Research Article

Optimizing Administrative Efficiency in Sewing Course Management : A Web-Based Application for Participant Registration And Attendance Monitoring at Bandung Vision Centre

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Abstract: The growth of the fashion industry in Indonesia, particularly in Bandung, has increased the demand for effective and efficient sewing courses. Bandung Vision Center, as one of the institutions offering sewing courses, faces challenges in managing registration and monitoring attendance of participants manually. This research aims to design and build a web-based application for registration and monitoring attendance of sewing course participants at Bandung Vision Center. The research method used is the Agile-based Software Development method, which allows flexible system development and is responsive to changing User needs. The results showed that the application built can improve registration efficiency, data accuracy, and monitoring of participant attendance. In addition, this application also provides practical benefits for course managers in managing real-time participant data and improving the quality of services provided. With the implementation of this application, it is expected to increase the competitiveness and reputation of Bandung Vision Center in the local fashion industry

Keywords: web-based application, participant registration, attendance monitoring

1. Introduction

The growth of the fashion industry and creativity in fashion in Indonesia, especially in Bandung, has created a high demand for sewing courses. The increasing interest in learning to sew has fuelled the need for effective management of participant registration and attendance monitoring at sewing centres. Bandung Vision Centre, as an institution that educates aspiring textile designers and craftsmen, faces challenges in managing the administrative process of registration and attendance monitoring manually.

The manual registration and attendance monitoring system at Bandung Vision Centre faced a number of problems, including data inaccuracies, slow processes, and difficulties in administrative management. In this context, the inability to adopt information technology can negatively impact the operational efficiency, service quality, and competitiveness of the institution. Socially, this research can improve the accessibility of sewing learning, while from an economic perspective, efficiency in course management can contribute to the economic growth of the local fashion sector. The urgency data of why this research should be conducted is because this sewing course activity has been going on for 52 waves, so the existing problems have been going on for quite a long time and require effective solutions.

The implementation of web-based applications is expected to provide practical benefits in the form of increased registration speed, data accuracy, and attendance monitoring. This will make it easier for course participants to access course-related information and increase the productivity of Bandung Vision Centre management. In addition, these practical benefits can strengthen the attractiveness of the institution, improve reputation, and support the rapid growth of the fashion industry in Bandung. This research will be conducted at Bandung Vision Centre, as a case study that represents a sewing course institution in Bandung. This

research will take place in the 8th semester which will be determined during the research process.

2. Research Methods

Software Engineering

IEEE defines software engineering as the systematic, disciplined, quantified application to the development, operation, and maintenance of software. The software development life cycle is related to these activities. Although the end product is important, it can be seen from the definition that the approach and steps required to produce software must be carried out in a systematic, disciplined and quantifiable manner in all software life cycles. By following the characteristics of such an approach, the resulting software will be more reliable, maintainable, and fulfil software needs, especially when software measures are interconnected (Sari & Utami, 2021).

Web-based application

Web-based applications are information systems that allow users to interact with the system through a web-based interface. Three stages make up a user's interaction with the internet: request, processing, and response. A website consists of a collection of interlinked pages that display information such as text, images, animations, sounds, or a combination of all of them. These pages can be static or dynamic and form a series of interrelated buildings called a network of pages (Rizki & Pasaribu, 2021).

Web-based applications are designed to facilitate various tasks and functions through the internet, allowing users to interact with the software without needing to install it on their local devices. This is particularly useful in educational settings, where accessibility and ease of use are crucial (Purnama et al., 2023).

React

React was first created by Jordan Walke, a software engineer at Facebook. It was incorporated into Facebook's newsfeed in 2011 and later on Instagram when it was acquired by Facebook in 2012. At JSConf 2013, React was made open source, and it joined the crowded category of UI libraries like jQuery, Angular, Dojo, Meteor, and others. At that time, React was described as "the V in MVC? In other words, React components acted as the view layer or the user interface for your JavaScript applications (Banks & Porcello, 2020).

ReactJS is one of the essential tools in web development due to its ability to create dynamic user interfaces for single-page applications, allowing data to be updated without having to reload the page. Its virtual DOM improves performance by updating only the parts of the UI that are needed, making applications more responsive. React also supports the use of reusable components, making development more structured and manageable. Features like lifecycle methods and React Hooks help manage interactions and application state more efficiently(Lahute & S.P Jadhav, n.d.).

Laravel

Laravel is a web application development framework based on the PHP programming language. It is an open-source framework designed to make it easy for developers to build high-quality web applications quickly and efficiently. Laravel provides a rich set of features that simplify the development process and allow developers to focus on the core functionality of their applications. The framework is well-suited for both novice users in the world of web development and experts in the field of development. Laravel is a PHP web framework that provides capabilities for building modern, full-stack web applications (Jain, 2024).

