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Automated Testing to Evaluate Employee Attendance System Performance Using GTMetrix

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ABSTRACT

The advancement of technology highlights the need for more efficient employee attendance systems, as conventional manual methods are prone to errors and inefficiencies, making it essential for companies to implement an effective information system for attendance management. This study aims to evaluate the performance of the employee attendance system through automated testing using the GTMetrix website performance analysis tool. Results of this study for the attendance website got grade A with a performance and structure value of 100% but had an LCP of 226 ms. Further research can take an approach using lazy loading, image compression, or improving network delays to reduce the rendering time of the largest elements in the viewport to reduce LCP. The results of this study can be a reference for information system developers in designing and implementing a more optimal employee attendance system. In addition, this study also provides insight into the importance of optimizing website performance in the context of business applications.

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1. INTRODUCTION

The development of technology is currently accelerating, especially in the field of information and communication technology [1], [2]. By 2025, an estimated 1.8 billion people will be using mobile internet, driven by advances in web technologies that improve application performance, where Google research shows that a 200ms delay in page loading can decrease searches by 0.22% in three weeks [3]. This technological development creates the need to adopt a more efficient system in various aspects, including employee attendance. Currently, attendance activities are still considered less efficient and effective when conducted conventionally (manually), whereas the advancement of the times continues to progress. The conventional attendance activities are very ineffective if still used at this time. This can lead to errors[4], making it imperative for the company to create an information system[5]. There is no specific system for recording attendance. Attendance is the process of recording and managing attendance data that is carried out daily during working hours in any company[6].

With the rapid advancement of technology, every task performed will become easier, especially since many companies already use technology in their infrastructure[7]. The employee attendance system plays an important role in assessing the work quality of employees in an institution or company. Employee attendance even becomes one of the determining factors in decision-making by management. However, the processing of attendance systems that are not effective and efficient, such as the use of conventional systems, can lead to a decline in the quality of the attendance system. Conventional attendance recording systems are less accurate and prone to human error.

Therefore, it is important for companies to ensure that the system they use functions well. The performance of an employee attendance system is greatly influenced by various factors, such as access speed, responsiveness, and system stability. Poor performance can lead to various issues, ranging from delays in processing attendance data to disruptions in other business processes [8]. Therefore, it is important to conduct performance testing periodically to ensure that the employee attendance system functions well [9]. Website performance testing is an important step to ensure that a website can be accessed quickly and responsively. Various tools have been developed to conduct performance testing, one of which is GTMetrix.

Many website performance tests have been carried out such as [10] which tests the performance of the Surakarta Aisyiyah University website but only focuses on speed testing. Then research by [11] which uses TAW and GTMetrix tools for testing the page speed performance of Health sites and e-learning sites with the result that both domain sites cannot meet the minimum accessibility requirements. Furthermore, research by [3] in the domain of web-based system performance evaluation, focuses more on general analysis of web application performance using tools such as Lighthouse or Webpage Test. These previous studies provide general guidelines for improving page load time and user experience. The focus of previous studies was on the optimization of visual elements and page speed performance but did not explore the impact on the context of organizational management systems such as attendance systems. Therefore, the difference in this research is that an automated test will be conducted on the employee attendance system using GTMetrix to evaluate system performance in terms of speed, responsiveness, and efficiency. GTMetrix, which is a tool developed by Google to measure website performance[12]. There are several points used as considerations to determine the quality of a website[13], namely by considering access speed, easily accessible and readable content, and a consistent layout or design.

In this study, the attendance system being tested is a mobile web-based application used by the company to record employee attendance, and the test results show that page load time is one of the key factors affecting user experience. Long loading times can cause user frustration and reduce employee productivity. The focus of this research is to analyze how testing results can be used to improve the performance of the attendance system and its impact on employee productivity. Therefore, it is important to identify the elements that slow downloading times and make the necessary optimizations. Through an organized and planned approach, this research is expected to make a significant contribution to the understanding of the importance of testing systems in the context of human resource management. The results of this research will provide practical recommendations for organizations in optimizing the use of information technology to support more effective and efficient attendance management.

