

SMARTFIT: AUGMENTED REALITY-INTEGRATED FOOTWEAR RETAIL AND CUSTOMIZATION PORTAL WITH AI-POWERED ASSISTANCE

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ABSTRACT

The Smartfit: Augmented Reality-Integrated Footwear Retail and Customization Portal with AI-Powered Assistance is a web-based system developed to enhance the online shoe shopping experience by making virtual shoe trials and customization of footwear designs available to the users based on their preferences. The developed system has been created to digitalize the footwear retail process while featuring an interactive and personalized experience for users. Customers can have access via registration and log-in to enter the system and search for available footwear, augmented reality (AR) to virtually try shoes on, and customize their favorite designs. The developed system also comes with an AI-powered assistant that can respond to user queries, help them to navigate through the platform, and help them to make well-informed decisions. A system administrator ensures the validation of user accounts, chatbot management, offensive language control, and customization orders. The developed system requires a stable internet connection as well as a compatible web browser for optimal performance. The Modified Agile Methodology was widely implemented by the proponents in system development, where iterative flexibility, adaptability, and efficiency in accomplishing tasks without consuming too much time are a priority. The system was assessed on usability, performance efficiency, and reliability and followed ISO 25010 standards: functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. A web-based system that was developed received a rating of 4.64, which interpreted as "Excellent," showing the effectiveness of the system in providing an engaging, reliable, and useful web-based solution for footwear retail and customization.

INTRODUCTION

Background of the Study

In today's digital era, technology has changed how consumers interact with products and make purchasing decisions. One of the most significant innovations is Augmented Reality (AR), which blends digital elements with the real world, improving user experiences across various industries. In retail, AR is reshaping the shopping experience by letting customers to visualize products virtually, reducing the need to visit physical store. In the shoe industry, AR-powered applications allow consumers to see at 3D models or try on footwear digitally, helping them preview different models, colors, and fits from the comfort of their homes or any location. This makes shopping more convenient, improves decision-making, and provides a more interactive shopping experience. As AR technology keeps developing, SmartFit bridges the gap between physical and digital shopping, offering a smooth and accessible solution for footwear selection anytime and anywhere.

Several top companies, including Nike, have adopted Augmented Reality (AR) to enhance customer experiences and make business operations more efficient. Nike's AR-powered applications allow users to try on shoes virtually, ensuring they find the right fit before making a purchase (Patov, 2024). This technology reduces return rates, increases customer satisfaction, and boosts online sales. The SmartFit system extends these benefits by not only offering a virtual try-on experience but also assisting businesses in managing stock levels, tracking transactions, optimizing retail operations, and distinguishing between online and physical store inventory. By integrating AR into both the customer experience and internal business processes, SmartFit helps companies improve efficiency, reduce costs, and enhance overall management.

The developed system is a user-friendly platform intended to enhance online shopping of shoes. Users can try shoes on virtually through augmented reality in the platform. Unlike other apps, such as Nike Fit, which only concentrates on sizing. The developed system has a customization feature that allows the users to design their own footwear by choosing basic colors, materials, and styles depending on their personal preference. It also supports products of different shoe shops, offering a broad variety of options instead of single-branders.

The main problem of the study was to develop and implement a web-based system that managed shoe business operations and enhanced the customer shoe-fitting experience through a technology. The study sought answers to how users could register on the platform; how shop owners and employees maintained the stock of shoes in the online catalog; how customers were able to try on shoes using AR feature; how the system handled customization options for shoes and provided cost estimates; how the customers placed their orders; how the customers tracked the status of their orders; how AI-powered customer support assisted customers with their inquiries; how the feedback and ratings were collected and managed; how was report generation implemented within the system.

SmartFit: Augmented Reality-Integrated Footwear Retail and Customization Portal is a web-based system that enhances the AR shopping experience while also managing transactions and inventory. It allows customers to try on shoes virtually and explore various styles while helping to manage stock and track sales more efficiently. The goal of this project is to simplify shoe retail by managing orders, tracking inventory, helping employees, and improving customer experience.

