

Green Star Auto Enterprise Car Selling System

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Abstract

The Green Star Auto Enterprise Car Selling System is a web-based solution aimed in enhancing the sales process by systematizing and streamlining operations. Green Star Auto Enterprise faces challenges in effectively marketing and reaching potential buyers within the highly competitive used car market. The purpose of developing this system is to address the specific issues encountered by Green Star Auto Enterprise. The proposed system is developed using the waterfall methodology involving requirements gather, design, implementation, verification and maintenance phases. Key findings highlight the significance of a transparent vehicle history presentation and trends show a growing preference for cost-effectiveness compact car. The Car Selling System is expected to enhance the enterprise's market reach, reduce time consumption, increase the efficiency of the selling process, and provide a secure transaction platform.

1. Introduction

Green Star Auto Enterprise Car Selling System is an online platform simplifying car transactions for dealers and buyers. The system optimizes the car selling process by streamlining transactions, enhancing seller visibility, providing a positive experience for buyers and ensuring secure payment processing. Traditionally, car selling involves offline channels like newspaper ads and physical lots, leading to limited reach and visibility for sellers and challenges for buyers in obtaining reliable information. The manual and physical storage of data further complicates the existing setup, causing organizational issues and potential document loss. The proposed solution introduces a centralized web platform to address these challenges. Sellers benefit from an easy-to-use interface, expanding their reach while buyers gain access to comprehensive search tools for accurate vehicle information. The system incorporates payment processing, streamlined communication, and efficient data management, offering a comprehensive and user-friendly solution to enhance the overall car selling process.

1.1 Problem Statement

The problem statement of the current car selling is facing inefficient and fragmented car selling processes. Due to the lack of a centralized platform, the existing car buying and selling procedure is disjointed and time-consuming for both buyers and sellers. Sellers face challenges in effectively marketing and reaching potential buyers, while buyers struggle to find comprehensive and reliable information about available vehicles.

This fragmented system inhibits transaction efficiency, causes missed opportunities, and affects the customer experience as a whole. There is a need for a robust car selling system that provides a user-friendly platform for sellers to list their vehicles and connect with potential buyers seamlessly. Moreover, they need an efficient search and filtering mechanism to find relevant vehicles based on their preferences. In contrast, some of the customers will lose the chance to buy their favorite car.

The system should also have secure payment processing and user management functionality to provide a safe and transparent transaction procedure. The car selling system seeks to improve the efficiency and convenience of buying and selling cars, hence improving the overall experience for all stakeholders. If the safety of the transaction between the buyers and sellers are not protected, they will face financial loss.

1.2 Objectives

The objective of this car selling system:

1. To design a web-based car selling system using structured approach.
2. To develop an ecommerce system for Green Star Auto Enterprise
3. To test the system developed for Green Star Auto Enterprise.

1.3 Scope

The Green Star Auto Enterprise Car Selling System, based in Nibong Tebal, Penang, involves various aspects of developing and managing a digital platform for buying and selling cars. It involves users such as administrator and customer as well as modules like User Authentication, Profile Management, Buying, Inventory, Payment, and Notifications. The User Authentication and Registration module facilitates user registration, login, authentication, and password reset. Besides, the User Profile Management module enables users to customize their profiles. Buying module enhances the purchasing process through features like search, filter, detailed product listings, and a streamlined checkout process. The Inventory module allows comprehensive management of car information, including search, add, update, and delete functions. Moreover, the Transaction Verification Module enhances the payment process by collecting user payment information and necessary documents to proceed with verification. Lastly, the Notification module enables admins to inform customers about new events.

The Green Star Auto Enterprise Car Selling System incorporates key modules to ensure an efficient, secure, and user-focused platform. User authentication and registration are streamlined, providing a secure and personalized experience. The system facilitates seamless transactions by allowing users to input payment details and upload transaction photos. It ensures secure fund transfers through admin verification, particularly for significant transactions. The search and filter module empowers buyers to efficiently find their dream car with advanced filters and sorting options. Listing management allows sellers to showcase vehicles accurately, boosting buyer confidence with detailed images and videos. Administrators have efficient tools for system management, overseeing users and listings, analyzing business insights, and resolving disputes effectively. This comprehensive approach ensures the entire car selling process is safe and smooth. The system offers a user-friendly and secure environment for both buyers and sellers, promoting confident transactions and interactions within a trusted community.

