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AI Web-based Computer Service Management System at PUSCOM

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Abstract

This research aims to develop a web-based computer service management system with artificial intelligence (AI) integration at PUSCOM to address challenges in manual service management, such as customer data recording, service status tracking, and report generation. The problems faced by PUSCOM include potential data errors, loss of physical documents, and delays in performance evaluation due to manual processes. The research method used is the Agile SDLC approach, covering problem identification, data collection through interviews and documentation, functional and non-functional requirements analysis, system modeling using UML, NoSQL Firebase database design, interface design, implementation using Next.js and Javascript, and AI chatbot integration using Vercel AI SDK with the Google Gemini model. The research results demonstrate the successful development of a system capable of automating data recording, facilitating online service registration, managing products, and providing an AI chatbot to assist admins in report generation and real-time damage analysis. This system is proven to enhance operational efficiency, reduce manual errors, and support strategic decision-making at PUSCOM, contributing to improved service quality and customer satisfaction.

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INTRODUCTION

The development of information technology has caused profound transformation in most business and public service industries, with Artificial Intelligence (AI) being among the rapidly developing technologies(Enholm et al., 2021). AI presents tremendous opportunities for improving efficiency; however, the majority of organizations continue to struggle with its implementation, mainly due to insufficient comprehension of the mechanisms through which it generates business value(Enholm et al., 2021). PUSCOM, a computer repair company, is beset with many problems that can be attributed to its

reliance on manual service management, generating data inaccuracy, document loss, and even tardiness in performance evaluation. The incorporation of artificial intelligence in a web-based service management system should, therefore, raise productivity and the quality of services at PUSCOM through process automation that was previously done manually, minimizing errors, and personalizing customers' service experiences(Giancarlo et al., 2024; Nurkholis et al., 2023; Samsi Wijaya et al., 2023). Moreover, AI-driven chatbots can give real-time answers and real-time solutions to customers' inquiries(Khasanul Huda et al., 2024).

The primary objective of this project is the development of an artificial intelligence-based web service management system at PUSCOM, with the purpose of enabling the automation of data recording, reporting, and making data-informed recommendations for services enhancement. The findings are anticipated to contribute to the existing body of knowledge in the application of AI in web-based service management, a field which is relatively new and constantly evolving, and serve as a template for other service-providing organizations(Siau & Wang, 2020).

RESEARCH METHODS

The Agile Software Development Life Cycle (SDLC) model was used in the research methodology. The chosen method was selected due to its inherent flexibility and iterative nature, which support ongoing feedback and adaptation during the development process, making it extremely well-suited for a project with AI integration that demands repeated model training and testing. The Agile methodology facilitates development in incremental steps, thereby enhancing responsiveness to changed project specifications(Ghumatkar & Date, 2023; Pargaonkar, 2023; Singh, 2021). The overall research flow is systematically illustrated in Figure 1.

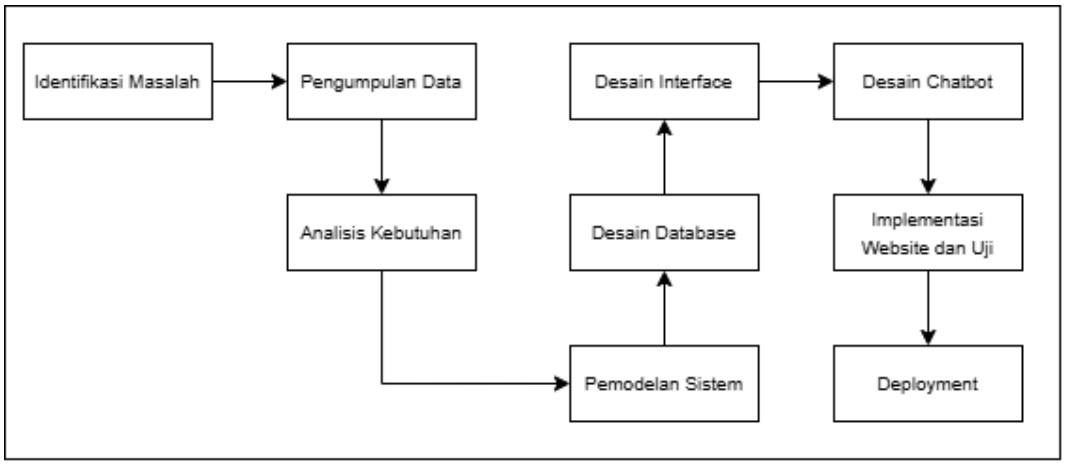

Figure 1. Research Flow

The research was conducted in line with a systematic sequence that started with the determination of the main problem and ended with the final application of the system. Each stage was built upon the previous one to ensure a comprehensive and integrated development process.

