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DESIGN OF THE DIGITAL CLOTHING MEASUREMENT APPLICATION USING DESIGN THINKING METHOD

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Abstract

The development of digital technology has provided significant opportunities for the garment industry to innovate in body measurement processes. This study aims to design a camera-based digital clothing measurement application using the Design Thinking approach. This method ensures that the application design aligns with user needs and experiences, particularly in achieving efficient, accurate, and easy-to-use body measurements without relying on physical measuring tools. The prototype was developed using HTML, CSS, and JavaScript programming languages, featuring A4 paper–based calibration as a scale reference, manual body point marking, and output results in TXT, PNG, and PDF formats. The design results indicate that the application of the Design Thinking approach facilitates the identification of user needs and leads to an interactive and functional application design.

Keywords: Application Design, Calibration, Camera, Design Thinking, Digital Measurement

INTRODUCTION

The garment industry is one of the sectors that plays an important role in supporting the growth of the creative economy in Indonesia. Clothing size is the primary reference for users when selecting garments that fit their body shape (Kaaffah et al., 2020). The body measurement process is one of the most crucial stages in determining and producing clothing, as well as ensuring the comfort of the garments produced (Manihuruk, 2019) (Rizky et al., 2022). To date, the measurement process has been carried out manually using a measuring tape. This manual method still faces several challenges, including potential errors due to the measurer's inaccuracy, variations in the tension applied when pulling the tape, and inconsistent body positioning of the subject.

On the other hand, advances in digital technology have opened new opportunities in the field of body measurement. Several studies have shown that camera-based or digital image-based measurements can serve as a faster and more objective alternative. However, most of these studies still rely on high-cost hardware such as 3D cameras or specialized sensors. This condition makes it difficult to apply such technology on a small and medium industrial (SMI) scale in the garment sector.

This study seeks to offer an alternative solution in the form of a digital clothing measurement application based on a two-dimensional camera (2D camera) that can be run

directly on a standard computer or laptop. The application uses an A4 sheet of paper as a calibration tool, allowing measurements to be automatically converted into centimeters. The Design Thinking approach is employed to design this system because the method is user-oriented and emphasizes a flexible, iterative process. This approach is expected to produce an application design that not only functions technically but also provides practical value for users such as students, tailors, and small-scale garment entrepreneurs.

LITERATURE REVIEW

Research related to digital measurement systems and innovative design approaches has been widely conducted. Brown (2008) introduced Design Thinking as an empathy-based approach that integrates creativity, rationality, and user needs within the product innovation process. This method is widely adopted in the field of technology due to its ability to generate human-centered solutions (Dinar et al., 2015).

Conventional methods commonly used in garment measurement are unable to accurately match clothing sizes to users, thus requiring the development of augmented reality applications for body measurement (Purnomo & Haryanto, 2012). Another study developed a web-based application designed specifically to measure upper-body garments. This application targets users with a minimum body weight of 90 kg and employs Artificial Intelligence (AI) to determine shirt sizes (Widyawati et al., 2021).

The e-Fitting system processes a customer's photograph and translates it into body measurement data. The digital image processing workflow consists of several stages: keypoint detection, image segmentation, contouring, and pixel-count measurement on various body parts, which are then converted into centimeters (Hartono et al., 2020). This image processing technique functions to analyze a person's body image to identify their clothing size using body photographs captured with an Android device at a predetermined distance (Ilyasa et al., 2020).

Other research has utilized the Convolutional Neural Network (CNN) method, where the output of the identification system is a set of human body size parameters in centimeters (Fachmi et al., 2020). Another study conducted body measurement for men using a Kinect camera connected to a monitor, alongside a processing unit for user interaction. The Kinect camera is used because, in addition to capturing images, it is equipped with an IR projector and depth sensor that provide depth information. Once the user activates the system, the Kinect camera transmits image and depth data to the processing unit for image processing, feature extraction, and further analysis to measure the user's body length and width (Purwanto et al., 2015). A similar study highlights how the Kinect sensor can measure the user's body and then visualize how selected clothing items would appear on the user's body (Gunawan et al., 2017).

RESEARCH METHOD

This study employs the Design Thinking method, which consists of five stages: empathize, define, ideate, prototype, and test. In the empathize stage, the researcher conducted observations regarding user needs, such as tailors and garment students who often experience difficulties in measuring bodies accurately and quickly. Users expressed the need for a simple system that can function using only a laptop camera without additional devices.

The define stage is used to formulate the core problem, namely how to create an application capable of performing accurate digital measurements using a 2D camera and a simple calibration object. After identifying the problem, the ideate stage was carried out by generating various alternative interface designs and measurement mechanisms. The selected idea was the use of an HTML canvas to display real-time camera video, allowing users to mark measurement points directly on the screen.

