

Design of New Student Registration System Using Web-Based Waterfall Method

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Article Info :	ABSTRACT
<p>Article History :</p> <p>Received : 29-12-2024</p> <p>Revised : 24-01-2025</p> <p>Accepted : 29-01-2025</p> <p>Available Online : 02-01-2025</p> <p>Keyword : web, waterfall, system, registration, online</p>	<p><i>New student admission is one of the crucial processes in educational institutions that requires accurate and efficient data management. MTs Amaliyah Sunggal, located at Jl. Tani Asli, Kp. Lalang, Kec. Sunggal, Deli Serdang Regency, North Sumatra, previously implemented a manual registration system that had many obstacles, such as a long process, data recording errors, and difficulty in monitoring registration progress. To overcome these obstacles, a web-based new student registration system was designed using the Waterfall development method. The Waterfall method was chosen because it has a systematic and orderly structure, which includes five main stages, namely needs analysis, system design, implementation, testing, and maintenance. In the design process, user needs are identified in detail to ensure that the system can accommodate all required functions. After that, the system is designed and implemented using web technology that allows prospective students to register online, thereby reducing the school's administrative burden. This system has been tested using Lighthouse which showed quite good performance with First Contentful Paint (FCP) of 1.6 seconds and Largest Contentful Paint (LCP) of 2.6 seconds, while Total Blocking Time (TBT) and Cumulative Layout Shift (CLS) obtained perfect scores reflecting the stability of the layout and speed of the system. This system provides convenience for prospective students to access registration information from anywhere and at any time. In addition, the school can monitor registration data in real time and generate reports automatically. Thus, it is expected that this system can improve efficiency, accuracy, and transparency in the process of accepting new students at MTs Amaliyah Sunggal.</i></p>

1. INTRODUCTION

The development of information technology has opened up opportunities for educational institutions to integrate technology into various aspects of their operations, including in the registration of new students (Yanti Yusman and Paris Harahap, 2020). The implementation of a web-based registration system provides many benefits, such as time efficiency, ease of access, and accuracy of prospective student data management (Hasan and Nurlelah, 2023). Currently, schools in Indonesia are starting to shift from conventional manual registration methods, which often face various obstacles, such as time-consuming processes, the risk of data recording errors, and difficulties in managing large numbers of physical files. MTs Amaliyah Sunggal, located on Jl. Tani Asli, Kp. Lalang, Kec. Sunggal, Deli Serdang Regency, North Sumatra, still uses the manual method in registering new students. This system involves collecting physical files, recording written data, and processing information manually, which causes several problems related to the efficiency and accuracy of the registration process. This manual process is often slow and requires a lot of

administrative staff to manage registration files. In addition, manual data recording is prone to errors such as typos or lost files which can complicate student data management in the future (Yusuf and Fachri, 2024).

The manual method also limits access to information for prospective students and parents who must come directly to the school to obtain information regarding registration requirements and the process flow (Susanto, Aprianti and Sejahtera, 2020). In certain situations, such as remote locations or time constraints, this can be an obstacle for prospective students and parents. Managing physical archives is also a challenge, as the number of applicants increases, the piling up of files requires large storage space and makes it difficult to search for data quickly. Therefore, a solution is needed that can overcome the obstacles in this manual registration system. One solution that can be implemented is the design of a web-based new student registration system. This system allows prospective students to register online without having to come directly to school. For schools, a web-based system makes it easier to manage applicant data automatically, so that it can save time, and energy, and minimize recording errors (Harono, Bagye and Purwata, 2022).

The application of web-based technology for new student registration provides several advantages. First, efficiency of time and energy. With an online system, prospective students can fill out forms anytime and anywhere, without being tied to school operating hours. For schools, incoming prospective student data can be accessed and processed automatically without manual recording. This system also allows automatic data validation, so that the risk of data entry errors can be minimized. Ease of access to information is also an advantage of a web-based system. Prospective students and parents can access information related to registration requirements, schedules, and process flow at any time without having to come to school (Supriyadi and Lutfiyana, 2020). Thus, the information provided will be more transparent and easily accessible. Data management also becomes more efficient because all data collected through the system will be stored in an organized digital database. Schools can easily search, update, or generate reports related to new student registration quickly and accurately (Ripandi, Hidayat and Budiarti, 2020).