Problem Identification

The initial stage of the study aimed to identify the issues in manual handling of computer and laptop service records. The major issues were inaccuracy in recording customer information, proneness to loss or damage of paper documents like receipts, discrepancies between physical documents and customer records, and consistent delays in generating vital reports—daily, weekly, monthly, or annually—that are necessary for evaluation. In order to solve this, the study suggested a website with features for organized monitoring of service requests. It had an online service registration form to save customer information directly to the database for ease of use and to avoid delays. Further, to offset the inefficiencies and vulnerability to errors of human reporting

mechanisms, a Chatbot functionality that used AI was established to mechanize report generation and thereby reduce the opportunity for data loss or errors.

Data Collection

At this phase, important information and data were gathered to ensure the authenticity of research work. Data collection comprised carrying out online interviews and systematic documentation of incoming customer care requests to gather the required information.

Needs Analysis

Following data collection, an analysis of both functional and non-functional requirements was conducted. This analysis was based on the information gathered from online interviews with the shop, forming the foundation for the system's features and specifications.

System Modeling

During this stage, the architecture and workflow of the system were modeled in a systematic manner. It included a sequence of basic activities: specifying the requirements and participants of the system and the use case, constructing the use case diagram to realize the workflow concerning each participant without conflict, constructing activity diagrams to explain the sequence of activities and use case-to-use case communication, and constructing sequence diagrams to explain object interactions from initiation to termination for each process.

Database Design

The process of database modeling was an important step in which a flowchart was created to outline the processes carried out by the users in the system. A class diagram was then built to illustrate each class and the relationships between them. The database architecture was then created from the flowchart and the class diagram to outline how the customer service data would be organized, controlled, and related in the database.

Design Interface

In this phase, the user interface was developed by first structuring the menus and functions to be included in the system. After the structural design, visual mockups were developed to give a clear description of the system to the end-users.

Chatbot Design

The design of the chatbot was a fundamental step aimed at creating a high-level virtual assistant with the aim of boosting user experience and functional efficiency. The design stage was centered on two main functions: as an external client assistant and as an admin tool for administrators and technicians. The stage included the definition of functionalities, designing rational conversational flows, and selecting the right architecture and technologies, such as the Vercel AI SDK and Google's Gemini model. A strategy for the integration of the chatbot with the database was devised for real-time access to information.

Google Gemini is an AI chatbot developed by the company Google. It utilizes advanced machine learning models, such as transformers and multi-modal processing, to comprehend natural language across various contexts. The model evolved from its predecessor, Bard, and is designed for a better user experience through integration with Google Workspace and third-party services, with a focus on data privacy and the reduction of bias in its generated content(Miller, 2019).

Website Implementation and Testing

This phase was where the system designs that had been made before were implemented into a fully functional website. The development process was carried out with the Javascript programming language along with the Next.js framework, and Firebase as the NoSQL database management. So that the system performance and SEO could be optimized as much as possible, a test was conducted with a Performance Testing method through the Lighthouse platform.

Deployment

Deployment was the final step in the development process whereby the website was moved from local development to a live server, thus accessible to the general public online. The researcher deployed and hosted the final website on the Vercel platform.

RESULTS AND DISCUSSION

The establishment of a centralized dashboard alongside a web-based system to supplant traditional record-keeping practices is in direct accordance with scholarly findings that indicate such systems can significantly improve the efficiency and effectiveness of data management practices. The system devised for PUSCOM has converted a manual, error-laden methodology into a user-friendly electronic instrument, reflecting the trend observed in various industries where specialized dashboards have supplanted manual procedures, thus facilitating real-time monitoring and user-friendly data engagement(AL-Zoubi et al., 2022). This is in line with the overall principle that good data visualization using dashboards enables improved understanding and analysis. Likewise, the shift from a traditional, time-consuming practice to a web-based system corroborates findings in other domains, including inventory and asset management, where web-based systems took over from error-prone manual practices and enhanced processing efficiency(Dwi Saputra et al., 2022; Jaya et al., 2020). This study substantiates the relevance of these advantages in the particular field of computer service management.