2. Related Work

There are three existing systems are briefly introduced and is compared with proposed system to identify appropriate technologies, solutions for business challenges and implementation methods. One of the existing systems is called Mudaseri Auto, a licensed used car dealer in Brunei, renowned for offering some of the most rarely used imported automobiles with unmatched service [1]. With a solid reputation built over the years, they provide a user-friendly system allowing customers to check current stock and search for their dream car using an Advanced Vehicle Search Filter. This comprehensive search engine enables users to filter by various criteria and the system also features a recent sale list, serving as social proof to instill trust in potential buyers.

Second existing system is Carwins Automobile, offers a wide range of new cars and services, including popular brands like Volkswagen, Lexus, Perodua, and Toyota [2]. Their system features a search and filtering module for specific car information, a user-friendly product listing navigation module, breadcrumb navigation for easy tracking of user paths and reCAPTCHA for enhanced security. The proposed system plans to incorporate breadcrumb navigation to improve the overall user experience.

D-Concept is a major car importing platform operating in Japan, Australia, England, and Malaysia, aiming to provide best service to customer [3]. Their platform includes features like user registration and authentication, reservation, purchasing, shipping, search and filtering, loan calculator and car model

comparison. Users can sign in, make reservations, purchase cars, estimate loan details, search for dream cars based on various criteria and compare car models. The proposed system plans to incorporate a loan calculator to help users understand their financial commitments and make well-informed borrowing decisions.

Mudaseri Auto Used Car System, Carwins Automobile and D-concept are the three existing system provide different features compared to Green Star Auto Enterprise Car Selling System. The comparison between these systems enables the integration of suitable technology into the proposed system, enhancing its functionality while meeting customer requirements. Table. 1 shows the different features between the three existing system and the proposed system.

Table 1 Comparison between three existing systems and proposed system

Features/System	Mudaseri Auto Used Car System	Carwins Automobile	Dconcept	Proposed Sytem
Registration	X	X	√	√
Authentication	X	X	√	√
User profile management	X	X	X	√
Buying module	√	X	X	√
Loan Calculator module	X	X	√	√
Insurance Calculator module	X	X	√	X
Inventory Module	√	√	√	√
Payment and transaction	X	X	X	√
Notification	X	X	X	√
Database	√	√	√	√
Requirement				
User Friendly	X	√	√	√

3. Methodology/Framework

The Green Star Auto Enterprise car selling system is developed using the waterfall approach of system development life cycle (SDLC) which begins with the requirement stage. The Software Development Life Cycle (SDLC) is a framework outlining the process employed by organizations to take an application from its inception to the conclusion of its life cycle [4]. Since the waterfall approach emphasises detailed project planning and extensive project documentation, it is typically used in small to medium-sized projects and offers outstanding quality control. This can be advantageous for Green Star Auto Enterprise Car Selling System, where clear documentation of requirements, design specifications and system functionalities are crucial. The integration of waterfall and iterative models in the software development process presents substantial benefits, especially in the development of large software products, surpassing the advantages offered by existing models [5]. The waterfall model includes five phase such as requirement, design, implementation, verification and maintenance as shown in Figure 1.

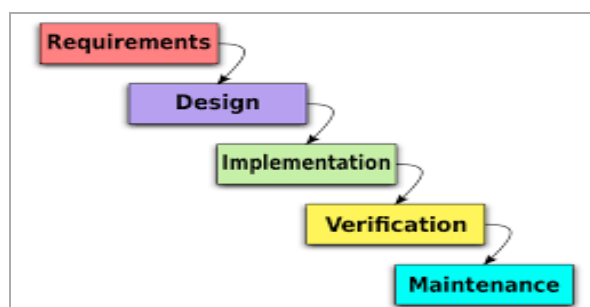


Fig. 1 Waterfall model

3.1 Waterfall Model Phase

In the requirements phase, it involves preliminary analysis of the enterprise background, collecting requirements, and conducting interviews with enterprise representatives to understand their needs. Software requirement specifications are then developed, encompassing problem definition, objectives, and project scopes. Project scheduling, crucial for a smooth and timely process, is executed, and a Gantt Chart is created using Microsoft Project. Information from articles, websites, and existing systems is gathered to ensure the developed system aligns with user requirements.

Next phase is the design phase. The interview sessions generate a comprehensive list of requirements, covering both functional and non-functional aspects, providing a detailed insight into the system's needs. The system design phase follows, incorporating Context Diagram, Data Flow Diagram and Entity Relationship Diagram. These diagrams illustrate the process flow, entities, and relationships within the system. Additionally, wireframes are constructed to design the user interface for each module.

In the implementation phase, Hypertext Preprocessor (PHP) is utilized for coding and page layout, interacting with MySQL for database connectivity. HyperText Markup Language (HTML), Cascading Style Sheets (CSS), and JavaScript contribute to webpage content, interface design, and interactivity to ensure an effective and dynamic system.

