The Indonesian Journal of Computer Science
www.ijcs.net
Volume 14, Issue 3, June 2025
https://doi.org/10.33022/ijcs.v14i3.4655

Designing a Web-Based Vehicle Tracking Application using the Design Thinking Method

Endang Amalia[1], Ivan Darmawan[2]
endang.amalia@widyatama.ac.id, ivan.darmawan@widyatama.ac.id[2]
[1,2]Information System Widyatama University

Article Information

Received : 20 Jan 2025
Revised : 5 May 2025
Accepted : 9 Jun 2025

Keywords

Design Thinking Methode, Web-Based Vichle Tracking, System Usability Scale, Vue.js

Abstract

The primary challenge faced by fleet managers in mining companies is the lack of sufficient visibility and control over their fleet operations. Without accurate, real-time information about the location, status, and performance of vehicles, companies may struggle to optimize routes, maintain fleet safety, and provide quality service to customers. Firm measures and strict supervision are necessary to ensure the continuity of mining product distribution. Therefore, a web-based application was designed to address these issues. In designing the web-based vehicle tracking application that aligns with user needs, the design thinking method was employed because this method places users at the core, ensuring that the resulting prototype truly meets users' needs and preferences. The prototype was then implemented as a web-based application using Vue.js and the OpenLayers Library to produce an application consisting of a login page, dashboard, vehicle tracking, device management, master data, violation, and reports that meet user needs using the System Usability Scale (SUS) method, thereby becoming a solution to users' needs.

A. Introduction

The development of digital technology offers many benefits to human life. In an increasingly competitive and fast-moving business environment, vehicle fleet management has become a key factor for operational success. Transportation companies, delivery services, logistics services, and other businesses that rely on vehicle fleets for their daily operations must ensure that their vehicles are operated efficiently, safely, and on time[1].

However, the main challenge faced by fleet managers is the lack of sufficient visibility and control over their fleet operations. Without accurate and real-time information about the location, status, and performance of vehicles, companies may struggle to optimize routes, maintain fleet safety, and deliver quality service to customers[2][3][4].

Based on information from managers in the field regarding activities in the mining area, many instances of fraud were found to be committed by drivers of vehicles transporting mining products. One such instance includes drivers unloading part of the mining products at other locations before reaching the primary destination.This fraud causes losses not only for the company but also for the ecosystem and local communities that rely on income from these mining activities. Strict measures and tight supervision are needed to ensure the continuity of mining product distribution.

To address the above issues, an online real-time vehicle tracking application has been designed, which is considered a responsive and measurable solution for fleet management by providing complete and real-time visibility over the entire company's vehicle fleet. Through this online vehicle tracking application, fleet managers can monitor vehicle locations and statuses directly from their computers or mobile devices. They can view travel routes, identify vehicles experiencing issues, estimate arrival times more accurately, and optimize the use of fleet resources through real-time vehicle tracking equipped with history and playback features[5][6].

Additionally, this application also allows fleet managers to manage fleets that have been equipped with registered tracking devices and configure virtual geographic areas to monitor devices entering and exiting an area. Thus, the design of the vehicle tracking application will bring significant benefits to companies in improving fleet management, providing better customer service, and achieving high operational efficiency. In the design of web-based applications in particular, the interface becomes very important as it serves as the central point of communication between users and the system.

The quality of the interface will affect the overall user experience, where a well-designed interface can increase user satisfaction by offering an intuitive, easy-to-use, and attractive experience. Furthermore, the designed interface should be responsive so that it is easily accessible from various gadgets, from computers to mobile phones or other devices through a browser.

There are many methods that can be used in implementing interfaces, one of which is design thinking. Design Thinking is used in application design because this approach places the user as the primary focus, ensuring that the resulting solution truly meets the users' needs and preferences. This method also encourages creativity and innovation in solving complex problems, allowing teams to think outside the box and find new solutions.