Moreover, the incorporation of AI chatbots lends robust support to the results of De Andrade and Tumelero's 2022 study, which established that AI chatbots greatly enhance customer service effectiveness(Andrade & Tumelero, 2022). In this study, the chatbot not only gave customers real-time status updates but also helped administrators in report generation and failure pattern analysis, thus saving manual effort and enhancing the decision-making process. This feature illustrates the theme of human-machine collaboration, where artificial intelligence brings velocity and analytical power to augment human abilities in service recovery and management(Ameen et al., 2024). The system created in this research is a practical implementation of this coexistence framework.

System Modeling and Design

The first development phase dealt with the design of the system architecture and the functionality of the system. The system stakeholders were determined to be Admin, Technician, Customer, and AI Chatbot, each with various roles and responsibilities as described in Table 1, the Actor Role Table. These actors' interactions and the system's nature were demonstrated with Use Case Diagrams, a good example being Figure 2, which depicts certain major features like service registration, product management, and user management.

Table 1. Actor Role Table

Aktor	Peran
Admin	Manage and supervise all system activities
Teknisi	Receive and process customer service requests
Pelanggan	Submit service requests and interact with the system
Chatbot AI	Provide automated information and reports to users

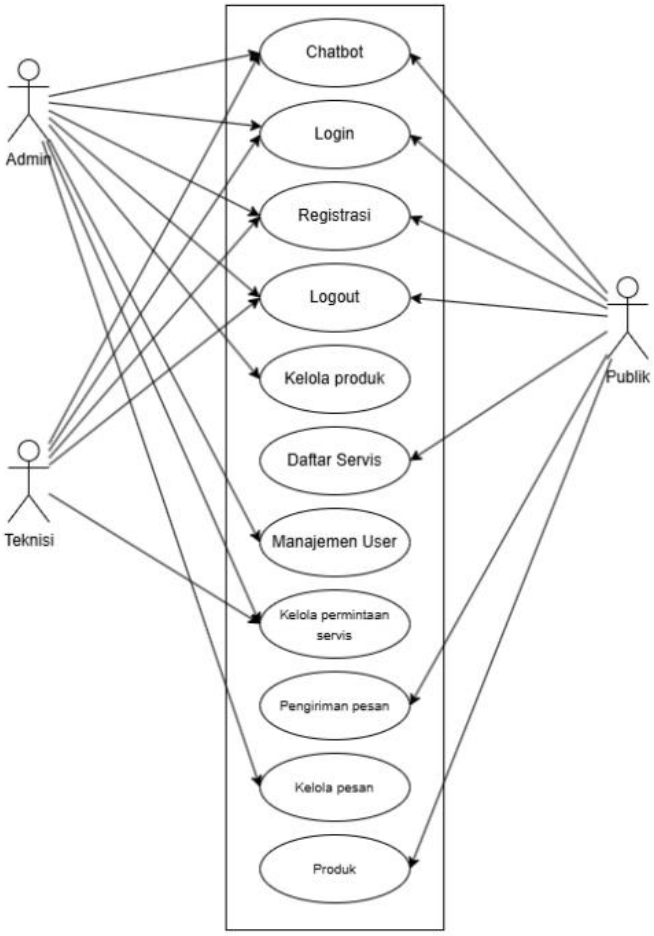

Figure 2. Use Case Diagrams

To detail the operational flow of the system, several Activity Diagrams were created. These diagrams illustrate the process for the public-facing chatbot in Figure 3 Public Chatbot Activity Diagram.

