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Analysis and Design of Responsive Museum Portal Application with Flexbox and Grid-Based

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ABSTRACT

The West Java People's Struggle Monument has an important role in preserving and disseminating information about the history of the struggle of the Indonesian people. In the digital era, the importance of an adequate digital presence to introduce and manage this information becomes increasingly apparent. This research aims to analyze and design a web-based responsive museum portal application at the West Java People's Struggle Monument using Flexbox and Grid responsive layout techniques in museum portal design. The existence of this website is expected to improve information management, as well as provide an optimal user experience through responsive and efficient user interface (UI) and user experience (UX) design. Therefore, this research focuses on fulfilling the digital needs of museums in overcoming information management challenges, so that this website can become an adequate and user-friendly marketing medium for introducing cultural and historical heritage to the public.

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1. INTRODUCTION

The West Java People's Struggle Monument is one of the most important historical attractions in West Java. This monument holds a lot of information and stories about the struggle of the Indonesian people in gaining independence. In the ever-growing digital era, the use of web technology has become very important in delivering information and building interaction between users and applications. The West Java People's Struggle Monument, as one of the cultural and historical heritages, also requires an adequate digital presence to introduce it to the public. The absence of a website at the West Java People's Struggle Monument is a significant shortcoming. A website can be a very effective tool to expand the reach and increase the accessibility of historical information [1]. With an online platform, visitors from different locations can access information virtually, increasing visibility and creating opportunities to introduce historical heritage to a wider public. Therefore, without a website, public interaction and engagement with the West Java People's Struggle Monument may be limited. A website can provide a platform for various interactive activities, such as virtual tours, discussion forums, or interactive educational content [2]. With online interaction, the public can be more involved in understanding and appreciating national history, creating a closer relationship between the monument and the community.

In recent years, web development has evolved significantly to support responsive design, ensuring optimal user experience across various devices. Museums, as cultural and educational institutions, increasingly rely on

digital platforms to provide access to exhibits, events, and information. The design of these museum portals must be both visually appealing and functionally efficient to accommodate a diverse range of users. some related studies include research investigating the use of mobile platforms in museums. This study focuses on presenting the design and implementation of a mobile application that satisfies various design criteria [3]. The research also introduced by Petsa, et all by building a portal prototype that integrates educational applications, a blog, advanced search functionalities, a forum, and social media features. Designed as a versatile solution, the prototype can be adapted for different museums to enhance the online visitor experience [4]. On the other hand, the study explores a potential approach to designing an interactive application for museum collections, where physical artifacts are interconnected through multiple complex logical relationships. The app aims to showcase elements of intangible cultural heritage that are challenging to present to the public using traditional methods [5]. Last, the research also investigates the use of mobile Augmented Reality (AR) applications in the National Museum of Malaysia, aiming to enhance visitors' educational experiences. The study seeks to tackle the challenge of improving museum engagement through innovative technology. The core research focus is the development of an AR application designed to deepen visitor interaction and comprehension at the National Museum of Malaysia[6].

Responsive Web Design (RWD) is a critical approach in modern web development, enabling websites to adapt to different screen sizes and resolutions [7]. Traditionally, responsive design relied on frameworks like Bootstrap and Foundation, which utilize predefined classes for grid-based layouts. However, the introduction of CSS Flexbox and Grid has significantly enhanced the capabilities of responsive design. Several museums have developed digital platforms to enhance visitor engagement. The Louvre Museum (France), which offers a responsive online portal with virtual tours and interactive exhibits [8]. In addition, The Metropolitan Museum of Art (MET) (USA), which integrates modern web technologies to provide seamless browsing experiences [9]. These implementations demonstrate the increasing adoption of responsive web technologies in museum portals. However, challenges remain in optimizing accessibility, performance, and user interaction across different devices. While museums have embraced digital transformation, many existing portals still rely on outdated frameworks or rigid grid systems, leading to inconsistencies in responsiveness. This research aims to address these gaps by analyzing and designing a museum portal application using Flexbox and Grid**,** providing a flexible yet structured approach to enhance responsiveness and usability.

