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Abstract

This research presents a mobile-based anthropometric measurement system for a human body size using deep learning algorithms hybridized with augmented reality.

The system uses self-learning technique to train a model that will have ability to capture a moving or a stationary human image using a mobile camera. It employs the PoseNet and MoveNet deep learning algorithms for detecting the dimension of body key points, and outputs the digital measurement into physical dimensions using augmented reality.

The accuracy of the system was found to be approximately 97.8% as against physical measuring using tapes. The system is found to be extremely useful for fashion designers as it automates the body size measurement procedures for their customers.

Keywords: Anthropometric measurements, Augmented Reality, Image Augmentation, Artificial Neural Network, Machine Learning, PoseNet, MoveNet, GoogleNet, Pose Estimation, Key Points, ARCore.

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# INTRODUCTION

## BACKGROUND TO THE STUDY

Overtimes, garment has been an essential need for humans and a great instrument used to amplify appearance and fashion. Naturally, textile materials are been processed into nice apparels of diverse types and sizes and displayed in a physical market to be bought. This is known as garment pattern making or garment construction. At the onset of this process, clients visit a fashion designer to help create clothing based on an agreed design. In this process the fashion designer uses a physical measuring equipment usually a measuring tape to measure the client`s body size.

Advancements in technology has made it possible for clothes to be purchased on the internet via an e-commerce store which may be at a distance or in a different country. Hence, often customers prefer purchasing cloth wears online than visiting a local fashion designer. This is a huge and awesome development which has also brought its own obstacles; Fashion designers, primitively must first collect tangible measurements of their clients to ensure that the cloth designed at the end of the process will suit the wearers specifications, but for an online client-tailor, a physical tape measurement is impossible. Hence, tailor-client interaction procedure for online body size measurement (tailor-client peer-to-peer) becomes a problem. To get the exact size of their clients virtually, the client is asked to take measurements and send the figures to the tailor. This measurement can be assumed or miscalculated or the task of getting another tailor to measure might even be inconvenient for the client.

Garment pattern constructors design patterns with sizes corresponding to the clients’ dimensions. Therefore, the need for anthropometric data is necessary in the design. Indeed, some body parts can easily be measured physically (height, waist, and hips) others prove more difficult to measure like the crotch length and abdomen. The crotch is regarded as the widest part of the human body; therefore, it is difficult to measure and locate (Liu et al., 2017). Measuring of the abdomen too is just as tricky too. And due to the advances in internet technology, most tailors find their customers online most where tape measurements would be impossible. Therefore, there is a need for a technique that will accurately estimate the anthropometric measurement of a tailor client to avoid disappointment, dissatisfaction or protest from the customer that could overall ruin of the business. Although preceding researches have investigated this concept, these researches have been proposed with limitation that reduces the accuracy of measurements. For instance, the Automatic human body feature extraction and personal size measurement (Xiaohui et al., 2018) used a model like that of a 3D camera to get the body model for measurement. Although, this method has been useful, it has its constraints such as computation inefficiency. So also, another research on this same field called The Construction of a prediction model for body dimensions used in garment pattern making based on anthropometricdata learning (Liu et al., 2017). While the research primarily focused on the assessment of lower body measurement for lower design, the upper body or whole-body prognosis received no attention or interest. Therefore, it cannot be fully accounted for. Therefore, automatic mobile human body size measurement using deep learning with augmented reality approach was introduced which creates a clearer and more digital to physical reality to achieve a more reliable and precise measurement result and hence, take garment makers a step closer to perfection.

## PROBLEM STATEMENT

In garment making industry, the main source of their existence is the customers. As the world begins to come into a modern age, everything gradually becomes online. For long distance customers with the desire to own a design and communicates the design through digital means, how does the fashion designer get an accurate measurement of the customer becomes a problem. In such a case, physical body size type measurement is not feasible

An online anthropometric measurement system which takes cognizance of the physical human body shapes and could convert them from the digital equivalence of concern to the real-life sizes using techniques of deep learning combined with augmented reality becomes necessary

## MOTIVATION

The ability to automatically capture anthropometric measurement will revolutionize the fabric world, solving the significant issues of flawed designs due to wrong measurements and reading errors. Hence room for more advanced researches will be opened and more use-cases will emerge after the success of this study. Although there have been some proposed solution to this problem but none have been proved efficient in translating the accurate body size measurement of an individual.

## AIM AND OBJECTIVES

### AIM

The aim of this study is to create a mobile based system that would capture an anthropometric measurement of an individual using a deep learning approach combined with augmented reality.

### OBJECTIVES

* To extract the anthropometric features of a human body using PoseNet & MoveNet algorithms.
* To process the anthropometric features.
* To estimate human body sizes by converting digital 2D key points to 3D physical equivalent

## SIGNIFICANCE OF THE STUDY

The study brings about innovative improvement in the fashion industry, enabling a designer to take accurate body size measurement of a potential customer remotely. It introduced a mobile based system that can be used for the purpose conveniently.

## SCOPE OF THIS STUDY

This study focuses on using the pretrained POSENET deep learning model designed with self-learning ability to detect human body parts retrieving the positions of its key points, sending the data into the augmented reality component which then extrapolates the body dimensions, by converting the digital positions calculated for a moving body, the system would automatically use the MoveNet deep learning techniques to extract the body key points before passing it to the augmented reality subsystem for the consequent physical estimation.

## LIMITATION OF THE STUDY

Although, this research is an improvement to the existing system in regards to the accuracy of the body-sized measurement, having enough anthropometric data remains a constraint. Thus, it affects its accuracy as the system is made to build its dataset through self-learning.

Also, issues exist surrounding the angle at wish the image is being captured, impacts the accuracy of the measurement as it expects the camera to be placed in front of the individual to be measured tilting the mobile device at different angles may reduce the capability to detect body dimensions correctly hence, creating wrong measurement calculations. Although this issue is been subsided by assigning a confidence level to different body parts and if the confidence level is less than a reasonable threshold, it does not move on to the next stage. More research is needed to fix this issue.