Previous studies have shown that web-based new student registration systems have been widely implemented with various technological approaches and software development methods. For example, at SD Negeri Pungkie, PHP and MySQL-based systems increase the efficiency and accuracy of registration data management and reduce operational costs (Alba sitompul *et al.*, 2022). Another study at SMK Yayasan Pendidikan Keluarga Medan used an Android-based system for new student registration with the Agile method in software development, which successfully overcomes problems in manual systems such as slow processes and the risk of data loss (Noviranda and Saleh, 2023). Research at PKBM Ristek Nusantara Jaya developed a web-based student registration system that increases registration efficiency and minimizes paper use, as well as provides easy access to information and administration (Anastasia Rugun Christiany Dian Gustina, 2021). Research at SMP Negeri 21 Samarinda showed that although the online PPDB system facilitates registration, there are still obstacles such as a lack of socialization and understanding of technology in the community (Jannah, Erawan and Burhanuddin, 2020). The evaluation showed the need for routine improvements to increase user engagement in the online system. This study aims to design and implement a web-based new student registration system at MTs Amaliyah Sunggal. It is hoped that this system can overcome the problems faced by schools in manual registration, such as time efficiency, data accuracy, and ease of access to information (Afriliana and Rahmadhani, 2021). In addition, this system is also expected to improve the quality of administration at MTs Amaliyah Sunggal and provide more modern and transparent services for prospective students and parents.

2. RESEARCH METHODS

The Waterfall method is a systematic approach to software development that is ideal for creating information systems (Supiyandi *et al.*, 2022). This process begins with problem formulation to identify constraints on the existing registration system and determine the objectives of the new information system, such as increasing efficiency. Literature studies and data collection through observation and interviews are carried out to understand system requirements. After the data is

collected, system analysis and design are carried out to compile functional and technical specifications, followed by program code design, system testing, and implementation which includes user training and initial monitoring.

The Waterfall method ensures that each stage of development is carried out sequentially and in a controlled manner, resulting in a system that meets business needs effectively (Akbar and Fauzi, 2022). The linear stage structure makes it easier to manage projects with clear requirements from the start. However, this method is less flexible to changes that may occur during development. Other alternatives, such as the Agile method, can be considered if continuous iteration is needed to accommodate dynamic changes.

2.1 Research Stages

This section shows the research stages from problem formulation to implementation, showing the relationships between stages and how each step influences the next.



Figure 1. Research Flow

The stages of the research flow in Figure 1 aim to design an application information system that manages new student data at MTs Amaliyah Sunggal. The following are the stages carried out:

- a. Needs Analysis: This stage focuses on gathering the system requirements needed to effectively support the new student registration process. These requirements include functional aspects (what the system should do) and non-functional aspects (such as security, speed, or user interface).
- b. System Design: This stage involves creating a technical design based on the needs that have been analyzed. This design includes the system architecture, database, user interface, and system process flow.
- c. Implementation: This stage is the process of developing a system based on the design that has been created. The programmer writes code to implement all the features and functions of the system.
- d. Testing: This stage ensures that the system runs according to needs and is error-free. Testing includes validation of system functions, security, and performance.
- e. Maintenance: The final stage where the system is maintained after implementation to ensure its operational sustainability. This includes feature updates, bug fixes, and adjustments to new needs.

2.2 Data Collection Methods

The data collection methods used for this study involved several approaches. The first step is direct observation of the current new student registration process. This observation aims to understand the registration workflow, types of documents required, and obstacles often faced by both administrative staff and prospective students (Nuswantoro and Suriyansah, 2022). In this way, the information obtained will provide a comprehensive picture of the needs of the system to be developed. In addition to observation, interviews are also an important method in data collection. Interviews were conducted with the principal, administrative staff, and several prospective students

to explore their needs in more depth. This approach allows developers to understand user expectations of web-based system features, including how the system can solve existing problems (Badrul *et al.*, 2021).

Another method is document study, where data is collected from documents used in the registration process, such as registration forms, prospective student lists, and student data archives. From here, the data format and management process can be studied to ensure that the new system meets administrative needs. To complement data collection, questionnaires can also be used. This questionnaire is given to prospective students and parents to get input regarding their experiences during the previous registration process and to find out the desired features of a web-based system. Finally, literature studies and analysis of existing systems are also important parts of data collection. Literature studies are conducted by reviewing references to similar systems to understand standards and best practices. Meanwhile, analysis of the registration system currently in use, both manual and digital, helps in identifying weaknesses and development needs (Yudahana, Riadi and Elvina, 2023).

2.3 Use Case Diagram

Use case diagrams work by describing typical interactions between users of a system and the system itself through a story of how a system is used. Figure 2 is a design of a use case diagram for a new student registration application by users, in this case, the system users are admin and students. This diagram describes the relationship between actors (Admin, Students) and the functions in the system.



