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Design and Development of an AI-Assisted Recommendation System for Batik Selection in MSMEs Using the Scrum Framework

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ABSTRACT
Digital transformation has become an essential strategy for Micro, Small, and Medium Enterprises (MSMEs) to enhance competitiveness and improve customer experience in the digital marketplace. However, many batik MSMEs still rely on conventional sales methods and lack intelligent features that assist customers in selecting products suited to their personal characteristics and intended occasions. This study presents the design and development of an AI-assisted web-based recommendation system for Batik Srimanganti using the Scrum framework. The proposed system collects user information, including gender, height, weight, preferred occasion, and an optional facial photograph to perform rule-based filtering that identifies the most relevant batik products. The filtered results are subsequently processed using the Google Gemini Application Programming Interface (API) to generate personalized recommendation explanations, thereby improving user understanding and confidence during product selection. The Scrum framework was adopted to support iterative development through product backlog management, sprint planning, implementation, review, and retrospective activities. The developed system was evaluated using Black Box Testing to verify functional correctness and User Acceptance Testing (UAT) conducted with the business owner to assess the system's suitability for supporting business needs. The evaluation results demonstrate that the proposed system successfully supports batik product selection, provides personalized recommendation explanations, and contributes to the digital transformation of batik MSMEs through an AI-assisted recommendation approach.

Keywords: AI-assisted recommendation system, batik MSMEs, digital transformation, Google Gemini API, Scrum framework

I. Introduction

Digital transformation has become a strategic priority for Micro, Small, and Medium Enterprises (MSMEs) as digital technologies continue to reshape business operations, customer engagement, and market competitiveness. The adoption of digital platforms enables MSMEs to improve operational efficiency, expand market reach, and deliver customer-oriented services that create greater business value. Recent studies have highlighted that successful digital transformation requires not only technology adoption but also the integration of digital solutions into business processes to enhance organizational performance and long-term sustainability [1],[2].

In Indonesia, the batik industry represents one of the most important sectors of the creative economy, with thousands of MSMEs contributing to employment opportunities and regional economic development. Despite its economic significance, many batik MSMEs still rely on conventional sales approaches and

simple digital catalogues that provide limited assistance during the product selection process. Customers often experience difficulties in choosing batik products that match their physical characteristics, intended occasions, and personal preferences. As a result, purchasing decisions frequently depend on subjective judgment or direct consultation with sellers, which may reduce shopping efficiency and overall user experience [3],[4].

Several studies have proposed web-based information systems, e-commerce platforms, and recommendation systems to support the digital transformation of MSMEs. Agile software development methodologies, particularly the Scrum framework, have also been widely adopted to improve collaboration, accelerate software delivery, and accommodate changing user requirements throughout the development process. Meanwhile, recommendation systems have become increasingly important in assisting users with product selection by analyzing user preferences and product characteristics. However, most existing studies primarily focus on presenting recommended products without providing personalized explanations that help users understand why specific products are recommended. Furthermore, only limited research has explored the integration of Large Language Models (LLMs) into recommendation systems to improve user interaction and recommendation transparency [5],[6].

To address these limitations, this study proposes an AI-assisted batik recommendation system developed using the Scrum framework. The proposed system collects user information, including gender, height, weight, preferred occasion, and an optional facial image. Rule-based filtering is first employed to identify batik products that match the user's characteristics. Subsequently, the filtered results are processed using the Google Gemini Application Programming Interface (API) to generate personalized recommendation explanations, enabling users to better understand the suitability of each recommended batik product. Rather than replacing the recommendation mechanism, Gemini enhances the interpretability of recommendation results by generating natural-language explanations based on the selected products and user profiles [7],[8].

The developed system was implemented as a web-based recommendation platform and evaluated using Black Box Testing and User Acceptance Testing (UAT) to verify functional correctness and assess its suitability for supporting the operational needs of Batik Srimanganti [9][10]. Based on the identified research gap, this study makes the following contributions:

- Develops an AI-assisted batik recommendation system that combines rule-based filtering with the Google Gemini API to generate personalized recommendation explanations.
- Implements the Scrum framework to support iterative, stakeholder-oriented, and adaptive software development.
- Supports the digital transformation of batik MSMEs by providing intelligent recommendation services that enhance customer experience.
- Evaluates the developed system through Black Box Testing and User Acceptance Testing (UAT) to validate its functional performance and practical suitability in a real MSME environment.

II. Related work

A. Digital Transformation in MSMEs

Digital transformation has become one of the key strategies for improving the competitiveness and sustainability of Micro, Small, and Medium Enterprises (MSMEs). Previous studies have demonstrated that the adoption of digital technologies enables MSMEs to optimize business operations, improve customer engagement, and expand market reach through digital platforms. In addition to improving operational efficiency, digital transformation also encourages innovation by integrating intelligent technologies into business processes, enabling enterprises to provide more personalized services and enhance customer experiences. Despite these benefits, many MSMEs still face challenges in implementing digital transformation due to limited technological capabilities, financial constraints, and insufficient digital literacy [11],[12].