In the verification phase, users are invited to test system functionality, ensuring it aligns with their requirements and expectations. Performance testing evaluates responsiveness, speed, and scalability under various conditions, while security testing identifies and addresses potential vulnerabilities such as unauthorized access and data breaches. If defects are found, subsequent maintenance is provided.

Minor bug or issues reported by users are fixed in the maintenance phase. Besides, there will be necessary updates or modifications to the system to accommodate changes in requirements, technology or business needs. The system's performance of the production environment is monitored and optimize it as needed.

3.2 Functional and Non-functional requirements

System Requirement Analysis involves identifying and documenting both functional and non-functional requirements. Functional requirements specify the exact features and functionalities that the system must deliver, while non-functional requirements outline the characteristics and qualities the system needs to possess. These requirements provide a comprehensive understanding of the objectives and operations the system is expected to fulfill. System requirements encompass all the specifications at the system level, detailing the functions necessary for meeting stakeholder expectations and needs. Table 2 shows the functional requirements of proposed system while Table 3 displays the non-functional requirements.

Table 2 *Functional requirements of proposed system.*

Modules	Functionalities
User authentication and registration	<ul style="list-style-type: none"> The system allows admin and user to register new account The system allows admin and user to login with valid username and password as well as captcha
User profile management	<ul style="list-style-type: none"> The system should alert the user for any invalid input The system should allow user to edit their profile such as profile picture, username, user ID and password
Buying module	<ul style="list-style-type: none"> User able to search the cars by filtering brand, models, price and year. The system will list out the product image and specifications. User able to add and delete product in the cart. User can book the desire car by paying the booking fee.
Loan calculator	<ul style="list-style-type: none"> User can calculate the loan based on the price, deposit, bank rates and loan period before buying the car.
Inventory module	<ul style="list-style-type: none"> Admin able to add, delete and update the products. Admin can check the booking list
Transaction verification module	<ul style="list-style-type: none"> Admin can verify the payment by reviewing the client's personal information and the transaction photo.
Notification	<ul style="list-style-type: none"> Admin will notice the user when there are promotions and special events. User will get notification when there are promotions.

Table 3 *Non-functional requirements of proposed system.*

Requirement	Description
Operational	<ul style="list-style-type: none"> The system should be user friendly. The system should be work on different web browser.
Performance	<ul style="list-style-type: none"> Each web pages will load within two seconds
Security	<ul style="list-style-type: none"> User can login to the system by correct username and password Only user that login as admin can view and manage the product list

4. Result and Discussion

4.1 Context Diagram (CD)

Context diagram (CD) delivers an overview of a system and how it connects with external entities. It contains elements such as stakeholders that interact with system, data flows and the proposed system in the centre of the context diagram. Figure 2 displays the context diagram of Green Star Auto Enterprise car selling system.

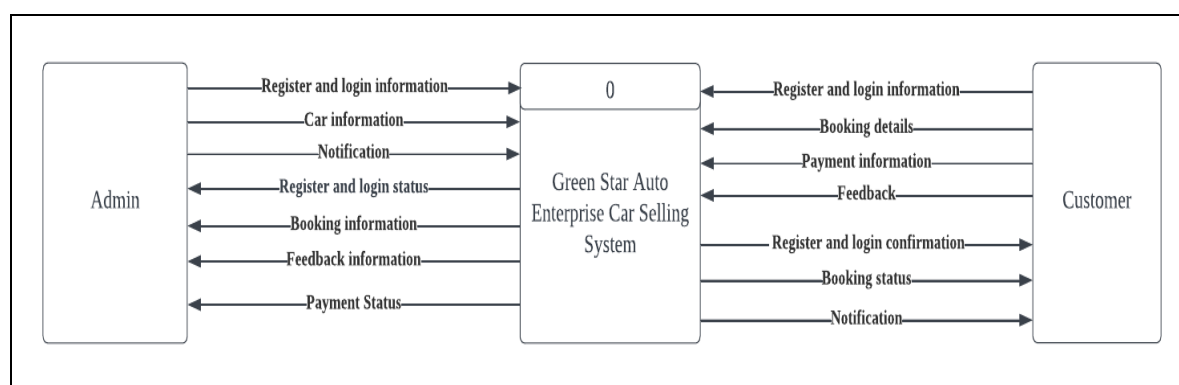


Fig. 2 Context Diagram

4.2 Data Flow Diagram (DFD) Level 0

A Data Flow Diagram is a method of structured analysis that illustrates how data moves within a software system [6]. Besides, DFD visually represents the features and requirements of a system by illustrating the flow of data between entities, processes and data stores. This graphical representation outlines how the system is structured and implemented, showcasing the interactions between different elements such as entities, functions and data storage. The DFD provides a clear and brief overview of the system's operational aspects, making it a valuable tool for understanding the system's architecture and data flow dynamics. Appendix A shows the DFD for level 0 of Green Star Auto Enterprise Car Selling System.