Laravel uses the Model-View-Controller (MVC) architecture, which separates application functionality and user interface. This separation simplifies application management and scaling, resulting in simpler code and better structure. This framework streamlines the development process by offering established structures and tools. This helps developers to construct apps faster than with traditional PHP, which requires them to set everything up from scratch (Saroni & Mulyanti, 2020).

Inertia

Inertia is a scaffolding for Laravel just like Livewire, it is the other scaffolding that we can select when working with Jetstream. Inertia allows you to quickly build modern Single Page Applications (SPAs) using classic server-side controllers and routes (Cruz, 2022).

Inertia.js is a contemporary framework that streamlines the development of single-page applications (SPAs) while retaining the advantages of traditional server-side frameworks. By integrating seamlessly with server-side technologies like Laravel, Rails, and Django, Inertia.js

eliminates the need for separate APIs, enabling developers to utilize existing server-side logic and data. This approach facilitates the creation of SPAs with the enhanced user experience they are known for. Additionally, Inertia.js is compatible with modern JavaScript frameworks such as Vue.js, React, and Svelte, offering developers the flexibility to select front-end technologies that align with their project requirements while maintaining robust server-side functionality(Гумарова et al., 2023).

Black box

Black box testing is a software testing method that focuses on evaluating the functionality of an application without knowing its internal code structure. Black box testing assesses how well the software performs its intended function based on specified requirements. The tester interacts with the user interface and verifies the output generated for the given input (Maspupah, 2024).

Black-box testing offers significant advantages within Agile software development. It enables testers to assess software functionality without requiring insight into its internal mechanisms, aligning with Agile's focus on rapid delivery and customer-centric approaches. By concentrating on the outputs produced in response to specified inputs, this testing approach effectively validates user requirements and ensures alignment with business objectives. Furthermore, black-box testing can uncover defects that might not be detected through alternative methods, such as white-box testing, which depends on knowledge of the code structure. This capability is particularly valuable in Agile contexts, where evolving requirements necessitate flexible and adaptable testing strategies. Additionally, black-box testing can be applied across various stages of the software development lifecycle, including unit, integration, and system testing, ensuring thorough application coverage (Barraood et al., 2023).

3. Results and Discussion

Research methods are explicit systems for gathering and investigating data. Fostering your research methods is a vital piece of a research design. When arranging research methods, there are two key choices one should make. Research configuration is an arrangement to address your exploration question. A research method is a technique used to carry out that arrangement (Mohammad Omer Faruqe Jubaer et al., 2021).

Agile Software Development is an iterative and incremental approach to software development that emphasizes the importance of delivering working products quickly and frequently. This approach involves close collaboration between the development team and the customer to ensure that the product meets their needs and expectations (Halim et al., 2023).

Agile methodologies prioritize adaptability, enabling teams to respond effectively to evolving project requirements or market dynamics. This flexibility ensures that the final deliverable aligns closely with customer expectations, thereby enhancing satisfaction and improving project outcomes. By employing an iterative approach, Agile facilitates the development process in smaller, manageable increments, allowing for continuous progress evaluation, feedback collection, and iterative refinements. This approach enables early identification and resolution of potential issues, mitigating the risk of significant challenges in later stages of the project lifecycle (chatgpt.opneai.com & Shamim, 2024).
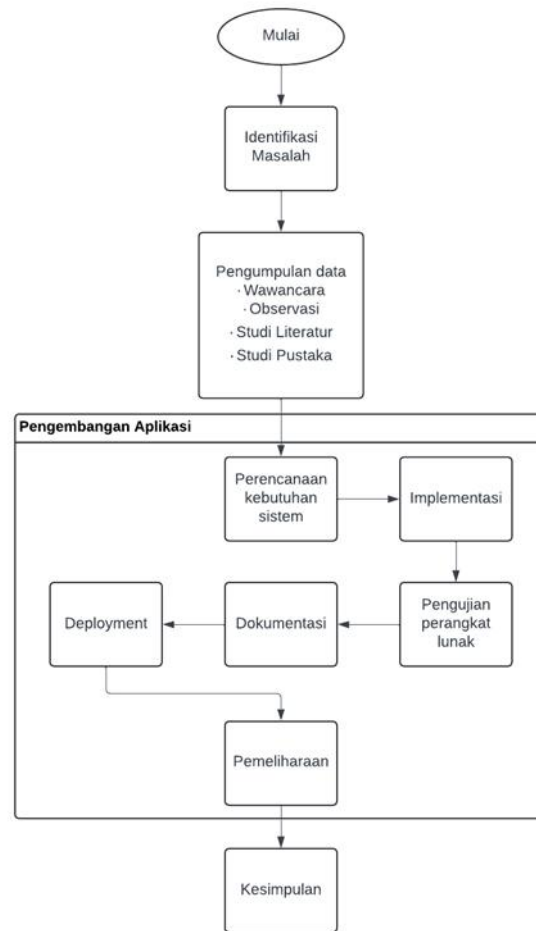
Figure 1. Author Research Flow

Stages in Agile Software Development:

1. Planning: This initial stage involves gathering information about user requirements through direct interviews. Based on this data, system design is done using system and application design tools.