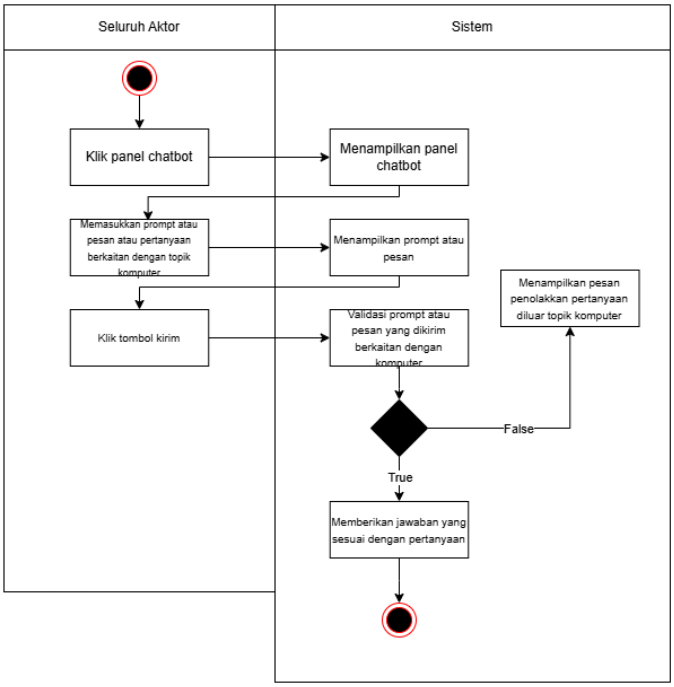

Figure 3. Public Chatbot Activity Diagram

The internal chatbot for service management in Figure 4 Chatbot Activity Diagram For Admin.

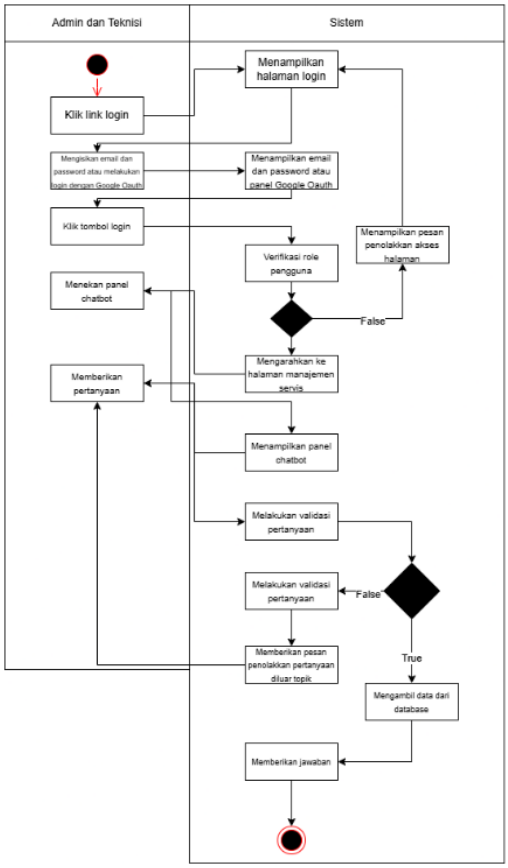

Figure 4. Chatbot Activity Diagram For Admin

The workflow for incoming service requests in Figure 5 Incoming Service Data Activity Diagram.

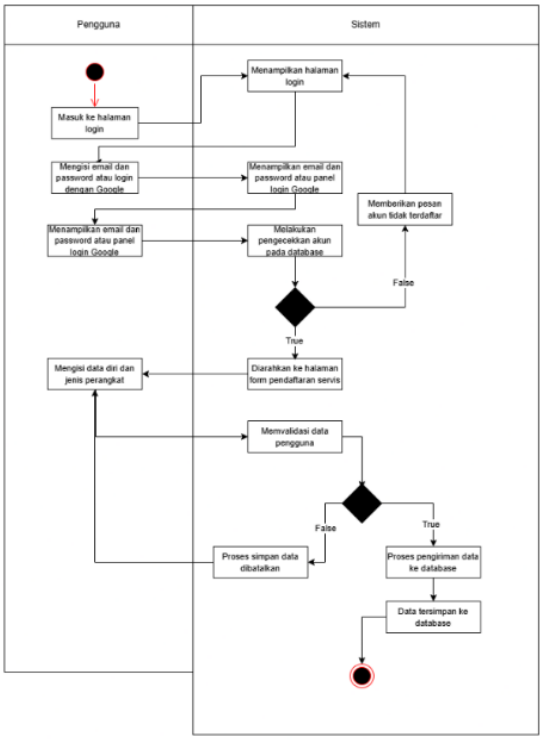

Figure 5. Incoming Service Data Activity Diagram

The static structure of the system is defined in the Class Diagram in Figure 7 Class Diagram structure that outlines the main entities-User, Service Request, Product, and Service Chatbot-and their attributes and relationships.