4.3 Data Flow Diagram (DFD) Level 1

DFD Level 1 expands on the higher-level DFD (Level 0), breaking down processes into sub-processes for a more detailed system view. There are total of six processes in the level 1 which are registration, login, manage product, manage booking, payment and feedback that shown in Appendix B, Appendix C, Appendix D, Appendix E, Appendix F and Appendix G respectively.

4.4 Entity Relationship Diagram (ERD)

An Entity Relationship Diagram (ERD) is a conceptual representation of a data model that portrays and depicts the real world through entities and relationships [7]. Diagrams and symbols are utilized to show the data store's location inside the system, as well as the relationships and methods of communication between them. ERD has three main parts such as entities which are like storage for data in the system, attributes which are the details about each piece of data and relationships which show how the different data storage are connected to each other. Figure 3 shows the entity relationship diagram of Green Star Auto Enterprise car selling system.

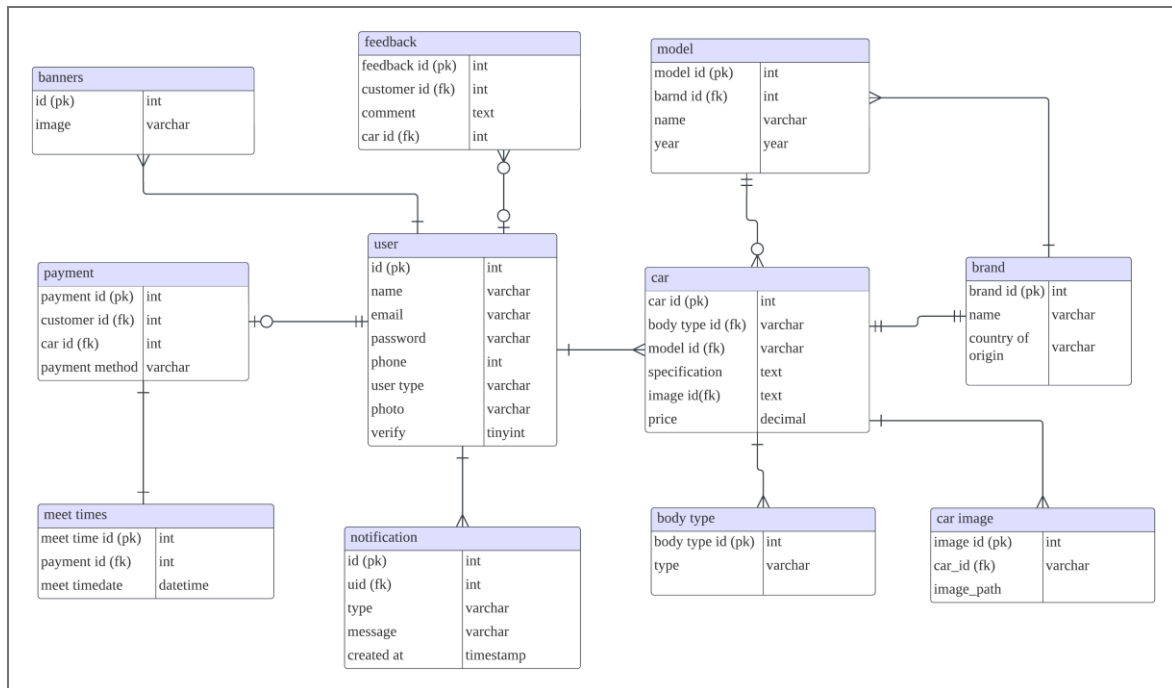


Fig. 3 ERD of Green Star Auto Enterprise car selling system

5. Implementation and Testing

The Green Star Auto Enterprise Car Selling System is developed based on user's and system requirements for both admin side and client side. The modules are discussed in this section are user authentication and registration module, user management module, buying module, inventory module, transaction verification module, notification module and feedback module.

5.1 User authentication and registration module

The authentication and registration module allows users to create new accounts and log in. During registration, users must provide their name, email, password and password confirmation. If the email already exists, the system displays "User already exist!". Upon successful registration, user information is stored in the user table. Users can then navigate to the login page by clicking "login now". Figure 4 shows the registration page.