2. METHOD

3.1. Research Methods

In the process of making this website, data analysis techniques use qualitative methods, which involve analyzing and discussing problems in the form of direct observation and interviews with museum managers in order to get conclusions. This method is inductive, meaning that the analysis is based on the data obtained, then developed according to a certain pattern to form a good and correct design.

3.2. Type of Data Source

The type of data collected in this research is qualitative data that involves a number of data collection methods to gain an in-depth understanding of the user experience in interacting with the UI/UX prototype developed using the Flexbox and Grid methods.

3.3. Development Method

This research adopts the WDLC (Web Development Life Cycle) methodology which consists of the following stages:

- **a.** Planning: The planning stage involves identifying the problem, objectives, and user needs. The researcher will plan the structure of the project, set goals for the implementation of the Responsive Museum Portal Application, and identify the technical specifications needed to achieve them.
- **b.** Analysis: In the analysis stage, the researcher will conduct a user needs analysis and detail the features to be implemented. This analysis involves an in-depth understanding of the West Java People's Struggle monument, potential users, and responsive design demands.
- **c.** Design & Development: The design stage involvesdesigning the user interface using Flexbox and Grid technologies. Researchers will plan the layout of UI (User Interface) elements, set grid and

flexbox properties, and develop the necessary HTML, CSS, and JavaScript code. development involves prototyping and coding responsive interfaces.

d. Testing: In the testing phase, researchers will test the user interface on various devices and browsers to ensure responsiveness and layout suitability. Functionality tests will also be conducted to check if all features are working properly.

e. Implementation & Maintenance: After testing is complete and the user interface is considered ready, the researcher will implement it on the West Java People's Struggle Monument website.

After implementation, researchers will conduct regular monitoring and maintenance to ensure that the site remains responsive and works well over time [10].

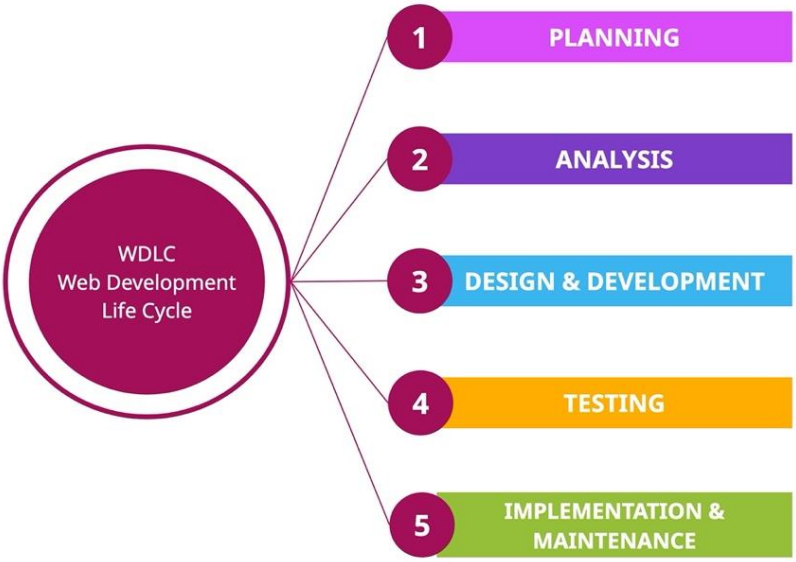

Figure 1. Web Development Life Cycle Model (WDLC)

3.4. Flexbox & Grid Method

In designing the application layout, this research will use the Flexbox and Grid methods. Flexbox is used to set the layout dynamically, so that the application is responsive and easily adapted to the user's device. Grid is used to define the overall structure of the page, making it easy to arrange the elements on the page with precision.

1. Responsiveness with Flexbox
   One of the main advantages of Flexbox is its ability to respond to changes in screen or device size. The use of properties such as flex-wrap, flex-shrink, and flex-grow allows the layout to remain responsive to environmental changes [11].