Figure 2. Use Case Diagram

2.4 Activity Diagram

Activity diagrams explain the activities carried out by users of the application system on the system. Figure 3 is a system activity diagram. This activity diagram illustrates the workflow or process carried out by the Admin. The process starts from logging in, inputting email and password, to validating credentials. If valid, the admin can:

1. View student data
2. Manage student data (print data and validate student data)
3. View reports
4. Create announcement schedules
5. Log out and exit the system.

If the credentials are invalid, the system displays an error message. This flow shows how the admin interacts with the system from start to finish in Figure 3. This diagram illustrates the flow of activities carried out by Students. After logging in and validating credentials, students can:

1. Input and edit data
2. Log out of the system.

Like the admin diagram, if an input error occurs, the system will display an error message. This diagram visualizes the main student activities and related decisions in Figure 3.

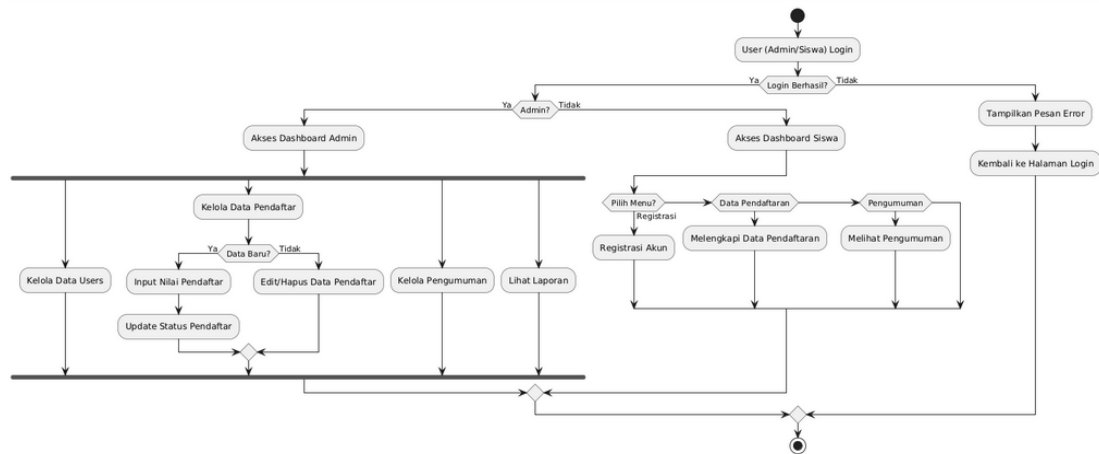


Figure 3. Activity Diagram

2.5 Flowchart

This study uses a flowchart or flow diagram that functions to see the flow of the registration data management system at MTs Amaliyah Sunggal school. Figure 4 is a flowchart of the registration data management application system at MTs Amaliyah Sunggal. The process begins when the user (admin or student) logs into the system. If the login is successful, the user is directed to the dashboard according to the user type. If the login fails, an error message is displayed, and the user is redirected back to the login page.

For admins, after successfully logging in, the admin can access the admin dashboard. The admin has the option to select the available menus, such as:

1. Manage User Data: Here, the admin can manage user data.
2. Manage Registrant Data: The admin can:
 - Add new data with value input.
 - Validate data to ensure accuracy.
 - Update the registration status if the data is valid or revalidate if it is invalid.
 - Update or delete existing data.
3. Manage Announcements: The admin can set the announcement information displayed to students.
4. Reports: Admin can view reports related to registrant data or activities in the system.

For students, after successfully logging in, they are directed to the student dashboard. Students can select menus such as:

1. Registration Data: Students can complete the data required for the registration process.
2. Account Registration: Students can register a new account if needed.
3. Announcements: Students can view the latest information that has been announced by the admin.

