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Web-Based Junior High School Student Attendance System with Face Recognition Feature using the Prototyping Method

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ABSTRACT

Technology is increasingly developing and innovating rapidly. Among them is the use of technology in various fields, especially in education. Teachers and students at the school still carry out attendance activities manually, namely with a conventional system that requires data recording for each attendance on paper. This system is vulnerable to damage or loss of data because the attendance results there still use paper. The attendance system that utilizes face recognition technology is the system proposed for the formulation of the problem that will be used for the research. The development method of this research uses the Prototyping method which prioritizes speed and time efficiency so that it is very suitable for use considering the current needs for a system that requires speed and accuracy. The framework used in the development of the system is Codeigniter 4. The process of working on the system is system requirements analysis, display design, coding, and testing. The results of the study are to create a website-based attendance application at SMP Daarus Sa'adah by utilizing face recognition technology which is carried out by auto-detecting faces so that it can facilitate users in carrying out attendance activities accurately and quickly.

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1. INTRODUCTION

The transformation of the education sector continues alongside advances in technology, globalization, and shifts in societal needs. These developments create new demands for educational institutions, which are now expected not only to deliver theoretical knowledge but also to equip learners with practical skills and relevant adaptive abilities. In navigating the dynamics of the modern era, educational institutions play a crucial role in fostering adaptability, creativity, and a balanced integration of theory and practice so that learners can compete and grow effectively. Moreover, institutions must continue to innovate to meet students' developmental needs across various aspects of life, including the management of administrative and operational processes [1].

One of the essential aspects of managing an educational institution is the administration of attendance data. In other words, attendance management serves as a key factor in ensuring that learners are not only physically present but also actively engaged and contributing optimally to the learning process. Attendance records function not only as evidence of participation but also as a critical basis for evaluation, enabling the assessment of individual performance as well as the overall effectiveness of educational programs [2]. To this day, attendance recording in many educational institutions including SMP Daarus Sa'adah, located in Bogor Regency still relies on a manual system. However, manual attendance methods give rise to various issues. One of the primary problems associated with manual recording is the potential for data manipulation, such as proxy attendance or forged signatures [3].

Such data manipulation not only undermines the integrity of the school but also reduces overall accountability. In addition, manual attendance procedures are time-consuming and inefficient, increasing the likelihood of fraud arising from human error [4]. Given these issues, it is evident that a more effective and efficient solution is needed for managing attendance data. The ideal solution is a system capable of improving data accuracy, efficiency, and institutional integrity [5]. This system must be able to address challenges inherent in manual recording methods, such as the risk of errors, data manipulation, and difficulties in validating attendance in real time [6][7].

Along with advances in information technology, various innovations in digital attendance systems continue to emerge [8]. Several studies have proposed the development of face recognition–based attendance systems and web-based tuition administration to address the inefficiencies of manual attendance methods. Other research has focused on developing Android-based attendance applications for teachers, equipped with camera features and reporting options for permissions, leave, and sick notes [9]. Meanwhile, another study highlights technical challenges such as network instability, time constraints for attendance, and difficulties in facial detection, while also proposing solutions to improve the effectiveness of face recognition-based attendance systems [10]. From these studies, it can be concluded that modern attendance systems still require further development to enhance security, practicality, and data integrity. One potential solution is the use of web-based face recognition technology. Face recognition is a biometric technology that uniquely identifies individuals by comparing live camera captures with stored facial images and facial features in the database [11]. Its advantage lies in its ability to identify users quickly and accurately through facial scanning, thereby reducing errors and preventing fraudulent practices such as identity substitution [12]. Additionally, face recognition operates without physical contact, making it practical and well-suited for school environments. The security features of this technology also help safeguard data and minimize the risk of attendance manipulation [13].

At present, the attendance system used at SMP Daarus Sa'adah still relies on manual procedures, resulting in piles of attendance documents that are difficult to manage and vulnerable to manipulation. Therefore, a responsive web-based attendance system is needed to address the shortcomings of the manual approach, streamline the attendance input process, and simplify the generation of attendance reports at SMP Daarus Sa'adah. For the development of this system, the prototyping method was chosen over other approaches due to its ability to accommodate uncertainty and evolving requirements more effectively. Prototyping enables the creation of an initial model or system prototype [14]. allowing users to view and interact with an early version of the system. This process provides opportunities for users to give valuable feedback and identify issues at an early stage, thereby reducing the risk of project failure and ensuring that the system developed aligns more closely with user expectations and needs [15].