2. Implementation: At this stage, planning is realized by creating program documentation using UML and developing user interfaces with Javascript and PHP programming languages.

3. Testing: The program that has been created is manually tested using the blackbox method to ensure its correctness and suitability. If errors are found when the website is used, the cause can be easily traced to the production server.

4. Documentation: This stage involves creating documentation of the modules and functions in the information system. This documentation serves as a record during development and facilitates further development by the team.

5. Deployment: At this stage, the system that has been developed is made available to the end users, namely the instructors and assessors of the sewing minotoring.

6. Maintenance: System maintenance is carried out periodically to prevent system failure, because there is no guarantee that the system will always be free from problems (Aji et al., 2021).

4. Research Result

Analysis of Company Business Processes

A business process is a structured flow of activities or work that is interrelated in the company from start to finish. In attendance monitoring activities, business processes related to registration and monitoring the attendance of sewing course participants can be described as follows. This analysis will help understand existing workflows and identify areas that require automation and improvement through web-based applications.
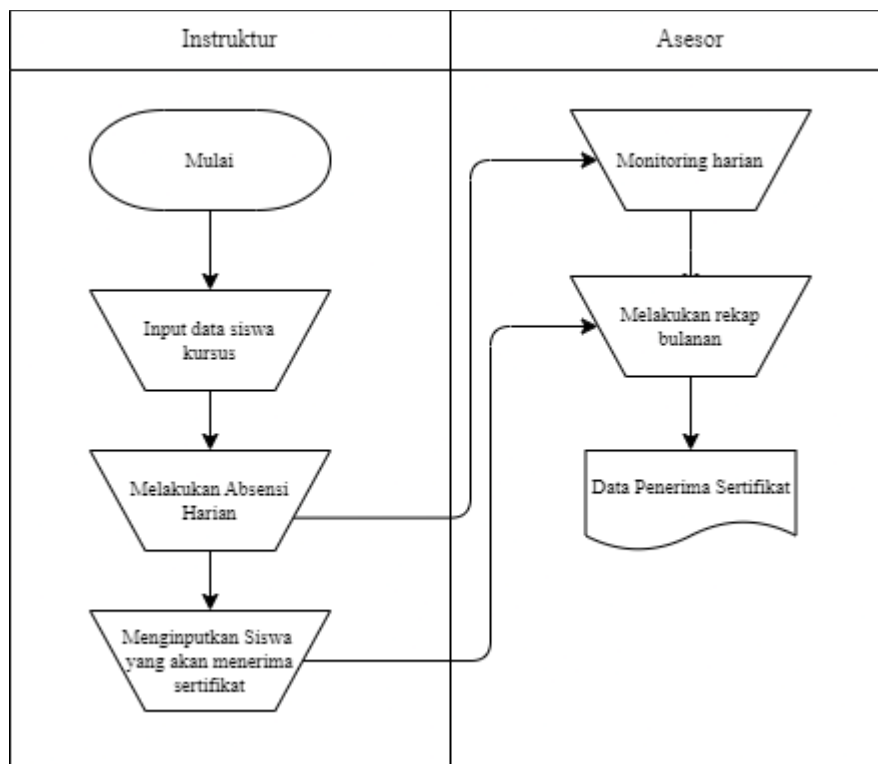

Figure 2. Monitoring Activity Business Process

User Characteristic Analysis

Analysis of user characteristics is essential in the development of a web-based application for registration and monitoring attendance of sewing course participants at Bandung Vision Center. By understanding the characteristics and needs of users, applications can be designed to provide an optimal and relevant experience. The application for monitoring the attendance of sewing course participants at the Bandung Vision Center Web-based is divided into 3 (three) access rights, namely super admin, instructor, and assessor. The access rights of each user or user can be explained as follows:

1. **Super admin**

   Super admin is a user who has full access to all features and functions of the application, which is responsible for overall system management. The access rights that the admin has are as follows:

   a. Login

      Admin can login to access the application and enter the admin page.

   b. Manage user data

      Admin can add, edit, delete user users such as new instructors and assessors.

   c. Viewing the attendance recap dashboard

      Admins can view attendance recaps based on dates in one month.

   d. Manage daily attendance data

Admins can edit the status of each student registered in the daily student attendance data.

e. Manage new student data

Admins can add, edit, delete prospective student data that will become daily attendance data.

f. Manage certificate recipient data

Admins can add, edit, delete student data that will become certificate recipients

2. **Instructor**

Instructors are users who have access to input data on prospective new course students, conduct daily attendance and input data on students who will receive certificates. The access rights that instructors have are as follows:

a. Login

Instructors can login to access the application and enter Instructor page.

b. View the attendance recap dashboard

Admin can view attendance recap based on date in one month.

c. Manage daily attendance data

Admins can edit the status of each student registered in the daily student attendance data.

d. Manage new student data

Admins can add, edit, delete prospective student data that will become daily attendance data.

e. Manage certificate recipient data

Admins can add, edit, delete student data that will become certificate recipients

3. **Assessor**

Assessors are users who have access to view the monthly attendance recap dashboard. The access rights that assessors have are as follows:

a. Login

Assessors can login to access the application and enter Instructor page.

b. Viewing the attendance recap dashboard

Admin can view attendance recap based on date in one month.

