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Sew-Cut: A Mobile Tailoring Management System with a Body Measurement Tool for Balala's Dressmaking and Tailoring Shop

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Abstract

Faced with a lack of face-to-face engagement, most businesses turned to integrated technology and online business transactions and found new methods of communication with their customers. Associated with bespoke tailoring, Information Technology has been one driver that has improved the tailoring industry. This project offered a technical solution to the difficulty of guiding customers through taking their measurements for custom-fitted clothing. The idea was to use the customer's image and visual and audio guide such that a clothing-size measurement was frictionlessly obtained. The researchers utilized the Agile Scrum System Development Lifecycle, which combines iterative and incremental processes. Tensorflow API was the primary technology and web application technologies such as ReactJS, JavaScript, and Node.js. For database management, MySQL Workbench and phpMyAdmin were utilized. Sew-Cut, a mobile tailoring management system with a body measurement tool for Balala's Dressmaking and

Tailoring Shop, was deployed through a shareable link and a QR code such that it reaches local customers within the BLISTT (Baguio - La Trinidad - Itogon - Sablan - Tuba - Tublay).

Keywords: *Automated Measurement, Guided Measurement, TensorFlow, Mobile Tailoring Management System, Micro, Small, and Medium Enterprises (MSMEs)*

Introduction

The COVID-19 pandemic caused global organizational operations to shift, leading to a "new normal." Industries have adjusted accordingly, and the IT industry has played a significant role in this transformation. Implementing information technology can benefit small-to-large industries (Howe, D. & et al., 2020). The fashion industry faced problems such as high product return rates due to sizing issues, leading to the emergence of virtual scanning technology to scan measurements for customization. Although customization in the fashion industry has not yet reached its full potential, the limited reach of physical stores due to the pandemic has made information technology such as e-channels and online stores become a reliable solution for the fashion and tailoring industries, leading to significant improvements in product order processing, making it faster and easier for customers to place their orders (Chae et al., 2018).

Micro Small and Medium Enterprises (MSMEs) are key for sustainable development, as they generate economic growth, jobs, and social welfare. However, they face many challenges that affect their performance and potential, such as limited access to finance, markets, skills, innovation, and environmental and social impacts. The rise of online platforms has also increased the competition and the need for innovation among businesses that offer the same goods and services. By adopting technology solutions, MSMEs can boost their competitiveness, resilience, and sustainability in the changing global environment (Cueto et al., 2022; Liu, 2021;

Raquiza, 2022).

Accordingly, MSMEs increasingly leverage digital tools like e-commerce, social media, cloud technology, and mobile platforms to manage and grow their businesses (Aziz, 2019). It has also leveled the playing field for MSMEs, enabling them to compete with larger enterprises. Accessible and user-friendly technologies empower MSMEs to develop sophisticated marketing strategies, expand their reach through online platforms, and engage directly with customers. This eliminates barriers to entry and allows MSMEs to establish their brand presence and compete globally without substantial financial investments. Additionally, technology facilitates data-driven insights and analytics, enabling businesses to make informed and strategic decisions. It revolutionizes supply chain management, optimizing logistics and procurement processes. Real-time tracking systems, inventory management software, and online marketplaces facilitate efficient inventory control, reduce stockouts, and improve delivery timelines. These advancements enhance customer satisfaction and allow MSMEs to compete effectively by providing timely and reliable products and services (*Robotic* et al., 2023).

To fully harness these opportunities, MSME owners and managers must develop strategies that enhance efficiency, reduce costs, attract new customers, establish an online presence through websites, and leverage digital technology for market expansion and increased sales in the era of the advanced digital economy. By adopting these strategies, MSMEs can optimize their operations and navigate the evolving business landscape driven by digital advancements.

MSMEs in the Philippines, particularly in the fashion industry, are crucial to economic development and social well-being, employing vulnerable groups. MSMEs have suffered immediate losses due to the pandemic. To recover, most of the sectors moved forward through

innovation (Department of Trade and Industry, 2020). Balala's Dressmaking and Tailoring Shop is a sole proprietorship owned by Mrs. Beth Balala, who produces three pieces of clothing daily and uses social media to connect with customers. The shop offers custom-fitted clothing, specialized teaching and non-teaching uniforms, and other items like wallets, face masks, and curtains. The shop primarily employs Mrs. Balala, her husband, and her children.

