International Journal of Computer Science and Information Technology (IJISIT)
Volume 1, No. 1 (2024) pp. 8-19
e-ISSN 3063-4156 | p-ISSN 3063-4172
DOI: 10.55123/ijisit

Methodical Approach: Building a Web-Based Warehouse Management System Using the Waterfall Method

Vanessha Wijaya[1,a], Vyorennity Joeanca[2,b], Hendrick Yap[3,c], Stanley Lim[4,d]
[1,2,3,4]Medan 20112, Universitas Pelita Harapan, Indonesia
[a]03082220027@student.uph.edu, [b]03082220013@student.uph.edu, [c]03082220017@student.uph.edu,
[d]03082220021@student.uph.edu

Article Info

Article history:

Received April 25, 2024
Revised April 26, 2024
Accepted June 15, 2024

Keywords:

Warehouse Management System
Web-based
Waterfall Method
Software Development
Efficiency

ABSTRACT

This paper presents a comprehensive methodology for developing a web-based warehouse management system (WMS) utilizing the Waterfall method. Warehouse management is a critical aspect of business operations, and the transition to web-based systems offers numerous advantages in efficiency and accessibility. By adopting the Waterfall method, which provides a structured and linear approach to software development, this study ensures a clear framework for system implementation. The system's architecture, including its use of HTML, CSS, JavaScript, and PHP, is discussed in detail, highlighting the technical aspects of the development process. Through the analysis of various diagrams, such as Use Case, Class, and Activity diagrams, the paper demonstrates the system's functionality and its potential to enhance warehouse management practices. This research contributes to the advancement of warehouse management technology, offering insights into the implementation of web-based systems using established software development methodologies.

Corresponding Author:

Vanessha Wijaya
Informatics (Medan Campus), Faculty of Computer Science
Universitas Pelita Harapan
20212, Medan, Indonesia
Email: 03082220027@student.uph.edu

1. INTRODUCTION

Warehouse management is one of the most critical operations in a business. Raw materials and work-in-progress items are stored in warehouses, which are then used in the manufacturing process. Therefore, warehouses are the most vital assets owned by most businesses, representing as much as half of a company's expenses or even half of the total capital investment [1]. Warehouse management requires several types of data to track processed goods. The required data includes lot numbers, serial numbers, item costs, quantities, and processing dates for the goods [2].

Manual goods management, if recorded on paper, poses potential risks such as recording errors, the risk of forgetting to record, loss of records, and even additional issues when multiple divisions simultaneously request goods. This could complicate tracking the incoming and outgoing goods from the warehouse, especially when goods are urgently needed, potentially leading to delays in fulfilling orders and impacting overall business operations [3]. This approach still proves to be inefficient and time-consuming in processing such data. Furthermore, with numerous large companies already transitioning to web-based warehouse management systems to streamline their operations, there's a growing recognition of the need for more efficient solutions.

Hence, the development of this management system aims to not only address the existing challenges but also to significantly enhance the performance of warehouse management, particularly for small business owners who lack substantial capital to invest in dedicated warehouse systems tailored to their specific business models [4].

In the pursuit of enhancing warehouse management efficiency, leveraging information technology, particularly through web-based platforms, emerges as an exceptionally pertinent solution. The creation of a warehouse management system in the form of a website not only facilitates convenient access but also enables real-time monitoring and process automation. Such advancements have the potential to substantially elevate productivity and precision in managing inventory and facilitating the distribution of goods, thereby optimizing overall operational efficacy within the warehouse environment [5]. Data and information within the website can also be communicated with other devices such as mobile phones, considering that websites are not solely limited to desktop devices. With the implementation of information technology, human tasks in the business sector can be efficiently managed. This integration of technology not only enhances accessibility but also ensures seamless communication and coordination across various platforms and devices, ultimately improving workflow efficiency and facilitating better decision-making processes [4]. Therefore, the presence of web-based inventory or stock management systems can serve as an excellent solution to assist individuals working in the warehouse sector. Moreover, the reason why the web is a great solution is because it is easy to use for many people and can accelerate the process of managing existing goods. This not only streamlines inventory management processes but also ensures accessibility and efficiency for warehouse staff, ultimately contributing to smoother operations and improved productivity within the warehouse environment [6].

This journal aims to discuss the steps involved in creating and implementing a web-based warehouse management system. The development of this website will also implement the waterfall method, which adopts a linear and highly structured approach, ensuring a well-defined and clear framework. In-depth analysis of business requirements, selection of appropriate technologies, and integration of this system with warehouse operational processes are the focus of this paper. Through the implementation of this system, it is hoped to make a significant contribution to improving efficiency, response speed, and accuracy in warehouse management. [4].