Data Requirement Analysis

To design and develop an effective application, it is important to thoroughly analyze the data requirements. This analysis aims to collect comprehensive and accurate data, which includes the data to be entered into the system (input) and the information expected to be generated by the system (output):

1. **Input Data Analysis**

Input data is data that is entered into the application to be processed so as to produce output data. The inputs include the following:

1) **Input data requirements by Super admin**

a. User Data, is input data needed so that users can be registered in the application. The data required includes: id, name, email, password, role.

b. Student Data, is input data needed so that the admin can enter student data, the required data includes: name, gender, no_hp, address.

    c.   Attendance Data, is the input data needed so that the admin can take attendance, the data needed includes: student_id, date, and attendance_status.

2) Input data required by Instructors

    a.   Student Data, is input data required so that instructors can enter student data, the required data includes: name, gender, no_hp, address.

    b.   Attendance Data, is input data required for instructors to be able to take attendance, the required data includes: student_id, date, and attendance_status.

2. Output Data Analysis

Output data is data in the form of information resulting from the processing of input data into the application. The output data includes the following:

1) Super Admin

    a.   User Data, is output data that displays information in the form of user data, namely, instructors and assessors.

    b.   Student Data, is output data that displays information in the form of student data.

    c.   Attendance Data, is output data that displays information in the form of attendance status for each student.

2) Instructor

    a.   Student Data, is output data that displays information in the form of student data.

    b.   Attendance Data, is output data that displays information in the form of the attendance status of each student.

3) Assessor

    a.   Attendance Report Data, is data that displays attendance reports for each student

    b.   Certificate data, is data that displays the names of students who will receive certificates

Functional Requirement Analysis

Functional requirements are an explanation of how the system operates, including details of each function that must be provided to ensure the system can provide accurate information to users based on existing data. The functional requirements of this application include:

1. Login

The application allows users to log into the system using valid credentials (username and password). After login, users will be directed to the dashboard page according to their role (admin, assessor, or instructor).

2. Logout

The application allows users to log out of the system. Upon logout, the user's session will be terminated and they will be redirected back to the login page.

3. Manage User data

The application can process user data management, namely, adding user data, displaying user data, changing user data, and deleting user data.

4. Manage student data

The application allows instructors to add, display, modify, and delete student data. Student data includes information such as name, gender, phone number, and address.

5. Manage attendance data

The application allows instructors to record student attendance on a daily basis. Users can add, display, modify, and delete student attendance data. Attendance data includes information such as date, attendance status (present, permission, sick, absent).

6. Manage certificate recipient data

The application allows instructors to manage certificate data awarded to students. Users can add, display, modify, and delete certificate data. Certificate data includes information such as student name, certificate name, and date of issue.

Non-functional Requirement Analysis

Non-functional requirements analysis is the process of understanding how the system will operate and determining the technical specifications required. This analysis includes software and hardware requirements that support the main functions of the application, beyond the features visible to the user (functional requirements). The software or software used is as follows:

1. **Software Requirements Analysis**

Software needs analysis is a requirement in the form of software used to run the application. as for the software or software used to run the application is as follows:

a. XAMPP web server package version 3.3.0 (Apache 2.0, PHP 7.3, MySQL 5.0.5.1).
b. Microsoft Edge version 124.0.2478.51.
c. Windows 11 Operating System.

2. **Hardware Requirements Analysis**

Hardware requirements analysis is the hardware requirements used to support the application to function properly. The specifications of the minimum hardware requirements needed in developing this application are laptops with the following minimum specifications:

a. Processor: Intel I3 Generation 10
b. RAM: 8 GB
c. 256 GB SSD

System Design

The design stage aims to visualize and model the system to be developed, based on the needs analysis that has been done previously. This modeling is done before the implementation of the system in the form of an application. To clearly describe the system design, UML (Unified Modeling Language) modeling is used, which includes Use case Diagrams, Class Diagrams, Activity Diagrams, Sequence Diagrams, and State Machine Diagrams.