The fashion industry operates in a fast-paced and competitive market influenced by the rise of the Internet (Gazzola et al., 2020). The International Labour Organization (2020) identified that the COVID-19 pandemic has accelerated the adoption of digital payments and forced many businesses to shift to e-commerce. Even before the economic disruption caused by the pandemic, which drove business innovation (Cueto et al., 2022), the tailoring industry faced problems such as fit and measurement, which technology was trying to solve. During the pandemic, customers had to take their measurements at home, leading to inaccurate manual measurements, frustration, and repetitive tasks. In the manual tailoring system, customers had to go to the tailor shop to order custom-fitted clothing, and tailors kept the measurements on paper, which could have been more efficient.

Given the issues, the team aimed to build Sew-Cut, a mobile tailoring management system with a body measurement tool to streamline Mrs. Balala's business. It reduces manual work, repetitive tasks and enables her to manage orders, records, and payments. Customers can order custom-fitted clothing conveniently and access real-time information. The system provides guided and automated measurement options and facilitates communication between the tailor and the customers. Electronic records ensure faster validation, exchange, and management of measurements and clothing details. The system aims to streamline operations at Balala's Dressmaking and Tailoring Shop while also serving as an effective platform to tackle market

reach and drive innovation in the fashion industry. By leveraging technology, the system expands Mrs. Balala's customer base, offers personalized clothing options, and enhances the overall customer experience.

Review of Related Literature

According to the studies of Nadile (2017) and Crook & Lomas (2017), companies like Fit Analytics, True Fit, and Body Labs are using technology in the tailoring industry to personalize clothing for online buyers. 3D body scanning and smartphone-based scanners are promising methods for measuring body measurements, according to the studies of Foysal et al. (2021), Chang et al. (2013), Xiaohui et al. (2018), and Xia et al. (2018).

The mentioned studies and technologies were effective but required resources that were only sometimes available, leading to incomplete and inaccurate results. The team decided against using the 3D approach due to the cost and time required, opting for a real-time 2D approach instead. The team will adapt primary functions from Mutembei's (2013) and Sauveur's (2012) studies and create a progressive web application.

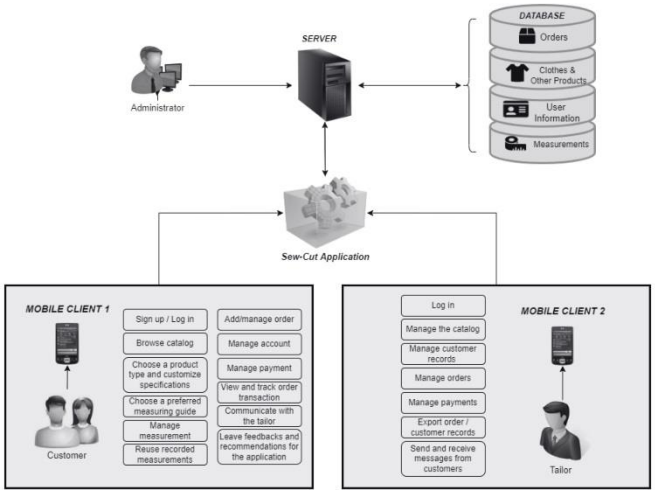
Framework

System Architecture

The system architecture of the Sew-Cut system involves a server managed by an administrator. The server is connected to a database containing customer orders, product offerings, user information, and measurements. Both the tailor and the customer can use the Sew-Cut application. Customers can log in to their accounts, browse products, place orders and provide recommendations. Tailors have access to a personal account to manage orders and records.