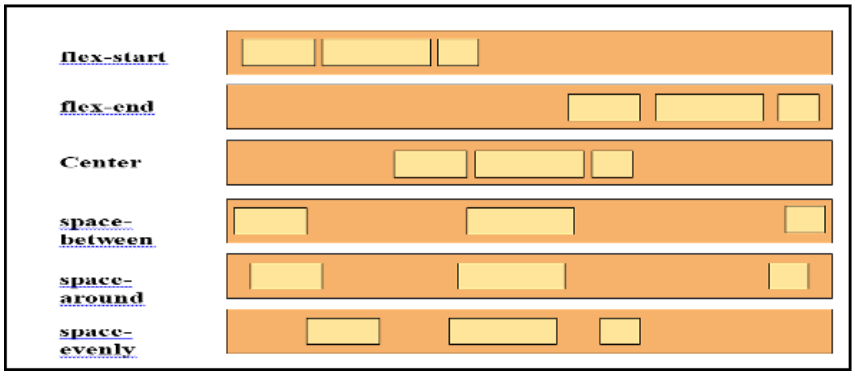

Figure 2. Flexbox CSS Property

2. Grid Application

   The following are the detailed steps in applying Grid to application development [12]:

   a. Defining Grid Containers (Grid Container);
   b. Determination of Rows and Columns Structure;
   c. Determination of Grid Areas;
   d. Placing Items in the Grid;
   e. Determination of Column and Row Gaps;
   f. Responsiveness with Grids: One of the main advantages of the Grid is its ability to handle responsiveness;
   g. Integration with Query Media: At the implementation stage, the Grid can be integrated with media queries to customise the layout based on specific device characteristics or screen sizes. This provides further control over application responsiveness.

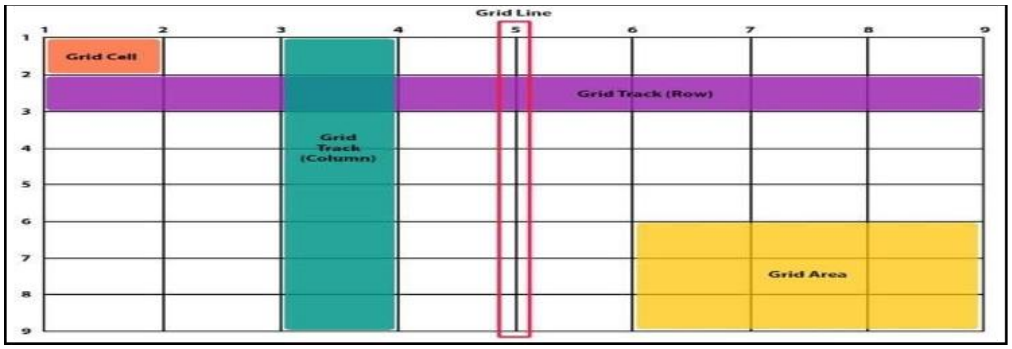

Figure 3. CSS Property Grid

3.5. System Design

1. Museum Website Navigation Structure

   Navigation will be designed intuitively with the type ofcontent in mind. The main categories, such as history, art, culture, and practical information, will be organized in a clear hierarchy, allowing visitors to easily navigate to the related pages shown in Figure 4.

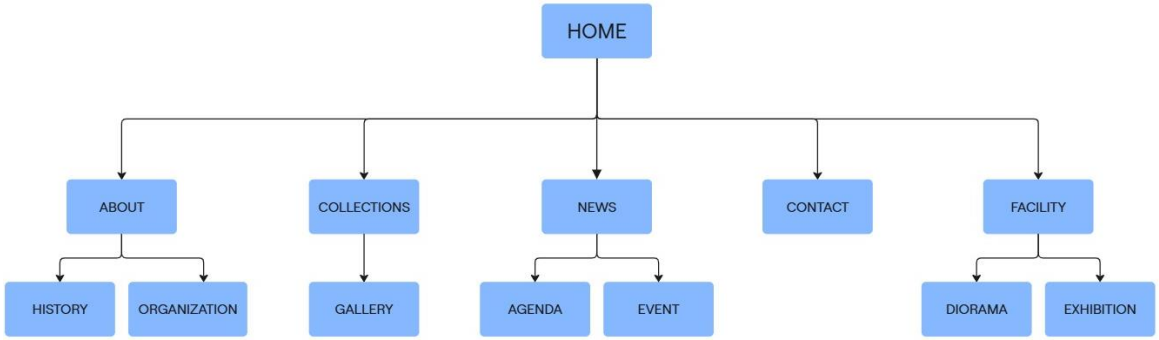

Figure 4. Museum Web Navigation Structure

2. Interface Design

   By using the Flexbox and Grid methods, elements such as slider images, headlines, and action buttons are placed in a dynamic arrangement. The use of Flexbox allows for automatic adjustment of elements based on screen size, while Grid is used to set up a system grid so that the contentis well organized on various devices which can be seen in Figure 5.