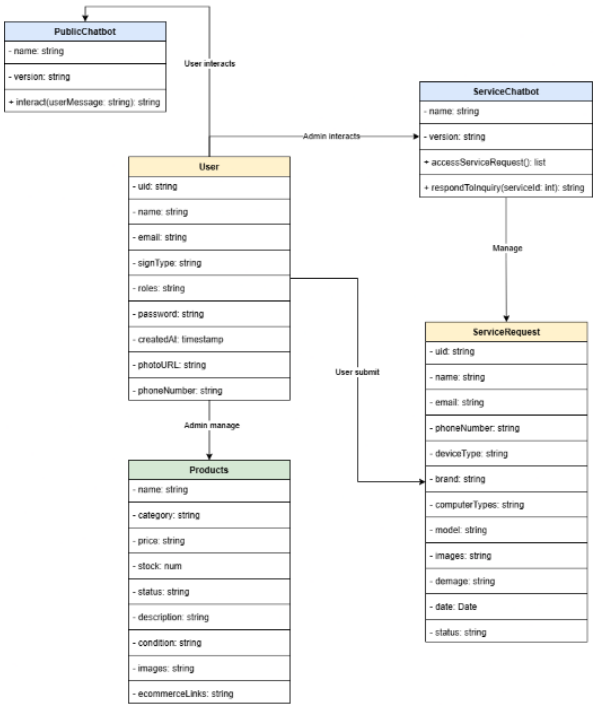

Figure 6. Class Diagram Structure

The dynamic interactions between these objects were further detailed in a series of Sequence Diagrams.

Figure 7 Incoming Customer Service Data Sequence Diagram illustrates the process where an Admin logs in the system then validates their role. If the role is confirmed as Admin, access is granted to the dashboard to view and manage customer service data. If the role is not Admin, the system denies access.

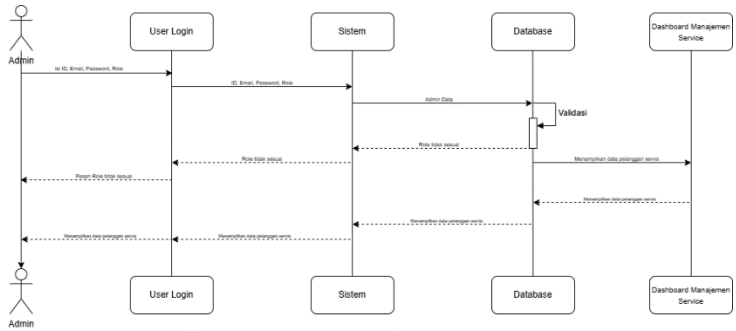

Figure 7. Incoming Customer Service Data Sequence Diagram

Figure 8 Service Registration Sequence Diagram depicts the workflow for a public user registering a device for service. The user logs in, and the system verifies if the user's account is already registered in the database. If the account is not found, the user is directed to a sign-up page. If the account exists, the user can proceed to fill in their personal data and details of the device requiring service.

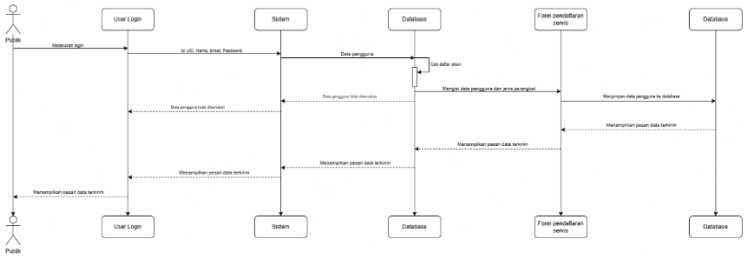

Figure 8. Service Registration Sequence Diagram

Figure 9 Chatbot with Direct User Sequence Diagram outlines the interaction flow when a user directly interacts with a public chatbot. It starts with the user entering a

question and the chatbot acting as an intermediary by utilizing Google search to provide answers relating to laptops and computers.

