Strengthening CRM based on live chat for customer service performance audits

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Abstract: The management of relationships between customers and companies is still largely carried out conventionally. Communication between companies and customers tends to be slow and is highly limited by time constraints. This condition makes it more difficult to maintain good relationships between customers and companies, even though such relationships are crucial for business continuity. Conventional communication methods also hinder the monitoring of customer service performance toward customers. Technology-based Customer Relationship Management (CRM) can be a strategic solution to overcome the weaknesses in managing and maintaining these relationships. The purpose of this research is to implement a CRM application using real-time live chat technology to enable faster customer service responses and facilitate service monitoring for the company's management, thereby making performance auditing of customer service easier. The CRM live chat application in this study was developed using the waterfall method and implemented using Visual Studio Code, Laragon as a web server, PHP, JavaScript, MySQL, and Pusher. The implementation was tested using Blackbox testing and User Acceptance Testing (UAT), with the results showing that all functions related to real-time communication and service monitoring operated properly, and the user satisfaction rate reached 85.8%.

Keywords: business sustainability, CRM, real-time live chat, waterfall

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Introduction

The continuous sustainability of a business is the goal of every company. In an effort to maintain their business in the long term, a company must consistently engage in product and service development alongside process innovation, employee competency enhancement, and the establishment of strong relationships with customers as the company's primary stakeholders [1]. The relationship between customers and the company can be fostered by implementing a Customer Relationship Management (CRM) system [2].

CRM is a business strategy focused on understanding, managing, and optimizing the interactions between the company and its customers to ensure efficiency, effectiveness, and visibility of these relationships, ultimately preserving customer loyalty [3]. CRM does not focus on the products produced by the company, but rather on the quality of service offered to customers [4]. Through CRM, companies can store a wide range of customer information, track interactions between stakeholders and customers, and identify opportunities to enhance relationships with the company's clientele [5]. CRM also simplifies the management of interactions between the company and customers, allowing for improved feedback on products or services before, during, or after usage [6].

The implementation of CRM can be realized through the use of live chat technology. Live chat technology enables real-time communication between customers and company representatives, usually provided by customer service via text messages on websites or applications [6] . The implementation of this technology can contribute to improving customer satisfaction by reducing the wait times customers experience when submitting complaints about products and services they have received [7]. This, in turn, can help maintain the company's

reputation in the eyes of customers, enhancing customer loyalty as an indicator of the quality of the company's products and services, ultimately supporting the sustainability of the business [8].

Live chat technology has evolved in recent years. What was initially a simple feature designed to facilitate basic interactions between users and system operators now supports more complex business automation, thereby improving company performance [9]. Various published studies have highlighted the importance of live chat for companies in maintaining customer relationships. Operators in the new student admission process can be replaced by chatbots available 24/7 [10]. The usability and responsiveness of chatbots influence customer satisfaction in customer service within e-commerce applications [11]. Chatbot technology is used to provide answers to customer queries via the chat application they use [12].

In this study, the live chat technology implemented connects customers directly to the company's customer service. Direct interaction without the use of chatbots offers a more human touch and a personal impression for the customer. The application of this technology in CRM is not only used as a communication tool with customers but also as a tool to strengthen the quality of CRM in evaluating customer service performance. The customer live chat application in this study will provide a summary of conversations that occur between customer service and customers through a dashboard feature for company management. This summary data can assist company leaders in evaluating customer service performance and provide new insights into customer interactions with the company's products and services.

