Implementation of Prototyping Method in Web-Based POS System Development for MSMEs: A Case Study in Airmadidi District, North Sulawesi, Indonesia.

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Abstract. This study aims to design a web-based Point of Sale (POS) system for MSMEs in Airmadidi District, North Sulawesi, Indonesia using the prototyping method. This POS system was developed to address the challenges faced by MSMEs in managing sales transactions, stock recording, and financial reporting quickly and accurately in the era of digital transformation. This study mapped user needs, designed the system interface, developed a prototype, and conducted direct evaluations with MSMEs to ensure the resulting system truly meets real-world needs. A descriptive method is employed with a prototyping approach in five stages, namely communication, quick planning, quick design, prototype development, as well as testing and feedback. The results of this study indicate that the developed POS system aligns with user needs, featuring key functionalities such as product management, sales transactions, payment processing, and data recap, all operating effectively. The system is also considered user-friendly, easy to access, and supports the operational efficiency of small and medium-scale MSMEs. The system's relevance to user needs is achieved through iteration and direct user involvement in each phase. Thus, the application of the prototyping method provides a relevant experience and a system that is adaptive to the needs of MSMEs, while also supporting business digitalization more effectively, efficiently, and sustainably.

Keywords: Digital Tranformation, MSMEs, Point of Sale (POS), Prototype Methode, System Development, Web-Based

1. Introduction

Currently, Micro, Small, and Medium Enterprises (MSMEs) play a significant role in the economy as they are the primary source of job creation and poverty reduction(Srijani 2020). They promote innovation, economic equity, and demonstrate resilience in times of crisis, thereby helping to maintain economic stability(Arifin, Ningsih, and Putri 2021). MSMEs have a vital role in economic growth and income distribution, making them indispensable to sustainable and equitable economic development(Endris and Kassegn 2022). However, many MSMEs still have difficulty becoming digital, particularly when it comes to managing operational data and transactions, which are often completed by hand using paper or conventional cash registers.(Susilo 2017). This approach is ineffective, prone to mistakes, and makes it more difficult to find and publish reliable data(Coastera et al. 2023). Because of that, digitalization and appropriate technical is important to improve efficiency and

competitiveness(Susilo 2017). Is Important solution to implement a web-based Point of Sale (POS) system that is tailored to needs and scalability of the organization, because this way it can enable automation in reporting and transaction process, minimize operational work time, minimize errors, and increase overall efficiency.(Herdiansyah et al. 2021), (Gede et al. 2021).

Digital transformation has become an important requirement for MSMEs to improve operation efficiency and increase market competitiveness(Gaol 2024). However, at the beginning of a project, user needs are often unclear because of limited knowledge about the necessary digital solution. This creates the need for a step-by-step system development approach that focuses on identifying user requirements to ensure the result truly meet MSME needs(Permatasari et al. 2025). In this case, a flexible development method such as prototyping is an effective choice, as it enables system to be built in stages, involves user from the start, and support testing and modifying features based on direct feedback(Camburn et al. 2017). Thus, the development system is able to adapt to changes and effectively address the real challenges faces by MSMEs during the digitalization process(Real et al. 2021). The example can be seen in MSMEs in Airmadidi District, North Sulawesi, which have advanced by blending local traditional with innovation(Tedjo, Rengkung, and Tangkere 2023). Observation reveals issues such as transaction recording, inventory control, and purchase history tracking that require immediate solution. Applying an appropriate POS information system is a strategic move to resolve these problems while also enhancing MSME efficciency and competitiveness in the market(Karamoy and Tirayoh 2022).

Many studies have demonstrated the advantages of using the prototyping approach in creating system that focus on user needs. For example, research on information system in healtcare and education services has shown that prototyping accelerates the process of identifying requirements and increases end-user satisfaction(G. E. Saputra, Utomo, and Wiseno 2022). Through continuous feedback cycle, this approach also promotes active collaboration between users and development in web-based system, leading to solutions that align more closely with user expactions(Asri et al. 2020). However, most existing research emphasizes large-scale enterprises or technical aspects without directly considering the views of MSME users (Hendrawan et al., 2024). Therefore, further studies are needed on how to apply the prototyping approach effectively in building simple yet essential digital system for MSMEs.

Considering these issuese, it is essential to develop a web-based POS information system using the prototyping method, aimed at assisting MSME owners, particularly street vendors, in solving the identified challenges. By applying the prototyping approach, the system will be built in stages with user involvement from the initial phases to ensure that the features align with actual needs. The system is expected to boost efficiency in terms of time, labor, and costs, reduce errors and potential losses, and improve the accuracy of information. Furthermore, it is designed to enhance transaction handling and report generation, support user history management, and produce precise reports. The goal is to provide significant benefits for entrepreneurs in their strategic decision-making processes for the growth of their businesses.