According to the study *UI/UX Design Web-Based Learning Application Using the Design Thinking Method*, the primary goal of the application is to create a platform that enables the broader community to contribute to education in Indonesia through the delivery of online classes [7]. Another study titled *UI/UX Design of Jäger Bakery Website Using the Design Thinking Method* [8] outlines a process that begins with the *Empathize* phase to gather user insights, followed by *Define* to identify key issues, and then continues through the *Ideate*, *Prototype*, and *Test* phases. Usability testing from this study indicated an improvement in the Direct Success Rate (DSR) from 65% to 93.8% and a reduction in Missclick Rate from 54.2% to 8%. Additionally, the System Usability Scale (SUS) evaluation yielded a Maze Usability Score (MAUS) of 79.23, which falls into the "good" category. These results demonstrate that applying the Design Thinking method effectively enhanced the UI/UX of the Jäger Bakery website by making it more intuitive, increasing user interaction, and streamlining the shopping experience. Lastly, the study *UI/UX Development Based on Design Thinking for Drug Swallowing Supervisors of Pulmonary Tuberculosis Patients* [9] highlighted that Design Thinking is a user-focused approach. UI/UX designs developed with a user-centered mindset tend to gain greater user acceptance. The method has been successfully used across sectors such as healthcare, education, marketing, sales, and management. The resulting UI/UX design was assessed using the SUS method, achieving an average score of 82.5, which corresponds to an "A" or "very good" classification, indicating high user satisfaction. Based on the above issues, this research discusses "Designing a Web-Based Vehicle Tracking Application Using the Design Thinking Method”.

B. Research Method

The diagram below illustrates the research framework employed in this study. Where, design is a process of selecting and reasoning that links facts to assumptions about the future, by outlining and planning activities believed to be necessary to reach specific goals and describing how to achieve them. The approach employed in design is known as design thinking. Design thinking is a problem-solving methodology focused on understanding the needs of individuals involved in the design process. It consists of five stages: Empathize, Define, Ideate, Prototype, and Test[10].

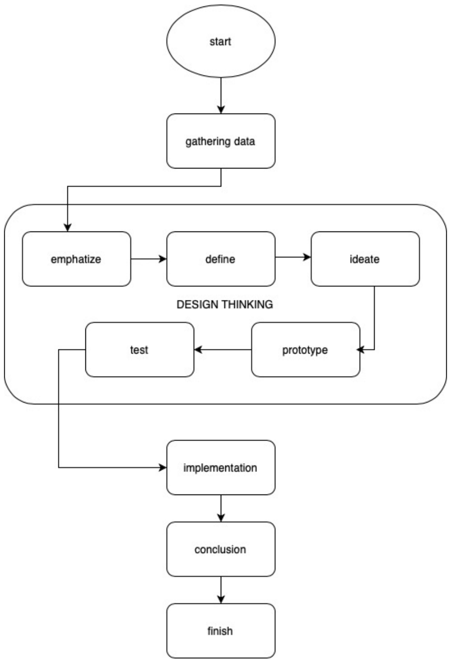

Figure1. Research Framework

1. **Empathize**
   The first step in applying the design thinking approach is empathy. During this phase, interviews and literature reviews are performed to uncover the challenges encountered by potential users. This information is represented in a user persona to grasp their needs and issues with the existing system, and an empathy map is developed for deeper insight into the users. The empathy map aids the design and development team in comprehending the users' needs, motivations, goals, concerns, and experiences more effectively[11].
2. **Define**
   In design thinking, the stage that follows empathy is definition. During this phase, the needs and challenges faced by potential users are pinpointed and represented through a "How Might We" (POV) statement. This technique is used to clarify the problems encountered by these users. It involves articulating a problem statement and creating pertinent questions that assist in discovering [12].
3. **Ideate**
   The third phase of application design is ideation, where solutions are generated based on the problems identified in the definition stage. This involves brainstorming sessions with potential users, which are represented using the now-how-wow matrix—a design thinking tool that evaluates ideas based on their creativity and feasibility. The matrix categorizes ideas into 'wow,' 'how,' and 'now' to help prioritize them. Additionally, software modeling with UML takes place, including use case diagrams, activity diagrams, and class diagrams. The ideation stage also establishes acceptance criteria that the application design must fulfill according to user requirements [13].

4. **Prototype**
   The next phase is the prototype, where the designer develops a "high fidelity" (Hi-Fi) design, which serves as the final version of the application. Prototypes are typically created as sketches, paper mockups, digital mockups, and similar formats [14].
5. **Test**
   The final step in designing the vehicle tracking application is testing through the System Usability Scale (SUS). During this phase, the prototype is presented to users to assess how effectively the application fulfills the requirements specified in the earlier acceptance criteria [15].