The registration page features a central form titled "Green Star Auto Enterprise REGISTER NOW". The form contains the following elements:

- Header: Green Star Auto Enterprise REGISTER NOW
- Input fields:
 - enter your name
 - enter your email
 - enter your password
 - confirm your password
- Submit button: Register Now
- Link: already have an account? login now

Fig. 4 Registration page

The login page enables both users and admins to access the system using their email and password. Login errors may occur due to incorrect credentials or unverified accounts, requiring users to complete

reCAPTCHA verification. Google’s reCAPTCHA, a widely used CAPTCHA challenge, serves as a point where the relationship between a web user and a web platform is negotiated [8]. The reCAPTCHA is implemented to protect websites from spam and abuse as well as differentiate between human users and automated bots. Figure 5 and figure 6 show the login page and authentication of reCAPTCHA page respectively.

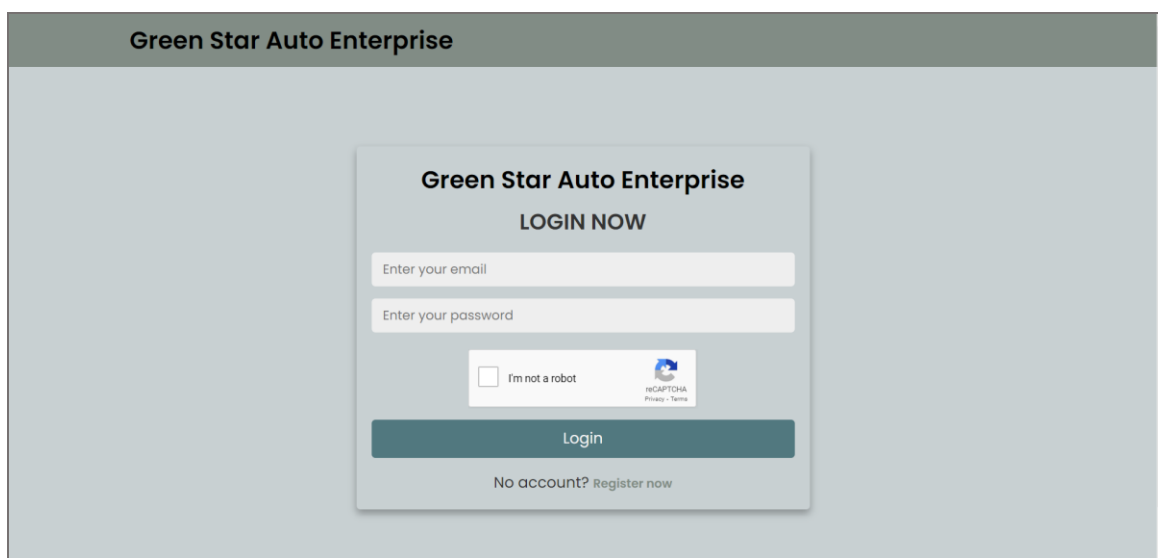


Fig. 5 Login page

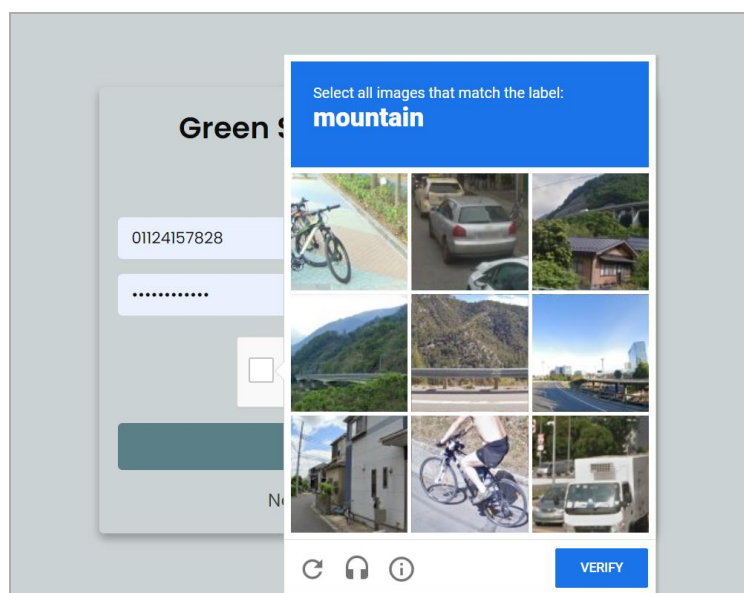


Fig. 6 Authentication of reCAPTCHA

5.2 User management module

The user management module enables admins to manage user verifications and deletions. After registration, user information is displayed on the user management page such as ID, name, email and user type. User only can login into the system after the verification of admin. This can ensure that the data integrity of the users and prevents the creation of fake or spam accounts. If there is any problem of the account, admin is allowed to delete the account that involved in suspicious activities. Figure 7 shows the user management page.