This study aims to design a web-based student attendance application for SMP Daarus Sa'adah, integrating an attendance recap feature to enhance the efficiency and validity of attendance data. The system was developed using the prototyping method, which proceeds sequentially through analysis, design, coding, testing, and implementation. The design process employed UML (Unified Modeling Language)[16][17], including use case diagrams to describe user requirements and activity diagrams to illustrate parallel processes within the system [18]. The software tools used in developing this information system include Visual Studio Code, the PHP programming language, a MySQL database, and Balsamiq for interface design. To ensure the quality and feasibility of the application, this study applied Black Box Testing to verify system functionality without examining its internal structure.

2. METHOD

Data were collected through interview techniques and literature references as analytical and theoretical support for the identified problems, using the prototyping approach [19]. This study employed the prototyping development method, a system development model carried out in stages through prototype creation, user evaluation, and iterative refinement until a final system that meets user needs is achieved. This method was selected because it minimizes the risk of analytical errors, accelerates the development process, and allows flexible feature adjustments based on user feedback [20].

The prototyping development method was chosen because it is iterative, flexible, and directly involves users, thereby minimizing requirement errors, accelerating system validation, and ensuring that the final outcome aligns with user expectations. Its objective is to produce a system that meets user needs, is easily adaptable, and enhances user satisfaction through their active participation throughout the development process.

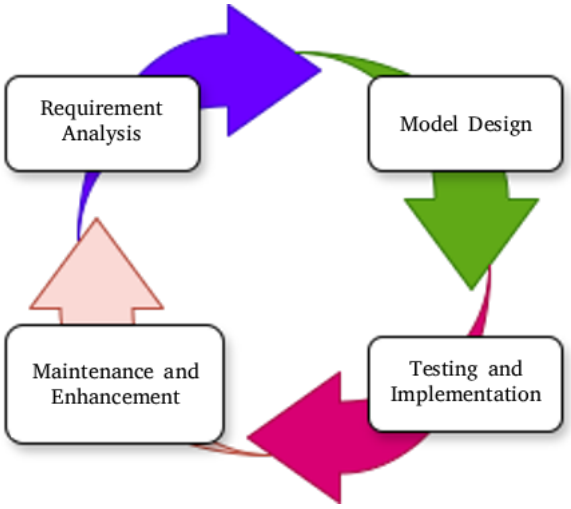

Figure 1. Stages in the prototyping method

1) Requirements Analysis
   This initial stage involves discussions between developers and users to identify system requirements, even if not yet in detail. The focus is on capturing a general overview of the desired functions, existing constraints, and the objectives of the system to be developed.
2) Model Design
   At this stage, developers create an initial prototype based on the analyzed requirements. This prototype typically consists of interface designs, workflow structures, and basic features that provide users with an early representation of the system.
3) Testing and Implementation
   The prototype is tested by users to determine whether its functions meet their needs. Users provide feedback and suggestions for improvement. The test results form the basis for revisions or further development.
4) Maintenance and Enhancement
   After the system is implemented, maintenance activities are carried out to fix bugs, improve performance, or add new features as needs evolve. This stage ensures that the system remains relevant and usable over the long term.

2.1. Analysis of the existing system

Before designing the new system, an analysis of the current system was conducted. This step aims to compare the performance of the existing system with the one being proposed. Based on the issues identified in this study, the attendance process at SMP Daarus Sa'adah is carried out as follows at Figure 2.