C. Result and Discussion

Empathize

The Empathize stage involves both direct and indirect observations and interviews. Observations are made by examining the business process to identify the features that will be required in the application. The interview stage is conducted to further validate the need for a vehicle tracking application that aligns with user requirements.

Once the interview process is finished, the next step is to organize the responses from the participants to simplify the creation of an affinity map or affinity diagram. This technique is used in user research to uncover insights and opportunities [16]. The outcomes of the Affinity Diagram process in this study are as follows:

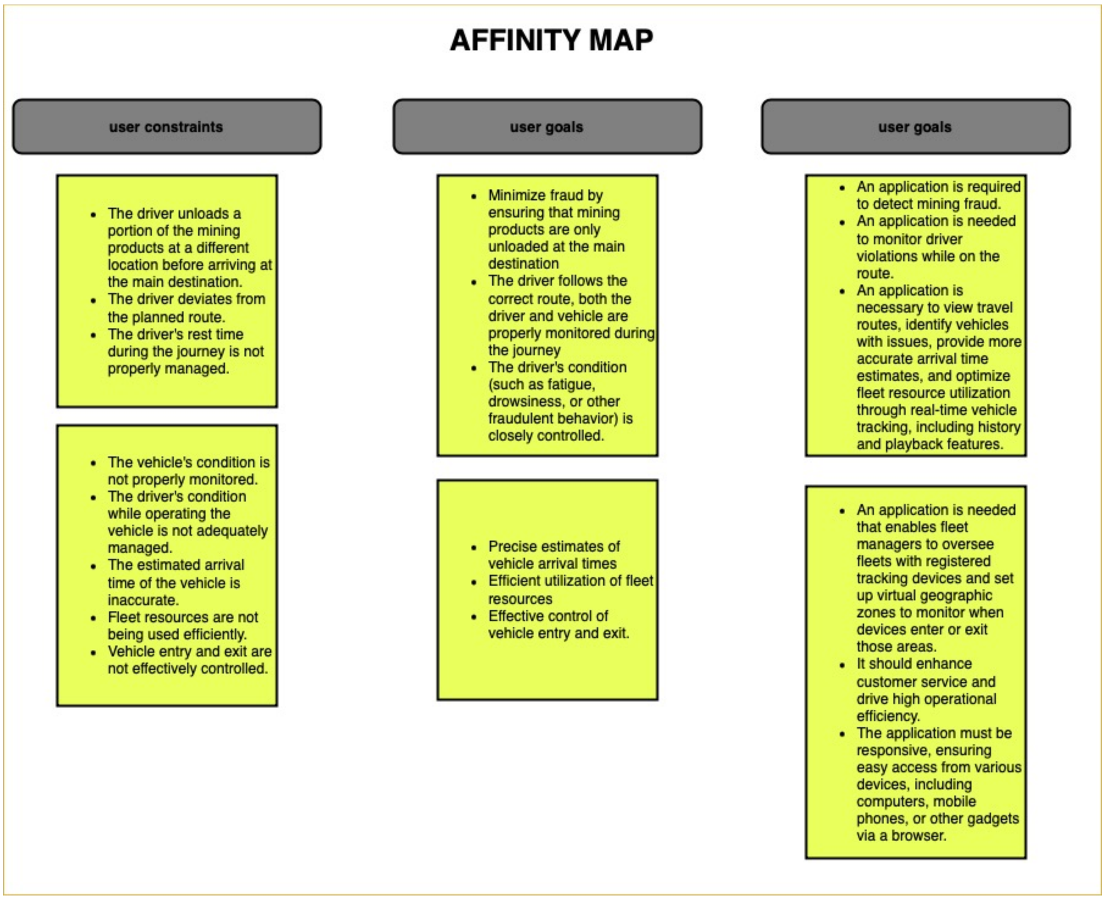

Figure2. Affinity Map

Define

The Define process involves identifying the key problems that will address user needs, based on insights from the Empathize stage. During this phase, a Journey Map is developed. A user journey map is a diagram that outlines the steps users take when interacting with a product, illustrating their entire experience with the application. The results of the User Journey Map created in this study are as follows:

Ideate

The ideas that were gathered were then evaluated and prioritized according to their impact on users of the "vehicle tracking" application. The goal of this idea generation is to inform the design process later on. The results of the brainstorming session are displayed in the following figure as use case diagram.