2. Literature Review

2.1. Digitalization of MSMEs and the Need for POS Systems

Micro, Small, and Medium Sized Businesses (MSMEs) must be digitized immediately to increase operational effectiveness and maintain their competitiveness in the digital economy. Installing Point of Sale (POS) systems is one of the most important phases in the procedure

since they can take the role of manual techniques for financial reporting, transaction recording, and inventory control. Point-of-sale (POS) systems that are compatible with digital payment technologies and available on several platforms provide business owners simplicity and use(Briliansyah and Avianto 2024).

The COVID-19 pandemic, which accelerated the shift in consumer behaviour towards online platforms and significantly expanded the usage of e-commerce, has also made digital solutions like point-of-sale (POS) extremely crucial. Therefore, to survive and prosper, MSMEs needed to go digital. Other issues with the process include low levels of computer literacy, unequal access to technology, and the potential for cyberattacks(Karr, Loh, and Wirjo 2020).

According to other research, many conventional retail businesses continue to use manual record keeping, which is prone to mistakes and inefficiencies. Point of sale (POS) systems provide real-time inventory tracking, increase transaction accuracy, and make judgements based on past customer data for better targeted marketing campaigns(Rofiqoh 2025). But the use of this technology is still not equitable since there isn't enough infrastructure or training help, people don't want to adapt, and there are gaps in understanding.

2.2. Prototyping Method in System Development

Prototyping method is an effective approach in information system development, especially when user requirements are still unclear(Purnomo 2017). Using an iterative cycle that includes gathering requirements, rapid design, prototype creation, evaluation, and refinement based on direct feedback, this method speeds up requirement validation by providing an initial system model that users can test immediately(Wulandari et al. 2021), (Izzuddin, Andri, and Hardiyansyah 2023). Moreover, theis repeated process strengthens communication between users and developers, enabling expectations to be adjusted flexibly during the development process(Susanto and Meiryani 2019).

Depending on the situation and development objectives, the four common forms of prototyping functional, evolutionary, simulative, and illustrative can be adapted(Susanto and Meiryani 2019). Functional and evolutionary prototypes allow testing of some or all system features, while illustrative and simulative prototypes focus on showing the interface without back-end functionality. Prototyping helps reduce development time and costs, enables early error detection, and allows adjustments to meet changing needs(Izzuddin, Andri, and Hardiyansyah 2023).

Applying this technique in a web-based donation system resulted in accurate, printable reports, automatic gift calculations, and improved transaction efficiency(Wulandari et al. 2021). In the development of a mobile based tajwid learning application, this approach facilitated rapid iteration using UML based design and implementation with Flutter, resulting in an application better aligned with user needs(Izzuddin, Andri, and Hardiyansyah 2023). Furthermore, using low and high fidelity techniques, as well as horizontal and vertical prototypes to model the system scope, prototyping has shown promise in tackling the problem of inadequately documented requirement exploration(Susanto and Meiryani 2019).

2.3. Previous Studies

Please refer to **Table 1** below for the summary of previous research, including their similarities and differences.

Table 1. *Previous Studies*

No	Author, Year	Previous Research	Similarities Articles	Differences Articles
1	G. E. Saputra, R. B. Utomo, and E. Wiseno, 2022 (G. E. Saputra, Utomo, and Wiseno 2022).	This article discusses the use of the prototyping method in the analysis and design stages of information systems.	The similarity of this article lies in the use of the prototyping method in information system development.	This study is general in nature and is not specifically intended for POS or the MSME context.
2	F. F. Coastera et al., 2023 (Coastera et al. 2023).	This article presents the development of a POS system for local MSMEs.	It focuses on the development of a web-based POS system for MSMEs.	It does not explain the software development method in detail, including no mention of the use of the prototyping method.
3	G. Saputra et al., 2023 (G. Saputra et al. 2023).	The discussion in this article applies the prototyping method to a healthcare service system.	It uses the prototyping method for a web-based system.	This article focuses on a different application sector (healthcare services), not on POS systems or MSMEs.