B. Recommendation Systems for Product Selection

Recommendation systems have been widely adopted in e-commerce platforms to assist users in selecting products that best match their preferences and needs. Conventional recommendation approaches generally employ collaborative filtering, content-based filtering, or hybrid recommendation techniques to identify products with high relevance. In the context of fashion products, recommendation systems have been developed to consider user preferences, product attributes, and purchasing behavior to improve recommendation accuracy [13]. However, most existing systems focus primarily on recommending products without providing understandable explanations regarding why the products are recommended.

Consequently, users may have limited confidence in the recommendation results, especially when selecting products that involve personal preferences such as batik clothing [14].

C. Large Language Models for Personalized Recommendations

Recent advances in Generative Artificial Intelligence have introduced Large Language Models (LLMs) as powerful tools for enhancing recommendation systems. Unlike conventional recommendation methods, LLMs are capable of generating natural-language explanations that improve recommendation transparency and user trust [15]. Rather than replacing traditional recommendation algorithms, LLMs function as intelligent assistants that provide contextual reasoning and personalized explanations based on user characteristics and recommended products. This capability significantly improves user interaction by making recommendation results more informative and easier to understand [16].

D. Scrum Framework for Web-Based System Development

The Scrum framework is one of the most widely adopted Agile software development methodologies due to its iterative and adaptive development process. Scrum divides software development into short development cycles called sprints, allowing development teams to continuously evaluate user requirements and implement improvements throughout the project lifecycle. Previous studies have shown that Scrum effectively improves collaboration among stakeholders, accelerates software delivery, and increases software quality by incorporating continuous feedback during development [15]. Therefore, Scrum is considered an appropriate framework for developing web-based recommendation systems that require continuous refinement based on user needs.

E. Research Gap

Although several studies have developed recommendation systems for fashion products, most focus solely on improving recommendation accuracy. Few studies integrate explainable AI capabilities through Large Language Models while simultaneously supporting the digital transformation of batik MSMEs using an Agile software development approach.

To address these limitations, this study proposes an AI-assisted batik recommendation system developed using the Scrum framework. The proposed system combines rule-based filtering based on users' physical characteristics and intended occasions with the Google Gemini API to generate personalized recommendation explanations. The integration of these approaches is expected to improve user understanding, increase confidence in recommendation results, and support the digital transformation of batik MSMEs through intelligent web-based services.

Table 1 Comparison of Previous Studies and the Proposed Study.

Reference	Recommendation Method	AI Explanation	Scrum	MSME Case Study
Study [4]	AHP + K-Means	✗	✗	✓
Study [9]	Collaborative Filtering	✗	✗	✗
Study [10]	LLM-based Recommendation	✓	✗	✗
Study [13]	Scrum Development	✗	✓	✗
Proposed Study	Rule-Based + Gemini	✓	✓	✓

As summarized in Table 1, previous studies have investigated recommendation systems, Large Language Models, and Scrum-based software development independently. However, limited research integrates rule-based recommendation, explainable AI through a Large Language Model, and Scrum development within a single web-based platform for batik MSMEs. Therefore, this study addresses the identified research gap by combining these approaches to provide personalized recommendation explanations while supporting the digital transformation of batik MSMEs.

III. Material and Methods

A. Research Method

This study employed the Scrum framework as the software development methodology due to its iterative and adaptive nature, enabling continuous collaboration between developers and stakeholders throughout the development process. Scrum facilitates incremental software development through a series

of short development cycles called sprints, allowing system requirements to be continuously refined based on stakeholder feedback. The development process consisted of five main Scrum activities: Product Backlog, Sprint Planning, Sprint Execution, Sprint Review, and Sprint Retrospective.

The case study was conducted at Batik Srimanganti, a batik MSME located in Sumedang, West Java, Indonesia. Business requirements were identified through direct discussions with the business owner to understand existing business processes, customer needs, and challenges related to batik product selection. These requirements were then translated into user stories and prioritized within the product backlog to guide system development.

As illustrated in Figure. 1, this study follows six sequential stages: problem identification, requirement analysis, Scrum-based development, system implementation, system testing, and system evaluation. The final stage focuses on verifying the functionality of the developed system through Black Box Testing and validating its practical suitability using User Acceptance Testing (UAT) conducted with the business owner.