Objectives of the Study

The main objective of the study was to develop and implement an Augmented Reality-Integrated Footwear Retail and Customization Portal with AI-Powered Assistance, which aims to manage footwear shops and enable customers to virtually fit and customize shoes through AR model viewing and an AI chatbot.

Specifically, the study aims to:

- Design a portal that is capable of:
 - a. Allowing all users to register through the registration module;
 - b. Providing shop owners and add employees with an inventory management module to update stock levels and manage the product catalog through inventory module;
 - c. Enabling customers to access the augmented reality website that lets them try on the shoes virtually;
 - d. Offering a basic customization option for shoes that allows customers to personalize their selections and receive cost estimates through the customization module;
 - e. Facilitating customers to place shoe orders easily through the ordering module;
 - f. Implementing a tracking system that allows customers to monitor the status of their shoe orders in real time;
 - g. Integrating AI-powered customer support to assist customers with their inquiries;
 - h. Establishing a feedback system where users can submit ratings and reviews; and
 - i. Creating a report generation to collect data from the system for easy report creation.

- Create a system using Java EE (Jakarta EE), DeepAR, Firebase, an internet connection, and Windows OS (10 or 11) as software requirements and a desktop computer, laptop, printer, router, and a mobile device as a hardware requirements.
- Test and improve the system in terms of functional suitability, usability, maintainability, and security.
- Evaluate the performance of the system based on ISO 25010 characteristics such as functional suitability, maintainability, usability, performance efficiency, compatibility, reliability, security, and portability.

Scope and Limitations of the Study

The developed SmartFit: Augmented Reality-Integrated Footwear Retail and Customization Portal with AI-Powered Assistance enhances the online footwear retail process by providing a web-based system that integrates augmented reality and artificial intelligence to offer an interactive and efficient shopping experience, allowing customers to browse shoe models and customize them, track orders, and receive AI-driven customer support, and ensuring that shop owners and employees can efficiently manage inventory, process orders, and update product availability.

The developed system enabled users to register on the platform by completing a sign-up form to create an account. It allowed the shop owners and employees to efficiently manage shoe inventory, process orders, and update product availability. Authorized employees could track transactions, monitor stock levels, and oversee customization requests, ensuring a streamlined and efficient retail experience.

With the integration of augmented reality integration, registered customers could virtually interact and visualize shoes before making a purchase, allowing them to explore basic styles, colors, and designs in real time.

Through the use of the ordering system, customers could easily place shoe orders through a user-friendly interface that simplified the purchasing process. Shop owners and employees managed orders, updated product availability, and processed transactions.

Through the use of the customization feature, customers could personalize their shoe selections by picking designs, colors, and materials while receiving cost estimates. Shop owners and employees checked these customization requests; made sure they were possible and processed personalized orders efficiently.

Through the use of the order tracking system, the customers monitored the status of their purchases in real time. Shop owners and employees updated order statuses to keep customers informed about the progress of their purchases.

Through the integration of AI-powered customer support, customers received prompt and precise answers for their inquiries. Also, the feedback system allowed the customers to submit ratings and reviews, providing valuable insights into product quality and service satisfaction. Lastly, the system featured report generation, enabled shop owners and employees to collect and organize data for effective analysis of sales, inventory, and customer feedback.

The web-based system ensured that only the shop owner and authorized employees can access the records within the system. For inventory, stock updates were based on the input of authorized employees only. The augmented reality feature allowed customers to visualize shoes but did not provide an exact fit measurement. AI-powered customer support assisted with basic inquiries but did not replace human customer service for complex concerns. The shoe customization options were available based on predefined models, and fully custom designs were not supported. The user was required to have a compatible mobile device. The system did not manage payment transactions.