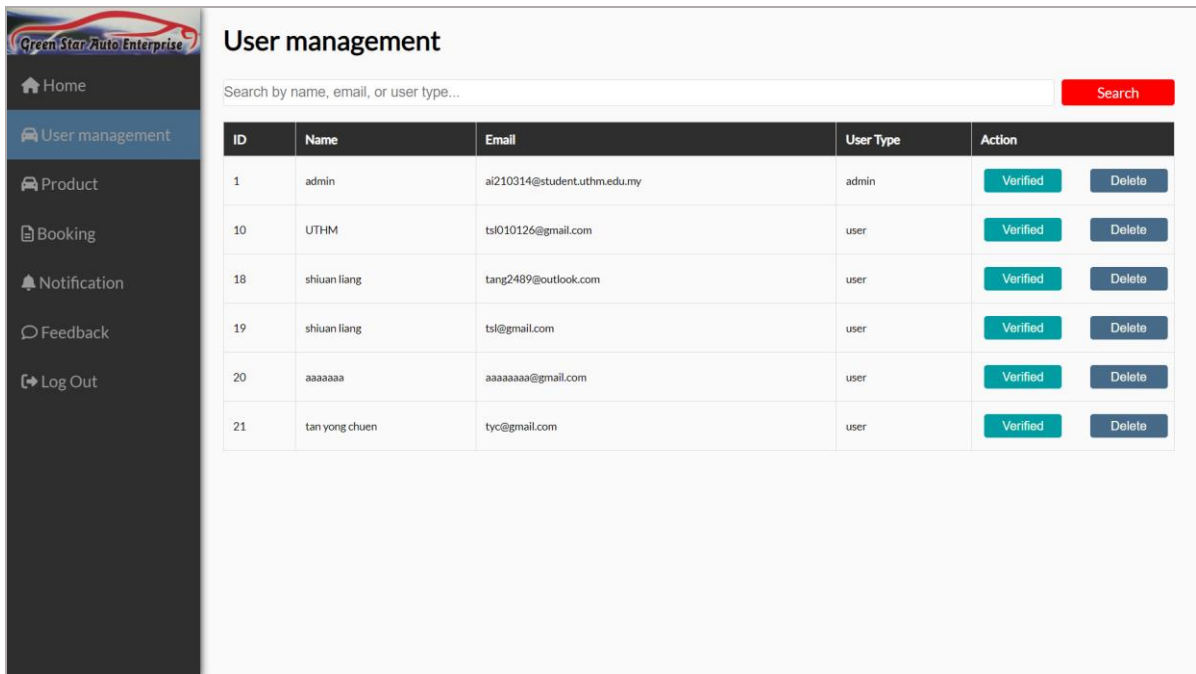


Fig. 7 User management page

5.3 Buying module

The buying module allows users to browse a comprehensive list of cars, comparing details such as brand, model, year, and specifications. Users can search for their dream car using the search bar and filter options. By clicking "Explore More," users can view additional images of the car's interior and exterior. Users can proceed to the payment page if satisfied with the car by clicking the "Book Now" button. Figure 8 displays the buying module.

