HUMAN HEAD MEASUREMENT STUDY USING KINECT CAMERA WITH THREE DIMENSION CAD SOFTWARE

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in fulfillment of the requirements for the degree of
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DECLARATION

I declare that this thesis entitled " HUMAN HEAD MEASUREMENT STUDY USING KINECT CAMERA WITH THREE DIMENSION CAD SOFTWARE " is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : SIVANESSHVAR A/L A P RAJAN

Date : 20 JANUARY 2023

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.

Signature : Mohd Fa'iz

Supervisor Name : En Mohd Fa'iz bin Wahid

Date : 20 JANUARY 2023

DEDICATION

This dissertation is dedicated to my beloved parents, my supervisor Dr En Mohd Fa'iz bin Wahid and to those who are unwavering affection, guidance and encouragement have enriched my soul and driven me to undertake and complete this work.

ABSTRACT

Anthropometry is that the systematic study of measurements of the physique. The physique size, shape and composition were measured using anthropometric measurements. This study tells how the measurements process were produced from CAD (Computer Aided Design) software because measurements of a person's anthropometry by using traditional method are complicated and takes lots of your time, direct body measurements using tape scale, spreading callipers and other hand measuring devices. There are several problems during taking the manual measurement because of the human error. This experiment was conducted on 30 male respondents. During the experiment, respondents will first be measured using tools such as calipers and anthropometers for conventional methods, after which CATIA and SOLIDDWORKS software is used for experimental measurements in 3D. As a result of the data, calculations, analysis and comparison between standard deviation, mean and percentile were performed. The use of computer-aided design (CAD) software, such as CATIA, can improve efficiency and accuracy when measuring the human body by reducing the need for manual labor and decreasing measurement time. This is because CAD software allows for the quick and accurate measurement of a 3D scanned image of the human body, which can be done in a fraction of the time it would take to manually measure the body using anthropometry tools. Additionally, the differences identified in this research can serve as a basis for future studies aimed at improving the measurement process. The final purpose of this project is to check anthropometric measurements from CATIA V5R19 Software and Solid works 2020 to compare it with manual measurements. The tactic employed in this study is CATIA V5R19 Software and Solid works 2020. Three dimensional (3D) data obtained from this study is from Camera Anthropometry System (3DCAS). This thesis target linear and circumferences measurement of head. This thesis also studied about the use of CATIA software and Solid work software for measurement that could quickly measure a human body that had been scanned into a 3D model. This thesis could been concluded that manual and 3D measurement were produced with a different reading.

Keywords: 3D CAS, CATIA software, SOLIDWORKS Software, Kinect camera

ABSTRAK

Antropometri adalah kajian sistematik pengukuran fizikal. Ukuran, bentuk dan komposisi fizikal diukur dengan menggunakan ukuran antropometri. Kajian ini memberitahu bagaimana proses pengukuran dihasilkan dari perisian CAD kerana pengukuran antropometri seseorang dengan menggunakan teknik tradisional adalah rumit dan memerlukan banyak masa yang lama semasa pengukuran badan langsung menggunakan skala pita, penyebar kaliper dan alat pengukur tangan yang lain. Terdapat beberapa masalah semasa mengambil pengukuran manual kerana kesilapan manusia itu sendiri. Eksperimen ini dijalankan ke atas 30 orang responden lelaki. Semasa eksperimen, responden terlebih dahulu akan diukur menggunakan alat seperti angkup dan antropometer untuk kaedah konvensional, selepas itu perisian CATIA dan SOLIDDWORKS digunakan untuk pengukuran eksperimen dalam 3D. Hasil daripada data tersebut, pengiraan, analisis dan perbandingan antara sisihan piawai, min dan persentil telah dilakukan. Penggunaan perisian reka bentuk bantuan komputer (CAD), seperti CATIA, boleh meningkatkan kecekapan dan ketepatan semasa mengukur badan manusia dengan mengurangkan keperluan untuk buruh manual dan mengurangkan masa pengukuran. Ini kerana perisian CAD membolehkan pengukuran pantas dan tepat bagi imej imbasan 3D tubuh manusia, yang boleh dilakukan dalam sebahagian kecil daripada masa yang diperlukan untuk mengukur badan secara manual menggunakan alat antropometri. Tujuan akhir projek ini adalah untuk memeriksa pengukuran antropometri dari CATIA V5R19 Software dan Solid work 2020 bagi memadankannya dengan pengukuran manual. Taktik yang digunakan dalam kajian ini adalah CATIA V5R19 Software. Data tiga dimensi (3D) yang diperoleh dari kajian ini adalah dari 3DCAS yang merupakan sistem antropometri kamera 3D. Tesis ini menyasarkan ukuran linear dan lilitan. Tesis ini juga mengkaji mengenai perbezaan corak 3D pengukuran antropometri pada bahagian kepala. Disimpulkan bahawa semasa kajian ini telah mencapai beberapa peningkatan dengan melakukan pengukuran menggunakan aplikasi dan pengukuran manual. Tesis ini juga mengkaji tentang penggunaan perisian CATIA dan Solid work untuk pengukuran yang boleh mengukur badan manusia dengan pantas yang telah diimbas ke dalam model 3D. Tesis ini dapat disimpulkan bahwa pengukuran manual dan 3D telah menghasilkan nilai yang berbeza.