Figure 1

System Architecture Diagram of Sew-Cut System



Development Architecture

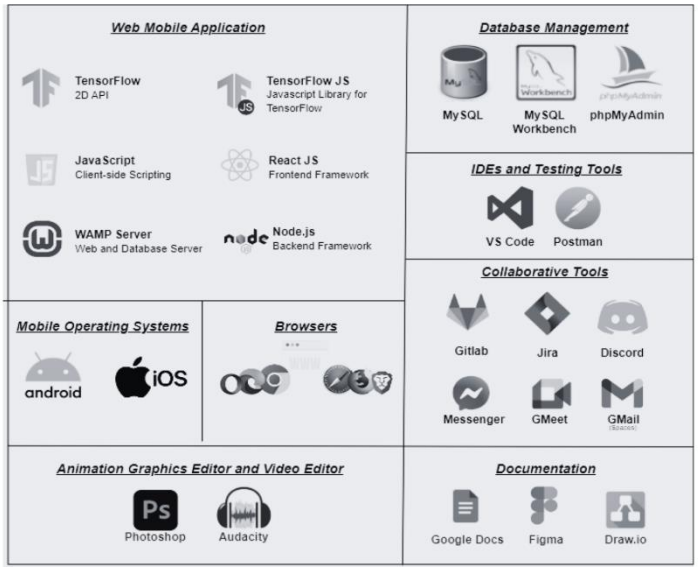
The development architecture of Sew-Cut involves integrating various tools and technologies into the project. This includes two measurement approaches: the automated measurement using the 2D approach, which involves body segmentation, calibration, and calculation, and the guided measurement. The development tools and technologies are detailed in Figure 2.

Tensorflow was utilized for the 2D approach of the automated measurement. The team has chosen ReactJS and JavaScript as the frameworks for the front-end development of the project. The team utilized the WAMP server, Tensorflow.js for libraries, and Node.js for the backend framework in mobile web applications. MySQL was used for data storage, with MySQL Workbench and phpMyAdmin used as database management tools. IDEs and testing tools such as VSCode and Postman were also used.

Moreover, GitLab was utilized as the project repository. Furthermore, Photoshop was used for animations and graphics, and Audacity for audio editing. The team used Google Docs, Figma, and Draw.io for documentation purposes.

Figure 2

Development Architecture of Sew-Cut

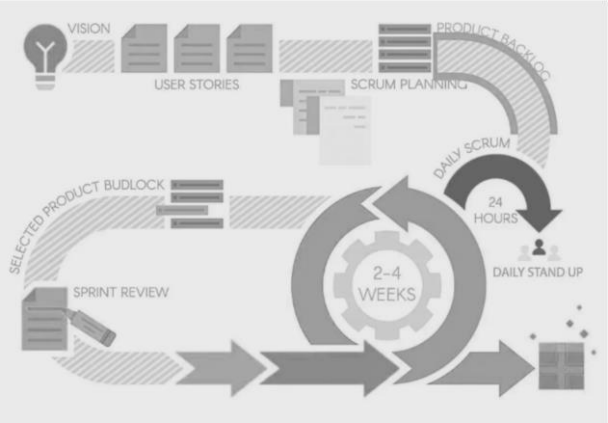


Methodology

The study aimed to achieve its objectives using the Agile Scrum System Development Life Cycle (SDLC) model. Figure 3 is the Agile Scrum SDLC model, which combines iterative and incremental processes. The team had chosen Agile-Scrum as the SDLC technique for developing the system since it allows the product to be developed faster as each set of goals must be fulfilled during the sprint. This method involves regular planning and goal-setting, encouraging the team to focus more on the current sprint's goals and increasing productivity.

Figure 3

Agile Scrum Model Illustrating the System Implementation



In Agile Scrum, the project was divided into seven sprints, each lasting three weeks. At the end of each sprint, specific features were delivered in releases. User stories provided a step-by-step representation of user interactions. Two user stories were created for tailors and customers. The coding process involved individual tasks for system development and enhancing skills. System testing included debugging and identifying errors to ensure smooth functionality. Once the system was stable, a potential release date was scheduled for consumers.

Functional and Non-functional Requirements

To determine the functional and non-functional requirements for the tailoring management system with a body measurement tool, the team implemented the first phase of the agile scrum model, which was the requirements gathering and elicitation. The team planned and interviewed Mrs. Beth Balala about the business processes of custom-made products. A survey was conducted, which was distributed through Google Forms intended for both the customers and non-customers of Balala's Dressmaking and Tailoring Shop. Measurements, preferences for custom-fitted clothing, customer connections, and views about the project's prototype were all essential data gathered. The gathered information from the survey was validated to guide the

team throughout the design and development process of the system. An activity diagram was also created to show the business and software processes. The activity diagrams illustrate the functional requirements and depict the business process together with the implementation of the system.