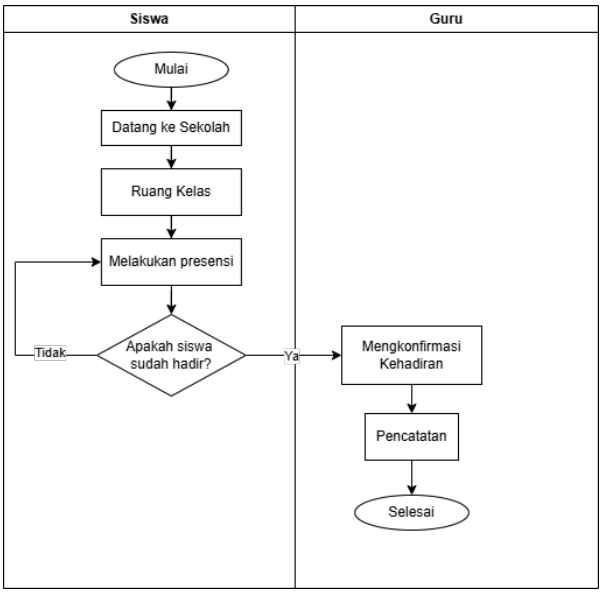

Figure 2. Flowchart of the existing system

The figure above illustrates the attendance process for students at SMP Daarus Sa'adah. The process begins when students arrive at school and proceed to their classrooms to record their attendance. The teacher then confirms whether each student is present or absent and records this information in the attendance book.

2.2. System design

The proposed system design includes the layout and interface of the website to be developed. This design stage holds particular importance in application development because it relates to how users interact with the system and how the interface is presented. The system proposed in this study is a dynamic web-based attendance system with data management performed through a dashboard built using the CodeIgniter 4 framework. The proposed system is illustrated in the following figure 3.

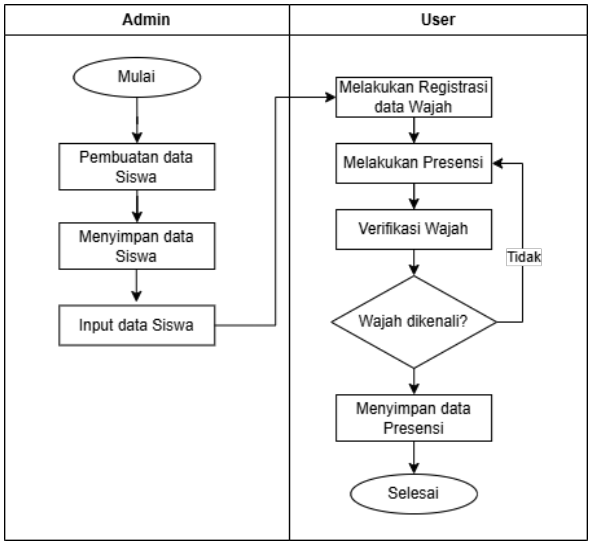

Figure 3. Flowchart of the proposed system

a. Use Case Diagram

A use case diagram is one type of UML used to describe the relationship between actors and the system. It also serves as a bridge between developers and users in illustrating how a system operates. This diagram helps in understanding how the system functions from the user's perspective by showing the actors involved and the use cases or functionalities they are able to access.

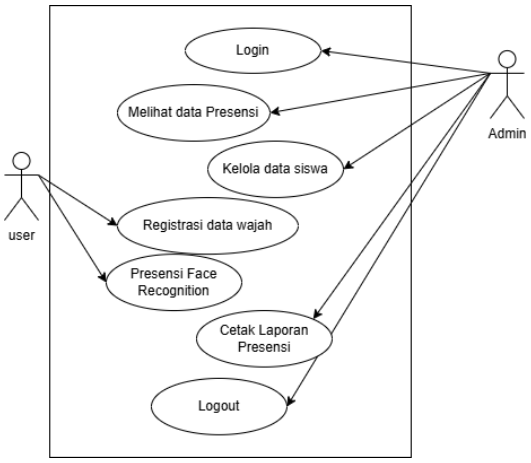

Figure 4. Use case diagram

The diagram above illustrates that there are two levels of users within the website. The first level is the superuser or administrator, who has access to more functions than other users. The second level consists of regular users; students and teachers who are responsible for performing facial registration and recording attendance using face recognition technology.

b. Class Diagram

A class diagram is a UML design model that represents the static structure of a system. It illustrates the system's classes, their attributes, methods, and the relationships among objects. This diagram serves to depict the software architecture in a static form, helping developers understand the data structure and interactions between objects within the system. With the use of class diagrams, system design becomes more structured, thereby facilitating both development and maintenance processes.