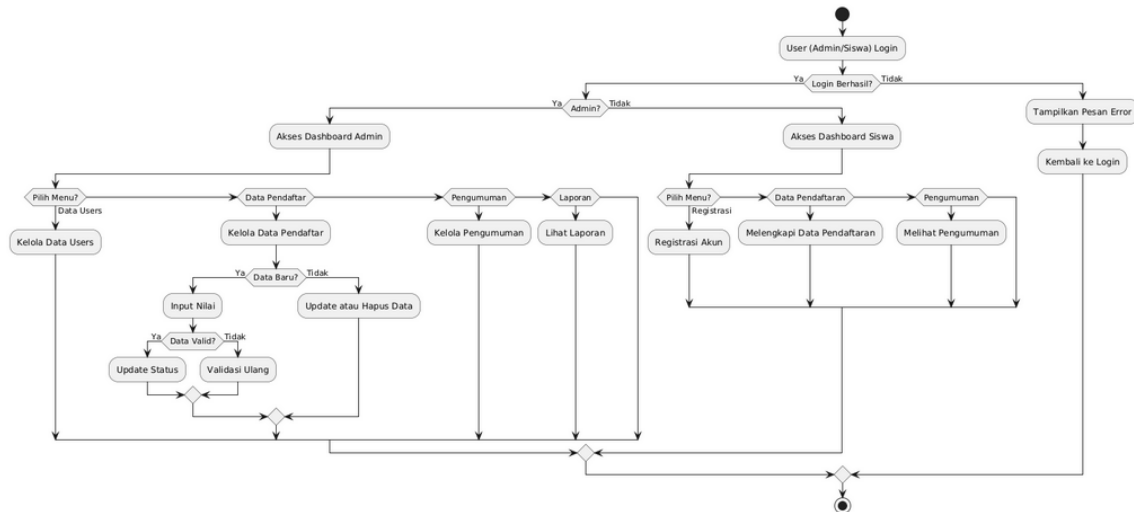


Figure 4. Flowchart

2.6 ERD (Entity Relationship Diagram)

ERD (Entity Relationship Diagram) is a modelling tool used in database design to describe data and its relationships in an information system. In the MTs Amaliyah Sunggal new student registration information system, this ERD consists of three main entities, namely:

1. Users: This entity contains system user data, such as ID, name, username, password, and level. This entity functions to manage user authentication and authorization, both admin and student.
2. Registrants: This entity stores registered student data, such as name, place of birth, date of birth, gender, religion, address, school of origin, NISN, and contact and parent information. This entity is connected to the Users entity through the users_id attribute to identify registered users.
3. Values: This entity records student grades, such as nilai_un, nilai_us, nilai_uts, and registration status. This entity is related to the Registrant entity through the pendaftar_id attribute to link grades to registered student data.

The relationships between entities are designed to ensure data integrity and facilitate the management of information related to new student registration. Figure 5 shows how these entities are interconnected in the system.

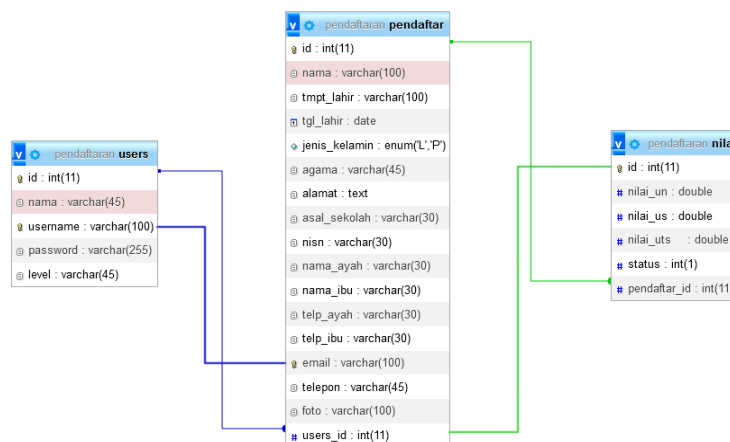


Figure 5. ERD (Entity Relationship Diagram)

2.7 Interface Design

The interface design in this study focuses on creating an intuitive, user-friendly display that meets the needs of users, both school administration and prospective students and parents. This process aims to ensure that the web-based registration system can be used easily without requiring special training.

2.8 Admin Dashboard Design

The Admin Dashboard page is a page that functions to display new students who register at MTs Amaliyah Sunggal School. In the picture, students who register are divided into 3 parts, namely incoming applicants, passed selection and new applicant data. On the admin dashboard, the meaning of incoming applicants is the total number of new students who register at MTs Amaliyah Sunggal school, while the passed selection section displays how many new students have scores validated by the admin. The new applicant data section displays new students who have just registered on the MTs Amaliyah Sunggal ppdb website.