System Analysis and Design

The system was designed by the determined functional and non-functional requirements from the previous section. The team created the system architecture components, use case diagrams, site maps, underlying features, and database architecture components.

Determine Tools and Technologies

They automated Body Measurement Process

There were two processes in the body measurement process. The first was the 2D space approach, wherein parts of the user's body were identified, and body key points were estimated, while the second was the calibration and calculation of measurements. The users identified body parts and key points obtained from the 2D approach were essential in calculating measurements. The team researched equations or methods to convert pixel metrics to real-world metric units, such as centimeters and inches.

Moreover, the team researched known body ratios such as head-to-height ratio, waist-level-to-height ratio, inseam-to-height ratio, and the like, all of which were used to approximately identify body parts such as chest, waist, leg, and other body ratios. Finally, the team investigated and learned methods for measuring distances between key points on the body to determine the dimensions of measurement points such as the chest, waist, inseam, leg, and collar, among others. The team experimented with testing the accuracy of automated body

measurements by comparing the measurement results obtained using automatic and manual measurements.

Guided Measurements

The team explored existing documentation of taking one's body measurements. They read about the preparations for taking measurements, such as the tools needed, clothes to wear, and other related matters. Moreover, the team researched both male and female essential measurement points, their usual allowance for ease for each measurement point, measurement techniques, guidelines and principles in taking body measurements, and standard sizing charts. They learned how to give simple and effective instructions through animation and speech. Additionally, the team has consulted with the proponent about obtaining one's measurements which were used as a basis for creating the animations used for the guided measurement.

System Implementation and System Verification and Validation

Unit and acceptance testing were performed to help address the issues with integrating new modules. Unit testing was carried out to ensure that adding new features would not interfere with existing ones and that the system operates flawlessly in the way it was expected. Moreover, acceptance testing was conducted to get the feedback of the proponent and assess whether the system complies with business requirements, then determine if it was suitable for delivery.

Discussion of Results

Tools and Technologies Specifications

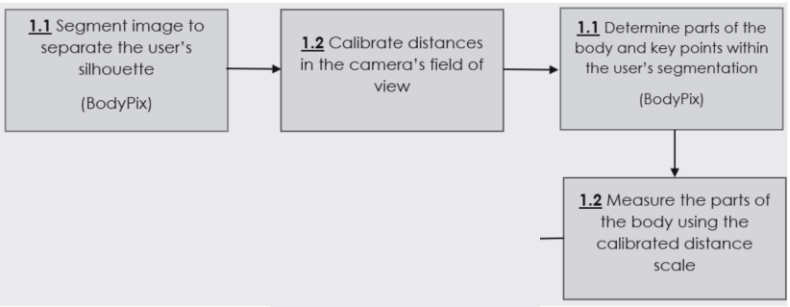
They automated Body Measurement

One measurement guide that a customer could use is the automated measurement. Automated body measurement was utilized to measure body parts that could be identified in 2D space by uploading a full body picture, while the customer would manually measure the

remaining measurements. The system would guide the customers through animation and speech during the manual measurement. Figure 4 shows the process of automated measurement.

Figure 4

Real-time Automated Measurement Process



Guided Measurements

The team developed a guided measurement tool for customers using animations and speech. Ms. Christine C. Ngaosi drew the animations using Photoshop, while Ms. Princess Jaylyn N. Tawatao provided voice-over instructions for the measurements, which were edited using Audacity. The team combined the animations and voice instructions to create a set of instructions for each measurement point based on research on instructional videos. Table 1 outlines the essential measurement points for tailoring, each with its animation and speech. Customers are given instructions on taking measurements correctly, with animated visuals and instructional audio.

Table 1

Essential Measurement Points for Tailoring

Important Body Measurements	
Chest/Bust	Sleeve Width
Top Length	Pant Length
Neck Size	Total Crotch Length
Neck Depth	Hip Girth
Shoulder Length	Thigh Girth
Apex Height	Calf
Apex Distance	Waistline
Wrist	Sleeve Length
Knees	

System Implementation and System Verification and Validation

System Implementation

The development process was followed during the implementation of the system, features were developed by the end of each sprint, and lists of attributes ordered by priority were created during the beginning of the development process. Collaborative tools such as Discord, Messenger, and GMail (Spaces) have greatly increased the efficiency of progress monitoring for each team member. The team correctly utilized the components and modules needed for the system to function and develop the project's functional requirements. The accessibility of the system was better because of its flexibility in being able to be opened using any electronic device via a web browser.