3. Method

3.1. Prototype Method

MSMEs, who frequently lack the capacity to properly specify system requirements at the outset, are subjected to the Prototyping Method(Fuggetta 2000). Developers can iteratively modify system features to satisfy real needs by incorporating users from the beginning(Pound 2018). In this study, prototyping is used to gradually develop a web-based POS system. **Figure 1** below describes the prototyping approach in developing a web-based POS system. Through five primary steps, this approach enables participatory and step-by-step system development
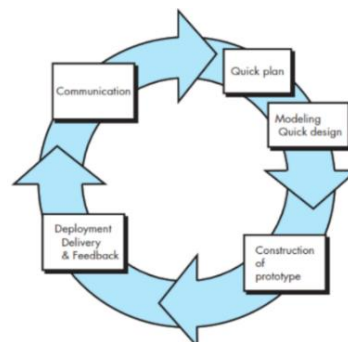

Figure 1. *Prototype Methodology in System Development (Source: Pressman, Roger S. 2010)*

1. **Communication**
   To understand MSME actors' problems and system expectations, needs are gathered through direct connections with them. This information forms the basis of the initial design of the solution.
2. **Quick Plan**
   The development platform, device selection, and design tools such as Figma for the system interface are all included in the initial design plan.
3. **Modeling Quick Design**

To put it simply, user demands were taken into consideration when designing the system interface. The focus is on ease of use and functional suitability.

4. **Construction of Prototype**

   The first working system (prototype) is then created from the designed interface. This system is tested to ensure that its core features function as planned and is used for early user demonstrations.

5. **Deployment, Delivery, and Feedback**

   Users are given the prototype to test and assess. The system is improved or developed further based on the feedback received until it best serves the needs of MSMEs.

This method is chosen because it allows active user participation from the beginning and supports an iterative process, resulting in a system that is more relevant, adaptive, and easier to adopt by MSMEs undergoing digital transformation(Putra et al. 2023), (Qintari, Suratno, and Mauladi 2019), (Angriani, Saharaeni, and Hasniati 2023).

3.2. System Conceptual Framework

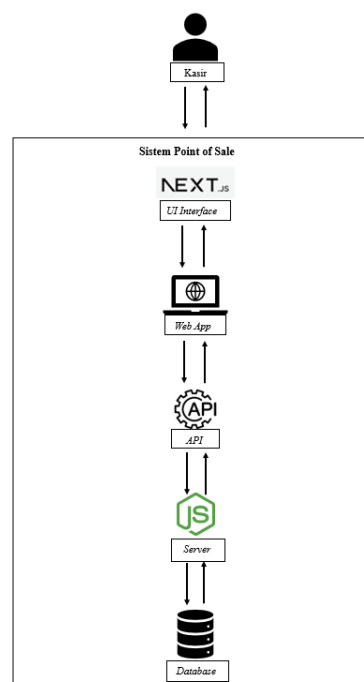The conceptual framework explains how the developed POS system works, as seen in **Figure 2** below.

Figure 2. System Conceptual Framework

1) The cashier must access the POS web application through a web browser using the URL provided by the developer or administrator.
2) After successfully logging in, the cashier will be directed to the cashier page or menu focused on sales transactions, which include items such as sales and payments.
3) The cashier will have access to sales transaction records, including product selection, product additions, and product pricing.
4) The imported transaction data will be automatically stored in the database.

5) The cashier can check the quantity of items available in the system to ensure that the sold items are in stock.

6) The cashier can access the menu containing a list of items or products offered. They will use this menu to input the items purchased by the customer.

7) The cashier must be able to access the history of previous transaction records. This can help the cashier provide information to customers regarding past purchases.

8) To record transactions and check inventory, the cashier will use the database that supports the Web POS system.

3.3. Data

1. Primary Data
Primary data refers to data directly obtained by the researcher from the research subjects. In this study, the researcher conducted interviews with MSMEs, and the interview data were used as primary data(Ajayi 2017).

2. Secondary data
Secondary data is information obtained by the researcher without direct data collection. In this study, previous research, consumer data, and literature sources were used. (Prada-Ramallal et al. 2018).

4. Results and Discussion

4.1. Communication and Quick Plan

The communication stage was carried out to understand the problems and needs of MSMEs in Airmadidi related to the POS system through interviews and direct observation. The results showed that several MSMEs had used POS applications; however, there were weaknesses, such as an excessive number of features, resulting in some being unused. These findings served as a reference in the prototype design to ensure that the developed system is simple, relevant, and aligned with the operational needs of MSMEs.