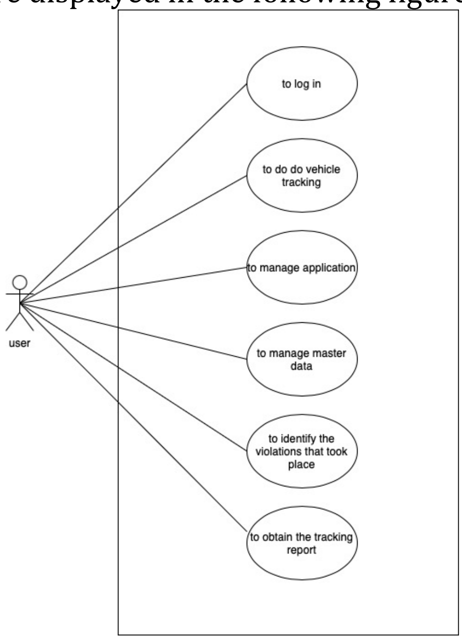

Figure3. Use Case Diagram of Vehicle Tracking Application

Prototype

Once the data collection, idea generation, and solution development are complete, the next step is to design the user interface for the product using the Figma application. The prototype screenshot is shown in the following image:

Figure4. Login Page

On this login page, users will be prompted to enter their username and password before proceeding to the next page and gaining access to the application's menus.

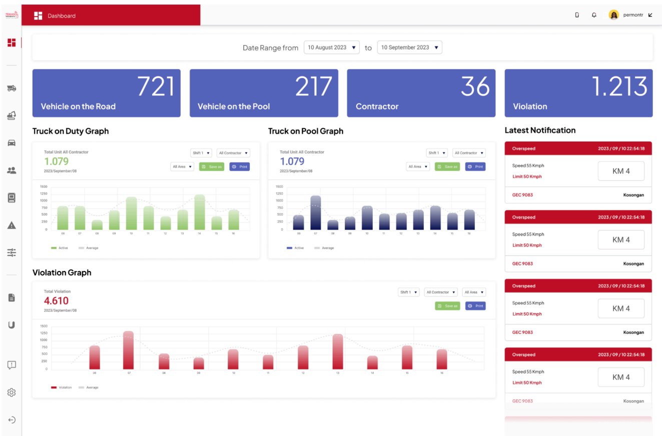

Figure5. Dashboard Page

The dashboard display allows users to view a summary of vehicles on the road, vehicles on the pool, contractors, violations, and the latest notifications.

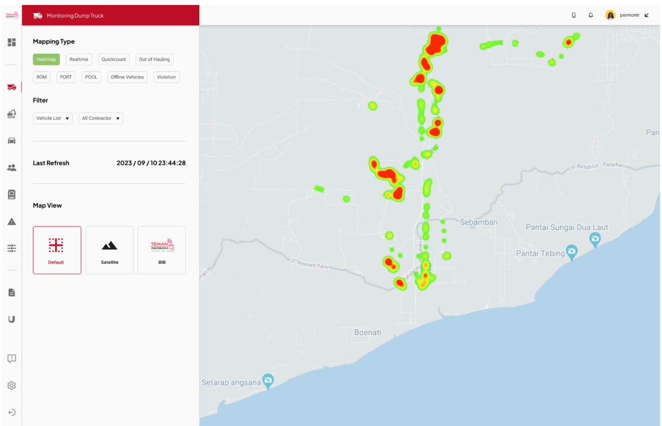

Figure6. Vehicle Tracking Page

On this page, users can monitor the vehicle's real-time location and determine whether it is in the correct lane or if a violation has occurred.