1. **Use Case Diagram**

Use case diagrams describe the interaction between users (actors) and the information system being developed. This diagram serves to identify the functions that exist in the information system and the parties who have access rights to use these functions.
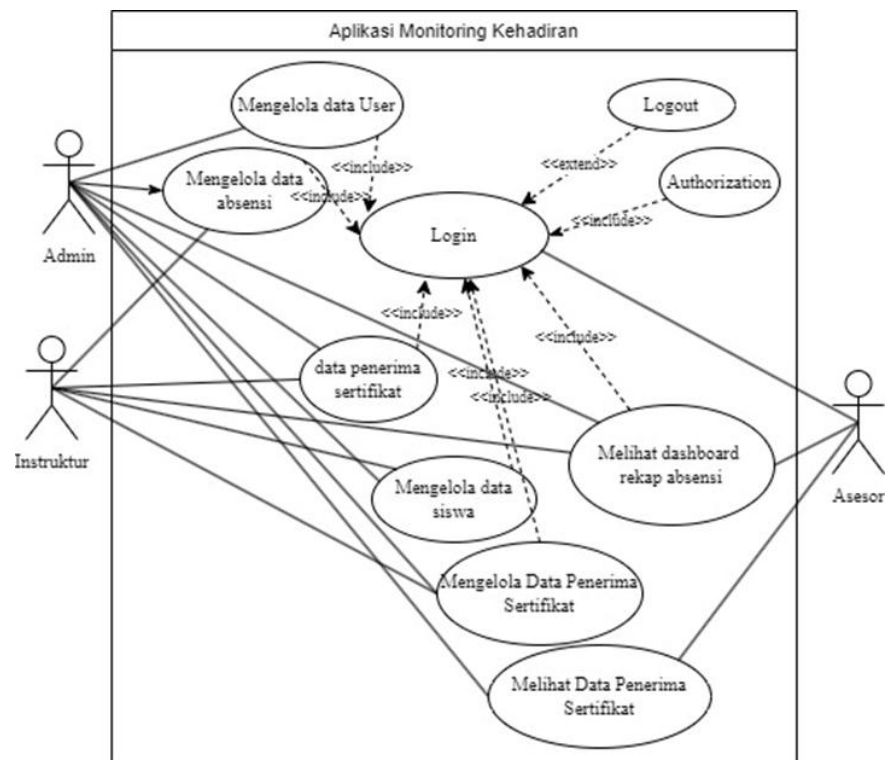
Figure 1. Use Case Diagram of Monitoring Application

2. **Activity Diagram**

Activity Diagram of Adding User, Data The process of adding user data begins when the super admin opens the user data menu, which causes the system to display the user data page. The super admin then selects the option "Add User," and the system displays the add user form. The super admin fills in the form with the required user data and presses the "save" button. The system then validates the inputted data. If the validation is successful, the system will save the user data to the database and display a save confirmation. If the validation fails, the system will return to the add user form for correction. This process ensures that only valid data is stored in the database, maintaining the integrity and quality of user data in the system.
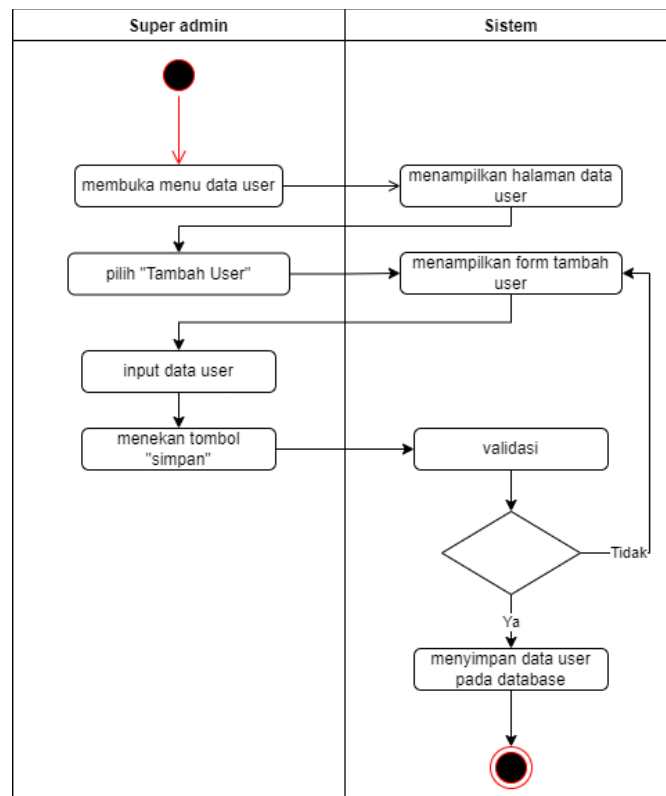
Figure 2. Activity Diagram of Adding User Data