Methodology

This study was developed by following the classical life cycle of system development using the waterfall method. The waterfall method is a straightforward system development approach that can yield optimal results for observing a system development model. The waterfall method involves a systematic and sequential development process [13]. Each phase must be completed before its results are used in the subsequent stage. This ensures that each phase is minimized for errors, making the developed system more accurate. This study chose this method because it aims to create a system prototype model that can assist customer service in serving customers without requiring continuous changes. The steps in this study are illustrated in Figure 1 below.
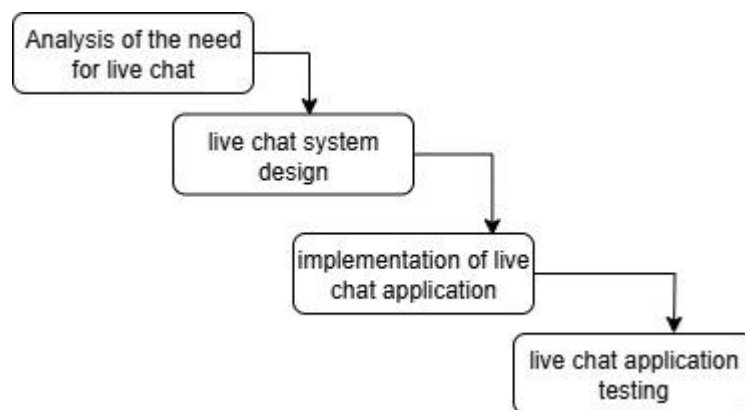
Figure 1. Research methodology

Analysis of The Need for Live Chat

This phase is intended to understand and identify the requirements of the system being developed. It generates the data necessary for the development of the live chat system. The requirements analysis process for the live chat system is carried out by applying observation, interviews, and literature study methods. Through this data collection process, an overview of the system is obtained, including the business process scenarios, the functional and non-functional requirements to be achieved by the system, the inputs managed by the system, and the outputs produced.

Live Chat System Design

The findings from the requirement analysis in the previous phase serve as the foundation for developing the new live chat system design in this study. Within this design phase, the system blueprint encompasses the proposed system architecture, database schema, and the design of the revised business processes. The resulting design is represented through relational models and structured modelling techniques.

Implementation of Live Chat Application

This stage is the process of translating the system design into a programming language. The live chat system is developed using Visual Studio Code and Laragon as the web server. PHP is used for the backend, JavaScript for the frontend, MySQL as the RDBMS, while the real-time communication is built with a cloud-based system architecture that utilizes the WebSocket protocol, with Pusher serving as the broadcaster.

Live Chat Application Testing

The results of the system implementation will be tested using two methods: black-box testing and User Acceptance Testing (UAT). Black-box testing is conducted to ensure that the features available in the built application function as intended. Testing focuses on input and output, message sending and receiving processes, real-time messaging, user authentication, and the user interface. Meanwhile, User Acceptance Testing (UAT) is used to evaluate user responses to the created system and assess their satisfaction with the system. Both testing methods help in drawing conclusions about the system's functionality and its readiness for use.

Results and Discussions

Results

The results of this study consist of the design of the system architecture, the database structure design, and the business process design, which are then implemented into an application prototype. The CRM application prototype with a live chat feature developed in this study is expected to optimize customer service through real-time communication between customers and company representatives. The developed application can be used to record the entire conversation history in detail, including response time, service time, and customer ratings. These conversation records are then utilized to evaluate the performance of customer service provided to customers. To achieve the desired results, the researcher followed the steps outlined in the research methodology. The discussion of the results based on the methodological steps carried out is as follows.

Analysis of The Need for Live Chat

In this phase, the elicitation process was conducted based on the results of observations, interviews, and literature studies. The elicitation process aims to identify the system stakeholders as well as the functional and non-functional requirements of the CRM live chat system. As a result, the users of this system consist of customers, customer service representatives, and company management. Customer service representatives are internal users responsible for providing services by responding to customer inquiries, while customers act as recipients of company information and submit inquiries to customer service. The interactions between these two groups can be monitored by company management. Each system stakeholder manages data within the business processes to achieve the desired non-functional requirements, namely customer satisfaction and service efficiency. All system users are also assigned access rights to ensure appropriate user access limitations within the developed system. The functional requirements of this CRM system are presented in Table 1 below.