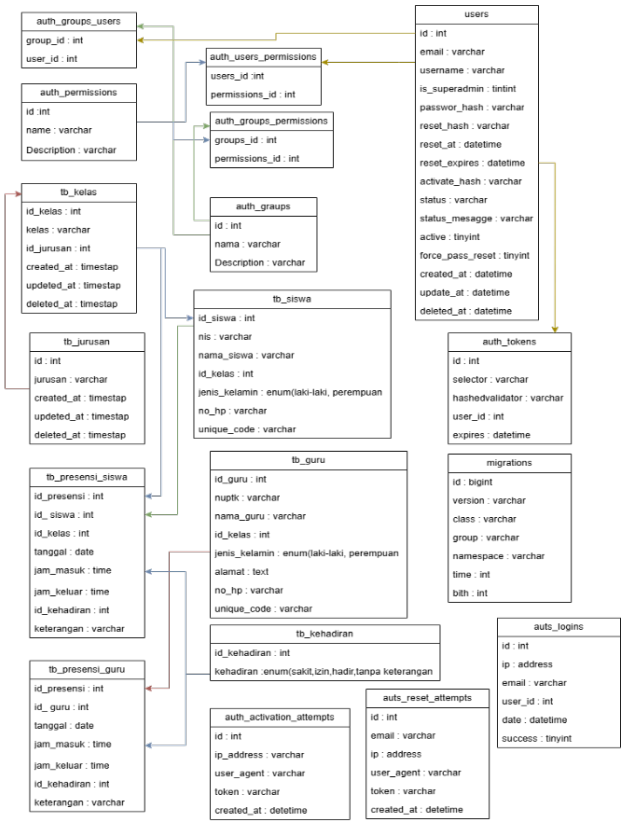

Figure 5. Class diagram

The class diagram in this study describes six main interconnected classes. The User class includes the attributes id_user, username, password, name, and access_rights, with the operations login() and logout(), functioning to manage access to all system modules. The Student class contains attributes such as id_siswa,

nis, nama_siswa, kelas, and alamat, along with the operations addStudent(), editStudent(), and deleteStudent(), and is related to the Class entity through a one-to-many relationship, where one class can contain many students. The Teacher class includes id_guru, nip, nama_guru, and mapel, with operations for managing teacher data (addTeacher(), editTeacher(), deleteTeacher()), functioning as the homeroom teacher.

3. RESULTS AND DISCUSSION

System implementation is the stage in which the system is operated and developed, encompassing both software and hardware components. The result of this study is the development of a web-based information system for attendance data management, equipped with several features such as the Home page, Login, Face Registration, Face Recognition, Attendance Data, and Attendance Report Printing. At this stage, the software is implemented as a series of programs or program units, each required to follow the predetermined design model. The output of this design process is a single platform, a website.

To build the system, the authors utilized the PHP programming language, Balsamiq Wireframes, Tailwind CSS, and the CodeIgniter 4 PHP framework, which applies the MVC (Model-View-Controller) architectural pattern. CodeIgniter 4 was chosen for its high performance, well-organized code structure, and built-in libraries that support structured and sustainable system development. Additionally, Face API.js was used to implement the face recognition feature [21].

3.1. Login and Face Registration Interface

The login interface is implemented by providing a simple yet secure user authentication page. The login form consists of input fields for email and password. The authentication process validates the user's credentials against the database to grant access to the admin dashboard.

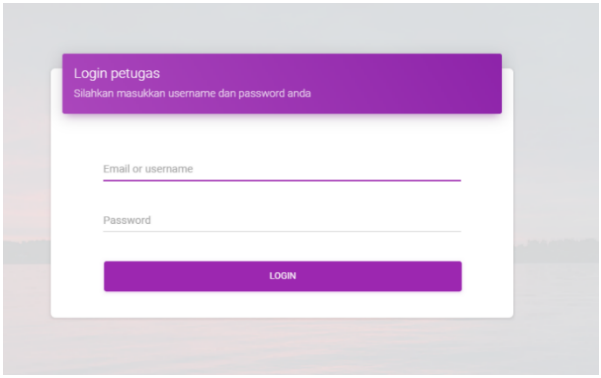

Figure 6. Login interface

The face registration interface allows users to add teacher and student data into the system by registering their facial images. This implementation includes the process of capturing facial images directly, storing the data in the database, and displaying the list of registered faces. Search and filter features are also provided to facilitate efficient management of facial data within the system.