3. **Sequence Diagram**

Sequence Diagram of Adding Student Data, it can be explained that users or users, namely super admins, and instructors can access the student data page and add student data. This page is used by the user to add new child data. The system stores student data in the database. The student data page can be accessed by super admins and instructors.
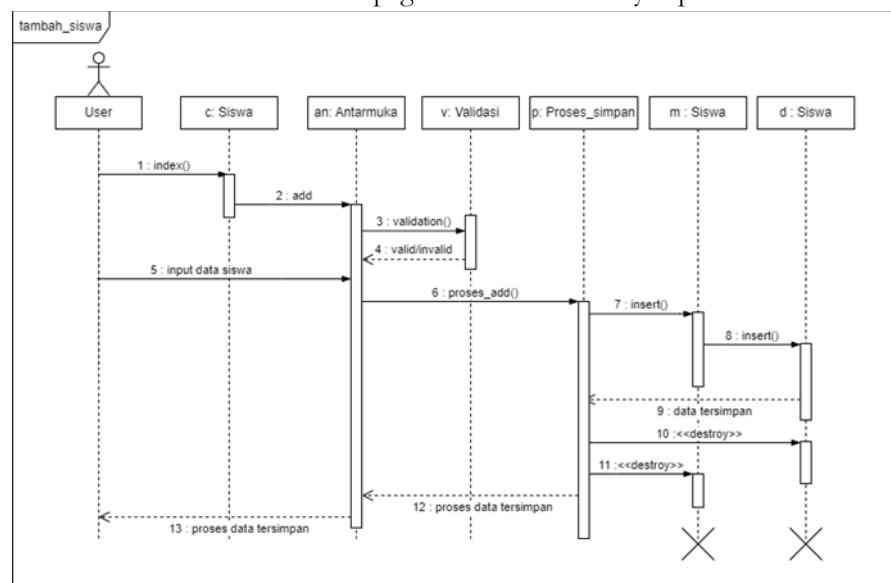

Figure 3. Sequence Diagram of Adding Student Data

4. **State Machine Diagram**

State Machine Diagram of Daily Attendance Data Update, the process starts when the user opens the attendance data page and selects the student who wants to update the attendance status. The user then selects the appropriate attendance status and inputs the attendance status data. After the data is inputted, the user presses the "save" button to save the changes. The system then processes the data saving. If the data is successfully saved, the system displays a message that the data has been successfully saved and updates the student attendance data in the database. This process ends after the student attendance data has been successfully updated. This flow ensures that the student's attendance status can be updated correctly in the system.
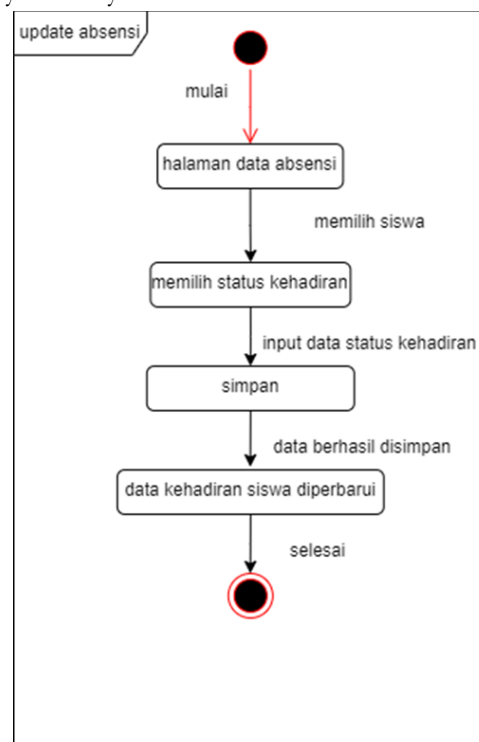

Figure 4. State Machine Diagram of Daily Attendance Data Update

5. **Class Diagram**

Class diagram describes a system structure from the definition of classes that will be created to build a system. The following is a class diagram of the design of the web-based Sewing Course Participant Registration and Attendance Monitoring Application:
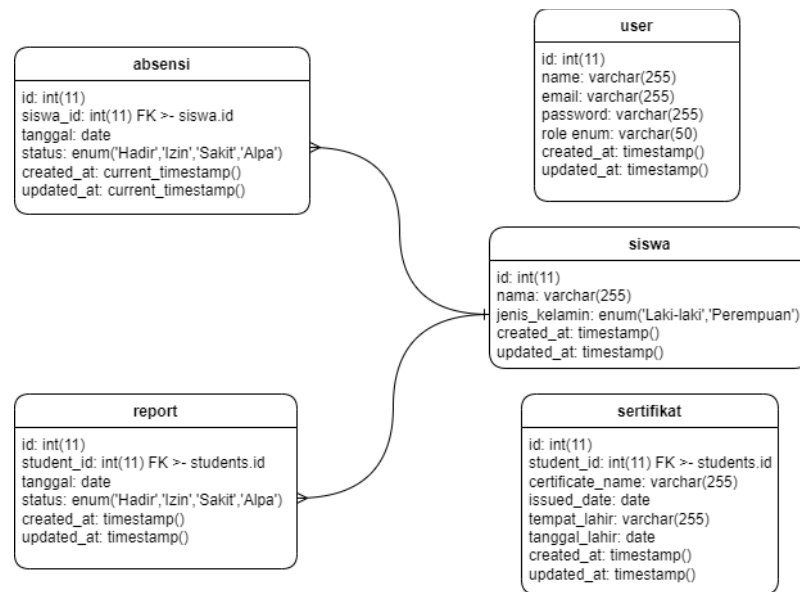
Figure 5. Class Diagram

Implementation

In the process of implementing the results of the system design process, database design, and user interface design into a web-based, using the Laravel framework for the backend and React JS Library as the frontend, and using Mysql as a relational database which is a type of DBMS (Database Management System).