Table 1. Functional requirement

Fungtional requirement	Description
Registration	This function provides a registration facility for service requesters so that customer data can be stored in the database
Live chat	This function enables real-time conversations between customers and customer service. The conversations that occur need to be stored in the database so that they can be used to draw conclusions about service quality
Chat history	This function is used by customer service to manage the chat data that occurs during conversations
Performance Management	This function is performed by the customer to provide a rating for the service from customer service. Response time and service time can be monitored by the company's management
Service Dashboard	This function will be used by management to view the evaluation results, which can then be used as a basis for auditing customer service performance in delivering services.
Knowledge Base	This function is for referencing the knowledge discussed by customer service and any supporting files that may be needed.

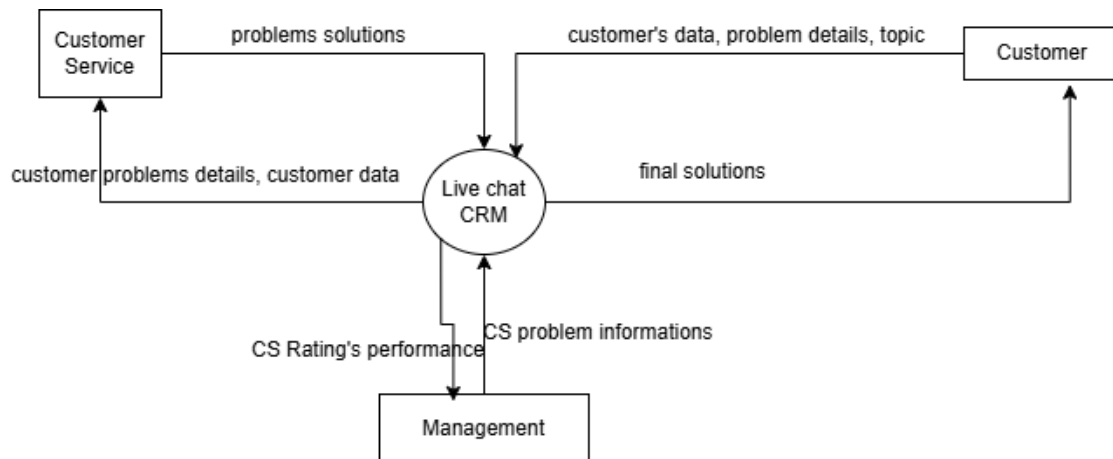## Live Chat System Design

At this stage, the design of the system architecture, database structure, and process design required for implementation is carried out. Based on the analysis, when customers wish to communicate their issues, they are still required to either visit in person or contact the customer service team via telephone. Such mechanisms result in suboptimal service quality due to delayed responses to customer complaints and inquiries. Therefore, to improve response time and enhance customer satisfaction, this study adopts live chat technology with a system architecture as illustrated in Figure 2 below.
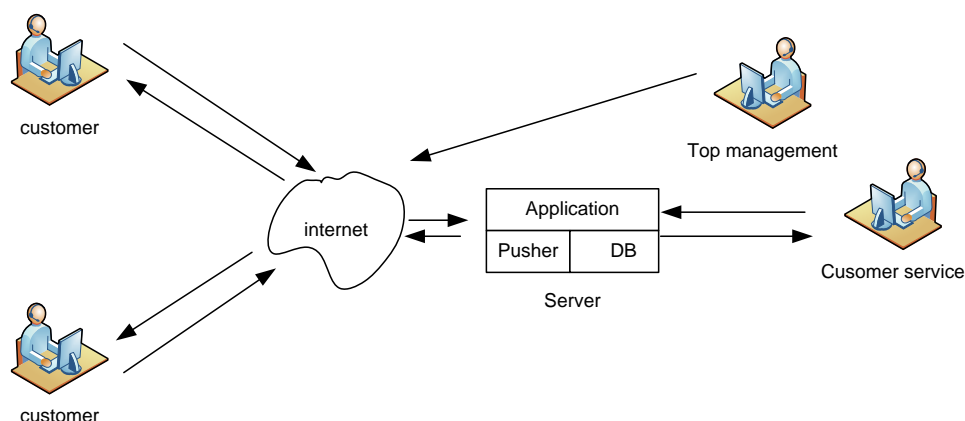