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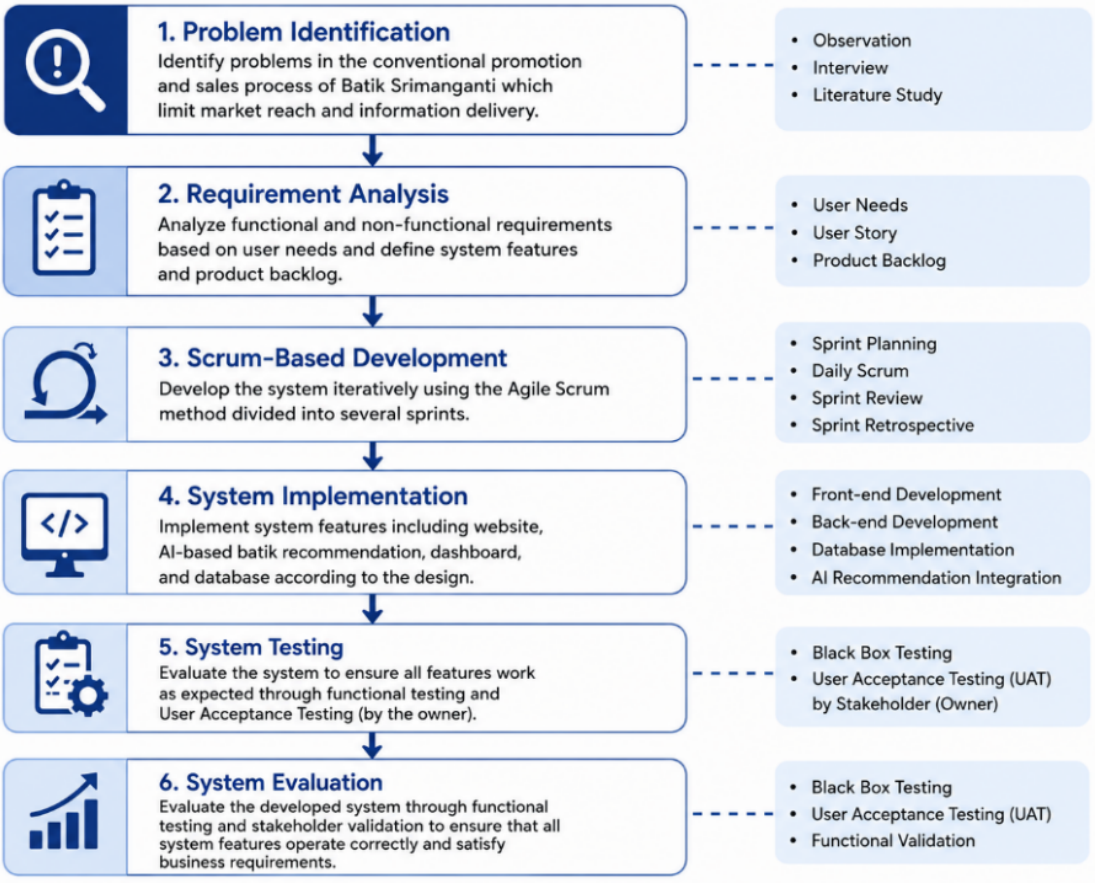


Figure 1. Research Framework

B. System Architecture

Initially, users provide personal information, including gender, height, weight, preferred occasion, and an optional facial photograph. These inputs are processed using a rule-based filtering mechanism to identify batik products that satisfy predefined selection criteria. Rather than directly recommending products using artificial intelligence, the filtered recommendation results are forwarded to the LLM, which generates personalized natural-language explanations describing why each product is suitable for the user's characteristics and intended occasion.

This architecture combines the consistency of rule-based recommendation with the reasoning capability of the AI model, resulting in recommendation explanations that are more informative and easier for users to understand. Figure 2 illustrates the overall architecture of the proposed recommendation system. The architecture integrates user input, rule-based filtering, the Gemini model, and the recommendation interface to provide personalized batik recommendations.