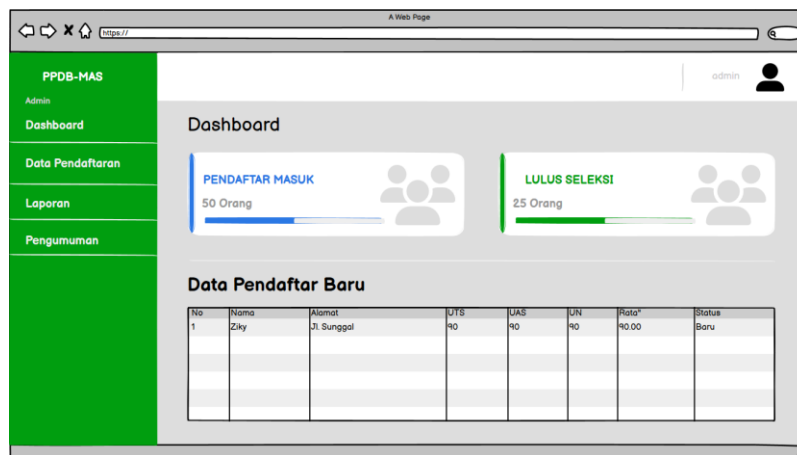


Figure 6. Admin Dashboard Design

2.9 Student Dashboard Design

The Student Dashboard page is a page that displays student personal data, re-registration file requirements and displays the re-registration announcement schedule. On the student dashboard page, there is a print personal data button that produces data in PDF format, and the edit profile button functions to edit student data.

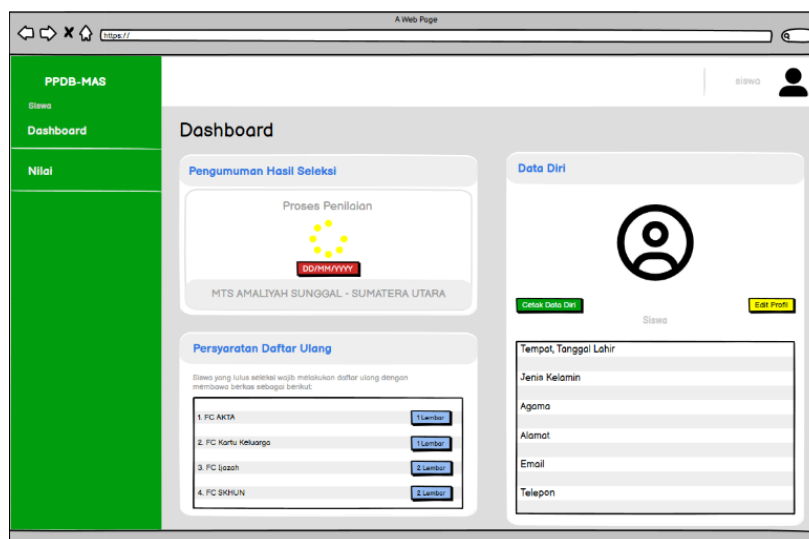


Figure 7. Student Dashboard Design

3. RESULTS AND DISCUSSION

3.1. Index Page

Figure 8 displays the index page containing the MTs Amaliyah Sunggal school profile. In addition to containing the school profile, there is a button to continue online registration. For those who already have an account, there is a "Login" button to continue the registration process, if you do not have an account, then create an account first by pressing the "Register" button.

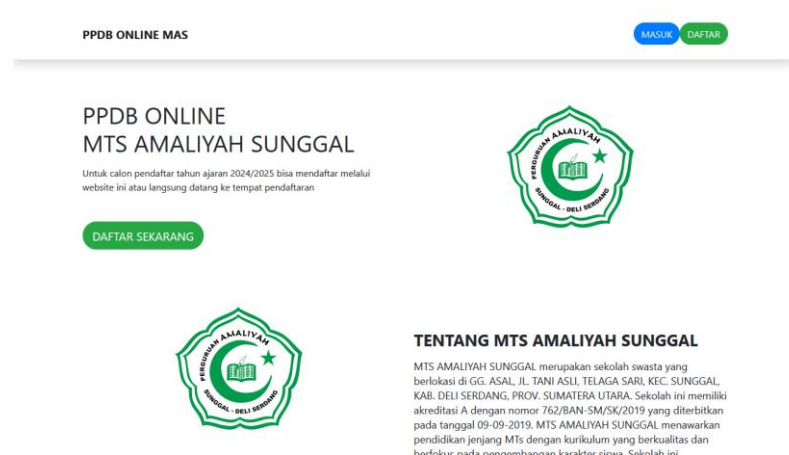


Figure 8. Index Page

3.2. Login Page

Figure 9 shows the login page with a simple interface consisting of several main elements: input fields for email and password, as well as a "Login" button and a "Register" link if you don't have an account yet.