Figure 2. Live chat system architecture

As illustrated in Figure 2 above, when a customer wishes to connect with customer service to submit a complaint or other matters, the customer must access the live chat web application, which can be used from various internet-connected devices. The real-time conversation between the customer and customer service is facilitated by communication technology using a third-party

service [14]. This approach is chosen because delegating the communication infrastructure to a third party ensures better maintenance, management, and security of the infrastructure [15]. The implementation of this architecture is carried out using Pusher. Pusher is a real-time service that provides an Application Programming Interface (API) utilizing WebSocket for two-way communication between the client and the server. The Pusher API functions as a courier for delivering each message. During the communication process via the Pusher API, all transaction data is stored in the database. This is intended so that the data can be used as a reference for evaluating the performance of the services provided by customer service. The resulting system architecture is then translated into process designs result, as illustrated in the Data Flow Diagram (DFD) shown in Figure 3 below.
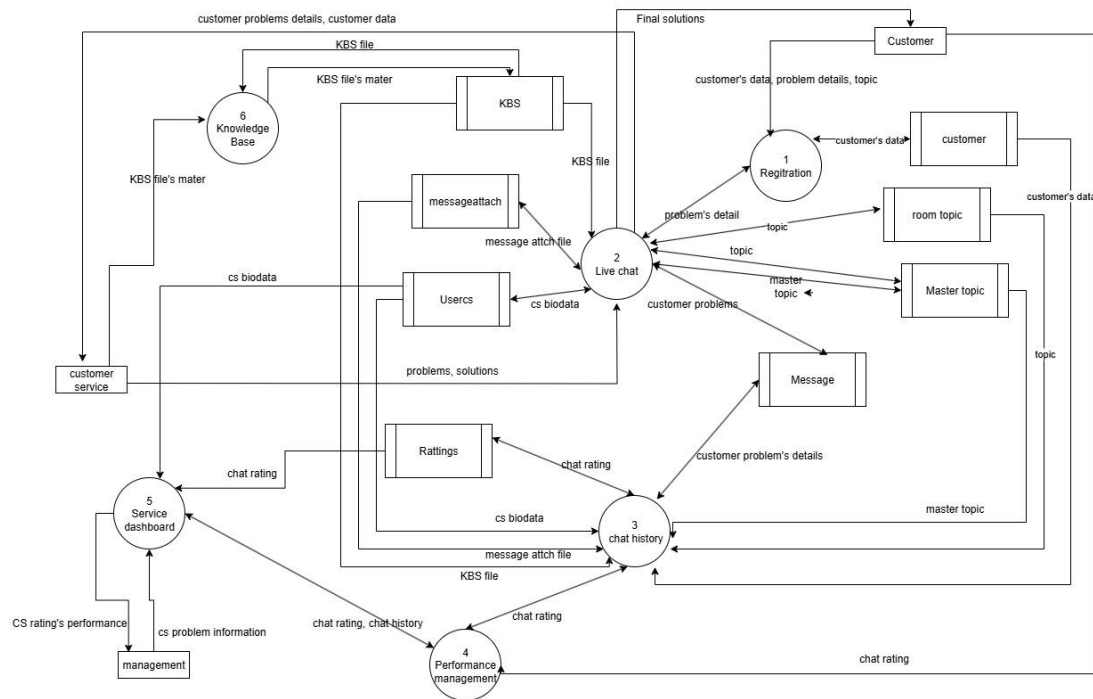