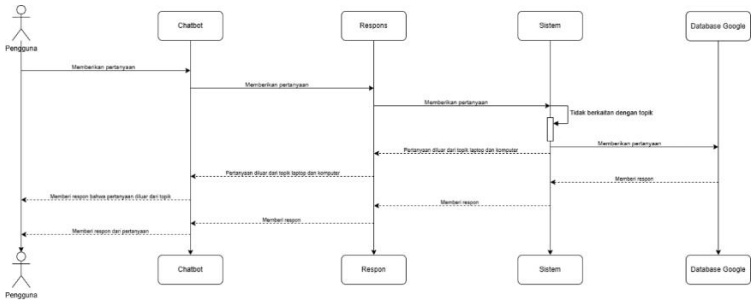

Figure 9. Chatbot with Direct User Sequence Diagram

Figure 10 Chatbot with Service Management Database Sequence Diagram shows the interaction between an administrator and the internal chatbot. This sequence starts with the admin's query and leads to a response generated by the chatbot based on data retrieved from the service management database. The chatbot facilitates admin tasks such as inquiring about specific customer device damages, requesting data summaries, and performing analyses.

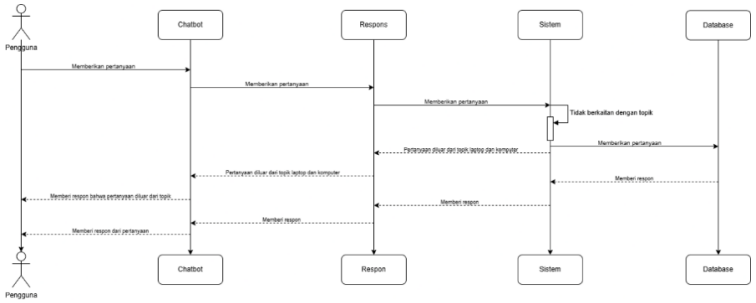

Figure 10. Chatbot with Service Management Database Sequence Diagram

These diagrams collectively provide a comprehensive blueprint of the system's architecture and interaction flows.

Database and Design Interface

The system's architecture is supported by a robust database and an intuitive user interface, both designed to ensure efficiency and ease of use.

Design Database

The system utilizes a NoSQL database implemented with **Firebase**. This choice allows for flexible data schemas and real-time data synchronization. The database is structured into four main documents (collections in NoSQL terminology) to manage different aspects of the service operations:

Table 2. Document Users

Kolom	Tipe Data	Deskripsi
uid	string	Unique user ID
name	string	User name
email	string	User email
photoURL	string	User profile photo
roles	string	User role (admin, technician, user)
signType	string	User account registration type
status	string	User status (active or inactive)

This document is designed to store essential information about all individuals interacting with the system, including administrators, technicians, and customers. Key attributes include a unique user ID (uid), name, email, photoURL for profile pictures, roles to differentiate access levels (admin, technician, user), signType indicating the registration method, and status to manage whether an account is active or inactive.

Table 3. Document Service Request

Kolom	Tipe Data	Deskripsi
serviceId	string	Customer service ID
name	string	Customer name
email	string	Customer email
phoneNumber	string	Customer's phone number
deviceType	string	Type of device (laptop, computer, etc.)
brand	string	Device brand
model	string	Device model
damage	string	Description of device malfunction
date	string	Date of service request
status	string	Service status (for example: waiting, completed)
images	string	Device malfunction image

This document captures comprehensive details for every service request initiated by customers. It includes a unique serviceId, customer's name, email, and phoneNumber, information about the device such as deviceType, brand, and model, a description of the damage, the date of the service request, the current status of the service (e.g., pending, in progress, completed), and images uploaded by the customer showing the device damage.

Design Interface

The user interface (UI) was meticulously designed to be user-friendly, responsive, and accessible across various devices, ensuring a positive user experience. The key visual components of the UI are as follows.

