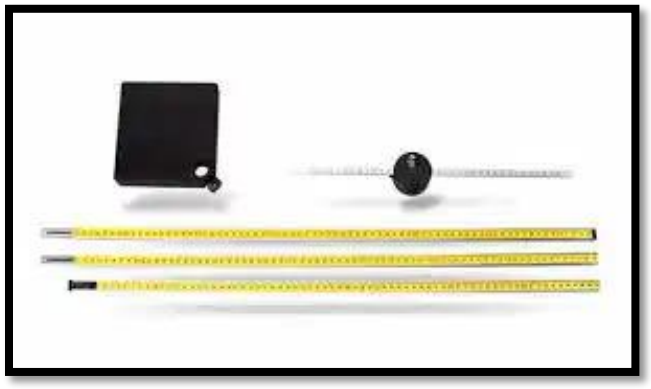

Figure 2.3-1 Vertical Measure Tool

Figure 2.3-2 Stabilizer and Measuring Needle

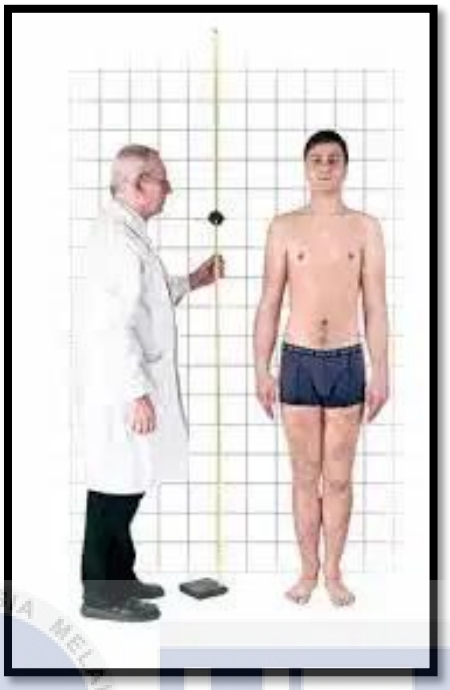

Figure 2.3-3 Acromial Height of a Person

2.3.2 Calliper

More modest callipers, regardless of whether spreading or sliding, are gadgets used to quantify the distance between the inverse sides of a specific item, as does the bigger shaft calliper. On account of the more modest callipers, they are utilized to quantify the length, expansiveness, or profundity of more modest body parts, like the fingers, the hand, the face, nose or ears. The Skinfold calliper estimates the thickness of a piece of skin that is squeezed between the fingers as shown in the figure 2.3.2.4 below. It's helpful in assessing the measure of muscle to fat ratio an individual is conveying.

Figure 2.3-4 Skin Fold Caliper

Anthropometric callipers such as shown in figure 2.3.2.2 below are explicitly intended for estimating living human bodies. The calliper can adjust tips and level edges. It dissimilar to the exceptionally sharp mechanical claimers that have comparative capacities. However it's very sharp too. (*Anthrotech Tools of the Trade | Anthrotech*, 2020)

Figure 2.3-5 Anthropometric Callipers