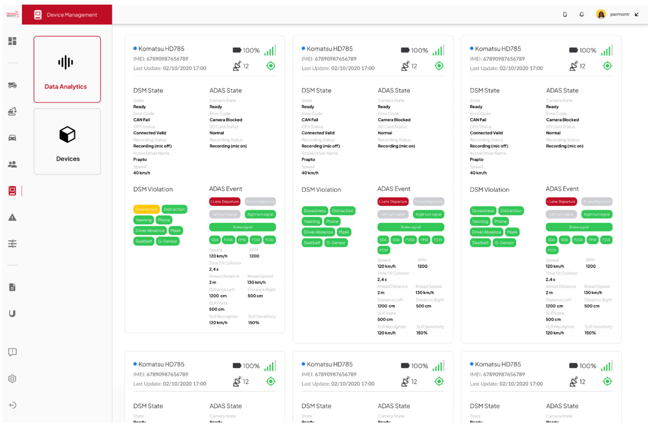

Figure7. Device Management Page

On this page, users can view, edit, add, or delete the details of each vehicle.

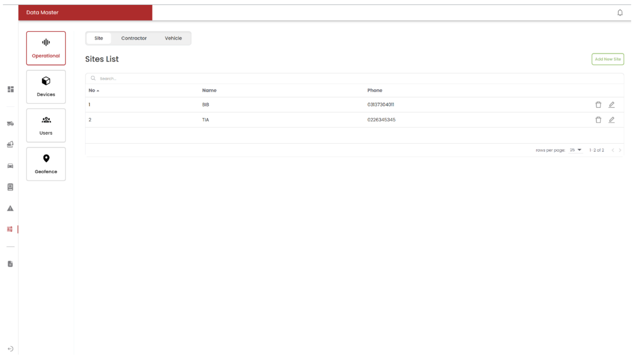

Figure8. Master Data Page

On this page, users can view, edit, add, or delete master data, including the list of sites.

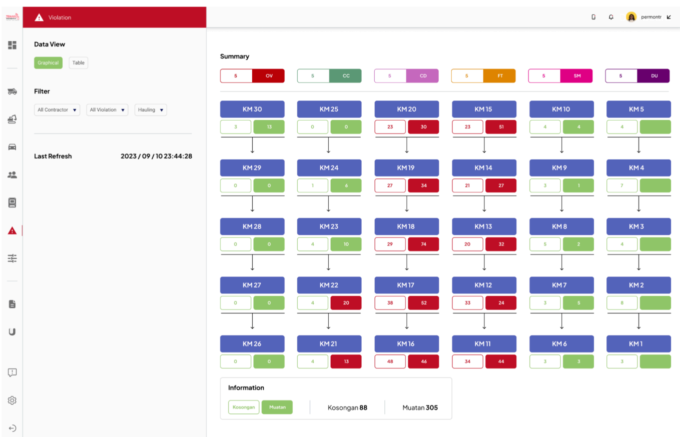

Figure9. Violation Page

In this view, users can view the details of violations occurring in each vehicle in summary.

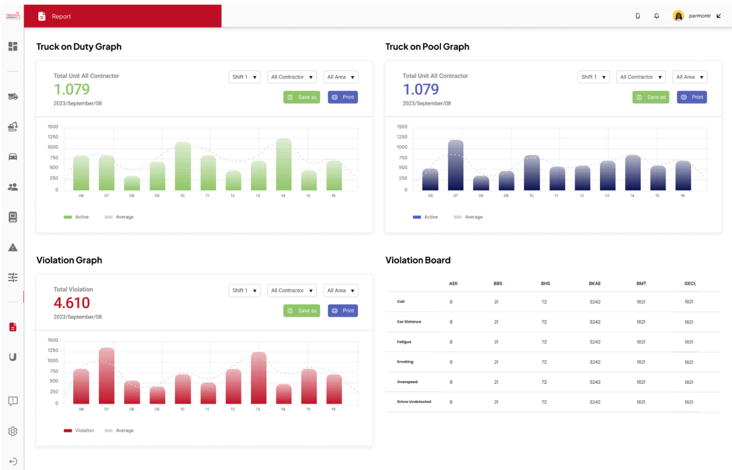

Figure10. Report Page

In this view, users can access reports for each vehicle at a specific time namely truck on duty graph, truck on pool graph, violation graph and violation board.