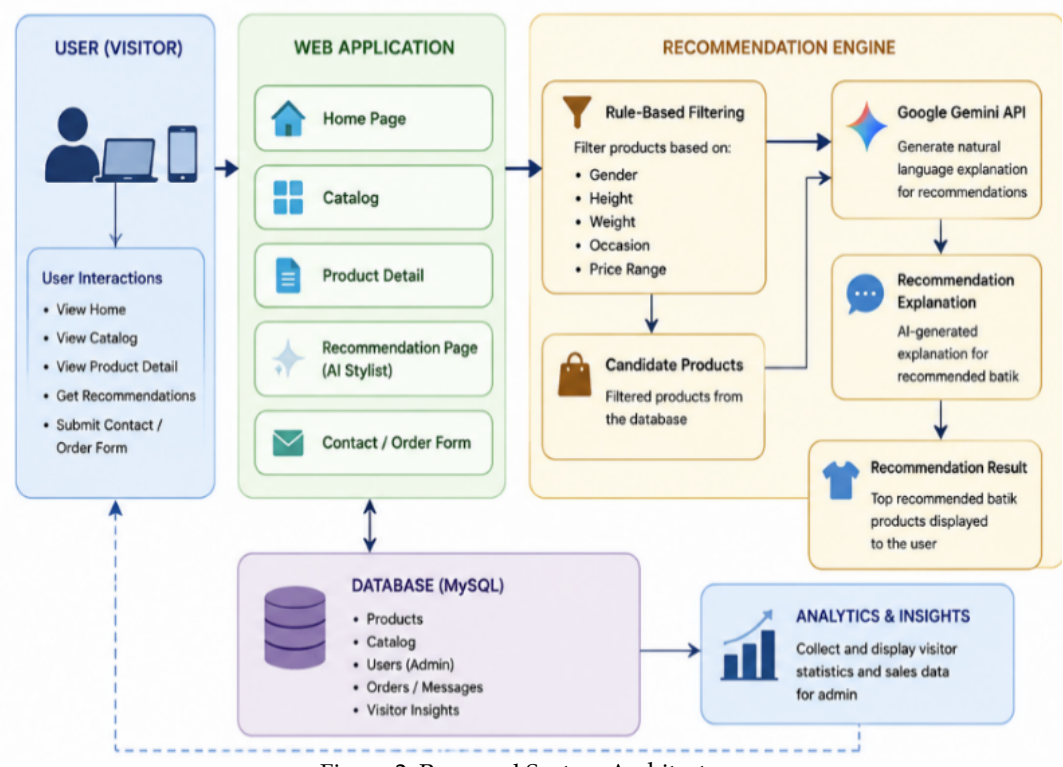


Figure 2. Proposed System Architecture

C. Scrum Development Process

The Product Backlog was established based on functional and non-functional requirements collected from stakeholders. Functional requirements included user authentication, batik catalog management, recommendation generation, order management, and sales reporting. Non-functional requirements included usability, responsiveness, and system performance [17].

During Sprint Planning, backlog items were prioritized according to business value and implementation complexity. Each sprint focused on a specific set of features, enabling incremental system development and continuous stakeholder validation.

Sprint Execution involved implementing both frontend and backend components of the web application, integrating the recommendation module, and connecting the system with the Google Gemini API for explanation generation.

At the end of every sprint, Sprint Review sessions were conducted to evaluate completed functionalities together with stakeholders. Feedback collected during these sessions was incorporated into subsequent sprints. Finally, Sprint Retrospective meetings were performed to evaluate team performance, identify development challenges, and define improvements for the following sprint.

D. Recommendation Mechanism

The recommendation process begins when users submit their personal information through the recommendation page. The system evaluates the user's gender, height, weight, and selected occasion using predefined recommendation rules developed in collaboration with the batik business owner. Products satisfying these criteria are selected as recommendation candidates.

Subsequently, the selected products together with user profile information are transmitted to the Google Gemini API. Instead of determining which products should be recommended, Gemini generates personalized recommendation explanations in natural language for each recommended batik product. These explanations emphasize the compatibility between user characteristics, intended occasion, and the selected batik products, thereby improving recommendation transparency and user confidence.

Figure 4 presents the workflow of the proposed AI-assisted recommendation mechanism. The process begins with user profile submission, followed by rule-based filtering to identify suitable batik products. The selected products are then processed by Gemini to generate personalized recommendation explanations before the final recommendations are presented to the user.