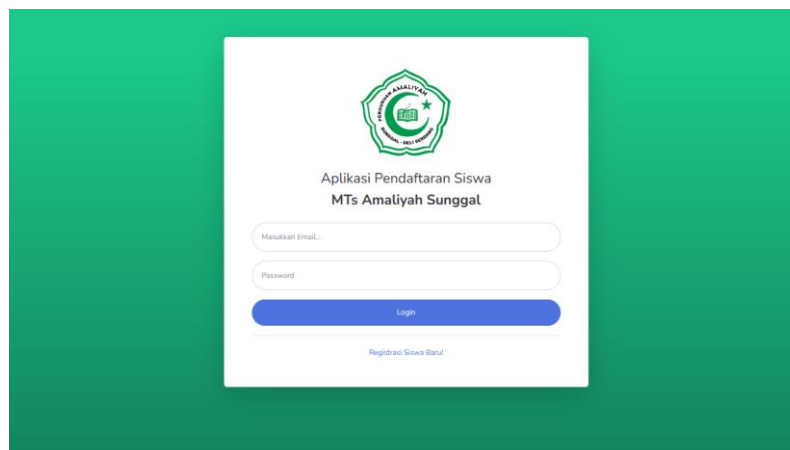


Figure 9. Login Page

3.3. Student Registration Page

Figure 10 shows the registration page for new students who do not have an account. This page has 15 input columns and 1 radio button for the choice of gender of new students. And has 1 button "Registration".

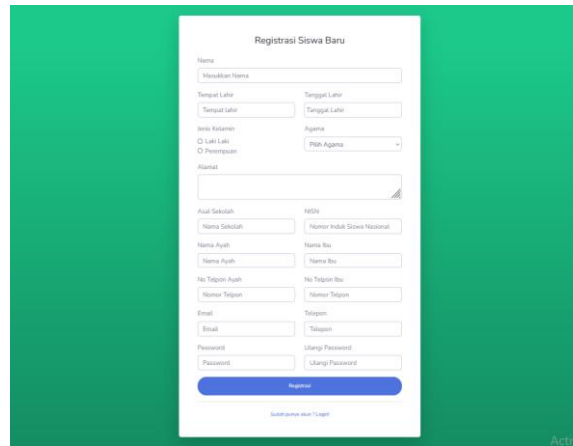


Figure 10. New Student Registration Page

3.4. Admin Page

3.4.1. Dashboard Page

Figure 11 displays the dashboard page (admin), this page displays a summary of student registration data in real time. The main section shows registration statistics, namely the total number of applicants (4 people) and the number who passed the selection (2 people). Below is a New Applicant Data table containing detailed information. This page is designed to make it easier for admins to monitor registration data and statistics easily.



Figure 11. Admin Dashboard

3.4.2. Registrant Data Page

Figure 12 displays a complete list of students who have registered, complete with information such as serial number, name (example: "D.T.M Ziky Azhar", "musof"), address, mid-term exam, final exam, and national exam scores, average, registration status ("PASS", "NEW", "FAILED"), and two action buttons: Check to check data and Delete to delete data. This page also has a search feature to make it easier to search for specific data and pagination at the bottom of the table for more data navigation. This page helps admins manage and monitor applicant data efficiently.

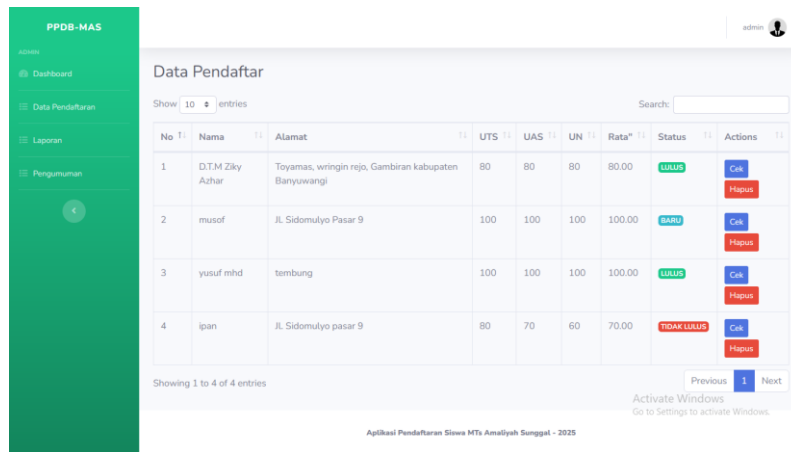


Figure 12. Registrant Data Page

3.4.3. Report Page

Figure 13 displays the Report page containing the names and addresses along with the grades of the registered students, and also displays the status of the students. This page can also print student data.