Figure 3. Data flow diagram level 0

Figure 3 above provides an overview of the business process in the developed CRM live chat system. The diagram illustrates the data flow within the Live Chat CRM system, which involves three main parties: customers, customer service representatives, and company management. Customers provide their personal data, problem details, and discussion topics through the live chat application. This information is then delivered to customer service representatives, who handle the issues according to the customer's needs. Customer service provides problem solutions, which are sent back into the system and then delivered to the customer as the final solution. In addition, all interactions between customers and customer service are recorded by the system and used as valuable information for management. The management team can monitor the data related to the issues handled and evaluate customer service performance based on customer ratings. Thus, the Live Chat CRM system not only functions as a two-way communication medium between customers and customer service but also serves as a monitoring and evaluation tool for service performance by management. To enable the implementation of the design process, the following is the result of the relational database design for the CRM live chat to store communication data, as shown in Figure 4 below.
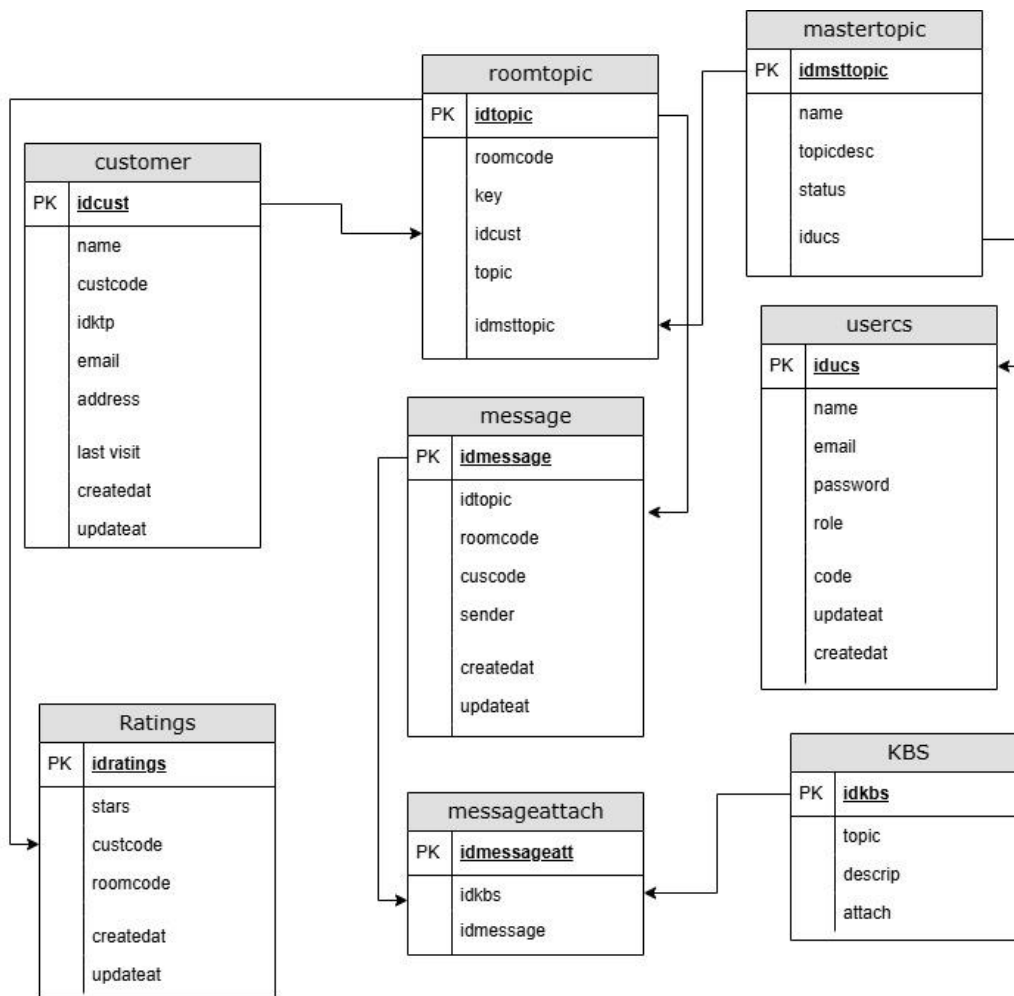
Figure 4. Database structure design

In Figure 4, it can be seen that to store user data and conversations that occur within the live chat system, eight tables are prepared and implemented in a MySQL database. These tables include: customer, ratings, room_topic, messages, messages_attach, master_topic, usercs, and KBS. When a customer enters their data into the system, it is stored in the customer table. To initiate a conversation, the customer selects a topic, which is saved in the room_topic table, the master_topic table, and the customer service data is stored in the usercs table. The conversation is stored in the messages table, including any connections to the messages_attach and KBS tables if additional files need to be shared during the conversation. This data recording is intended for storing conversation history. After completing the conversation, the customer can provide a rating, which is saved in the ratings table. The data in the ratings table is then used as a performance evaluation metric for the respective customer service representative. The designed tables are then used in each detailed feature implemented by the system. The results of the detailed process design of the live chat system and its connection to the database are illustrated as shown in Figure 5 below.