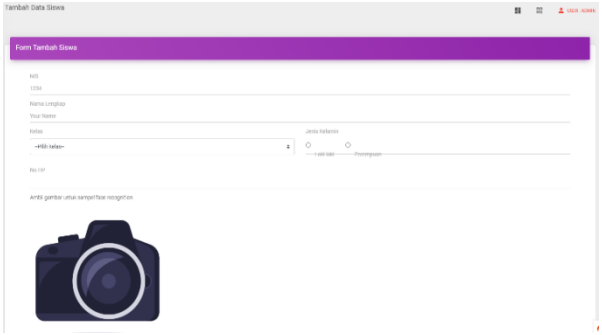

Figure 7. Face registration interface

3.2. Home and Face Recognition Interface

The home interface is designed with a modern and intuitive layout, featuring the headline "Modern Solutions for Attendance Systems," which highlights the advantages of face recognition technology. This page includes a brief description of the system's benefits, action buttons such as "Get Started" and "Watch Video,"

and an illustration of the face-scanning process. The top navigation menu provides easy access to various features, including system information, teacher lists, student lists, and the dashboard.

Figure 8. Home interface

The face recognition interface is developed by integrating camera-based facial recognition technology. This implementation includes capturing the user's facial image in real time, analyzing facial features, and matching them with the data stored in the system. If the face is successfully recognized, the system automatically records the attendance and displays a success notification.

Figure 9. Face recognition interface

3.3. Attendance Data Interface and Report Printing Interface

The attendance data interface displays a list of recorded user attendance within the system. This page is implemented using a table that contains information such as the user's name, check-in time, check-out time, and attendance status. In addition, search features based on date or name are provided to help users easily browse attendance history.

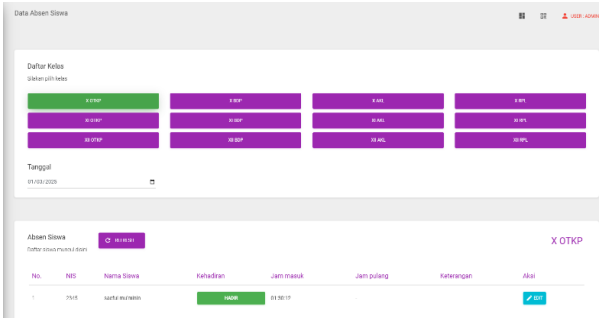

Figure 10. Attendance data interface

The attendance report printing interface is implemented to enable users to generate attendance reports in PDF or Excel format. This page includes filter features based on date range, department, or specific individuals to produce more targeted reports. In addition, print and export buttons are provided to facilitate saving or distributing the reports to relevant parties.

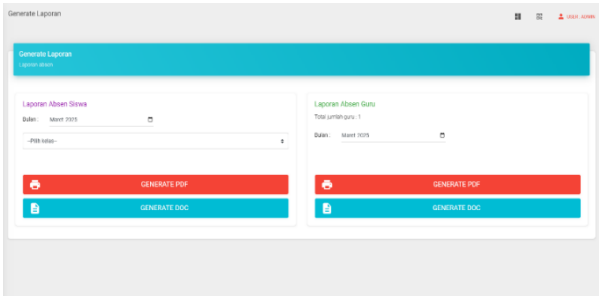

Figure 11. Attendance report printing interface

3.4. Black Box Testing

The testing phase is carried out to ensure that the system functions properly and meets user requirements [22]. This phase involves two primary testing methods: Black Box Testing, which evaluates system functionality, and the User Acceptance Test (UAT), which assesses whether the system meets the expectations of end users.

Table 1. Black box testing

Test Object	Expectation	Expected Result	Conclusion
Login Test with Valid Data	Valid registration number	User successfully logs into the dashboard	Successful
Login Test with Invalid Data	Incorrect email/password	Error message “Incorrect email or password” appears	Successful
Face Registration Test	Appropriate facial image	Facial data successfully saved to the database	Successful
Face Recognition Test	User’s facial image	System recognizes the face and records attendance	Successful
Face Recognition Test with Unregistered Face	Unregistered facial image	Error message “Face not recognized” appears	Successful
Attendance Data Display Test	Request to display attendance	Attendance data displayed according to date and user	Successful
Attendance Report Printing Test	Request to print report	Report file in PDF/Word format successfully downloaded	Successful
Logout Page	Click logout button	User redirected to the login page	Successful

3.5. User Acceptance Testing (UAT)

In this study, the User Acceptance Test (UAT) was used to measure the level of user satisfaction. The purpose of UAT is to provide developers and researchers with effective data for assessing user perceptions of a system’s usability. The following are the UAT results obtained at Figure 12 (a).