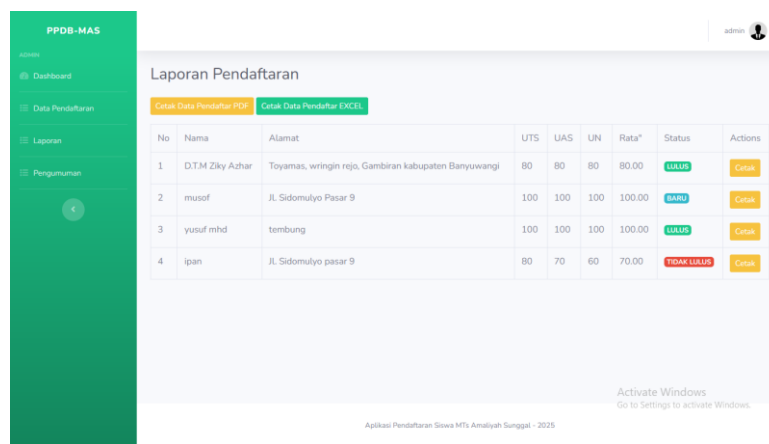


Figure 13. Report Page

3.4.4. Announcement Page

Figure 14 displays the announcement page containing an input column of type “date” and 1 save button to save the announcement date filled in by the admin. The date will appear on the dashboard page (student) if the student data has been declared passed by the admin.

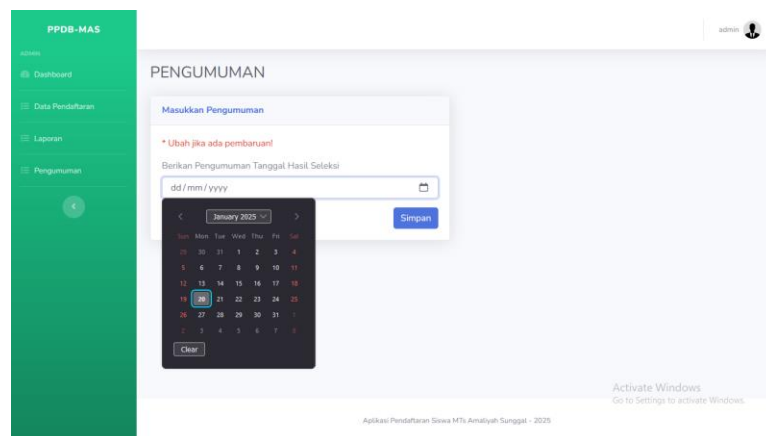


Figure 14. Announcement Page

3.5. Student Page

3.5.1. Dashboard Page

Figure 15 displays the dashboard page (student) which contains student data, selection announcements and file requirements for the next registration. On this page you can also edit student data and print student data into an excel file.

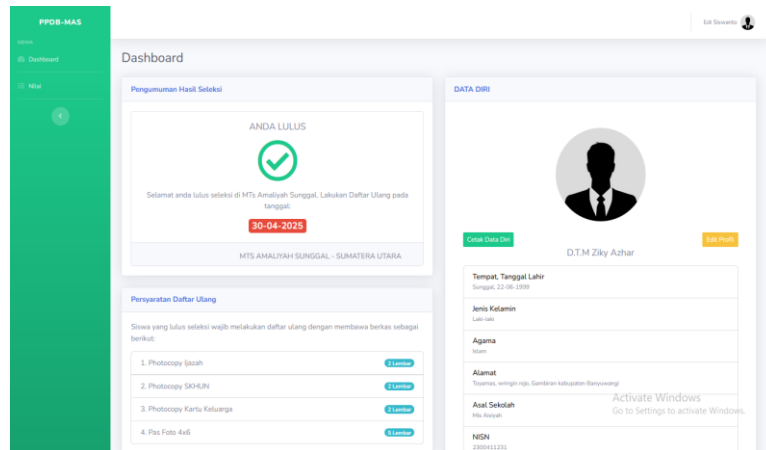


Figure 15. Student Dashboard

3.5. Student Grades Page

Figure 16 shows the student grade edit page, this page functions to edit student grades that have been previously filled in by the student on the student dashboard page. On this page, there are 3 input columns, in the form of UN grades, school exam grades, and UTS grades and there are two buttons "Save" and "Back".