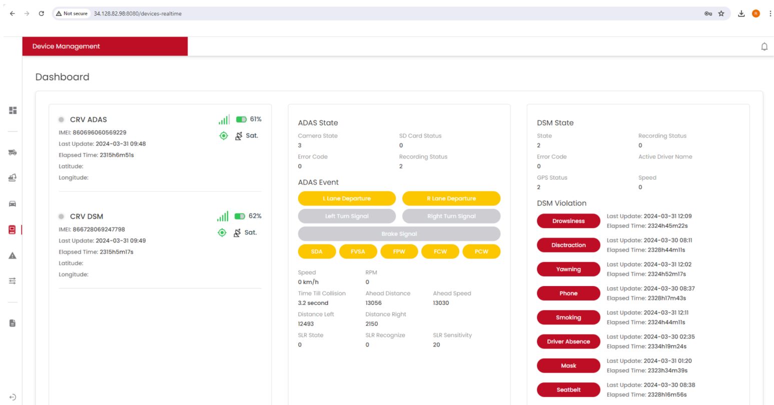

Figure11. Implementation of Device Management Page

In this view, users can access details about dashboard page of device management.

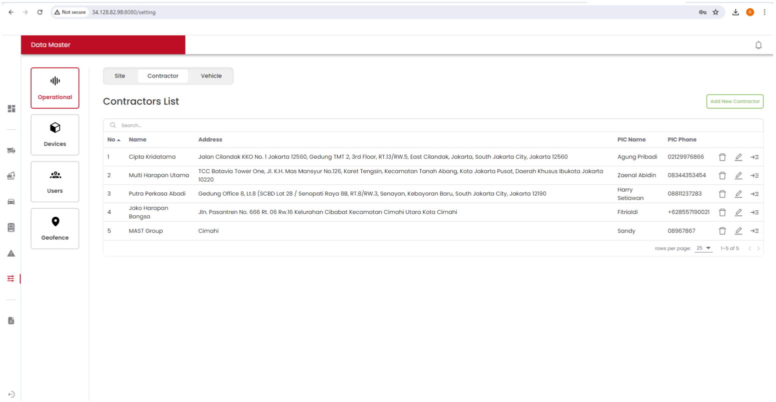

Figure12. Implementation of Master Data Page

This page provides users with the details of the master data, including operational detail, contractor detail, users detail and geofence detail.

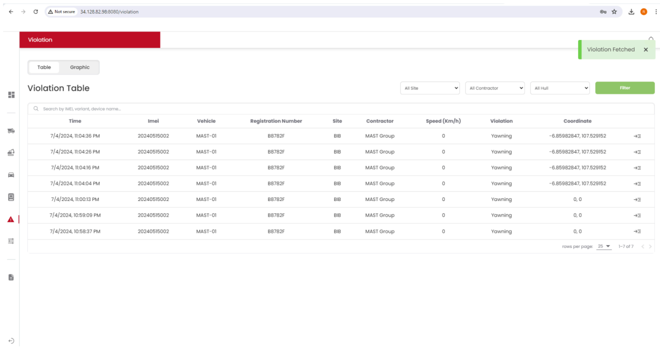

Figure13. Implementation of Violation Page

This page allows users to view the details of the violations that took place, such as time, imei, vehicle, registration number, site, contractor, speed, violation and coordinate.

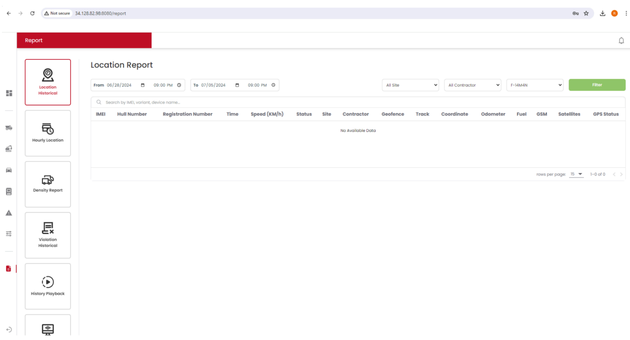

Figure14. Implementation of Report Page

On this page, users can view the report details for a particular time period.

Test

The final phase of designing the vehicle tracking application involves testing using the SUS (System Usabilty Scale) method. There are 10 questionnaire questions, namely: 1) I am interested in using this application frequently. 2) I feel that this app is too complicated and needs to be simplified again. 3) I feel that this app can be used easily. 4) I feel that I need to be guided by an expert when using this application. 5) I feel that the functions of this app are well integrated. 6) I feel that there are many incompatible parts in this app. 7) I feel like most people are able to understand how to use this app in a short time. 8) I find this app very complicated to use. 9) I feel confident that I can use this app smoothly. 10) I need to learn a lot of things first before using this app [17].