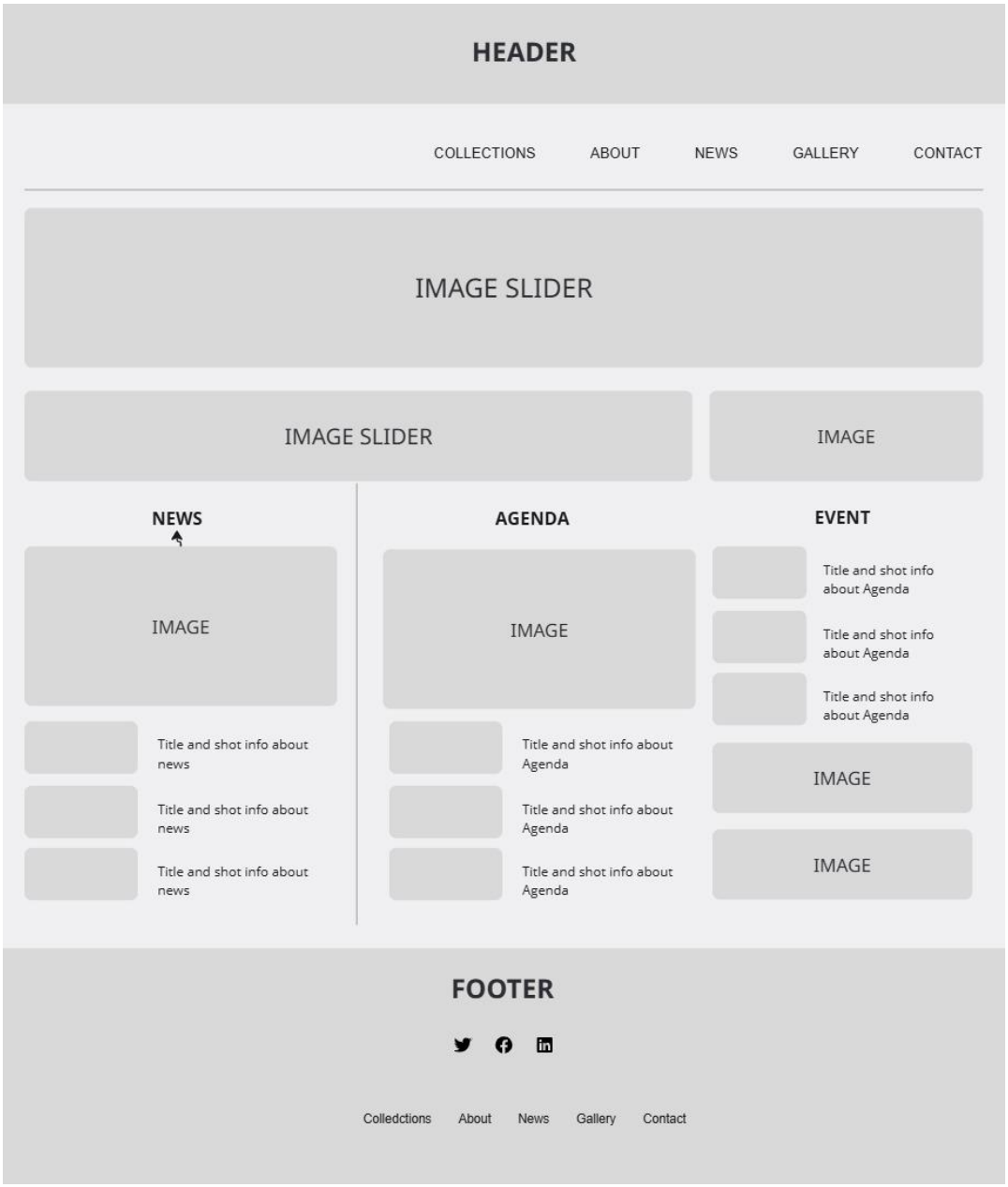

Figure 5. Interface Design

3. Demonstration
   The demonstration scenario of the museum portal website is where there are two actors who can interact with the system, namely the Museum Admin and the User or Visitorof the website. All these activities are shown in the system flowchart in Figure 6 [13] and use case diagram in Figure 7 [14] .