2. RESEARCH METHOD

This research uses the system development methodology known as Extreme Programming (XP). Extreme Programming (XP) is an agile software development methodology that focuses on coding, which is the main activity in all stages of the software development cycle [14]. The Extreme Programming method, known as the XP method, is a form of software development model that makes the system development stages more efficient, adaptive, and flexible [15]. Extreme Programming (XP) is more suitable for projects that require high flexibility, rapid response to change, and intensive collaboration [16]. XP enables software development with short iterations, automated testing through Test-Driven Development (TDD), and practices such as pair programming to ensure quality and speed [17]. Compared to Waterfall, XP is more adaptive to change and risk [18], while Scrum provides a more structured iterative framework [19], but XP offers higher technical intensity and more responsive development speed [20]. XP is ideal for projects with high quality and fast delivery requirements, especially in evolving and complex situations [21].

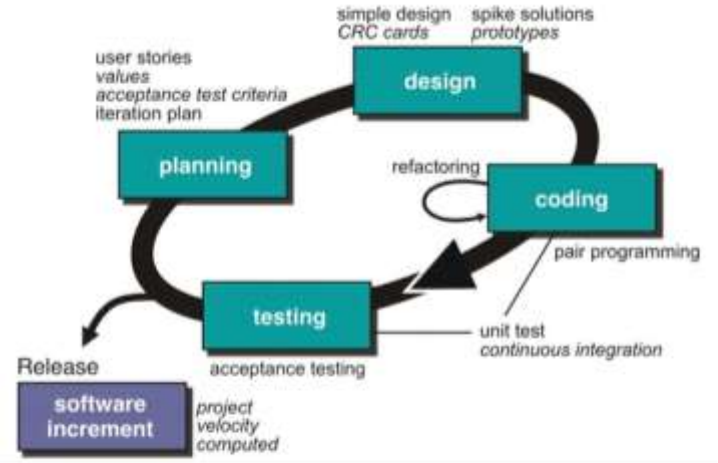

Figure 1. Extreme Programming Method

Figure 1 is the steps of the extreme programming system development method which includes:

a. **Planning:**

Planning is the initial step in the system development cycle. Needs analysis is conducted to identify the system requirements that will be built. Here are the requirements needed for this attendance system:

1) Admin
Administrators can manage their accounts by logging in using their email and password. Additionally, this system allows administrators to comprehensively manage employee attendance data, including downloading reports. Other available features include managing employee data and admin data. As an additional innovation, this system also allows administrators to create unique QR Codes for each employee as a more efficient means of attendance.

2) Employees
Employees can use accounts accessed through email and password, allowing them to easily edit their profile data. In addition, this system also allows employees to view their attendance history in real time. The practical QR Code scan feature simplifies the attendance process, both when arriving and leaving work.

b. **Design**

The next stage is design, where modeling activities are carried out, starting from system modeling, architecture modeling to flow and process modeling, including system and service models. The architecture of this system is visualized and specified using UML (Unified Modeling Language) diagrams to illustrate its structure, as follows:

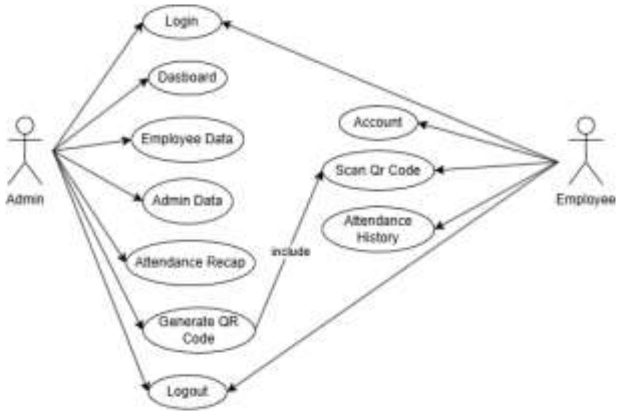

Figure 2. Use Case Diagram

Figure 2 shows the interaction flow between the admin and employees in a QR Code-based attendance system. The admin, as a user with full access rights, can perform various actions, such as managing employee data, creating unique QR Codes for each employee, and viewing the attendance recap of all employees. On the other hand, employees have limited access, which is to mark their attendance by scanning the QR Code and viewing their attendance history.

whereas for modeling the flow and processes in this system, the researcher uses a flowchart as follows:

1) Admin

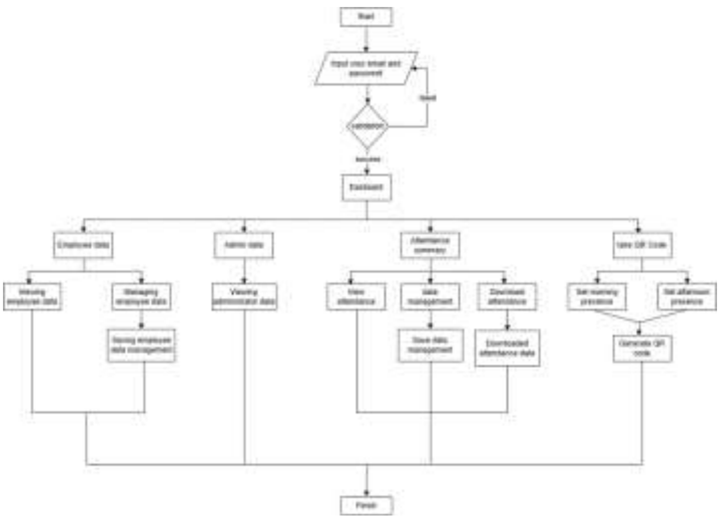
Figure 3. Admin Flowchart

In the admin flowchart process in the figure 3, it begins when the user enters their email and password to log in. After verification, the user will be directed to the main dashboard. From the dashboard, users can access various features such as managing employee data (adding, modifying, or deleting), viewing attendance summaries, and setting up QR Code generation for attendance. This QR Code feature is very important as it will be used by employees to record their attendance. Additionally, the system also allows users to download attendance data in file format for reporting purposes. Overall, this flowchart illustrates how this system is designed to facilitate the process of managing employee data and attendance, as well as providing convenience for employees in clocking in.

2) Employee

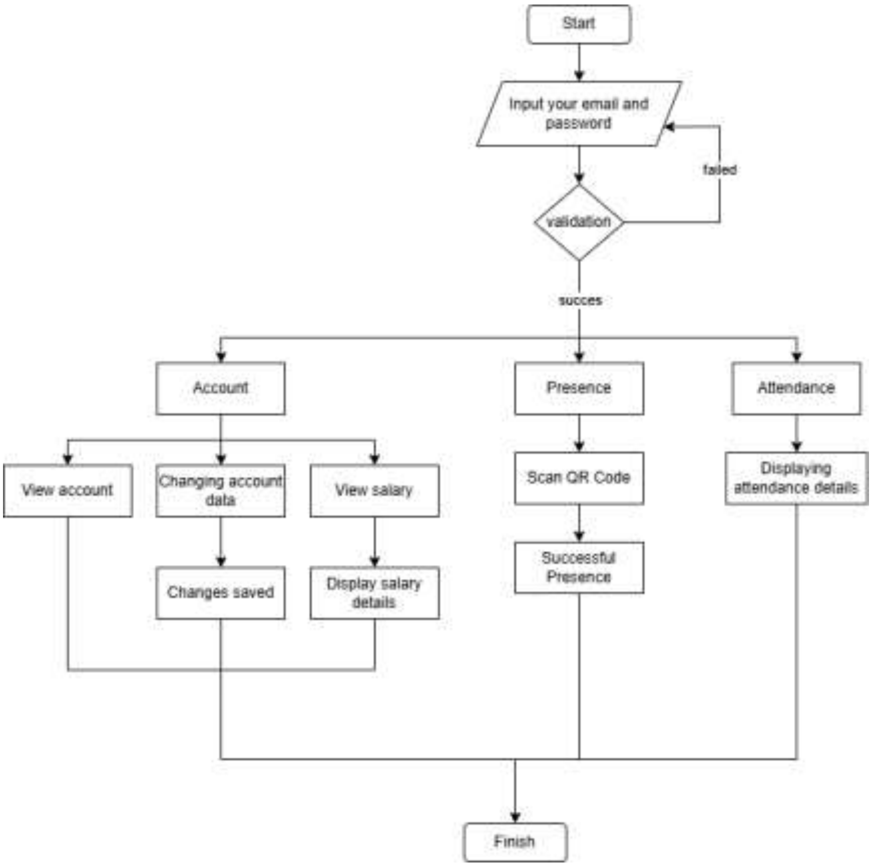

Figure 4. Employee Flowchart

In the employee flowchart process in the figure 4, it begins with the user authenticating by entering their email and password. After verification, the system can display the main page. On the main page, users have several menu options, one of which is the attendance menu. To take attendance, users simply need to scan the provided QR Code. The system will then automatically record the user's attendance data. In addition to the attendance feature, users can also manage their personal accounts, such as viewing and editing profile information. In other words, this system not only functions to record attendance but also provides convenience for users to access their personal information.