The proponents have used the required software suitable for the system. The developed system used Java EE (Jakarta EE) for backend development, DeepAR for augmented reality features, and

Windows 10 or 11 as its operating system. Also, Firebase is used as the database in order for the developed system to work properly. At the same time, a computer system such as a desktop or laptop with the required software and a working browser should also be provided.

The developed system is evaluated using ISO 25010, which includes eight main quality characteristics: functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. The proponents interviewed one hundred (100) individuals as respondents. The target respondents consist of five (5) shoe retail shop owners, ten (10) employees, thirty (30) customers, and fifty-five (58) students, for a total of one hundred (103) respondents.

Methodology

The system that was developed have used an Agile-based approach, focsuing on flexibility, teamwork, and continuous deployment. Agile enables the team to work in cycles, with system functionalities like Augmented Reality integration, AI support, and footwear customization segmented into manageable modules and implemented as sprints. This approach allows for continuous user feedback and fast adjustments, ensuring the system remains aligned with changing objectives and user requirements. Although some planning was done at the outset to establish the scope of the project, emphasis was still placed on flexibility and responsiveness. Development and testing were done simultaneously so that the team could maximize efficiency while continuously refining the system via real-time feedback and incremental enhancements.

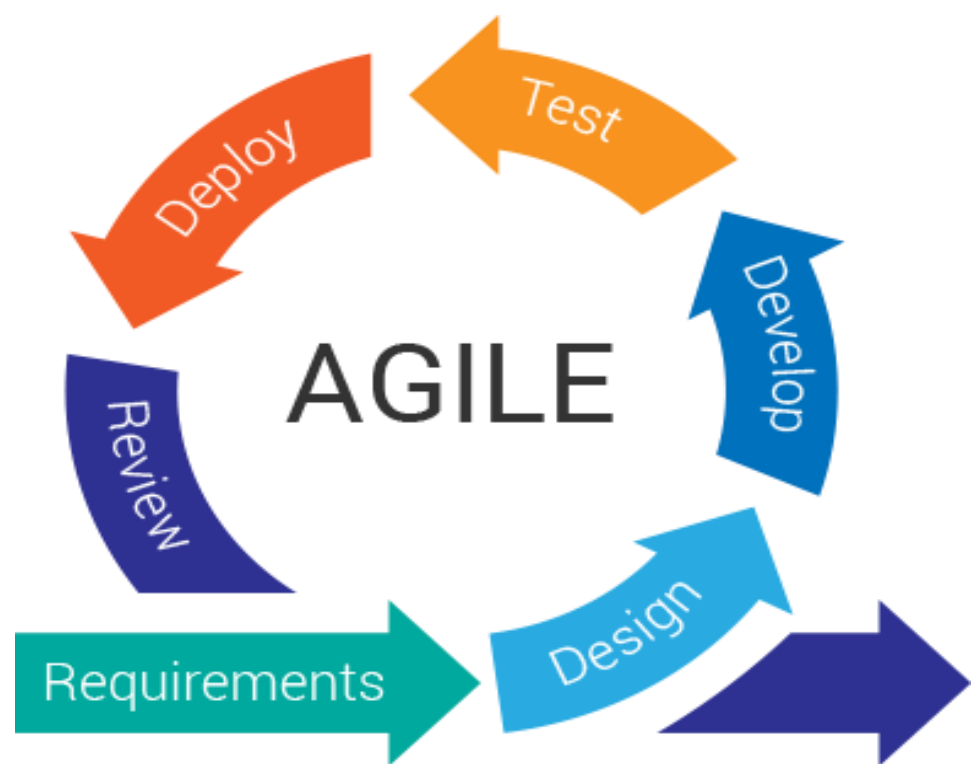


Figure 1.0 Agile Model

Reference: <https://medium.flutterdevs.com/what-is-agile-methodology-in-mobile-app-development-fa83ed6ac09>

1. Requirements

Asana (2021) specified that gathering requirement is a detailed process of identifying all the specific needs of a project from the beginning until the end. This process occurs during the project initiation phase, but it is essential to keep checking and updating these project requirements throughout the entire duration of the project.