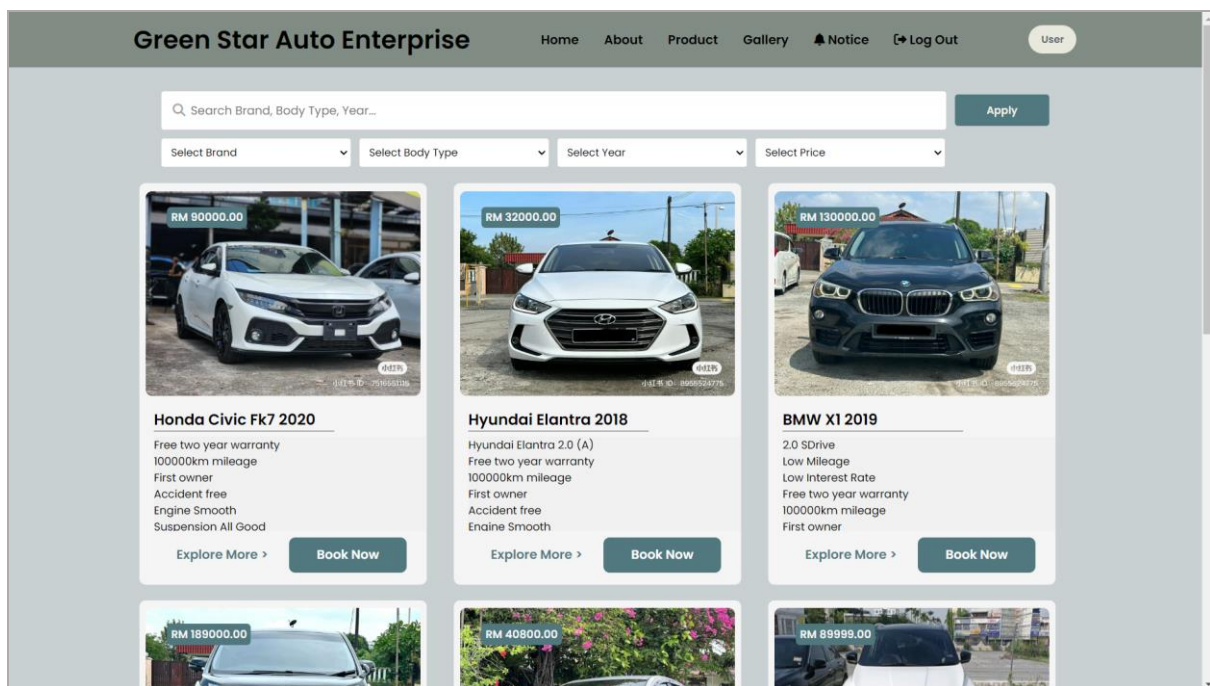


Fig. 8 Buying page

5.4 Inventory module

The inventory management module allows admins to efficiently manage used car listings. All the information of the car list such as car brand, car model, body type, specification and images are showed.

Admins can search for car information by brand or model to quickly locate specific information without navigating through multiple screens. Besides, admin can add, delete, or edit car details through dedicated buttons. Figure 9 shows the interface of inventory module.

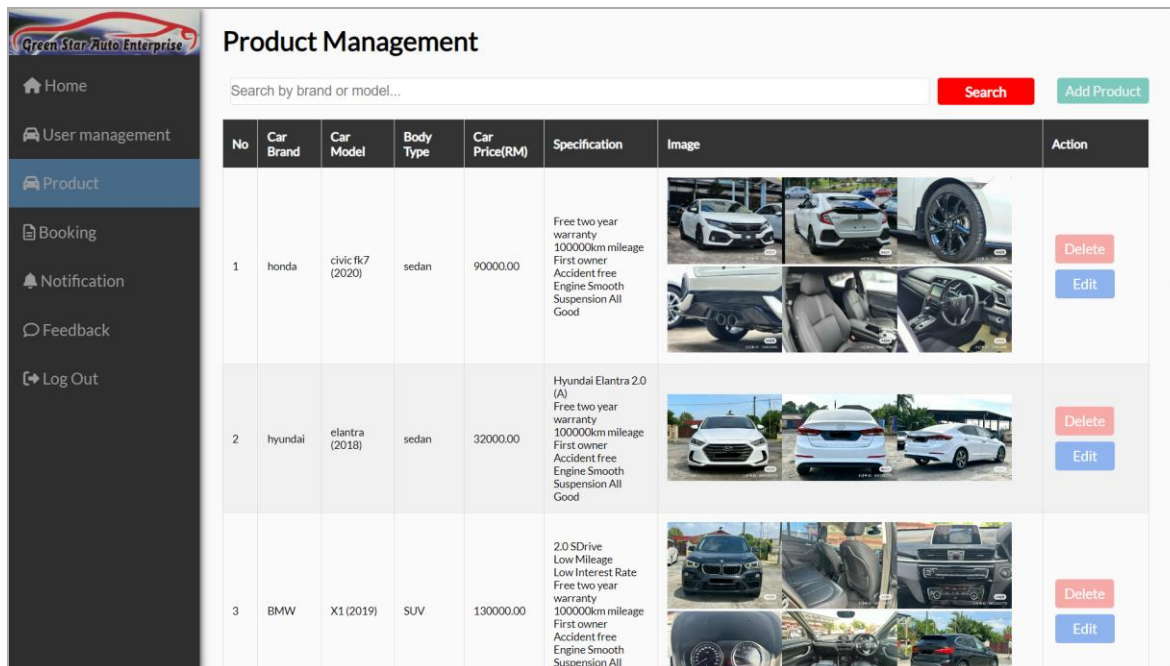


Fig. 9 Inventory page

5.5 Transaction verification module

The transaction verification module facilitates the booking and payment process for clients. Clients are required to enter their contact name, phone number, meeting date and time, payment amount, and upload a transaction photo to complete their booking. The payment method provided is online banking through Public Bank. Figure 10 shows the payment page at the client side.