2. METHOD

A warehouse can be described as a structure that serves as a storage facility for goods. In principle, warehouses function as distribution centers where received goods can be promptly dispatched with speed, effectiveness, and high efficiency [7]. Warehouse management is directed towards the control and optimization of warehouse activities with the primary objective of reducing costs associated with warehouse operations. By implementing effective management practices, the aim is to enhance efficiency in the processes of picking, storing, and managing goods within the warehouse environment. Additionally, a key focus is placed on providing accurate and easily accessible inventory information, thereby facilitating informed decision-making and ensuring seamless coordination across various aspects of the supply chain.

In general, web-based inventory management systems are tailored to suit the needs of small to medium-sized enterprises. Over time, each company typically develops its own unique inventory management strategies or methods. Extensive research conducted by various scholars has yielded numerous case studies focused on small and medium-sized businesses. The consensus drawn from these studies underscores the critical importance of implementing web-based inventory management systems for the sustained success and profitability of companies operating within this sector [8].

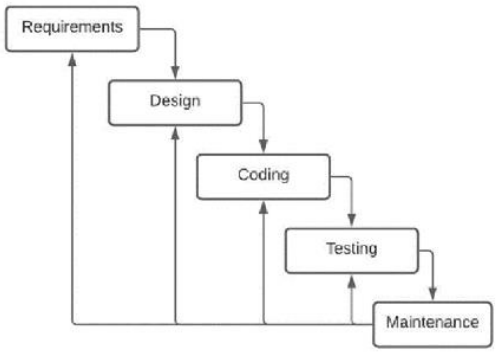

Figure 1 Cycle of Waterfall Method

Software development methodology encompasses the systematic approach employed to plan and execute the software development process. In this academic work's context, the chosen methodology is the Waterfall method, aligning with the research paper's title. The Waterfall method represents a structured and methodical approach to development, characterized by distinct and well-defined stages that progress linearly from one phase to the next. This sequential process ensures a clear delineation of tasks and deliverables throughout the software development lifecycle, facilitating effective planning, execution, and management of the project [9]. This method comprises stages such as analysis, design, implementation, testing, and software maintenance [10]. By employing this method, the process becomes more structured, with the workflow progressing systematically from one step to the next. Moreover, the outcomes of implementing this method can yield satisfactory results because the execution is gradual, focusing on each stage individually rather than attempting to address multiple stages simultaneously [11].

The implementation stage involves coding, where languages such as HTML, CSS, JavaScript, and PHP will be utilized, with Visual Studio serving as the development application. This stage is critical for translating the design and requirements into functional software components.

1. Hypertext Markup Language (HTML) is an essential markup language used in the creation of web pages, reports, and electronic books. With HTML, users can define the structure and elements of web pages, reports, or books, including text, images, tables, lists, and more. HTML provides the foundation for organizing and presenting content on the internet, allowing for the creation of interactive and visually appealing digital experiences [12].
2. Cascading Style Sheets (CSS) is a style sheet language utilized to apply styles or formatting to HTML pages. CSS files are text files containing rules for presenting HTML elements by the browser. Each rule comprises a selector specifying which elements to apply the style to and a declaration defining the style to be employed. This declaration includes properties and values defining various aspects of the element's appearance, such as color, font, size, and layout. CSS allows designers to segregate content from presentation, facilitating enhanced flexibility and consistency in web page design [13].
3. JavaScript is one of the most popular languages for programming websites. According to the Stack Overflow website, JavaScript is the most famous and frequently used programming language. JavaScript is utilized by more than 90% of websites currently viewed [14].
4. PHP (*Hypertext Preprocessor*) is an open-source server-side scripting language. As a scripting language, PHP executes programming instructions at runtime. The outcome of these instructions will naturally vary depending on the processed data. PHP is a server-side programming language, meaning that PHP scripts are processed on the server [15].

UML (Unified Modeling Language) will be used as the method for creating diagrams during the planning stage. UML has become a standard in the software development world due to its ease of documenting the progress made in system development [16]. UML provides a variety of diagrams and graphics that are highly effective. Some diagrams highlight the fundamental principles of object-oriented programming, while others focus more on design and implementation details. All of these diagrams aim to facilitate communication between software development teams and users [10].

3. RESULTS AND DISCUSSION

In this section, the results and discussions of the warehouse management system journal are presented, which encompass the implementation of various diagrams. These diagrams serve as visual representations of the system's architecture, functionality, and interactions, providing insights into its design and operational aspects. Through the analysis and interpretation of these diagrams, insights into the implications and significance of the system's development are provided, addressing its effectiveness, usability, and potential for enhancing warehouse management practices.