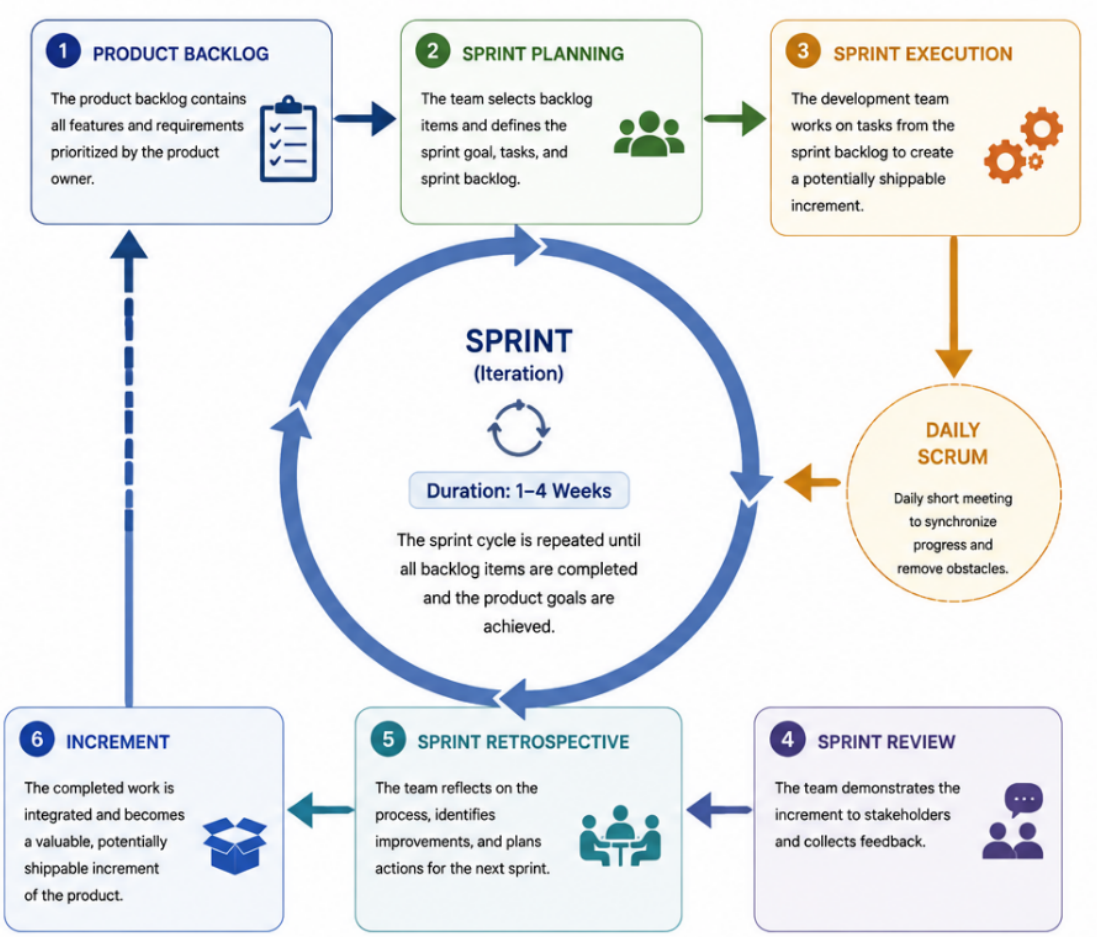


Figure 3. Scrum Development Process

The filtered recommendation results and user profile are transformed into a structured natural-language prompt before being sent to the Google Gemini API. The prompt contains the user's gender, height, weight, preferred occasion, and the list of batik products selected through the rule-based filtering process. Based on this information, Gemini generates personalized recommendation explanations describing why each product is suitable for the user's characteristics and intended occasion. It is important to note that the Large Language Model is not responsible for selecting the recommended products; instead, it functions solely as an explanation generator that improves recommendation transparency and enhances user understanding. This approach combines deterministic rule-based recommendation with the natural-language generation capability of a Large Language Model, resulting in recommendation outputs that are both accurate and easily understandable by users.

E. System Evaluation

The developed system was evaluated using Black Box Testing and User Acceptance Testing (UAT). Black Box Testing was conducted to verify that all implemented system functionalities operated according to the specified functional requirements. Meanwhile, UAT was conducted with the owner of Batik Srimanganti as the primary stakeholder to evaluate whether the developed system satisfied the identified business requirements and supported daily operational activities.

The evaluation results were subsequently analyzed to assess the functional correctness and practical applicability of the proposed web-based batik recommendation system.



Figure 4. AI-Assisted Recommendation Workflow

IV. Results and Discussion

A. System Implementation

The proposed web-based batik recommendation system was successfully implemented using the Scrum framework through iterative development cycles. The system consists of two primary modules: the user module and the administrator module. The user module enables visitors to explore batik products and obtain personalized recommendations, while the administrator module provides functionalities for

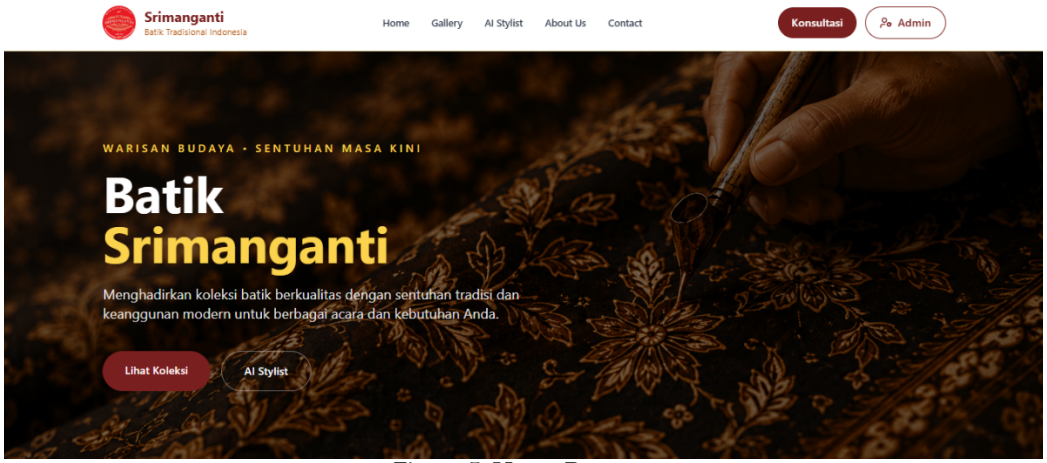


Figure 5. Home Page

managing product information, monitoring website activities, and maintaining business content. The implementation results of each major system interface are presented in Figures 5–10.

Figure 5 presents the home page of the developed website. This interface serves as the primary entry point for visitors by providing information about Batik Srimanganti, featured batik products, and the AI-assisted recommendation feature. The home page was designed with a responsive and user-friendly interface to improve user engagement and simplify navigation across the website.

Figure 6 illustrates the recommendation page, where users provide personal information required for the recommendation process. The collected information includes gender, height, weight, preferred occasion, and an optional facial photograph. These inputs are subsequently processed by the recommendation mechanism to identify suitable batik products before personalized explanations are generated by the LLM.