In this phase, the proponents determined essential features for the developed system by combining AR and AI capabilities before collecting user input. This ensures that the system achieved both user expectations and project objectives.

2. Design

Senarath (2021) defined that system design involves taking the needs of the users into detailed plans that guide the development process. This planning helps in defining the system structure, the way users interact with it, and how the system behaves. It ensures that the technical aspects match the functional needs before the deployment.

During this phase, the proponents created the developed system framework and structure of the system including the interface, to ensure all parts like virtual fitting options and customization features were integrated properly. The design phase mainly focuses on establishing the user interface, making sure that the design aligns the functional specifications of the project.

3. Develop

Asana (2024) summarized that an implementation plan, or strategic plan, is a complete outline that details the necessary steps for a team to achieve common objectives. This plan includes important parts such as overall strategy, the process involved, and the actions required. It covers all parts of the project, from scope to the budget. The guide explains the concept of an implementation plan and provides useful guidance on how to develop one effectively.

The proponents began coding and developing the system's architecture and layout during the design phase. In this phase, the proponents created a user interface to align the system's functional requirements.

4. Test

Bensaid et al. (2025) mentioned that in classical models such as V-model, software testing requires a strict order of stages and testing processes to check every part of the development. These models help keep software quality high by checking and verifying things early in the development process.

The testing process makes sure that all features of the developed system work as their intended purposes. The proponents executed unit and integration testing to both confirm system functionality and track down defects and verify performance expectations.

5. Deploy

As highlighted by Sable (2023), deployment is one of the critical phases within the software development cycle where the software program or system is released and made available to users. It involves the installation, configuration, and activation of software within the intended environment to ensure seamless integration and optimum performance.

The proponents have deployed the developed system for integration into the user environment. In this phase, user setup and configuration work followed system deployment to enable public implementation of the system.

6. Review

According to Joshi et al. (2021), the review phase in Agile methodology is one of the most important processes since it involves reflection on the tasks that are carried out, noting any difficulties, and strategizing on what can be done better the next time. This phase incorporates technical and group feedback-based practices of gathering, measuring, and adapting the planning as well as improve the

overall effectiveness and efficiency of the project. Moreover, the review step can facilitate corrective as well as proactive measures to guarantee that the development process follows project objectives and becomes more effective over the time.

In this stage, the project is successful based on periodic team reflections and enhancements after every cycle. The proponents implemented reviews to define what worked, issues the proponents faced, and suggestions on improvements. The continuous process assists in keeping the project-related goals attuned, enhances effective teamwork, and ensures that the developed system remains effective in serving the needs of its users as they change and develop.