Figure 5. Data flow diagram level 1

The Level 1 DFD diagram above shows that there are six features provided in the developed CRM live chat application. The customer, as the service requester, uses the live chat application to register in the system. This process is carried out to digitally record the customer's personal data so that it is stored and can be accessed later. The registration data is then used to access the live chat service from customer service. The customer service agent responds to service requests through the chat management feature and promptly replies to questions in the live service queue. All conversations are recorded in the database to serve as a source of information on customer service quality. If the customer's inquiry is satisfactorily addressed, the customer can end the session and provide a service satisfaction rating. This customer satisfaction rating can be accessed by the management, enabling them to evaluate the customer's feedback on the service quality provided by the company's customer service team.

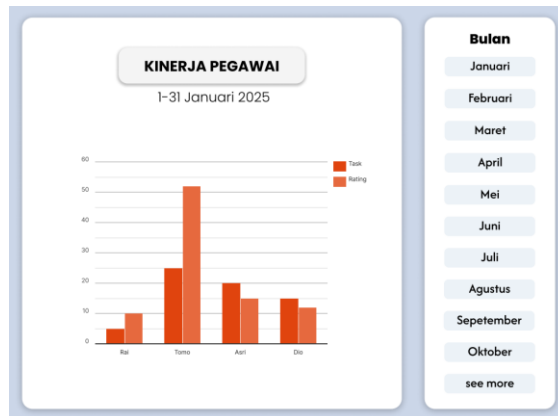## Implementation of Live Chat Application

The implementation of the system design into a CRM live chat prototype was successfully carried out using Visual Studio Code, Laragon as the web server, PHP, JavaScript, MySQL, and Pusher. The system provides real-time communication features that enable customers to interact directly with company representatives through a live chat dashboard. Messages in the form of text, files, and images can be transmitted and received seamlessly, as illustrated in Figure 6. To ensure user engagement and service quality, a customer rating feature was integrated at the end of each conversation session (Figure 7). This rating serves as a performance feedback mechanism for customer service representatives. The recorded data is subsequently processed and displayed through a management dashboard in the form of reports and graphical visualizations (Figure 8), allowing management to monitor and evaluate customer service performance effectively.
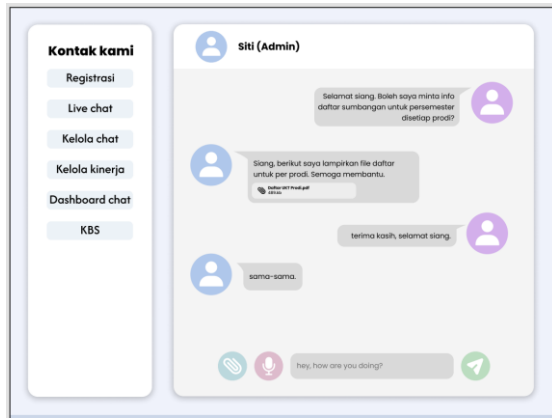
Figure 6. Live chat feature

Figure 7. Customer rating

Figure 8. Management dashboard

Live Chat Application Testing

The system was tested using two methods: black-box testing and User Acceptance Testing (UAT). Black-box testing was conducted to ensure that all system functional requirements were met and that the system performed as expected, while UAT was carried out to evaluate user satisfaction with the developed system. The results of the black-box testing are shown in Table 2 below.