In the testing phase of the Waterfall method, we employed real-world product data from the tools business field to rigorously evaluate the functionality and performance of our web-based warehouse management software. By utilizing authentic product data, sourced from the tools industry, we aimed to simulate realistic scenarios and ensure the robustness of our system across diverse inventory types and operations. This approach allowed us to validate the accuracy of inventory tracking, order processing, and data management functionalities within our designed software, thereby enhancing confidence in its reliability and suitability for practical deployment in warehouse environments.

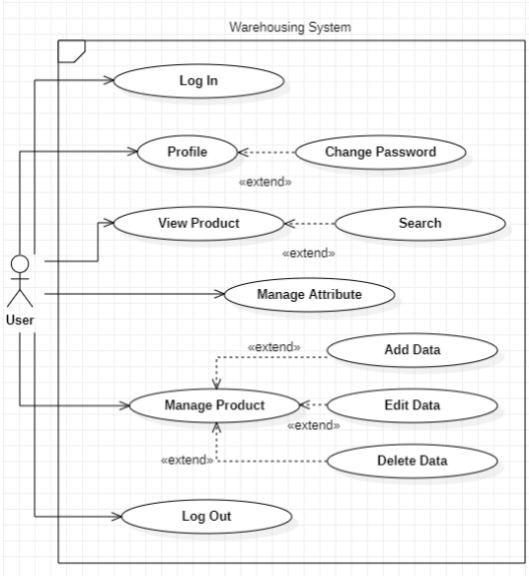

Figure 2 Use Case Diagram

A Use Case Diagram serves as a model to depict the system's requirements, particularly focusing on the actors who will interact with the system. By employing the use case technique, it becomes possible to comprehensively represent all essential system requirements. This technique allows for the clear delineation of the system's functions and the identification of the users who are entitled to utilize the system. Through the use of actors and their interactions with the system, Use Case Diagrams provide a visual representation of the system's behavior and functionality, aiding in the understanding and communication of system requirements among stakeholder [6].

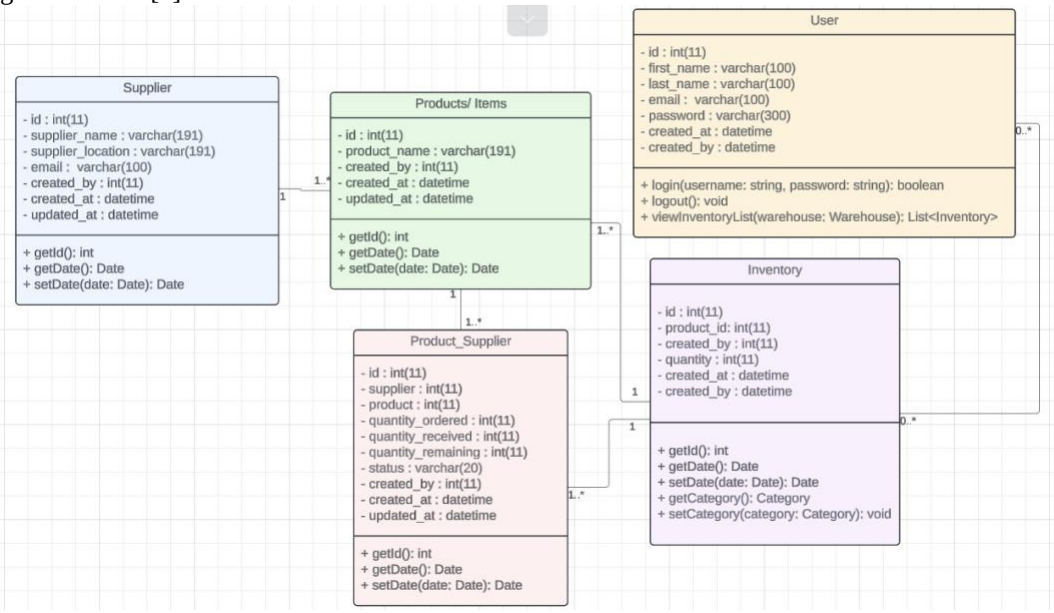

Figure 3 Class Diagram

Class Diagram is one of the most useful tools for providing a comprehensive understanding of requirements. [17]. Class Diagram is a crucial and commonly used depiction of an object-oriented system. It illustrates the static structure of the core classes forming the system. The Class Diagram displays attributes and methods for each class, as well as the relationships between classes [18].