c. Coding

Coding is the stage where the design created is then implemented in the form of a programming language recognized by computers [22]. The creation of this system is divided into two stages: the development of the user interface (front-end) and the development of business logic (back-end). The back end of this system is implemented using the JavaScript programming language, React.js technology for building the user interface, and native JavaScript for the business logic. At this stage, the design that has been prepared will be implemented through coding, resulting in an appearance as designed.

1) Login Page

Figure 5. Login Page

Admin login page, before the admin logs into this system, the admin can enter the email password in the provided login form. When the admin successfully logs in, the admin will then enter the dashboard page.

2) Dasboard page

Figure 6. Dashboard Page

If you have entered this page, the admin can perform activities on the dashboard page. The admin can see the number of employees, late employees, present employees, and the time.

3) Employee Data Page

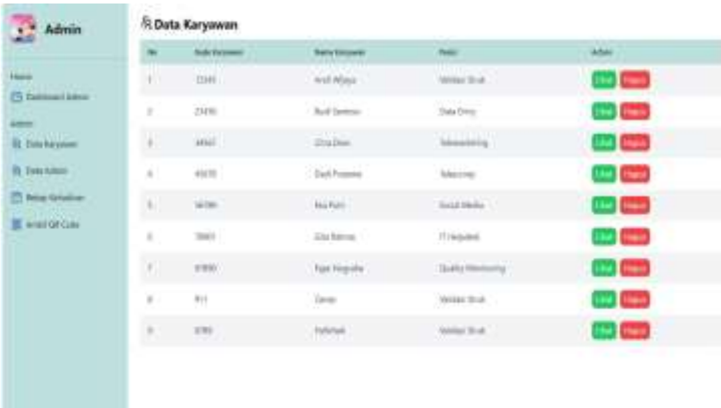

Figure 7. Employee Data Page

This page is designed for administrators to access and manage employee information within the company. Administrators can perform various actions here, including viewing employee details and deleting unnecessary data.

4) Admin Data Page

Figure 8. Admin Data Page

This page provides a complete list of administrators who have access to the system. This page displays relevant data for administrators, such as (administrator name, username, email, and creation). (tanggal pembuatan akun admin).

5) Attendance Recap Page

Figure 9. Attendance Recap Page

This page provides a view for administrators to see, manage, and download employee attendance data, which will subsequently be used by the administrator to create employee attendance reports.

6) QR Code Retrieval Page

Figure 10. QR Code Retrival Page

This page is used by the admin to generate a QR Code that will later be scanned by employees when they arrive (07:30) and leave (17:00) during office hours. In this feature, the admin will set the date and time of attendance before printing the QR (Quick Responsive) Code and distributing it to the employees.

3. RESULTS AND ANALYSIS

Automated testing using GTMetrix on the employee attendance system aims to assess the performance of the web-based application used for recording attendance. In this context, system performance is crucial because it can affect user experience, operational efficiency, and employee productivity. GTMetrix is an effective tool for analyzing various aspects of website performance, including page load time, page size, and the number of HTTP requests, and here are the test results:

Figure 11. Analysis GTMetrix result

The results of the system testing analysis on figure 11 using GTmetrix show very good results for the website https://presensi-web-blond.vercel.app/. This site achieved a perfect A score, both in terms of loading speed and code structure. This indicates that the website is very responsive and efficient. However, there is an anomaly in the largest contently paint metric, which reaches 226 seconds. This figure is considered very high and needs to be investigated further. The possible causes are the presence of large assets such as images or scripts, or issues with server configuration. Suggested approaches to LCP anomalies include the use of lazy loading, image compression, or fixing network delay to reduce the rendering time of the largest element in the viewport [23]. Nevertheless, other aspects such as blocking time and layout shift show very good performance. To improve overall performance, it is recommended to optimize images, minify CSS and JavaScript, and consider using a CDN. By making these improvements, it is hoped that the website can provide a much better user experience.