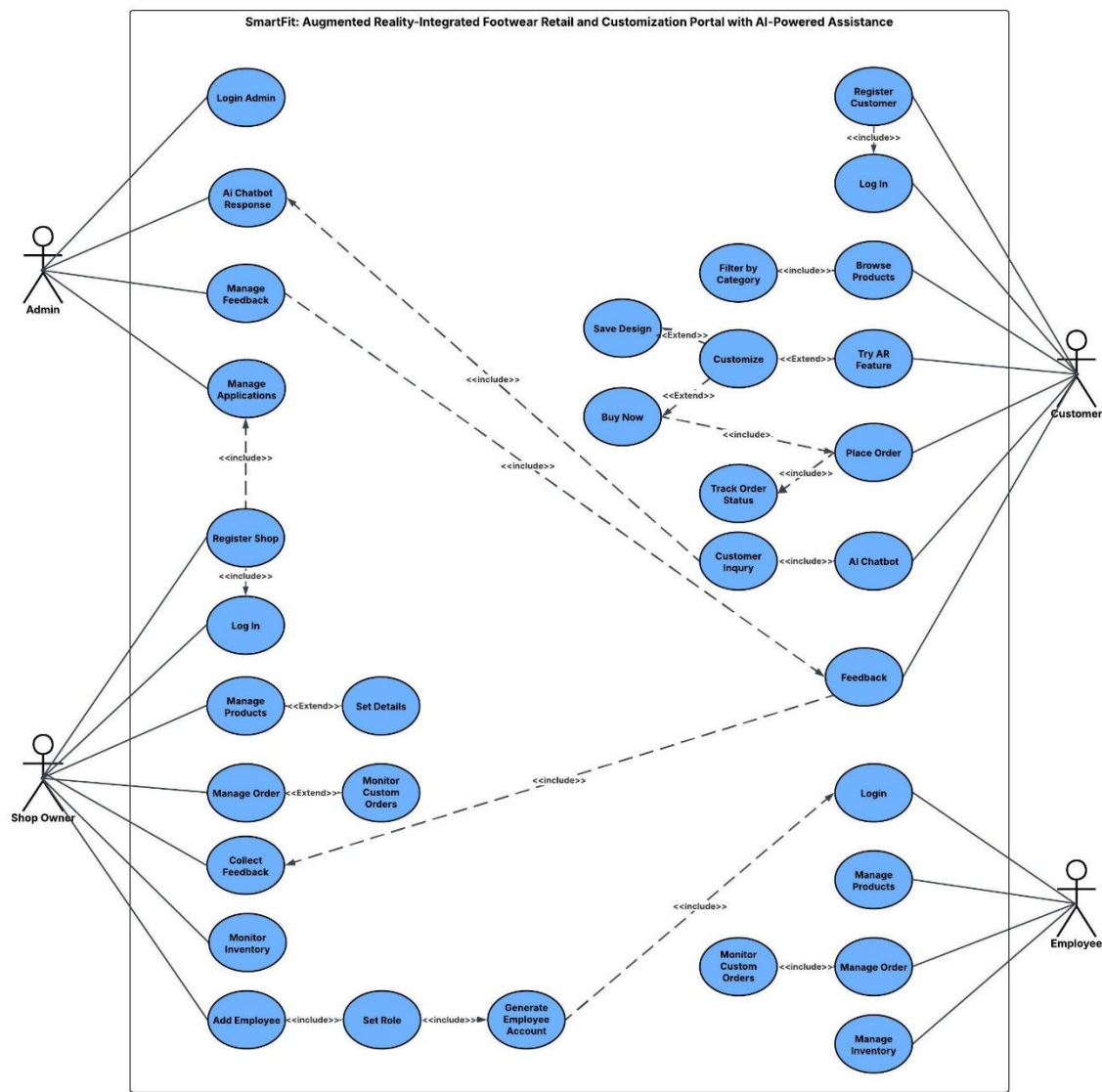


Figure 2.0 Use Case Diagram

Figure 2 shows the use case diagram of the SmartFit platform which is an augmented reality integrated footwear retail and customization portal with AI enhanced support. There are four key actors accommodated by the system; Customer, Shop Owner, Employee, Admin. Customers are able to register or log in, browse and filter products, make use of the AR feature through the website, place and track orders, manage their cart and profile, provide feedback and engage the AI chatbot. Shop Owners can register their shop, upload documents to be approved and once approved can operate on products, orders, inventory, receive low stock alerts and add employees. Employees have the same set of functionalities that a shop owner would have, such as product admin, order management and stock monitoring. But managers only have access to sales records. Also, employees are not allowed to add other employees. The Admin helps to check and approve or reject shop owners' applications with correct

notification, administers AI chatbot responses by adding, editing or deleting entries to provide smooth communication in the platform.

RESULTS AND DISCUSSION

Project Description

SmartFit is a two-way technology that combines the use of augmented reality (AR) and artificial intelligence (AI) in improving the experience of footwear customization and the retail industry. It allows customers to virtually try on shoes and customize designs. The store owners also can use the system to maintain inventories, monitor sales, and produce timely reports.