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LIST OF SYMBOLS AND ABBREVIATIONS

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

We are living in an anthropocentric world, where the size and shape of human body parts influences on creating designs for every object. Dimensions of human head plays an important part in creating objects for safety purpose, health purpose and general purpose.

- To take a measurement of head using traditional or manual measuring consume a lot of time and energy while using basic measuring equipments. There will be high waiting time during measuring session where respondents have to wait for a longer period.

- Physical contact issue is also one of the problem we have to face during conventional body measurement, we have Muslim female students which we did not consider them as respondents and we have to respect their culture.

- Moreover, using traditional or manual method there is a huge possiblity to make a human error measuring the straight measurement of human head such as length and width, circumference, and other parts. This will lead to inacurrate reading and since this method is more time consuming it will require the respondent’s patience.

- In addition, another issue is the method of using digital 3D photo, such as cameras which will have various flaws such as images created by the camera not being as obvious as the lens used is not the right one and it could be blurry.

- Furthermore, making sure the respondents attend the experiment at given time is a challenge as they could not attend at the time or busy during manual and conventional measurements.

1.3 Research Objective

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

a) To collect and compare the measurements data between conventional anthropometry method and by using 3D Camera Anthropometry System (3DCAS) on human's head.

b) To measure the 3D rendered data by using CATIA V5 and Solidworks 2020 software.

c) To analyse the data of measurements using statistical method which focused on standard deviation, mean, and percentile (5^{th} , 50^{th} and 95^{th}).

1.4 Scope of Research

The scope of this research is focused on 3D Camera Anthropometry System with the total 18 parameters of the linear and circumference measurement of the head anthropometry. This study was conduct at conventional measurement in Ergonomics Laboratory in Faculty of Mechanical and Manufacturing Engineering Technology and 3D scanning in Faculty of Manufacturing Engineering. This experiment was done with 30 of male respondents aged 22 to 26 years old. The measurements were obtained using CATIA and SOLIDWORKS software and also 3D rendered device such as a 3D Camera Anthropometry System (3D CAS) which is Kinect Camera. The calculation both conventional and 3D measurement using Statistical Analysis which is standard deviation, mean and percentile (5th,50th and 95th).

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The head is one among the necessary parts of the human body. There are several very important organs on the head that require to be protected. The protection aims to take care of the organ's safety and security. Safety and security factors are often achieved by coming up with varied products which will shield these organs. Additionally, on top of factors, comfort factors also ought to be considered in order that the created products are in accordance with human desires, to fulfill these three factors, a science in product design is needed. The supposed science is measurement, science that serves to measure the dimension of physical structure, as well as the head. These measurements aim to get information that would be used in planning design products for users' characteristics.

2.2 CONVENTIONAL ANTRHOPOMETRY

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)

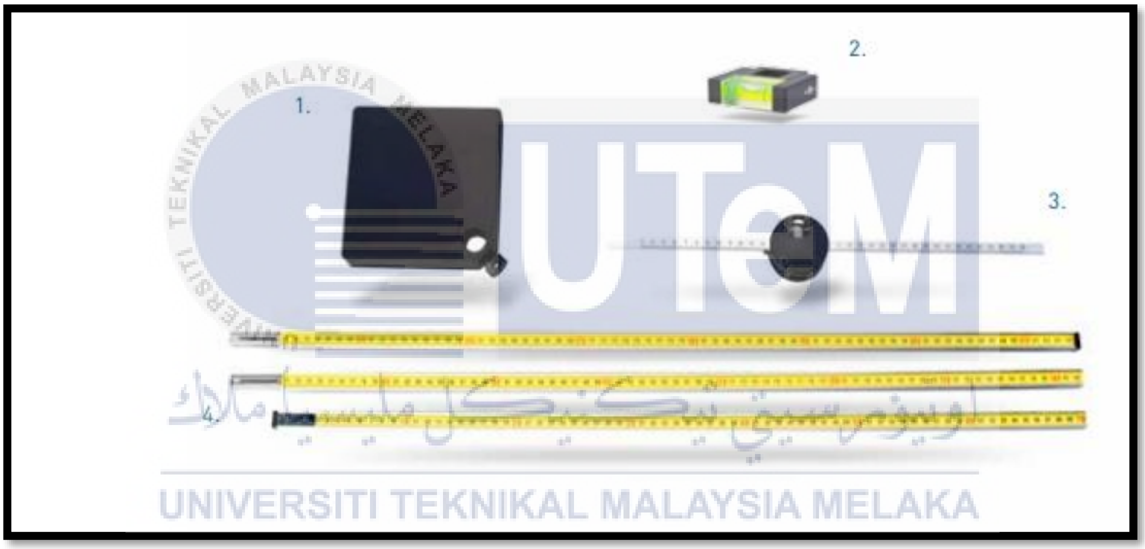

Figure 2-1 Shows the manual measuring tools