Based on the distribution of questionnaires to 10 respondents as users of this application, the results of the score calculation using the System Usability Scale (SUS) method are in the following table:

Table 1. Prototype Test Result

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total	Total x 2.5
R1	3	2	3	2	3	4	3	3	5	2	30	75
R2	3	4	3	2	3	4	3	2	5	2	31	77,5
R3	3	4	3	2	3	4	3	2	3	2	29	72,5
R4	3	4	3	2	3	4	3	2	3	3	30	75
R5	4	4	3	2	3	3	2	3	4	4	32	80
R6	4	2	5	3	4	3	2	4	4	4	35	87,5
R7	4	5	4	3	2	3	2	3	4	4	34	85
R8	5	5	4	3	2	3	1	3	4	4	34	85
R9	3	3	4	3	2	2	1	3	4	4	29	72,5
R10	3	3	3	3	2	2	1	5	4	4	30	75
											Total	**785**
											Average SUS Score	**78,5**

The average System Usability Scale (SUS) score from 10 respondents was 78.5, as shown in the SUS column in Figure 15. This score falls into category B (good), indicating that the UI/UX design is considered very good and is well-received by users.

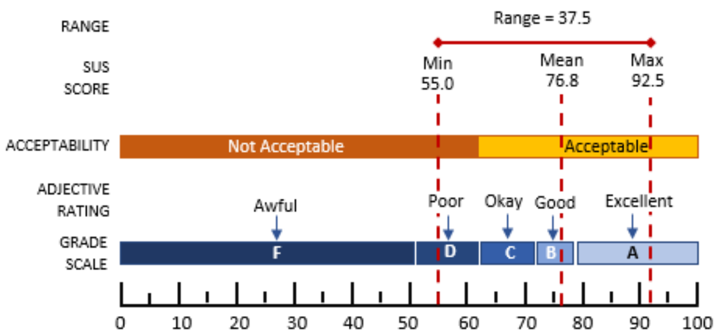

Figure15. SUS Calculation [17]

D. Conclusion

The use of the Design Thinking method, including the stages of Empathize, Define, Ideate, Prototype, and Test, is highly effective in creating a prototype that aligns with user experiences and needs. The developed prototype aims to address the issues present in the vehicle tracking application. It is designed to be user-friendly, ensuring that users can easily track vehicles without encountering difficulties.

E. References

[1] F. Prezita, E. Vania, E. Pratika, S. Astuti, D. Roaini, and B. Ulum, “Tantangan Kapabilitas Sumber Daya Manusia Dalam Menghadapi Era Digital,” *Yapakama Journal*, vol. 1, 2024, doi: 10.59971/jamapedik.v1i2.66.

[2] K. Hemachandran, S. Tayal, G. S. Kumar, V. Boddu, S. Mudigonda, and M. Emudapuram, “A Technical Paper Review on Vehicle Tracking System,” in *Proceeding of the International Conference on Computer Networks, Big Data and IoT (ICCBI - 2019)*, vol. 49, A. P. Pandian, R. Palanisamy, and K. Ntalianis, Eds., in Lecture Notes on Data Engineering and Communications Technologies, vol. 49. , Cham: Springer International Publishing, 2020, pp. 698–703. doi: 10.1007/978-3-030-43192-1_77.

[3] B. Yang, M. Tang, S. Chen, G. Wang, Y. Tan, and B. Li, “A vehicle tracking algorithm combining detector and tracker,” *J Image Video Proc.*, vol. 2020, no. 1, p. 17, Dec. 2020, doi: 10.1186/s13640-020-00505-7.

[4] N. I. Akanda, Md. A. Hossain, Md. M. I. Fahad, Md. N. Rahman, and K. Khairunnaher, “Cost-effective and user-friendly vehicle tracking system using GPS and GSM technology based on IoT,” *IJEECS*, vol. 28, no. 3, p. 1826, Dec. 2022, doi: 10.11591/ijeecs.v28.i3.pp1826-1833.