Table 2. Black box result

No	Feature Tested	Test Scenario	Given Input	Expected Output	Actual Output	Status
1	Registration Form	User fills out the form with complete and valid data	Name, valid Email, matching Password	Account successfully created and redirected to login page	Same as expected	PASSED
2	Registration Form	User leaves one required field empty	Leave email field blank	Error message 'Email is required' appears	Error message appears	PASSED
3	Live Chat Feature	Customer sends a message to customer service	Text message 'Hello CS'	Message appears on CS side in real-time	Appears instantly	PASSED
4	Live Chat Feature	Customer Service replies to the customer message	Reply 'Good afternoon'	Message appears on customer side immediately	As expected	PASSED
5	Chat Management	Admin opens the chat details	Click 'View History' button	Shows complete chat history	History displayed	PASSED
6	Service Dashboard	Admin opens the dashboard page	Click 'Dashboard' menu	Displays service trend graph and summary data	As expected	PASSED
7	KBS	File and knowledge base store	Click KBS	Shows files	As expected	PASSED

The testing results in Table 2 indicate that the system's functionality operates properly. Scenario testing conducted on the system's features, using specific inputs, produced outputs that matched the expected results, confirming that the system functions correctly without errors. To assess user acceptance of the application based on its functionality and performance, a User Acceptance Test (UAT) was conducted involving 25 respondents, consisting of 10 customers, 5 customer service agents, 3 managers, 4 IT administrators, and 3 operational staff. The testing was carried out through Likert-scale questionnaires (1 = Very Dissatisfied, 5 = Very Satisfied), direct observation, and real task simulations. The evaluation focused on six key aspects commonly used in UAT: functional suitability, ease of use, response speed, system stability, user interface appearance, and ease of access and navigation. The results of the UAT testing are presented in Table 3 below.

Table 3. UAT result

Testing Element	Customer (10)	CS (5)	Management (3)	IT Admin (4)	Operational (3)	Average
Functional Suitability	4.6	4.5	4.7	4.4	4.4	4.52
Ease of Use	4.3	4.2	4.4	4.1	4.3	4.28
System Responsiveness	4.1	4.2	4.3	4.3	4.1	4.20
System Stability	4.5	4.4	4.6	4.4	4.2	4.40
User Interface (UI) Design	4.1	4.0	4.2	4.1	4.0	4.10
Access & Navigation	4.2	4.3	4.4	4.2	4.1	4.25

Based on the testing results from 25 respondents with various roles in the application, it was concluded that the application is feasible for use in an operational environment, with minor improvement recommendations to enhance user experience. This conclusion is supported by the UAT results, which showed an average overall acceptance score of 4.29 out of 5, equivalent to 85.8%.

Discussions

The results of the UAT across six dimensions and the black-box testing indicate that the developed system functions optimally in providing services and effectively supports performance audits of customer service, making it easier for company management. The UAT was conducted on six features: registration, live chat, chat history, performance management, service dashboard, and knowledge base. The testing evaluated six dimensions of user acceptance: functional suitability, ease of use, system responsiveness, system stability, user interface appearance, and accessibility/navigation. Based on the test results, the application demonstrated excellent functional performance, with the highest scores in functional suitability (4.52) and system stability (4.40), indicating that the application runs stably without issues. Other aspects such as ease of use, system responsiveness, interface design, and navigation also scored well, each receiving a score above 4. All functions in the application operated without error; however, it can be concluded that improvements are still needed in the UI appearance, as it received the lowest average score among the evaluated aspects.

Conclusion

The results of this study indicate that the use of the waterfall method in developing the CRM live chat application using Visual Studio Code, Laragon as the web server, PHP, JavaScript, MySQL, and Pusher successfully produced a system that functions well. This conclusion is supported by the black-box testing, which showed the system operated as expected without errors, and by the UAT results, which recorded a user satisfaction rate of 85.8%. This research also provides a means for auditing customer service performance through a rating feature that allows customers to evaluate the service they received. The results are displayed in graphical form on the management dashboard. In future development, system service optimization is recommended by integrating AI-based chatbots and adding features for automatic sentiment analysis based on the processed chat data.

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