The target users of the project are footwear shop owners, employees, and customers seeking an innovative shopping experience.

The developed system offers an easy way for customers, shop owners, and employees to manage shoe shopping and customization. The customer registered an account through the website by providing the necessary details. Once registered, the customer can log in to browse available products, customize shoe designs, view the total cost in real time, and place orders. After receiving the order, the customer can give product reviews and ratings through their account. The customer can open an Augmented Reality feature through the website to test out shoes virtually after which they can choose to purchase. In case of queries, the customer may consult the AI-powered chatbot available on the website.

The shop owner have registered an account through the website and log in to manage their online store. They can add new shoe listings by providing product details, images, and prices. They are also able to adjust inventory, change the product details, and remove products. The owner of the shop is able to view details of the order, make changes to the delivery, and ensure that a customer is informed when it comes to customer orders. The shop owner is also able to access the sales records page, where sales of the day, week, or month can be tracked; business performance reports produced; and customer comments consulted in order to enhance services.

The employee logged in through the website using the account provided by the shop owner. They were able to assist with the processing of orders, including confirmation of payment, preparation of the products to ship, and update the delivery statuses. They are also able to help in stock control by adding or removing stock adjustments and availabilities of the items. Employees may also respond to customer inquiries assigned to them by the shop owner.

Summary of Findings

Based on the analysis of data and evaluation results, the findings are as follows:

1. On the result of the evaluation of SmartFit: Augmented Reality-Integrated Footwear Retail and Customization Portal with AI-Powered Assistance
 - 1.1. The Functional Stability characteristics got a mean rating of 4.69 with the descriptive interpretation of Excellent. This means that the system can be very much able to handle its intended purposes. Respondents state that the developed system executes its functions fully, properly, and suitably. They emphasized the effectiveness of the customization of the product process, the correctness of the integration of the augmented reality, and the suitability of the AI support in guiding the customers through the system. In general, the respondents showed satisfaction with the way the system meets its fundamental functional requirements.
 - 1.2. The Performance Efficiency characteristic got a mean rating of 4.6 with the descriptive interpretation of Excellent. The system was praised by the respondents due to the short response time and effective usage of resources. They valued the smooth data manipulation in the process of email verification and AI-driven operations, despite the concomitant presence of several users online. The system proved to be highly capable and efficient, significantly fulfilling user expectations of performance.

- 1.3. The Compatibility characteristic got a mean rating of 4.66 with the descriptive interpretation of Excellent. Respondents confirmed how the system seamlessly integrates with different devices and web browser. However, compatibility is essential for certain features like AR try-on, which is only supported on mobile devices through WebAssembly (Wasm) and WebGL. They emphasized the ability of the system to work in a wide range of environments without contradiction, which made it flexible and available. Also, the interoperability of the system ensures easy intermodule communication that also improves user experience.
- 1.4. The Usability characteristic got a mean rating of 4.66 with the descriptive interpretation of Excellent. The respondents expressed satisfaction with the design of the user interface, describing it as being very attractive, user-friendly, and easy to use. They highlighted the functionality of system's features, the ease with which they could customize, and the effectiveness of AI assistant in guiding them. The system was also noted for its ability to minimize user errors and facilitate quick learning, thus making it a highly user-friendly platform.
- 1.5. The Reliability characteristic was rated on average 4.61, which is interpreted as Excellent. The users observed that the SmartFit platform operates smoothly, consistently accessible, and performs reliably during testing. They appreciated the system's ability to function effectively even when several individuals are using the system simultaneously. The backup features also ensured that important data was not lost when there were outages. This demonstrates that it is a highly reliable system and continues to offer reliable service.
- 1.6. The Security characteristic got a mean rating of 4.66 with the descriptive interpretation of Excellent. The security measures highlighted by the respondents, including the privacy of personal information in the system, data integrity, and the authentication process, were appreciated. Specifically, users noted that after completing the registration, they received an email verification to verify their account before accessing the dashboard. They also felt assured that the system's accountability and non-repudiation features give them with confidence when making transactions. In general, users felt confident that their communications and data were secure within the system.
- 1.7. The Maintainability characteristic got a mean rating of 4.59 with the descriptive interpretation of Excellent. Respondents highlighted that SmartFit is well-structured and can be easily modified and adapted to future improvements. They emphasized the system's modularity and reusability of its components, which simplifies testing and updating. Additionally, users appreciated the basic customization option that allows them to personalize their selections, as well as the easy control over the chatbot assistant. These features contribute to the system's maintainability, making it suitable for long-term usage.
- 1.8. The Portability characteristics got a mean rating of 4.66 with the descriptive interpretation of Excellent. The respondents noted that the system can be easily adapted to multiple environments and devices without any difficulties, as they were familiar with the recommended browsers that can be used with the system. They also praised the simplicity of the installation process and the ease with which system can be modified or updated. The system's ability to support virtual interaction and real-time visualization of shoes, including basic styles, color, and designs, was also appreciated. These results confirm the fact that the system is very portable and can support the same performance under a variety of technological conditions.