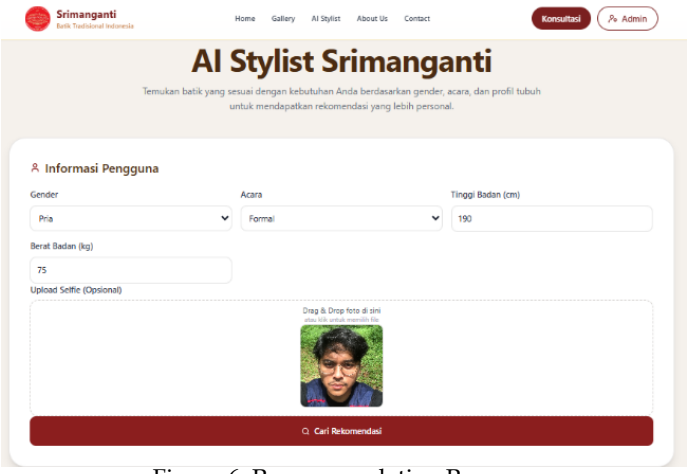


Figure 6. Recommendation Page

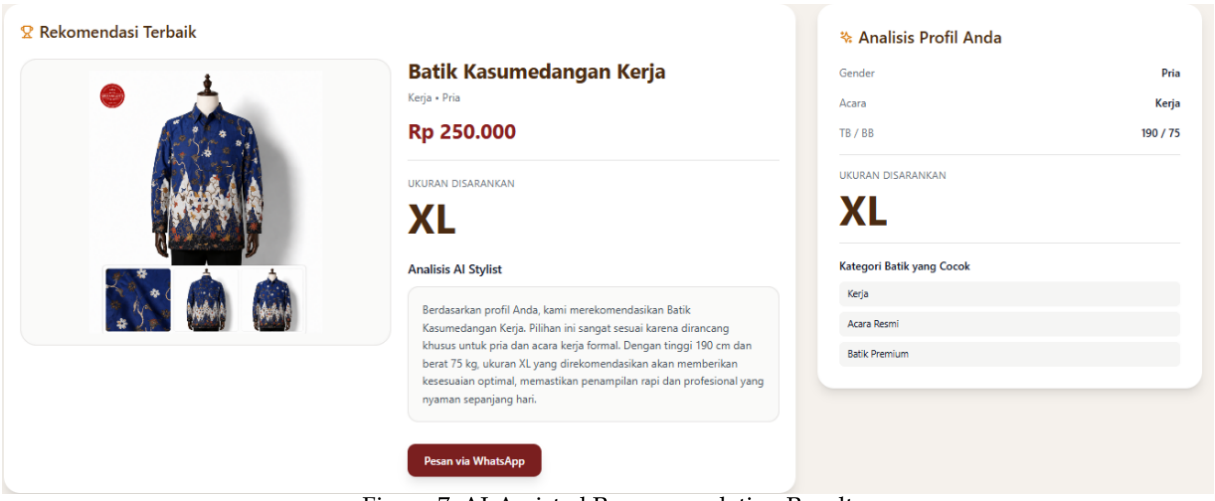


Figure 7. AI-Assisted Recommendation Result

Figure 7 presents the recommendation result generated by the developed system. After the user submits the required personal information, the system first applies rule-based filtering to identify batik products that match the predefined criteria. The filtered recommendation is subsequently processed by the Large Language Model (LLM), which generates a personalized explanation describing why the selected batik is appropriate for the user's profile and selected occasion. This approach improves the transparency of the recommendation process by providing users with understandable and context-aware explanations rather than displaying recommendation results alone.

Figure 8 illustrates the administrator dashboard developed to support the management of Batik Srimanganti's digital platform. The dashboard provides a centralized interface that summarizes essential information, enabling administrators to monitor website activities and access management features

efficiently. This interface simplifies administrative tasks and supports daily operational management through an organized and responsive web dashboard.