3.1 Performance

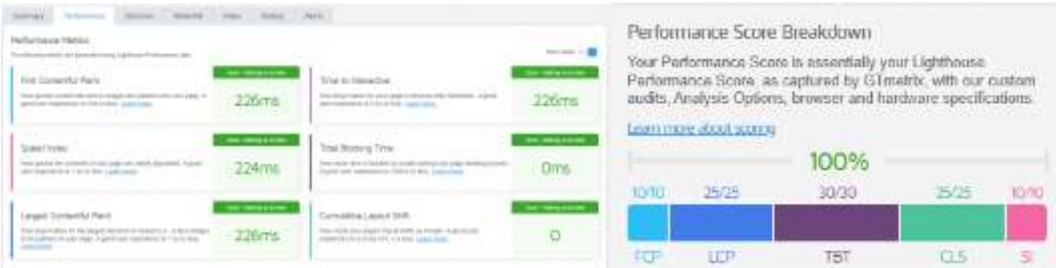

Figure 12. Performance analysis

The figure 12 is the test results using GTmetrix that you shared show very impressive results, with an overall score of 100%. This indicates that the website you tested has excellent performance and can provide an optimal user experience. The First Concertful Paint (FCP) was recorded at only 226 ms, indicating a quick response in displaying the first content on the screen, while the Speed Index of 224 ms indicates that the page content is fully visible in a very short time. In addition, the Largest Contentful Paint (LCP) which also stands at 226 ms shows that the largest elements on the page are loaded very efficiently. The system achieves Time to Interactive (TTI) in 226 ms, indicating that it can respond to user interactions almost instantly, with no Total Blocking Time (TBT) recorded at zero, ensuring a seamless process. With a Cumulative Layout Shift (CLS) value of 0, the system provided perfect visual stability with no layout shifts during page loading. Overall, these results demonstrate the system's outstanding performance, with fast response times, stable user experience, and efficiency that meets or even exceeds industry standards.

3.2 Structure

Figure 13. Structure analysis

A Structure Score of 100% on GTmetrix indicates that the code building your website is very efficient and organized. It's like having a house built with very good and sturdy architecture. Every part of the house (in this case, the website) is well-connected and functions optimally. The GTMetrix report in figure 13 shows that the system performs quite well, with the largest element loading time (Largest Contentful Paint) of only 230 ms and a server response time of 9 ms, which is the optimal result. However, there are some areas for improvement, such as the removal of 22 KB of unused JavaScript, the reduction of the network payload size that reached 330 KB, and the optimization of the three detected request chains. In addition, the work on the main thread took 125 ms, and there was a potential time saving of 18 ms if the resources blocking the rendering were optimized. Recommendations for improvement include removal of irrelevant JavaScript scripts, compression and minification of network files to reduce payload size, and merging or rearranging critical resources to minimize request chains and resources that block rendering. Improvements in these areas are expected to significantly increase system efficiency and provide a better user experience.

3.3 Largest Contentful Paint

Figure 14. Largest contentful paint analysis

Largest Contentful Paint (LCP) is a metric that measures how quickly the largest visual element on your webpage, such as the main image or a large title, is visible to visitors. In this test in the figure 14, the LCP was recorded at just 0.7 seconds, which means that the largest elements on the page loaded very quickly and met Google Core Web Vitals' optimal standard of under 2.5 seconds. This process begins with First Paint (0.2 seconds), where small elements start to appear, followed by First Contentful Paint (FCP) (0.4 seconds), where the main content such as text starts to appear. LCP, which occurs at 0.7 seconds, ensures that the largest elements are fully displayed on the screen within a short period of time. These results show that the tested web pages have excellent performance, providing a fast, stable user experience that complies with modern standards.