Figure 3. Interview with Airmadidi MSMEs

In this study, the software or tools used for developing the POS system for MSMEs in Airmadidi are as follows:

1) Operating System: Microsoft Windows 11 Home Single Language
2) Source-code Editor: Visual Studio Code
3) Figma for interface design
4) Next.js for the user interface (UI)
5) Node.js for the server
6) Firebase for the database

4.2. Analysis and Design

Figure 4 below is an illustration of a class diagram that provides an overview of the classes present in the system as well as the relationships among the classes.
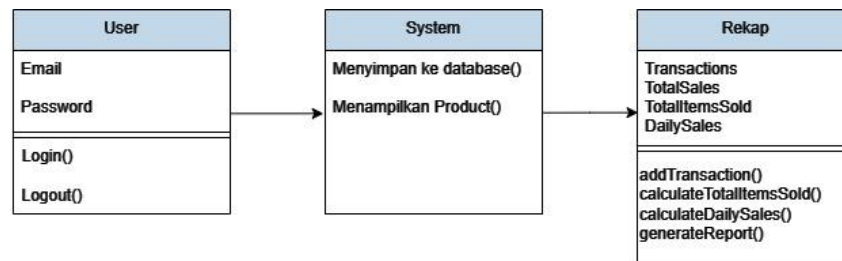

Figure 4. *Class Diagram*

Figure 5 and **Table 2** represent the interactions that occur between the user and the system when the user attempts to log in or create an account.
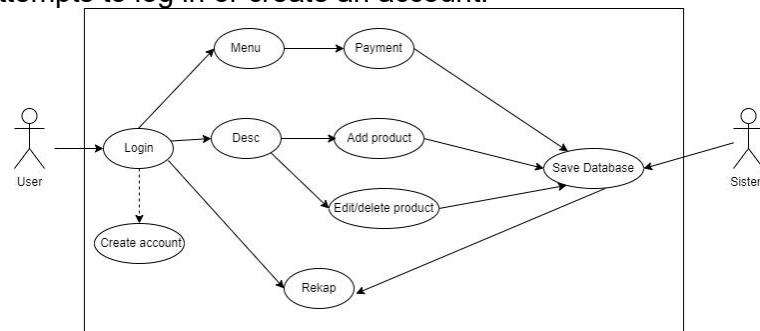

Figure 5. *Use Case Diagram of MSME POS*

Table 2. *Use Case Diagram*

Use Case Name		MSME POS
Goal In Context		User logs into the system
Pre-condition		User is on the login page
Successful End Condition		User successfully logs into the system
Failed End Condition		User fails to log into the system
Primary Actors		System,User
	Step	**Action**
Trigger	1.	User presses the login button
	2.	User presses the Create New Account button
	Step	**Action**
	1.1	User presses the login button
Main Flow	1.2	System displays the login form page
	2.1	User presses the Create Account button
	2.2	System displays the Create Account page

4.3. Implementation

This section describes the interfaces contained within the system. The application's login and account creation procedure is depicted in **Figure 6** below(Left). The login form is displayed on the login page for users who already have an account. Additionally, it offers options for email and password login, Google login, and a button to create a new account. Meanwhile, (Right) shows the registration page for users who do not yet have an account, where users are asked to enter their email and password to securely save their information.
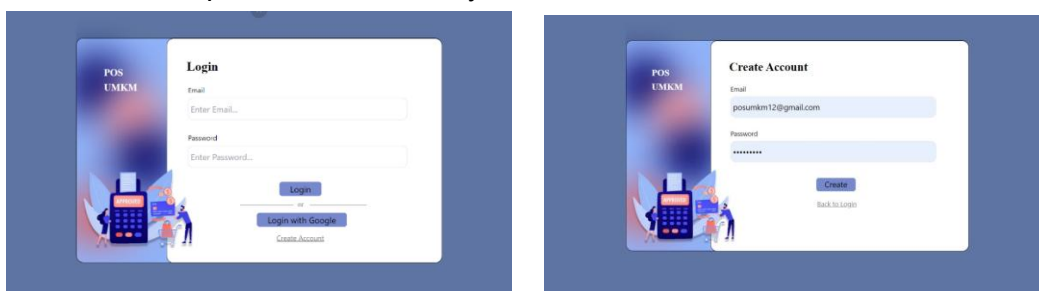
Figure 6. Login Page (Left) and Create Account Page (Right)

Figure 7 below is a displays the main page of the MSME POS application, which contains several core features: Menu for accessing main functions such as adding products, viewing orders, and making payments; Desc for viewing, adding, editing, or deleting product details; Rekap to display transaction summaries in table format; and Logout to safely exit the application and return to the login page**.**
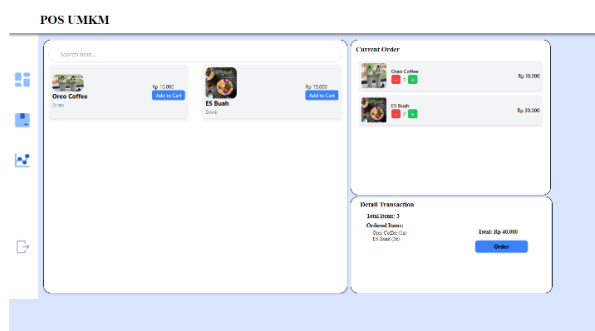

Figure 7. Menu Page

Figure 8 below (Left) shows the payment page, which displays details of ordered items, total purchase amount, and input fields for customer payment. The right side (Right) shows the summary order page containing item details, order date, price, payment amount, and change returned.