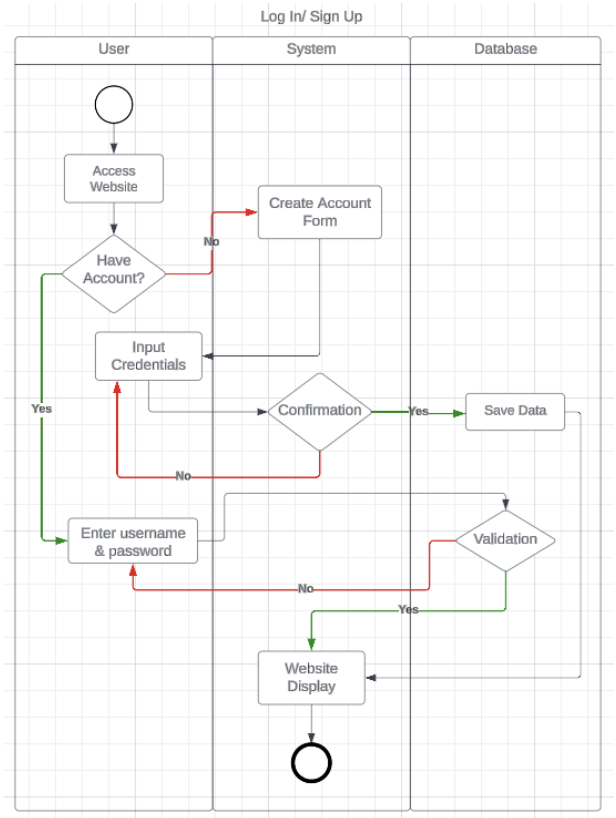

Figure 4 Log In / Sign Up Activity Diagram

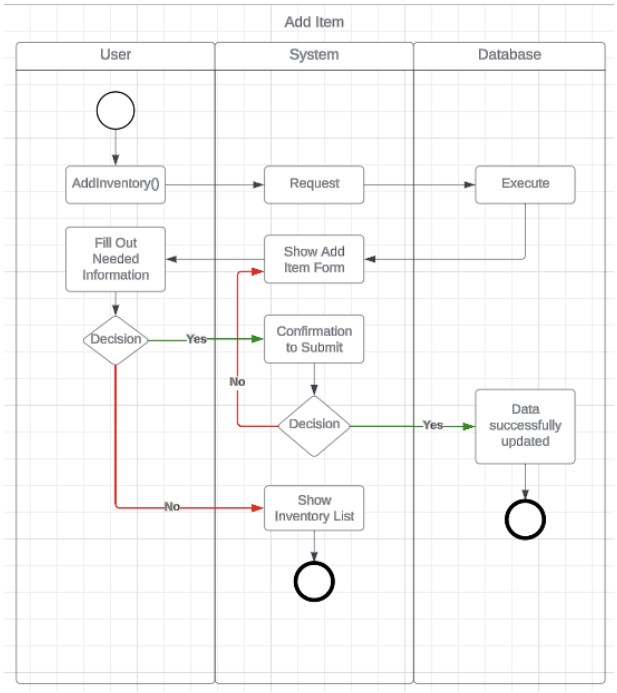

Figure 5 Add Item Activity Diagram

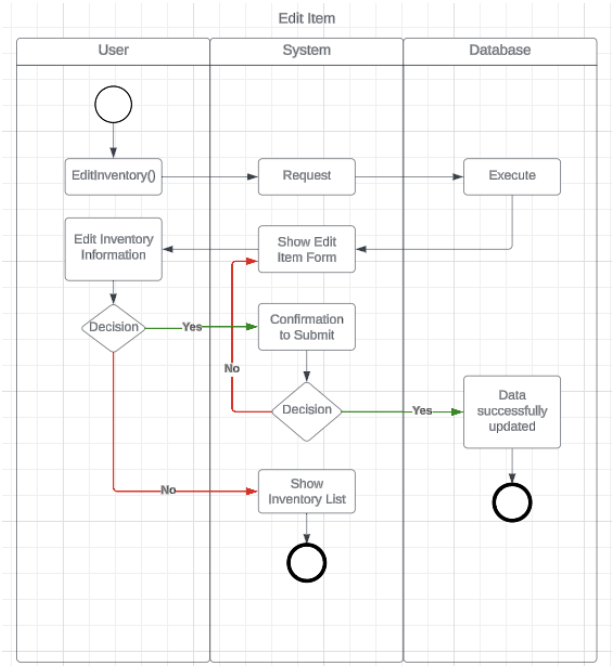

Figure 6 Edit Item Activity Diagram

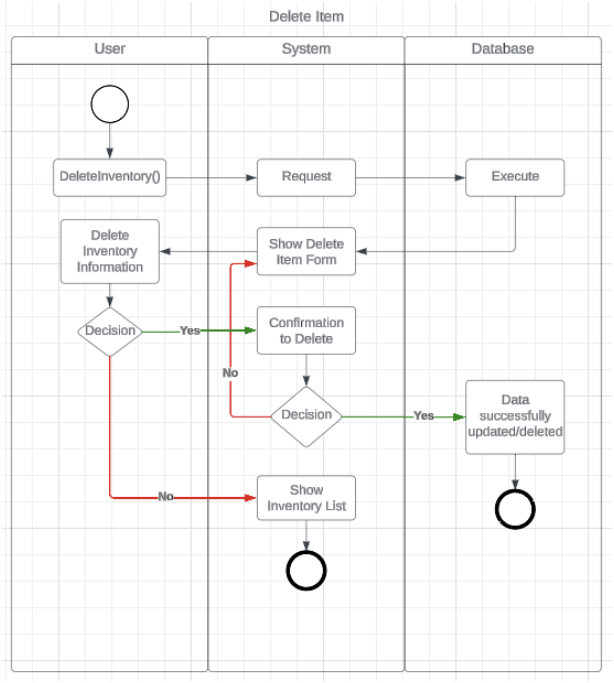

Figure 7 Delete Item Activity Diagram

Activity Diagram is a visual representation of the sequence of activities or actions that occur within a planned or designed system. It aids in understanding how the system operates as a whole and how each element connects and interacts with one another to achieve desired objectives [19]. Several diagrams are developed within the warehouse process, namely adding, modifying, and deleting items listed in the warehouse.

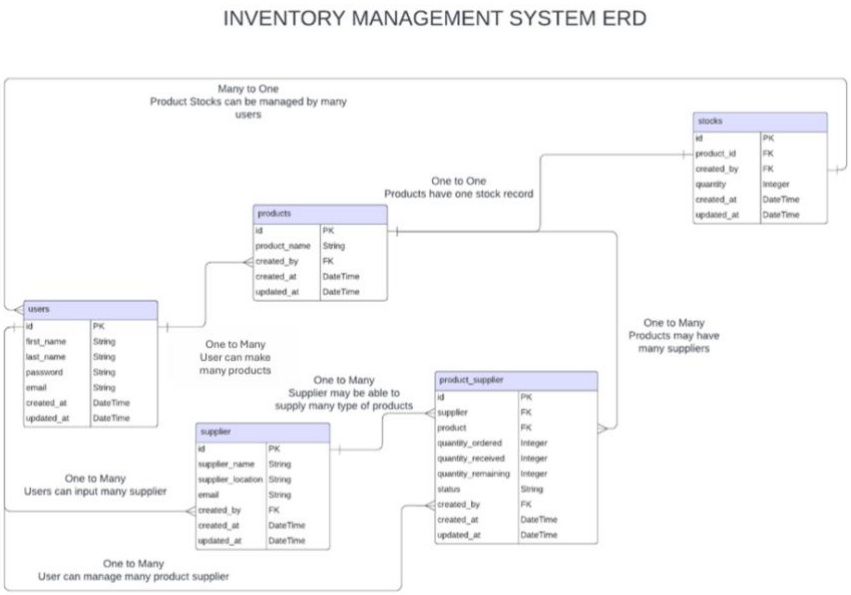

Figure 8 Entity Relationship Diagram

An Entity Relationship Diagram (ERD) is a visual representation used to document data, illustrating the contents of each entity and depicting the relationships between entities [20].
The interface of this information system is as follows:

a. Dialog Screen: Home Screen

Function: The home screen serves as the initial landing page for users accessing the web-based warehouse management system. Through intuitive navigation elements and informative prompts, the home screen guides users to explore further options, such as logging in to access their personalized dashboard or learning more about the system's benefits and functionalities

Figure 9 Home Screen

b. Dialog screen: Login

Function: This initial page serves as the entry point for administrators to input their login credentials (like username and password) necessary for accessing the software. Upon entering the correct details and clicking the login button, users are seamlessly redirected to the main menu. Yet, an alert notification pops up on the screen in case incorrect username or password is entered.

Figure 10 Log in Screen

c. Dialog screen: Dashboard

Function: Upon successful login, users are seamlessly redirected to the dashboard page, which serves as the central hub for navigating the warehouse management system. Through intuitive data visualization and interactive features, users can quickly assess the current state of operations and take informed actions to optimize warehouse efficiency