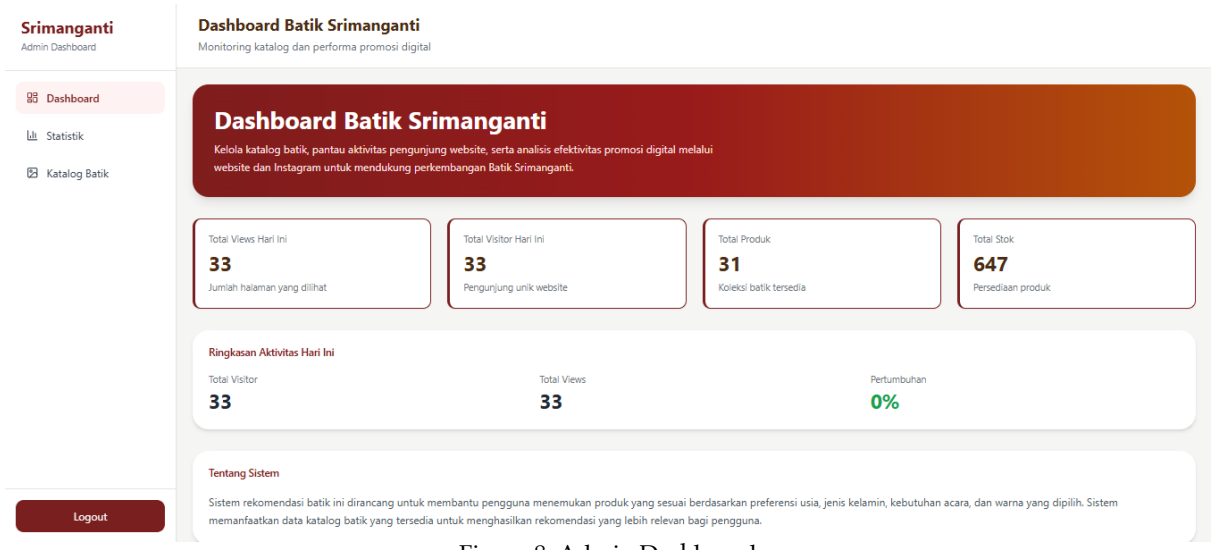


Figure 8. Admin Dashboard

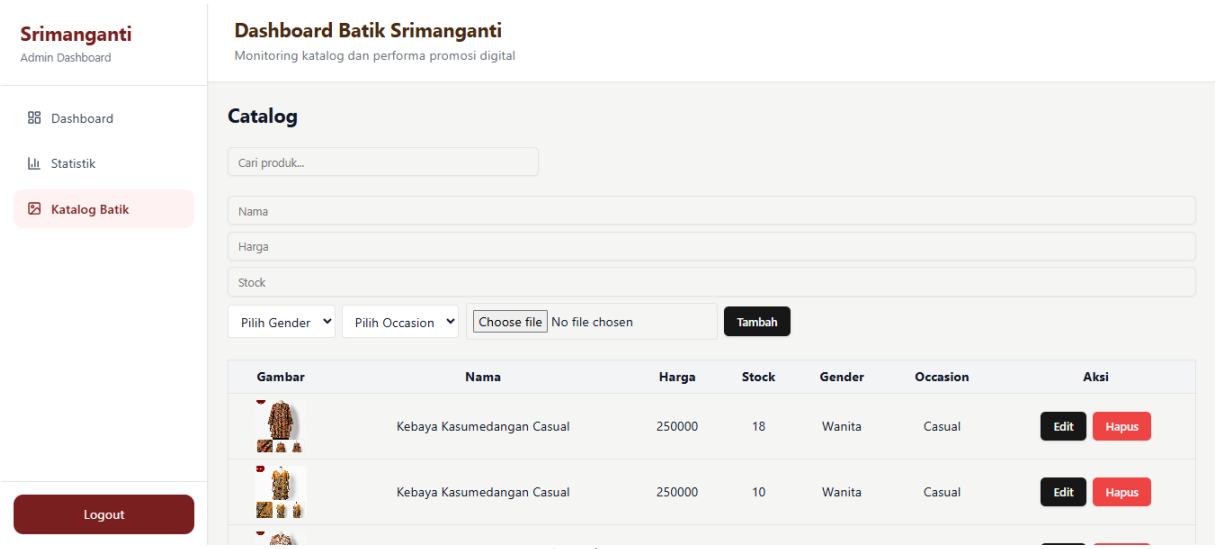


Figure 9. Catalog Management

Figure 9 presents the catalog management interface used by administrators to maintain batik product information. The module supports Create, Read, Update, and Delete (CRUD) operations, allowing administrators to manage product names, descriptions, prices, stock availability, product images, and other relevant information. This functionality ensures that the recommendation system always utilizes up-to-date product data when generating recommendations.

Figure 10 presents the website statistics dashboard, which provides administrators with insights into visitor activity on the developed platform. The dashboard records website traffic and visitor statistics over time, enabling administrators to monitor user engagement and evaluate website utilization. Although these statistics are not directly involved in the recommendation process, they provide valuable supporting information for assessing the effectiveness of the implemented digital platform and assisting future decision-making.