The prototype stage produced an initial web-based application design using HTML5, CSS, and JavaScript. The application consists of several main modules, including a calibration module, a measurement module, and a result export module. The final stage, test, was conducted through internal functional testing to ensure that each feature operated properly according to the design, although external users had not yet been involved in the evaluation process.

Stage	Activities	Output
Empathize	Identifying user needs, namely students and tailors who require a fast method for measuring the body without using physical measuring tools.	User requirements list.
Define	Formulating the main problem: "How can a digital clothing measurement application be designed to be easy to use while providing accurate results without the need for physical measuring tools?"	Problem formulation and solution criteria.
Ideate	Developing ideas for the main features: calibration using an A4 sheet, manual measurement points (left shoulder, right shoulder, wrist), automatic display of results, and the ability to save measurement outputs.	Interface sketches and feature design.
Prototype	Developing a web-based application prototype using HTML, CSS, and JavaScript.	Digital clothing measurement apllication

RESULT AND DISCUSSION

The application consists of several main components:

1. Camera Input: Captures real-time images of the user's body through navigator.mediaDevices.getUserMedia().
2. Canvas Layer: Displays the live video feed and allows users to mark measurement points.
3. A4 Calibration: Two points on an A4 sheet are used to calculate the conversion from pixels to centimeters.
4. Body Measurement: Three measurement points (left shoulder, right shoulder, and wrist) are used to calculate chest width and sleeve length.

5. Output Results: The calculated measurements are displayed on the screen and can be downloaded in TXT, PNG, or PDF format.

Distance calculation between points is performed using the Euclidean formula. Euclidean distance is used to measure the distance between two points in Euclidean space, which examines the relationship between angles and distances (Fauziah & Saragih, 2023). The Euclidean equation is written as follows:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

The conversion of pixel distance into centimeters is carried out using the formula:

$$\text{size (cm)} = d \times \text{cmPerPixel}$$

where the cmPerPixel value is obtained from the A4 sheet calibration.

The application interface is designed to be simple and easy to use. The main buttons include: Start Camera, A4 Calibration, Process Measurement, Reset, and Download Results. Interactive step-by-step instructions are displayed to guide users through each stage correctly.

The prototype displays real-time video from the camera, accepts calibration and measurement points, and calculates body dimensions in centimeters. The measurement results can be saved and downloaded by the user. The application also stores the last measurement in Local Storage to prevent data loss when the page is refreshed.

The application prototype is designed to run directly through a web browser without requiring any additional installation. When the application is launched, the laptop camera activates and displays a live video feed on the canvas element. Users can click two points on the image of the A4 sheet used as the calibration reference. The distance between these two points is calculated in pixels, then converted into centimeters based on the actual paper length entered by the user.

After the calibration stage is completed, users can mark three main points on the body: the left shoulder, right shoulder, and wrist. The system then calculates the distance between these points using the Euclidean formula. The measurement results are displayed as text, including chest width, shoulder width, sleeve length, garment length, and size estimation based on common size categories (S to 3XL).

After the calibration stage is completed, users can mark three key points on the body: the left shoulder, right shoulder, and wrist. The system then calculates the distances between these points using the Euclidean formula. The measurement results are presented in textual form, including chest width, shoulder width, sleeve length, garment length, and a size estimation based on common categories (S to 3XL). In addition to displaying results on the screen, the application provides a data-saving feature. Users can download the results in three different formats: TXT for raw data, PNG for a screenshot of the measurement output, and PDF for a formatted report generated using the jsPDF library. From an interface perspective, the application layout is designed to be simple, accompanied by step-by-step instructions. Semi-

transparent body guide lines are visualized to assist users in understanding the correct placement of measurement points.

The Design Thinking approach provides clear direction throughout the development process of this application. Through the empathy stage, the researcher identified that users require a simple, low-cost solution that can be used without specialized technical training. The ideation stage enabled the exploration of various technical possibilities, ultimately identifying an effective solution using the HTML canvas. The prototyping stage became the most crucial part of this study, as it allowed conceptual ideas to be transformed into a functional system. The resulting application has fulfilled the essential requirements for two-dimensional digital measurement while ensuring a high level of user-friendliness.

CONCLUSION

This study designed and implemented a prototype of a camera-based digital clothing measurement application using the Design Thinking approach. The user-oriented development process resulted in a system design that is simple, easy to use, and relevant to the needs of small- and medium-scale garment industries.

The resulting application is capable of performing automatic calibration using an A4 sheet of paper, measuring distances between body points, and displaying measurement results in real time. The findings demonstrate that the Design Thinking method is effective for developing simple technological systems that still prioritize functionality and user-centered considerations.

For future research, it is recommended to conduct accuracy testing of the measurement results using field data, as well as to integrate automatic body detection algorithms to further enhance precision and user convenience.

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