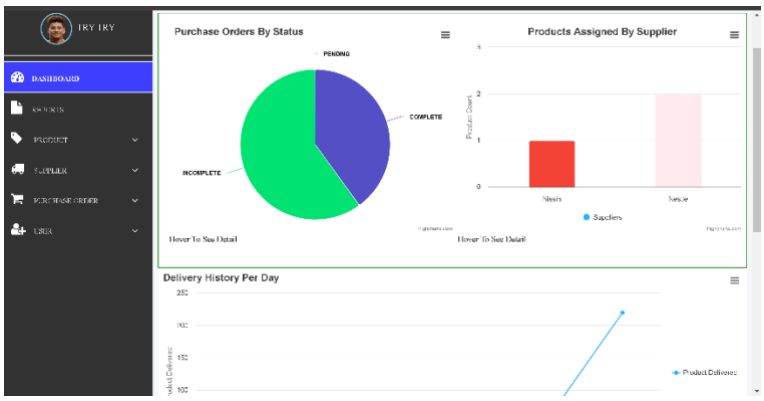

Figure 11 Dashboard 1

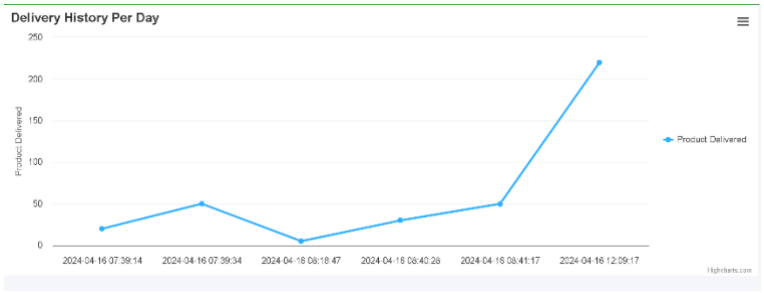

Figure 12 Dashboard 2

d. Dialog screen: User Management

Function: this initial page enables administrators to efficiently manage user accounts within the warehouse management system. Administrators have the capability to add new users, edit existing user information, delete user accounts as needed, and view detailed user profiles containing information such as full name, email address, and registration date.

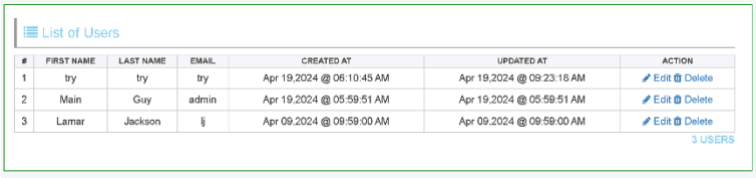

Figure 13 User Management

e. Dialog Screen: Report Page
Function: The report page offers users the ability to generate and export comprehensive reports containing crucial information from the warehouse management system.

Figure 14 Options to Export Report

f. Dialog Screen: Add Product
Function: The add product feature enables users to effortlessly input new product data into the warehouse management system. Users are prompted to fill out essential product details such as product name, description, etc.

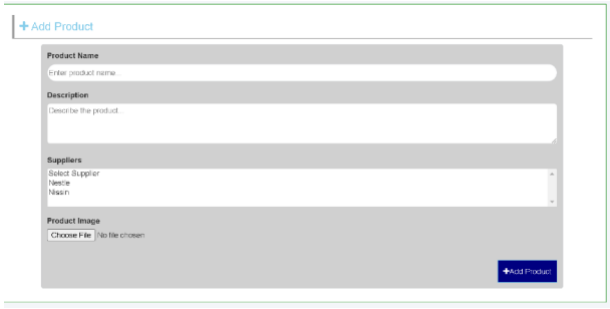

Figure 15 Add Product

g. Dialog Screen: Inventory Receipt
Function: The page that enables users to receive and record incoming items into inventory

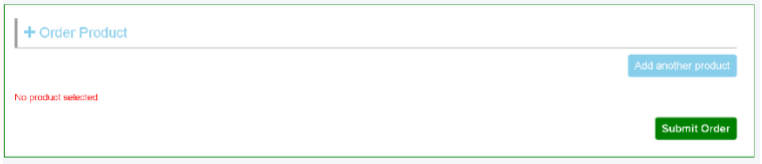

Figure 16 Order Product

h. Dialog Screen: Manage Product Order
Function: It involves receiving and processing customer orders, updating inventory levels accordingly, and coordinating the fulfillment and delivery of orders. This includes tasks such as order validation, inventory allocation, order tracking, and generating invoices.

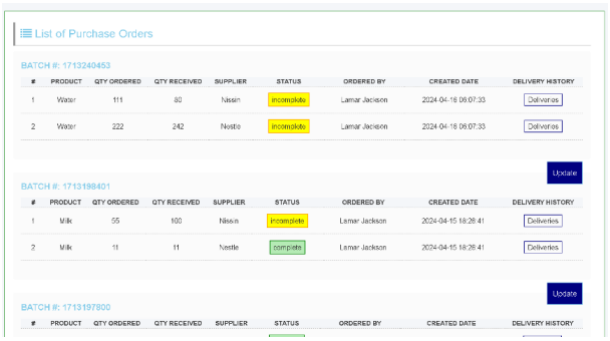

Figure 17 Manage Order Product

i. Dialog Screen: Add Supplier
Function: To facilitate the input and registration of new supplier information into the system. This includes capturing details such as supplier name, contact information, and address / location.