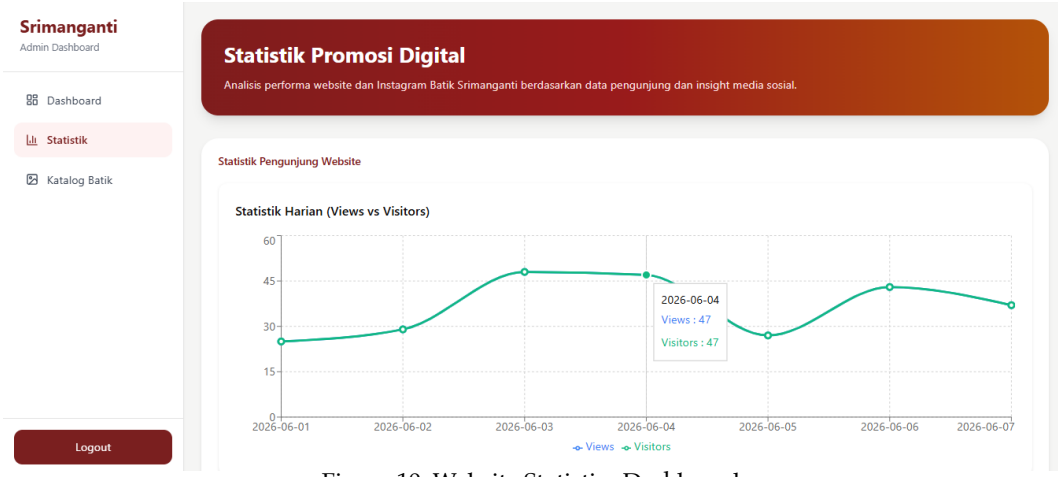


Figure 10. Website Statistics Dashboard

B. System Testing and Validation

The developed system was evaluated through Black Box Testing and User Acceptance Testing (UAT) to verify both the functional correctness of the application and its suitability for practical use within Batik Srimanganti. Black Box Testing focused on validating whether each system function operated according to the specified requirements, while UAT was conducted with the owner of Batik Srimanganti as the primary stakeholder to evaluate whether the implemented system met the identified business needs.

Table 2 Black Box Testing Results

No.	Tested Feature	Expected Result	Test Result
1	Admin Login (Valid Credentials)	Administrator successfully accesses the dashboard	Pass
2	Admin Login (Invalid Credentials)	Error message is displayed	Pass
3	Dashboard	Dashboard information is displayed correctly	Pass
4	Add Product	New product is successfully stored	Pass
5	Edit Product	Product information is successfully updated	Pass
6	Delete Product	Product is successfully removed	Pass
7	Website Statistics	Visitor statistics are displayed correctly	Pass
8	Home Page	Visitor statistics are displayed correctly	Pass
9	Product Catalog	Product catalog is displayed correctly	Pass
10	Product Detail	Product details are displayed correctly	Pass
11	Order/Contact Form	User is redirected to WhatsApp successfully	Pass
12	AI-Assisted Recommendation	Recommendation results are generated successfully	Pass
13	Logout	Administrator successfully logs out	Pass
14	Business Profile	Business profile information is displayed	Pass

As presented in Table 2, all tested system functionalities operated successfully according to the predefined functional requirements. Every tested feature, including administrator authentication, catalog management, AI-assisted recommendation, website statistics, and customer interaction modules, produced

the expected results without functional errors. These findings indicate that the developed web application satisfies the specified functional requirements and is ready for practical implementation.

Table 3 User Acceptance Testing Results

Evaluation Aspect	Assessment Result	Remarks
Functional Suitability	5	All features operated as expected
Ease of Use	5	The system was easy to operate
Recommendation Feature	5	Recommendation explanations were considered useful
Catalog Management	5	Product management features worked properly
Overall System	5	The system met the business requirements

User Acceptance Testing (UAT) was conducted with the owner of Batik Srimanganti as the primary stakeholder. The evaluation assessed five aspects, namely functional suitability, ease of use, recommendation functionality, catalog management, and overall satisfaction, using a five-point assessment scale. As presented in Table 3, the stakeholder assigned the highest score (5/5) to all evaluated aspects, indicating that the developed system fulfilled the identified business requirements and was considered suitable for supporting daily business operations.

C. Discussion

The implementation results demonstrate that the proposed AI-assisted recommendation system successfully supports the digital transformation of Batik Srimanganti by providing personalized batik recommendations through the integration of rule-based filtering and a Large Language Model (LLM). Unlike conventional recommendation systems that rely solely on recommendation algorithms, the developed approach enhances recommendation transparency by generating personalized explanations that help users understand why specific batik products are recommended.

The adoption of the Scrum framework also contributed significantly to the successful development of the system. Through iterative development cycles and continuous stakeholder involvement, system functionalities could be refined according to evolving business requirements. This development approach enabled efficient implementation while ensuring that the final system aligned with the operational needs of Batik Srimanganti [18].

Compared with previous studies, this research integrates three important aspects within a single web-based platform: rule-based recommendation, explainable recommendation using a Large Language Model, and Agile software development through Scrum. This combination not only improves recommendation quality but also provides practical support for MSMEs seeking to adopt digital technologies for customer service and product promotion.

V. Conclusion

This study successfully designed and developed an AI-assisted batik recommendation system for Batik Srimanganti using the Scrum software development framework. The proposed system integrates rule-based filtering with a Large Language Model (LLM) to provide personalized recommendation explanations, enabling users to better understand the suitability of recommended batik products based on their personal characteristics and intended occasion. The implementation results demonstrate that the developed web-based platform successfully supports product management, personalized recommendation services, and website administration. Furthermore, system validation through Black Box Testing and User Acceptance Testing confirmed that all implemented functionalities operated correctly and satisfied the stakeholder's business requirements. Overall, the proposed system contributes to the digital transformation of batik MSMEs by improving customer experience and supporting more effective digital service delivery. Future work may incorporate computer vision techniques and advanced recommendation algorithms to further improve recommendation accuracy and personalization.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Author Contributions Statement

Putra Dinnur Rohman conceived the research idea, designed the system architecture, implemented the web-based recommendation system, integrated the Google Gemini API, conducted system testing and

evaluation, analyzed the research findings, and prepared the manuscript. Fidi Supriadi and David Setiadi supervised the research, provided methodological guidance, reviewed the manuscript, and approved the final version for publication.

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