Labeled "PUSCOM AI Assistant," this panel provides an interactive interface for public users to communicate with the AI chatbot for assistance with computer-related issues or general inquiries.

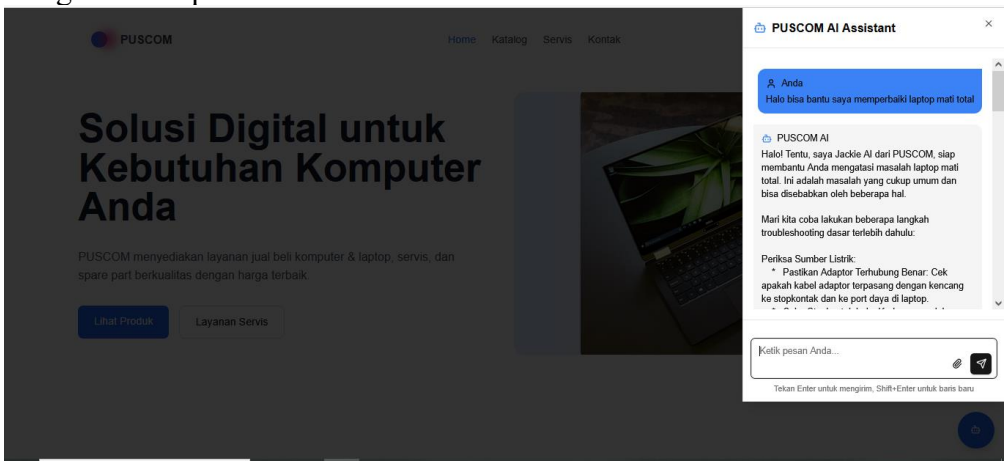

Figure 11. Public AI Chatbot Panel

This specialized dashboard is designed for managing and analyzing service requests. It includes an "Dashboard Analitik Rani AI," which appears to be the name of the internal AI assistant integrated for service data analysis and reporting.

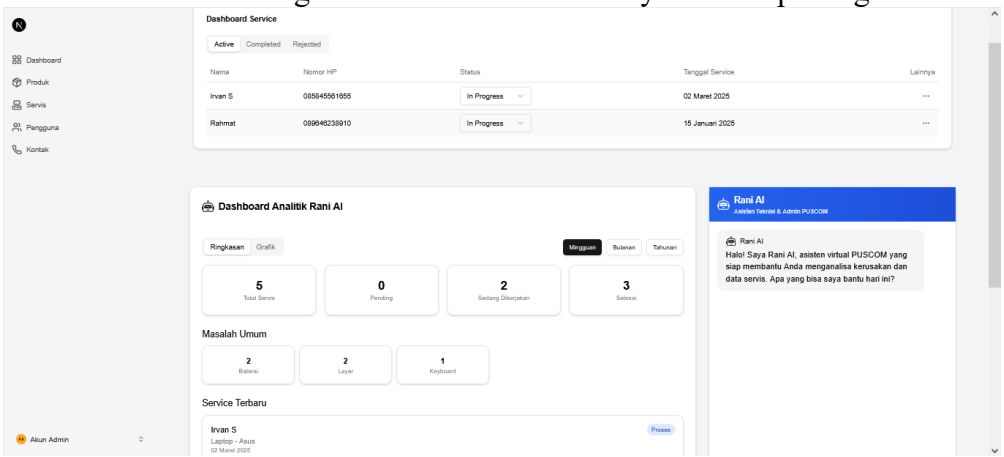

Figure 12. Service Admin Page

System Implementation and Testing

The system was implemented as designed and underwent rigorous testing to ensure its functionality and reliability. Additional testing was performed on each core component of the system. The user management module was tested to ensure successful registration, login, and profile updates in Table 4 Account Registration Testing Table.

Table 4. Account Registration Testing Table

Test Case	Input Expected	Output	Result
TC1: Pendaftaran Pengguna	Name: John Doe, Email: johndoe@gmail.com, Password: password123, Role: Admin	User successfully registered, confirmation email sent	Pass
TC2: Login Pengguna	Email: johndoe@gmail.com, Password: password123	User successfully logs in and is directed to the dashboard	Pass
TC3: Pencarian Pengguna	Email: johndoe@gmail.com	Display user data: Name: John Doe, Email: johndoe@gmail.com, Role: Admin	Pass
TC4: Pembaruan Profil Pengguna	Name: Jane Doe, Email: janedoe@gmail.com	User profile updated successfully	Pass

The service request module is validated to ensure requests can be submitted and their status updated correctly in Table 5 Service Request Testing Table.