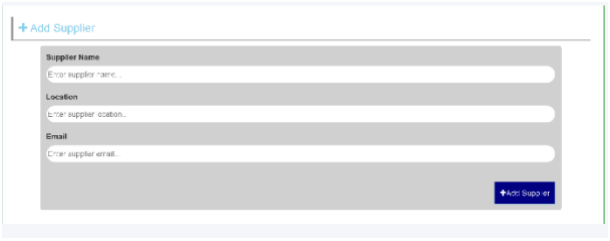

Figure 18 Add Supplier

j. Dialog Screen: Add User Account
Function: capturing user information, validating input data, creating a new user account, and storing user credentials securely in the system's database.

Figure 19 Add User Account

k. Dialog Screen: Access Denied
Function: To display a message informing the user that they do not have permission to access a particular resource or perform a certain action. It typically includes options for the user to navigate back to a previous page or contact the administrator for assistance.

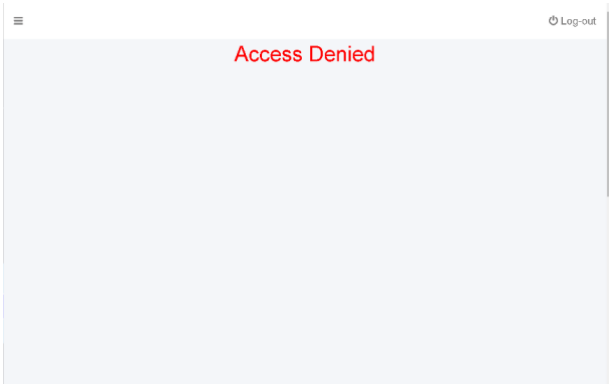

Figure 20 Access Denied

4. CONCLUSION

In conclusion, employing the Waterfall method in designing and building warehouse management systems proves to be advantageous in streamlining the process of conception and implementation. This structured approach offers clear delineation of project stages, allowing for thorough analysis, design, development, testing, and deployment. By adhering to a sequential progression, stakeholders gain a comprehensive understanding of project requirements and deliverables, minimizing the risk of miscommunication and ensuring alignment with project goals. Furthermore, the Waterfall method facilitates effective resource allocation and project management, leading to the timely delivery of high-quality solutions. Overall, the utilization of the Waterfall method in warehouse management system development enhances efficiency, reliability, and stakeholder satisfaction, thereby contributing to the success and sustainability of the project.

ACKNOWLEDGEMENTS

We would like to extend our heartfelt gratitude to our friends who provided invaluable data throughout the system design process. Your contributions have been instrumental in shaping the development of our project. Additionally, we would like to express our sincere appreciation to Universitas Pelita Harapan for providing us with a conducive learning environment. Your support has been invaluable in our journey towards academic and professional growth. Thank you for your unwavering support and collaboration.

REFERENCES

[1] J. B. Munyaka and V. S. S. Yadavalli, "INVENTORY MANAGEMENT CONCEPTS AND IMPLEMENTATIONS: A SYSTEMATIC REVIEW," *South African Journal of Industrial Engineering*, vol. 33, no. 2, pp. 15–36, 2022, doi: 10.7166/33-2-2527.

[2] I. N. D. Gunawan and P. Y. Setiawan, "Inventory Management with EOQ Method at 'Nitra Jaya' Fashion-Making Company in Badung," *European Journal of Business and Management Research*, vol. 7, no. 3, pp. 347–351, Jun. 2022, doi: 10.24018/ejbmr.2022.7.3.1444.

[3] Hery, J. Renaldo Luih, C. Alencia Haryani, and A. E. Widjaja, "Penerapan Teknologi Qr Code Berbasis Web pada Sistem Manajemen Inventaris di Gudang PT XYZ," *Technomedia Journal*, vol. 7, no. 2, pp. 202–215, Aug. 2022, doi: 10.33050/tmj.v7i2.1903.

[4] J. S Pasaribu, "Development of a Web Based Inventory Information System," *International Journal of Engineering, Science and Information Technology*, vol. 1, no. 2, pp. 24–31, Mar. 2021, doi: 10.52088/ijesty.v1i2.51.

[5] E. S. Soegoto and A. F. Palalungan, "Web Based Online Inventory Information System," in *IOP Conference Series: Materials Science and Engineering*, IOP Publishing Ltd, Aug. 2020. doi: 10.1088/1757-899X/879/1/012125.