Figure 8. Payment Page (Left) and Summary Order Page (Right)

Figure 9 below (Left) displays the product description page that allows users to view details of each product in the system, while (Right) is the page for adding new products to the menu and description.
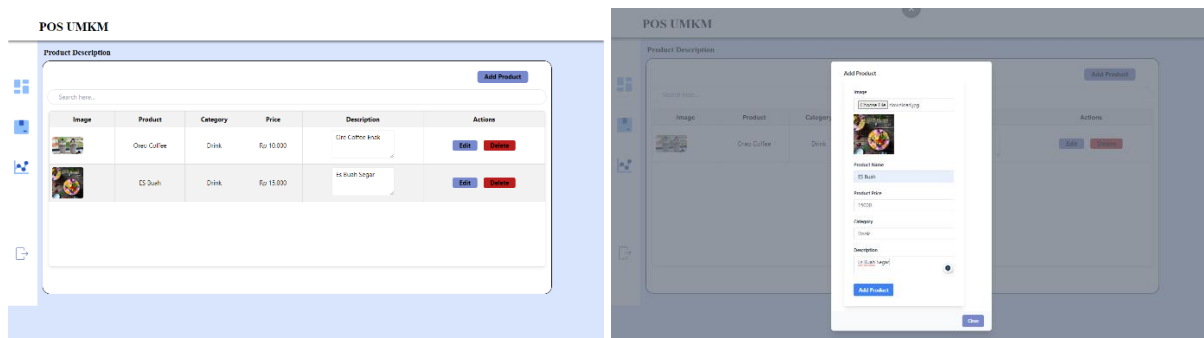

Figure 9. Desc Page (Left) and Add Product Page (Right)

Users can view summaries of completed transactions on the recap page shown in **Figure 10** below.

Figure 10. Recap Page

4.4. Testing

Table 3 and **Table 4** below show the results of system testing to ensure the developed features function properly. Table 4 assesses the features' overall viability, while Table 3 concentrates on feature tests from the viewpoint of the user.

Table 3. User Testing

No	Fitur	Output	Hasil
1.	**Create Account**	*User can create a new account*	Successful

2.	**Login**	*User can enter the main page*	Successful
3.	**Menu**	*User presses the Menu button so the system can display the menu list and enable transactions*	Successful
4.	***Desc***	User presses the Desc button so the system can display product descriptions and enable adding, editing, and deleting products	Successful
5.	**Rekap**	*User presses the Rekap button and the system displays the results in table format*	Successful
6.	**Logout**	*User presses the Logout button to exit the MSME POS application*	Successful

Table 4. System Testing

No.	Fitur	Output	Hasil
1.	Saving user data	The system securely saves user login data to the database so the user can access the MSME POS application using the stored data	Successful
2.	Sending order data to the user	The system stores order data in the database, which is then displayed on the summary page when the user wants to view recap results	Successful

4.5. Discussion

The results of this study are consistent with previous findings but provide a more specific contribution. The application of the prototyping method in this research follows the view of (G. E. Saputra, Utomo, and Wiseno 2022), who highlight its effectiveness in refining system requirements, yet here it is applied directly to the MSME POS context. Compared with (Coastera et al. 2023), who developed a web-based POS system without emphasizing the development methodology, this study strengthens the writing by explicitly documenting the use of prototyping throughout the development stages. In addition, while (G. Saputra et al. 2023) show the flexibility of prototyping in healthcare services, this paper demonstrates its practical implementation for MSMEs, ensuring that the system features remain simple, relevant, and aligned with business operations. Thus, the writing emphasizes not only the system outcome but also the methodological approach, filling the gap in previous discussions.

5. Conclusion

The study's conclusions indicate that MSMEs have benefited from the successful use of the prototype approach in the development of a web-based point-of-sale system, particularly about efficiently managing transactions and operational data. By including users from the start, this method allows the system to develop gradually, creating features that are easier for MSME actors to adopt and more applicable. The developed POS system successfully provides essential features such as product management, transaction recording, payment, and data recap, and has been tested with results indicating that all functions operate properly. Thus, this study makes a tangible contribution to promoting the digitalization of MSMEs through a system development approach that is responsive to user needs.

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