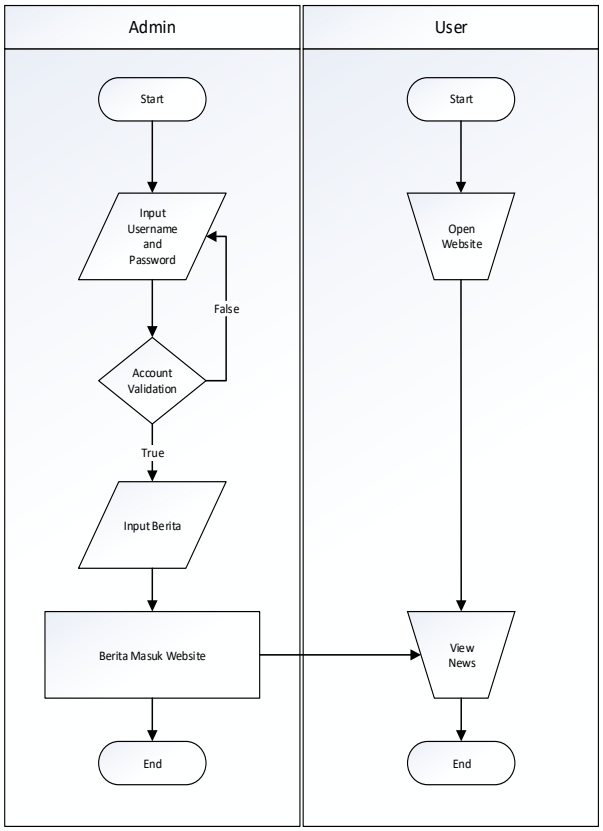

Figure 6. System Flowchart

Figure 7. Use Case Diagram of Museum

3. RESULTS AND DISCUSSION

The results of the research focus on the implementation and design of the home page of the Museum Web Portal built using PHP and MySQL as a database [15] . The main components of the web are the focus of attention to create a responsive, attractive, and informative interface.

3.1. Administrator Application

The main focus includes the admin login page that involves a verification process with a successful notification, as well as the admin main page view that includes a dashboard, profile management, news, and agenda with easy-to-use navigation support.

3.2. System Testing

This section highlights a critical stage in application development, namely System Testing. System testing became an important step to verify and evaluate the successful implementation of the responsive museum portal, using the Blackbox testing is focussed on aspects of functionality that can be observed from a user perspective, but also maintains the internal integrity and security shown in Table 1 and Table 2.

Table 1. Testing Login and Logout Sessions (Admin Dashboard)

No.	Case Type	Scenario	Result	Status
1	Positive	Login with correct username and password	Login success	OK
2	Negative	Login with incorrect username and password	Login Failed	OK
3	Positive	Admin Session Logout	Logout Success	OK

Table 2 Testing The News Page

No.	Case Type	Scenario	Result	Status
1	Positive	Login with correct username and password	Login success	OK
2	Negative	Login with incorrect username and password	Login Failed	OK
3	Positive	Admin Session Logout	Logout Success	OK

4. CONCLUSION

The existence of a website is an essential step to improving information accessibility, expanding community involvement, and overcoming the weakness of responsive display in various media, from desktop to mobile. With a responsive and interactive website, the West Java People's Struggle Monument is expected to be more effective in spreading historical and cultural values to the public. Therefore, creating, developing, and optimizing the website as a fast and appropriate solution is necessary. The suggestions focus on increasing presence by creating an official website, expanding online information, developing interactive features, optimizing responsive displays, and involving visitors in the development process. Through these suggestions, it is hoped that the West Java People's Struggle Monument can provide visitors with a more in-depth, educational, and interactive experience and be more accessible to the broader community.

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