Testing

At the implementation stage there is a testing stage, researchers will continue to the testing stage using the blackbox testing method.

1. **Super admin level testing**

Table 1. Super admin level testing

No	Process Design	Expected Result	Notes
Login			
1	Login (email and password)	Successfully enters the dashboard page.	Valid
2	Login (email and password) not filled in	Displays the message "Please enter Username and password".	Valid
3	Incorrect login (email and/or password)	Displays the message "Incorrect Username or password".	Valid
User Data			
1	Click the User menu	Successfully displays the User page and shows the list of Users.	Valid
2	Add User data	Successfully adds User data.	Valid
3	Edit User data	Successfully modifies or edits User data.	Valid
4	Delete User data	Successfully deletes User data.	Valid
Student Data			

No	Process Design	Expected Result	Notes
1	Click the Student menu	Successfully displays the Student page and shows the list of Students.	Valid
2	Add Student data	Successfully adds Student data.	Valid
3	Edit Student data	Successfully modifies or edits Student data.	Valid
4	Delete Student data	Successfully deletes Student data.	Valid
Certificate Data			
1	Click the Certificate menu	Successfully displays the Certificate page and shows the list of students who received Certificates.	Valid
2	Add Certificate data	Successfully adds data of students who received Certificates.	Valid
3	Edit Certificate data	Successfully modifies or edits data of students who received Certificates.	Valid
4	Delete Certificate data	Successfully deletes data of students who received Certificates.	Valid
Attendance			
1	Click the Attendance menu	Successfully displays the Attendance page and shows the list of students whose attendance status is still empty.	Valid
Report			
1	Click the Report menu	Successfully displays the Report page and shows the list of students whose attendance status has been filled in.	Valid

2. **Instructor level testing**

Table 2. Instructor level testing

No	Process Design	Expected Result	Notes
Login			
1	Login (email and password)	Enters the dashboard page.	Valid
2	Login (email and password) not filled in	Displays the message "Please enter Username and password".	Valid
3	Incorrect login (email and/or password)	Displays the message "Incorrect Username or password".	Valid
Student Data			
1	Click the Student menu	Successfully displays the Student page and shows the list of Students.	Valid
2	Add Student data	Successfully adds Student data.	Valid
3	Edit Student data	Successfully modifies or edits Student data.	Valid
4	Delete Student data	Successfully deletes Student data.	Valid
Certificate Data			
1	Click the Certificate menu	Successfully displays the Certificate page and shows the list of students who received Certificates.	Valid
2	Add Certificate data	Successfully adds data of students who received Certificates.	Valid
3	Edit Certificate data	Successfully modifies or edits data of students who received Certificates.	Valid

No	Process Design	Expected Result	Notes
4	Delete Certificate data	Successfully deletes data of students who received Certificates.	Valid
Attendance			
1	Click the Attendance menu	Successfully displays the Attendance page and shows the list of students whose attendance status is still empty.	Valid
Report			
1	Click the Report menu	Successfully displays the Report page and shows the list of students whose attendance status has been filled in.	Valid

3. **Assessor level testing**

Table 3. Assessor level testing

No	Process Design	Expected Result	Notes
Login			
1	Login (email and password)	Enters the dashboard page.	Valid
2	Login (email and password) not filled in	Displays the message "Please enter Username and password".	Valid
3	Incorrect login (email and/or password)	Displays the message "Incorrect Username or password".	Valid
Certificate Data			
1	Click the Certificate menu	Successfully displays the Certificate page and shows the list of students who received Certificates.	Valid
Report			
1	Click the Report menu	Successfully displays the Report page and shows the list of students whose attendance status has been filled in.	Valid

4. **Conclusions And Recommendations**

Based on the research conducted, the conclusions obtained from the three problem formulations are as follows:

1. Design of Registration and Monitoring Application

The registration and monitoring application designed successfully minimizes errors in the administrative process. By implementing a structured and integrated system, this application is able to reduce data input errors and duplication of information, thereby increasing accuracy and speed in managing participant data.

2. Web-based Application Development

The web-based application built for the administrative management and registration process of sewing course participants at Bandung Vision Center proved to be effective. This system facilitates access and use by various parties involved, both participants and course managers. With a user-friendly interface and comprehensive features, this application is able to increase efficiency and transparency in the registration process.

3. Implementation of Web-Based Applications

The implementation of the web-based application at Bandung Vision Center showed a significant improvement in the administrative management and efficiency of the registration process for sewing course participants. The application not only speeds up the registration process but also assists in real-time monitoring and management of participant data. This has a positive impact on the quality of services provided and the satisfaction of course participants..