[6] P. Hendra Wijaya and Y. R. Beeh, "Perancangan Sistem Informasi Manajemen Gudang Jamu Semar Berbasis Web Menggunakan Framework Laravel," *Jurnal Teknik Informatika dan Sistem Informasi*, 2023, [Online]. Available: http://jurnal.mdp.ac.id

[7] V. A. Z. Sodikin, Reni Amaranti, and Djamaludin, "Perancangan Sistem Informasi Manajemen Gudang PT. X," *Jurnal Riset Teknik Industri*, vol. 1, no. 1, pp. 58–67, Oct. 2021, doi: 10.29313/jrti.v1i1.141.

[8] F. F. Agboola, Y. M. Malgwi, M. A. Mahmud, and J. P. Oguntoye, "DEVELOPMENT OF A WEB-BASED PLATFORM FOR AUTOMATING AN INVENTORY MANAGEMENT OF A SMALL AND MEDIUM ENTERPRISE," *FUDMA JOURNAL OF SCIENCES*, vol. 6, no. 5, pp. 57–65, Nov. 2022, doi: 10.33003/fjs-2022-0605-1064.

[9] M. Badrul, "PENERAPAN METODE WATERFALL UNTUK PERANCANGAN SISTEM INFORMASI INVENTORY PADA TOKO KERAMIK BINTANG TERANG," vol. 8, no. 2, 2021.

[10] E. Mardiani, F. Akbar Ramadhan, and H. Artikel, "Rancang Bangun Perangkat Lunak Penjualan Dengan Menggunakan Metode Waterfall," *Digital Transformation Technology (Digitech) | e*, vol. 3, no. 2, 2023, doi: 10.47709/digitech.v3i2.3224.

[11] E. Mardiani *et al.*, "A Jauharah Hijab Web Site Design," *Media Kreatif Jl. Srengseng Sawah Raya*, vol. 20, no. 2, pp. 914–919, 2023.

[12] S. T. Arisantoso *et al.*, *PERANCANGAN DAN PEMROGRAMAN WEB: MEMAHAMI HTML, CSS, JAVASCRIPT, PHP, SERTA WEB HOSTING SECARA PRAKTIS PENERBIT CV. EUREKA MEDIA AKSARA*. EUREKA MEDIA AKSARA, 2023.

[13] M. Annafri, A. B. P. N, H. Priyanto, Yulianti, H. S. Pratiwi, and N. Candraningrum, "Making a Website Using HTML and CSS for SMK Students," *TANJUNGPURA INTERNATIONAL JOURNAL ON DYNAMICS ECONOMIC, SOCIAL SCIENCES AND AGRIBUSINESS*, 2023.

[14] S. Sakharkar, "Systematic Review: Analysis of Coding Vulnerabilities across Languages," *Journal of Information Security*, vol. 14, no. 04, pp. 330–342, 2023, doi: 10.4236/jis.2023.144019.

[15] Muqorobin and N. A. R. Rais, "Comparison of PHP Programming Language with Codeigniter Framework in Project CRUD," *International Journal of Computer and Information System (IJCIS)*, 2022, [Online]. Available: https://ijcis.net/index.php/ijcis/index

[16] D. D. Darmansah, "Perancangan Sistem Informasi Pengolahan Jadwal Mata Pelajaran Siswa Secara Online Di SMPN 31 Padang Berbasis Web," *JATISI (Jurnal Tek. Inform. dan Sist. Informasi)*, vol. 7, pp. 451–465, 2020.

[17] E. A. Abdelnabi, A. M. Maatuk, and M. Hagal, "Generating UML Class Diagram from Natural Language Requirements: A Survey of Approaches and Techniques," in *2021 IEEE 1st International Maghreb Meeting of the Conference on Sciences and Techniques of Automatic Control and Computer Engineering, MI-STA 2021 - Proceedings*, Institute of Electrical and Electronics Engineers Inc., May 2021, pp. 288–293. doi: 10.1109/MI-STA52233.2021.9464433.

[18] C. Nurqueen Paradis, M. Robert Yusuf, M. Farhanudin, and M. Ainul Yaqin, "Analisis dan Perancangan Software Pengukuran Metrik Skala dan Kompleksitas Diagram Class," 2022.

[19] N. Oktria Supatra and F. Masya, "ANALISA PERANCANGAN SISTEM INFORMASI PEREKRUTAN KARYAWAN OUTSOURCING BERBASIS WEB PADA PT BSI PRO," 2020. [Online]. Available: https://jurnal.ikhafi.or.id/index.php/jusibi/256

[20] I. Budiawan[1], M. Nasrulloh[2], I. [12]sekolah Tinggi, M. Informatika, D. Komputer, and N. Mandiri, "Real Time Unit Monitoring Information Systems Using The Waterfall Method PT. Andhana Kirana Yasa Jakarta," *International Journal of Information System & Technology Akreditasi*, vol. 4, no. 1, pp. 447–456, 2020.