[5] I. Kadir, M. Yamin, H. Handrawan, A. Ma’ruf, and L. O. M. B. Aksara, “Sosialisasi dan Penguatan Sistem Informasi dan Pengelolaan Administrasi Desa dalam Menghadapi COVID-19,” *jpmit*, vol. 2, no. 2, p. 161, Oct. 2020, doi: 10.33772/jpmit.v2i2.15185.

[6] B. Oktaviani, R. M. Chandra, M. Irsyad, and P. Pizaini, “Desain Sistem Pemasaran Produk UMKM dengan Konsep UI/UX Menggunakan Metode Design Thinking,” *josh*, vol. 4, no. 3, pp. 980–987, Apr. 2023, doi: 10.47065/josh.v4i3.3387.

[7] W. S. L. Nasution and P. Nusa, “UI/UX Design Web-Based Learning Application Using Design Thinking Method,” *ARRUS J. Eng. Tech.*, vol. 1, no. 1, pp. 18–27, Aug. 2021, doi: 10.35877/jetech532.

[8] M. R. Wahyudi and N. Widjiyati, “Perancangan UI/UX pada Website Toko Kue Jager Bakery dengan Metode Design Thinking,” *jtim*, vol. 7, no. 1, pp. 149–163, Jan. 2025, doi: 10.35746/jtim.v7i1.663.

[9] F. Felix and R. A. F. Adriansyah, “UI/UXDevelopment Based On Design Thinking For Drug Swallowing Supervisors Of Pulmonary Tuberculosis Patients,” *Instal: Jurnal Komputer*, vol. 17, no. 02, 2025, doi: https://doi.org/10.54209/jurnalinstall.v17i02.357.

[10] S. G. Vanness Kenrick Erwi, S. Viswanatan Kravizt Erwi, F. Feriyanto, Y. Fransisco Mardi Chandra, and M. Rizky` Pribadi, “Perancangan Ui/Ux Pada

Aplikasi V&F Menggunakan Metode Design Thinking," *The 1st MDP Student Conference 2022*, vol. 1, no. 1, 2022.
[11] V. Wijaya, M. Fadli, and Y. Andika Dharma, "Pengembangan UI/UX pada Aplikasi Go-Print Dengan Menggunakan Metode Design Thinking," *The 1st MDP Student Conference 2022*, vol. 1, no. 1, 2024.
[12] S. Yesua Sutanto, F. Kurniawan, R. Rijaya, and M. Firmansyah, "Penerapan Design Thinking Pada Perancangan User Interface Aplikasi Supplier Sayur," *The 1st MDP Student Conference 2022*, vol. 1, no. 1, 2024.
[13] H. Y. Madawara, P. F. Tanaem, and D. H. Bangkalang, "PERANCANGAN UI/UX APLIKASI KTM MULTIFUNGSI MENGGUNAKAN METODE DESIGN THINKING," *JUKANTI*, vol. 5, no. 2, pp. 111–125, Nov. 2022, doi: 10.37792/jukanti.v5i2.560.
[14] L. Nathacia, R. Chandra, M. Hamdandi, F. Bachtiar, D. Apriyanti Sastika, and M. Rizky Pribadi, "Perancangan UI / UX pada Aplikasi Bapakkost Idemopet Dengan Menggunakan Metode Design Thinking," *The 1st MDP Student Conference 2022*, vol. 1, no. 1, 2022.
[15] A. Wijaya *et al.*, "Perancangan UI/UX pada Aplikasi WE-CARE Menggunakan Metode Design Thinking," *The 1st MDP Student Conference 20221*, no. 1, 2022.
[16] M. A. D. Pratama, Y. R. Ramadhan, and T. I. Hermanto, "Rancangan UI/UX Design Aplikasi Pembelajaran Bahasa Jepang Pada Sekolah Menengah Atas Menggunakan Metode Design Thinking," *Jur. Ris. Kom.*, vol. 9, no. 4, p. 980, Aug. 2022, doi: 10.30865/jurikom.v9i4.4442.
[17] M. F. Fiandhika and B. Kelana, "System Usability Scale Validation from The Expert Perspective," *E3S Web Conf.*, vol. 483, p. 03008, 2024, doi: 10.1051/e3sconf/202448303008.