No.	Responden	Nilai									
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
1	R1	5	1	5	1	4	1	5	2	5	1
2	R2	5	2	4	1	5	1	5	1	4	1
3	R3	4	1	5	1	5	2	4	1	5	1
4	R4	5	1	5	1	5	1	5	1	5	1
5	R5	5	1	5	1	5	1	5	1	5	1
6	R6	5	1	5	1	4	1	4	1	5	1
7	R7	5	1	5	1	4	1	4	1	5	1
8	R8	5	1	5	1	4	1	5	1	5	1
9	R9	5	1	5	1	5	1	4	1	5	1
10	R10	5	1	4	1	5	1	5	2	5	1
11	R11	5	1	4	1	5	1	5	1	5	1
12	R12	5	1	5	1	5	1	5	1	5	1
13	R13	5	2	5	1	5	1	5	1	5	1
14	R14	5	1	5	1	5	1	5	1	5	1
15	R15	5	1	5	1	5	1	5	1	5	1

(a)

No.	Skor Hasil Hitung										Jumlah	Nilai (Jumlah × 2,5)
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10		
1	4	4	4	4	3	4	4	3	4	4	38	95
2	4	3	3	4	4	4	4	4	3	4	37	92,5
3	3	4	4	4	4	3	3	4	4	4	37	92,5
4	4	4	4	4	4	4	4	4	4	4	40	100
5	4	4	4	4	4	4	4	4	4	4	40	100
6	4	4	4	4	3	4	3	4	4	4	38	95
7	4	4	4	4	3	4	3	4	4	4	38	95
8	4	4	4	4	3	4	4	4	4	4	39	97,5
9	4	4	4	4	4	4	3	4	4	4	39	97,5
10	4	4	3	4	4	4	4	3	4	4	38	95
11	4	4	3	4	4	4	4	4	4	4	39	97,5
12	4	4	4	4	4	4	4	4	4	4	40	100
13	4	3	4	4	4	4	4	4	4	4	39	97,5
14	4	4	4	4	4	4	4	4	4	4	40	100
15	4	4	4	4	4	4	4	4	4	4	40	100
Jumlah Total Skor											582	1455
Jumlah Skor Rata-Rata											97,0	

(b)

Figure 12. Respondents’ assessment (a) and calculation result (b)

After the values from each respondent were obtained, they were converted into scores based on the formula used in the User Acceptance Test. For odd-numbered questions, the final score for each user was calculated by subtracting 1 point from the given value. For even-numbered questions, the final score was derived by subtracting the user’s given value from 5. The results were then summed and multiplied by 2 [31].

To determine the average score given by users, the total score was divided by the number of respondents. The following are the results of these calculations at Figure 12 (b). The evaluation results show a score of 97.0. Analysis of the 15 respondents indicates that the majority (15 respondents or 97.0%) rated the application as "Strongly Agree" in terms of ease of use. From this test, it can be concluded that the system's usability level is very high, aligning with the criteria outlined in the user acceptance testing table. The high score signifies that users can operate the system easily and efficiently to meet their needs.

4. CONCLUSION

The web-based attendance system for SMP Daarus Sa'adah has been successfully developed. This new system is designed to simplify the student attendance process, replacing the less efficient conventional method. The system digitally integrates student and teacher data into a centralized database, making the recording of attendance easier, more practical, and more accurate. By utilizing an automated face detection feature, students and teachers can perform attendance simply by facing the camera on the website, which automatically verifies and records their presence. The development of this website employed the PHP programming language with the CodeIgniter 4 framework, which proved effective for managing dynamic data. The success of this system is demonstrated by the User Acceptance Test (UAT) results, which reached 97%, confirming that the system is well-received by users.

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