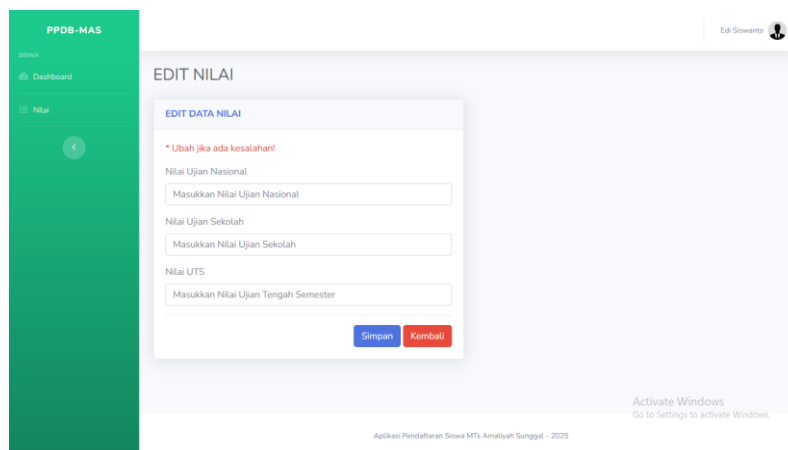
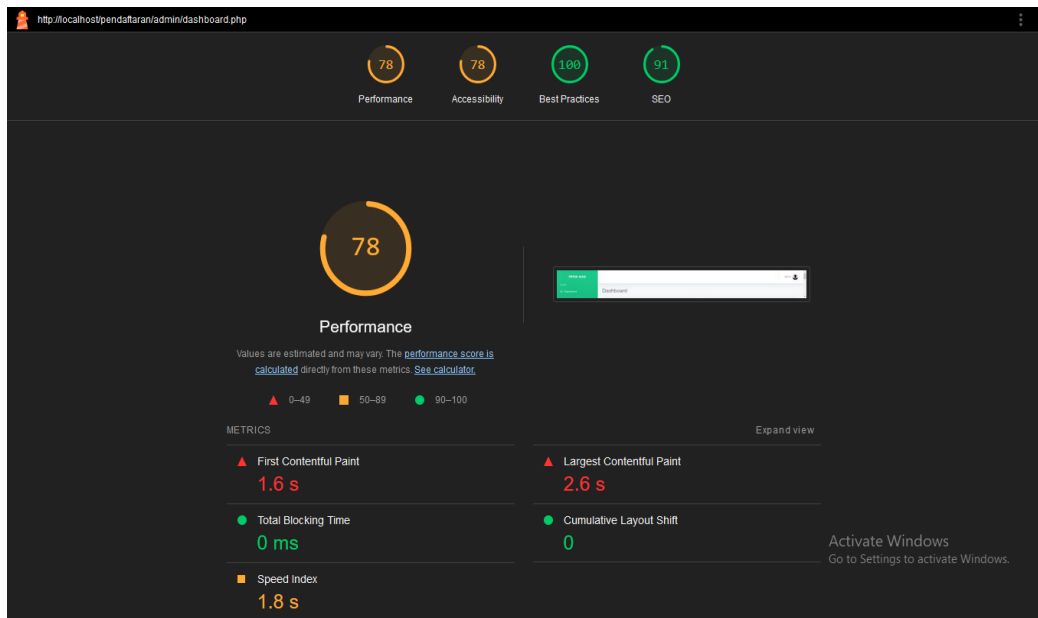


Figure 16. Student Grades Page

3.6. Lighthouse Testing

The Lighthouse test results show quite good performance with First Contentful Paint (FCP) of 1.6 seconds (score 0.47) and Largest Contentful Paint (LCP) of 2.6 seconds (score 0.44), which can still be optimized by reducing image sizes and minimizing CSS/JS files. Total Blocking Time (TBT) and Cumulative Layout Shift (CLS) scored perfectly, indicating no script blocking and layout shifts during loading. Time to Interactive (TTI) of 2.6 seconds (score 0.88) is quite responsive, while the server responds to the main document in 20 ms, without console errors. To improve it, it is recommended to optimize the initial elements, do caching, and use lazy loading, which ensures a

faster and more stable user experience. Lighthouse was chosen because it is an open-source tool from Google that is easy to use, free, and directly integrated with Chrome, providing important metrics such as Performance, Accessibility, Best Practices, and SEO. To strengthen the analysis, the tool is compared with GTmetrix which provides in-depth reports on waterfall and caching optimizations, and PageSpeed Insights which focuses on desktop and mobile performance separately. In addition, WebPageTest can be used for additional details such as DNS lookups and connection speeds. This comparison aims to provide a more complete picture of system performance, with Lighthouse excelling in analysis efficiency, while other tools add specific details for further optimization.



Gambar 17. Lighthouse Testing

4. CONCLUSION

The new student registration system at MTs Amaliyah Sunggal is designed to overcome various manual system constraints such as time-consuming processes, recording errors, and difficulties in data monitoring. This system was developed using a systematic Waterfall method, through the stages of needs analysis, system design, implementation, testing, and maintenance. Utilizing web-based technology allows registration to be done online, making it more efficient and easily accessible anytime and anywhere without having to come directly to school. This system also supports centralized data management, automatic validation, and real-time report generation, which increases the efficiency, accuracy, and transparency of the new student admission process. Performance tests using Lighthouse showed good results, reflecting the stability and speed of system interaction. This system is expected to provide more modern and optimal services for prospective students, parents, and schools.

5. DECLARATION OF COMPETING INTEREST

We declare that we have no conflict of interest.

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