Based on the above conclusions and the research conducted, several suggestions are obtained which are expected to be taken into further consideration in order to improve the quality of the application that has been made. The suggestions obtained are as follows:

1. Further Development

It is recommended to continue developing this application by adding new features such as online payment systems, automatic reminders for participants, and data analysis to improve the quality of decision making.

2. Training and Socialization

It is important to conduct training and socialization for app users, both administrative staff and course participants. This will ensure that all parties can make optimal use of the app's features and minimize usage errors.

3. Periodic Evaluation

Conduct periodic evaluations of the application to ensure that the system is running well and in accordance with user needs. Feedback from users also needs to be considered to make necessary improvements and adjustments.

4. Data Security

A focus on data security is essential to maintain the privacy and integrity of participants' information. Implementation of strong security protocols such as data encryption, two-factor authentication, and regular data backups is necessary.

5. Technical Support

Provide responsive technical support to address any issues or constraints faced by users. This will help maintain smooth operation of the application and provide a good user experience.

References

[1]. (Catatan: Informasi nama penulis dan gelar perlu dibersihkan jika hanya berisi gelar. Jika "M. M., M. Sc., DTM, SMIEEE" adalah gelar saja, abaikan dari daftar penulis.)

[2]. Aji, A. M. B., Aulianita, R., & Lubis, B. O. (2021). Sistem informasi penjualan jersey berbasis web dengan menggunakan Agile software development. Journal of Information System, Informatics and Computing, 5(2), Article 2. https://doi.org/10.52362/jisicom.v5i2.637

[3]. Banks, A., & Porcello, E. (2020). Learning React: Modern patterns for developing React apps. O'Reilly Media, Inc.

[4]. Barraood, S. O., Mohd, H., Baharom, F., & Almogahed, A. (2023). Verifying Agile black-box test case quality measurements: Expert review. IEEE Access, 11, 106987–107003. https://doi.org/10.1109/ACCESS.2023.3320576

[5]. chatgpt.opneai.com, & Shamim, D. M. M. I. (2024). Agile project management in software development industries: Challenges and opportunities. Non Human Journal, 1(05), Article 05. https://doi.org/10.70008/nhj.v1i05.30

[6]. Cruz, A. (2022). Getting started Laravel 10 Inertia 1: Here continue your roadmap in the development of web applications in Laravel with Inertia. Andres Cruz.

[7]. Halim, F. R., Kiramy, R. A., Oktoriani, D., Vernia, S., Erlangga, D., & Hamzah, M. L. (2023). Rancang bangun sistem informasi pengumuman kelulusan siswa berbasis web menggunakan metode Agile. Jurnal Testing dan Implementasi Sistem Informasi, 1(2), Article 2.

[8]. Jain, D. (2024). Ultimate Laravel for modern web development: Build robust and interactive enterprise-grade web apps using Laravel's MVC, authentication, APIs, and cloud deployment (English edition). Orange Education Pvt Ltd.

[9]. Jubaer, M. O. F., Hoque, L., Oyes, I. B., Chowdhury, T. R., & Miah, M. S. (2021). Research methodology and methods: Theory and practice. Innovative Technologia Methodical Research Journal, 2(5), 201–227.

[10]. Lahute, S. V., & Jadhav, S. P. (n.d.). React JS – A JavaScript library. International Research Journal of Modernization in Engineering Technology and Science, 6(4), 1200–1203.

[11]. Maspupah, A. (2024). Literature review: Advantages and disadvantages of black box and white box testing methods. Jurnal Techno Nusa Mandiri, 21(2), Article 2. https://doi.org/10.33480/techno.v21i2.5776

[12]. Purnama, H. I., Wilujeng, I., & Jabar, C. S. A. (2023). Web-based e-learning in elementary school: A systematic literature review. JOIV: International Journal on Informatics Visualization, 7(3), 749–759.

[13]. Rizki, M. A. K., & Pasaribu, A. F. O. (2021). Rancang bangun aplikasi e-cuti pegawai berbasis website (Studi kasus: Pengadilan Tata Usaha Negara). Jurnal Teknologi dan Sistem Informasi, 2(3), Article 3. https://doi.org/10.33365/jtsi.v2i3.887

[14]. Sari, P. D. I. R. F., Utami, A., & (Sari's additional credentials). (2021). Rekayasa perangkat lunak berorientasi objek menggunakan PHP. Penerbit Andi.

[15]. Saroni, M. I. N., & Mulyanti, B. (2020). Hypertext preprocessor framework in the development of web applications. IOP Conference Series: Materials Science and Engineering, 830(2), 022096. https://doi.org/10.1088/1757-899X/830/2/022096

[16]. Гумарова, А., Rabcan, J., A., V., & G., K. (2023). Modern frameworks for web-application development. Ġylym Žắne Bìlìm, 3(3[72]), Article 3(72). https://doi.org/10.52578/2305-9397-2023-3-2-33-40