3.4 Total Blocking Time

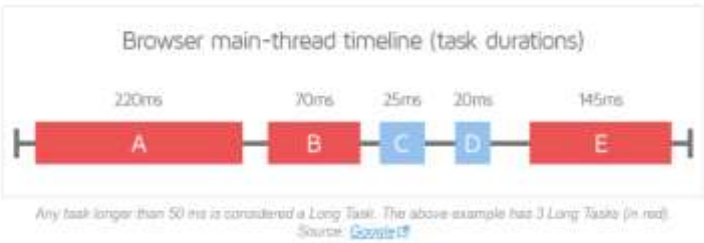

Figure 15. Total blocking time analysis

Website performance metric called Total Blocking Time (TBT). TBT measures how much time is wasted during the web page loading process due to scripts that block user interaction. In simple terms, this is the time when users must wait for the page to finish loading before they can interact with it, such as clicking a button or scrolling the page. The figure 15 shows the Browser Main-Thread Timeline which illustrates the duration of tasks on the main thread during page loading. Total Blocking Time (TBT) measures the time spent by long tasks (more than 50 ms) that impede page responsiveness. Tasks marked red (A, B, and E) have a duration of more than 50 ms, while blue tasks (C and D) are shorter. TBT is calculated by subtracting 50 ms from the duration of long tasks, such as Task A (220 ms - 50 ms = 170 ms), Task B (70 ms - 50 ms = 20 ms), and Task E (145 ms - 50 ms = 95 ms). Total TBT = 285 ms. A high TBT value indicates the page is slow and requires optimization, such as breaking up long tasks or using asynchronous processing.

3.5 Cumulative Layout Shift

Figure 16. Cumulative layout shift analysis

website performance metric called Cumulative Layout Shift (CLS). CLS measures how often and how far elements on your webpage shift after the page starts loading. These shifts can occur due to images with unknown dimensions, dynamically loaded ads, or fonts that have not fully loaded.

Figure 17. Website performance audit

The website performance audit report on this system on figure 17, indicates several major issues that need to be addressed immediately. These issues are related to how your website loads and displays content. GTMetrix Website Performance Audit shows several areas for improvement: first, Reduce Unused JavaScript (LCP), where unused JavaScript slows down page loading. The solution is to clean up code, use tree-shaking, and load JavaScript asynchronously or with a defer method. Second, Avoid Enormous Network Payloads (LCP), where a payload size of 330 KB slows down LCP. The solution is to compress files using gzip or Brotli, optimize images with formats like WebP, and reduce unnecessary dependencies. Third, Avoid Chaining Critical Requests (FCP, LCP), which hinders FCP and LCP because the loading order depends on other requests. The solution is to reduce the request chain by prioritizing critical resources, as well as using preload or prefetch to load critical files early and implementing lazy loading for non-critical ones.

3.6 Discussion

The results of this study indicate that performance evaluation using GTMetrix provides in-depth insight into the technical aspects of a web-based employee attendance system, such as page load time, Largest Contentful Paint (LCP), and Total Blocking Time (TBT). Compared to research by [10] who obtained test results for university websites, getting Grade E with a performance value of 56% and Structure 53% and an access speed of 2.3 seconds. Then research by [24] who also used GTMetrix to test attendance websites with Geolocation features got Grade B with Performance 74% and Structure 93%. Then research by [25] which tested the performance of the Zomato service website got Grade B with results of 81% Performance and 99% structure and the Zomato website had a TBT of 318ms and CLS 0.02. Compared to previous research, the results of this study for the attendance website got grade A with a performance and structure value of 100% but had an LCP of 226 ms. Further research can take an approach using lazy loading, image compression, or improving network delays to reduce the rendering time of the largest elements in the viewport to reduce LCP. Another advantage of this study is the use of Extreme Programming (XP) methodology. Compared to the Waterfall approach in [26], the XP method allows for iterative development that improves system response time by up to 20%. This is relevant to industry norms that increasingly demand rapid iteration and responsiveness to user feedback. The results of this study also highlight that the performance of the attendance system can be further improved by paying attention to anomalies in the LCP, which specifically contributed to a 5% decrease in user efficiency in the initial test. By comparing the results of this study with industry norms, we can conclude that GTMetrix-based optimization not only improves technical performance but also ensures a better user experience, which is key to the success of web-based applications.

4. CONCLUSION

Performance testing of the employee attendance system using GTMetrix resulted in an A grade with a 100% score for both Performance and Structure, indicating the website is well-optimized with fast load times and a user-friendly structure. However, despite optimizations in blocking time and layout shift, the Largest Contentful Paint (LCP) remains high at 226 seconds, meaning visitors must wait over 3 minutes to see the main content. This delay may negatively affect user satisfaction. The study highlights the importance of further optimizing LCP to enhance user experience. However, it is limited using only one testing tool and does not account for factors like network or device variations. Future research could incorporate multiple testing tools and test across different devices. It is recommended to focus on reducing LCP time, optimizing page elements, and considering techniques like lazy loading for improved performance.

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