Conclusion

1. SmartFit: An Augmented Reality-Integrated Footwear Retail and Customization Portal With AI-Powered Assistance was developed to give customers a new opportunity to order shoes online. This system enables customers to use a virtual fitting to try shoes on, design them in accordance with their styles and preferences, and receive assistance with an AI-powered chatbot. Users can create and manage accounts, and the system has secure verification to conduct safe transactions. It also allows the shop owners and employees to keep track of inventory, take orders, and update the availability of products. Also, the augmented reality feature allows the customers to preview shoes prior to purchase, and the AI-powered chatbot is responsible for answering customers' inquiries.

Sales, inventory, and feedback of the shop can be analyzed and generated reports. Also, the system enables customers to make orders, monitor purchases, customize shoes, and leave ratings and reviews. Lastly, the system administrator is responsible for validating shoe products and shop owner accounts. The admin also maintains the AI chatbot, custom order management, and feedback checking to eliminate inappropriate language.

2. SmartFit: An Augmented Reality-Integrated Footwear Retail and Customization Portal with AI-Powered Assistance was built on Java EE (Jakarta EE) as the backend development framework, DeepSeek for the augmented reality feature, and Firebase as the database and runs on Windows 10 or 11. Hardware requirements include a desktop, laptop, printer, router, and a mobile device.
3. SmartFit: An Augmented Reality-Integrated Footwear Retail and Customization Portal with AI-Powered Assistance was tested and enhanced with regard to usability, performance, efficiency, and reliability. The system achieved the anticipated outcome and succeeded. the specifications following its testing using the determined criteria of evaluation and test script forms.
4. SmartFit: An Augmented Reality-Integrated Footwear Retail and Customization Portal with AI-Powered Assistance was evaluated using ISO 25010 that follows the following criteria: functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. It received an overall mean rating of 4.64 with an interpretation of "Excellent".

Recommendations

Based on the foregoing conclusions, the following are recommended for the further improvement of the project:

1. To implement SMS or push notifications for order updates, promotions, and system alerts.
2. To integrate API connection for digital payment gateways.
3. To provide multi-currency support for digital payments.
4. To adopt phased implementation by initially focusing on core features, such as AI-powered sizing recommendations from SafeSize, Perfitt, and mySHOEFITTER, then expanding AR virtual try-on and full customization.
5. To explore partnerships with Augmented Reality (AR) or Artificial Intelligence (AI) technology providers.
6. To establish partnerships with multiple shoemakers to expand the product availability.
7. To incorporate multi-language support for global market expansion and help non-native speakers use the service easily.