Table 5. Service Request Testing Table

Test Case	Input Expected	Output	Result
TC1: Pendaftaran Servis	Name: Alice, Email: alice@gmail.com, Device Type: Laptop, Damage: Broken screen	Service request successfully added and data saved	Pass
TC2: Update Status Servis	ServiceId: S1234, Status: Completed	Service status successfully updated to “Completed”	Pass
TC3: Pencarian Permintaan Servis	ServiceId: S1234	Display service details: Name: Alice, Damage: Broken screen, Status: Completed	Pass

After component testing, integration testing is performed to verify that the separate modules work together cohesively. The test cases included end-to-end scenarios, such as a user logging in, submitting a service request, and the request appearing on the admin dashboard. The results, as shown in the integration testing table in Table 6 and 7 Testing Table, confirm that all integrated functions, including chatbot interaction based on database records, are successful. This shows that the system operates as a unified and effective whole.

Table 6. Testing Table

No	Test Case	Input Expected	Output	Result
1	**Pengujian Login Pengguna**	Email: johndoe@gmail.com, Password: password123	User successfully logs in and is directed to the dashboard	Pass
2	**Pengujian Pendaftaran Servis**	Name: Alice, Email: alice@gmail.com, Device: Laptop, Damage: Broken screen	Service request successfully added to the database	Pass
3	**Pengujian Update Status Servis**	ServiceId: S1234, Status: Completed	Service status successfully updated to “Completed”	Pass
4	**Pengujian Pengelolaan Produk**	Name: XYZ Laptop, Price: 7000000, Stock: 10, Category: Laptop	Product is successfully added to the product list in the system	Pass
5	**Pengujian Pengguna Tidak Ditemukan**	Email: unknown@gmail.com, Password: password123	“User not found” error message appears	Pass
6	**Pengujian Pencarian Servis**	ServiceId: S1234	Display service details: Name: Alice, Damage: Broken screen, Status: Completed	Pass

Table 7. Testing Table

No	Test Case	Input Expected	Output	Result
7	**Pengujian Chatbot**	Question: "My service status"	The chatbot provides an answer: "Your service status: Completed"	Pass
8	**Pengujian Logout**	-	User successfully logs out and is redirected to the login page	Pass

Lastly, the research's end-to-end, integrated design of the merged web-based service management framework is aligned with Yang's 2021 work(Yang, 2021), which also developed a holistic solution for managing network services. The present research expands on the idea to incorporate a customer-centric service registration portal and a top-level AI chatbot meant to facilitate support for both internal and external users. In summary, the findings of this research do not debunk but enhance and implement tested theories, demonstrating that a properly designed web system coupled with artificial intelligence can yield significant competitive benefits and enhance the operational efficiency of small- to medium-sized service forms.

CONCLUSIONS AND SUGGESTIONS

Conclusion

This project effectively developed a web-based service management system for PUSCOM, effectively addressing key operational challenges such as inaccuracy of data and delays in reporting using automation and integration of artificial intelligence. Built using an Agile approach, the system automates data entry, allows online registration of services, and provides an AI chatbot for real-time analytical assistance, thereby enhancing operational efficiency, reducing manual errors, and supporting strategic decision-making. The incorporation of artificial intelligence was highly beneficial to enhance user interaction and service quality, thereby meeting all research goals established.

Suggestion

For its future development, it is recommended that PUSCOM continue to enhance the analytical functions of the system with trend analysis on service requests and technician performance that would facilitate strategic resource allocation. It is also essential to enhance system security through features such as two-factor authentication (2FA) for the safeguarding of sensitive customer information. Follow-up research could continue to enhance the capability of the chatbot to manage more complicated questions, for example, detailed troubleshooting steps, or delve into additional artificial intelligence capabilities such as predictive maintenance algorithms derived from historical service records. This development would further expand the practical applications and knowledge of artificial intelligence in the service sector.

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