System Verification and Validation

The testing and evaluation of system requirements started alongside the implementation sprint. Every feature added was tested and confirmed in this manner which avoided any potential bugs and other problems. Specific testing was performed on each module due to the system

integrating several modules and other technologies. Unit testing was conducted for the backend components to help ensure that different system parts work correctly together and reveal hidden bugs early in the process. These tests can ensure that code meets pre-defined requirements, detect and fix any problems early on in the development cycle, and improve overall quality. Finally, user acceptance testing was conducted with the client.

System Deployment

After multiple development releases, a review of issues, and testing of all the features and functionalities of the system, the system was deployed by hosting it on a local server.

Conclusions

The determined functional and non-functional requirements enabled the developers to create an appropriate design for the system through different diagrams and architectures. By creating use case diagrams, site maps, underlying features, and database architecture components, the developers could visualize and identify the basic components and interactions of the end-users with the system. Creating different system designs for the application was one of the developers' challenges. The developers needed to consider how the users would interact and use the system. Various factors, such as presentation clarity, word complexity, detail consistency, element representation, and overall usability and functionality of the application, were evaluated based on the requirements for each user type. As a result, the developers could approach system design with more scrutiny, incorporating user empathy and considering how users would navigate the system.

After researching and exploring various existing tools and technologies, the developers integrated suitable development tools for the project. During this exploration, they encountered challenges such as cost and resource constraints, which prompted them to find alternative

solutions that met the required criteria while maximizing performance. This experience taught the developers to be resourceful and carefully consider all available options before making implementation decisions. The developers encountered an issue with implementing the 2D space approach for the automated measuring feature, which proved inaccurate and inconsistent during testing. As a solution, they shifted their focus to the 2D automated measurement that utilized 2D images to measure the user's body parts.

Moreover, exploring different tools and technologies allowed the developers to familiarize themselves with new tools and technologies to understand their strengths and weaknesses and the pros and cons of each implementation. The developers were able to implement the system by following the Agile SDLC methodology. The major features for all three modules, the tailor, customer, and admin modules, were developed by the end of each sprint. Different development tools, technologies, version control, and collaborative tools were utilized during implementation. Moreover, two types of tests, namely unit testing and user acceptance testing, were done to validate the system's features and functionalities. During the demo with the client, it was explained thoroughly and in detail that the automated measurement feature needed to be completed due to the limited body parts that it only covered and its slight difference of 1 to 3 cm from the exact measurement of customers. Knowing this, the client agreed to it and mentioned that it would not be a problem because she could estimate customer measurements given their pictures as required during the automated measurement process. With her acceptance and confirmation, it can be concluded that the user requirements per module were delivered accordingly.

Once the functional and non-functional requirements were tested throughout the implementation of the system, together with the proponent's verdict of approval, the developers could assess that the system was ready for deployment.

Limitations and Recommendations for Future Research

Acquiring measurements using the 2D automated method in the system only includes some of the customer's body parts, which was one of the main areas of concern for the team. This concern compromised the accuracy of the measurement provided by the application. Given this finding, the group recommends that future researchers measure more body parts to make more accurate and complete measurements. Furthermore, future researchers could implement a 3D body model generator so that users could look at their measurements and anticipate how they would look, given the measures they would provide. From the research conducted by the developers, one good technology or tool for this is the 3D body measurement generator, BodyApps 3D Body Visualiser. In addition, a live camera could provide a better method of obtaining measurements rather than just uploading them. Since Sew-Cut only had static images for the catalog, future researchers could utilize technologies that could implement Augmented Reality (AR) technologies into Sew-Cut so that users could see the 360° view of the products the tailoring shop offers.

As part of the research conducted for tools and technologies connected to the system's features, the developers could not implement such technologies due to their costs and complexity. We recommend further research and experimentation with the following technologies. Live 2D/3D Measuring Tools and Model generators: Bodypix Bodypart segmentation powered by TensorFlow, TTF technology (True To Form), 3D Body Cloud API,

3D Look API (size recommendations, 3D model builder, and measurement getter), Size Stream Mobile Fit, 3D Measure Up API.

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