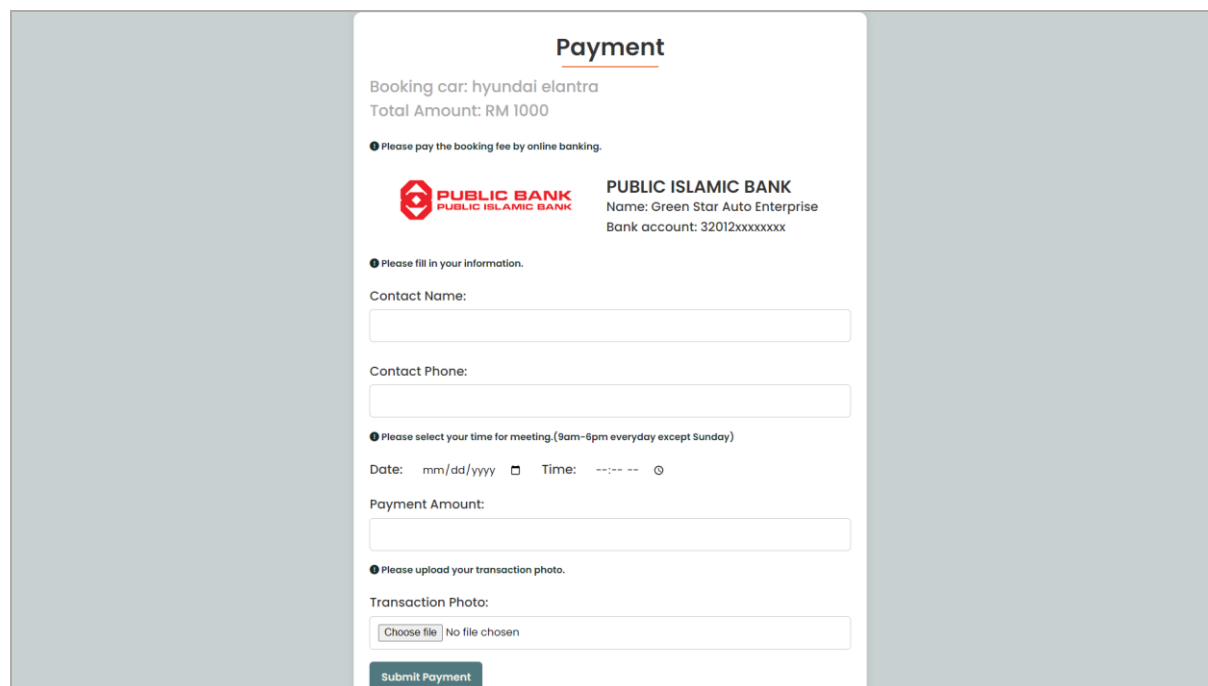


Fig. 10 Payment page

Once the payment form is submitted, the booking details are recorded in the system. The admin should verify the transaction by clicking the "Confirm" button, which will update the transaction status to "done." If not verified, the status will remain "pending". Figure 11 displays the interface of payment verification at the admin side.



Booking Details									
Search by contact name, contact number, date and time Search									
Car ID	Car	Car Price	Contact Name	Contact Phone	Date & Time	Booking Fee	Transaction Photo	Transaction Status	Confirmation Status
83	BMW X1	RM 130000.00	tang shuan liang	0123456789	2024-06-08 12:21:00	RM 1000.00		Pending	<div style="text-align: right;"> CONFIRM DELETE </div>

Fig. 11 Transaction verification page

5.6 Notification module

The notification module enables the admin to send emails to users. Admins can fill out a form with the necessary information, including the recipient's name, email, subject, and message. Admin is allowed to select the user's email by clicking on the dropdown button. After click the submit button, the chosen email will receive the notification from the admin. Figure 12 displays the notification module.



- Home
- User management
- Product
- Booking
- Notification
- Feedback
- Log Out

Notification

All Users ▼

Type Message Details Here...

Submit Now

Fig. 12 Notification page

5.7 Feedback module

The feedback module allows the admin to manage user feedback after submission feedback of user. Admins can toggle the status of each feedback whether it is visible or hidden. By managing visible feedback, it helps in maintaining a positive public image by showcasing positive user experiences. Figure 13 shows the feedback module.

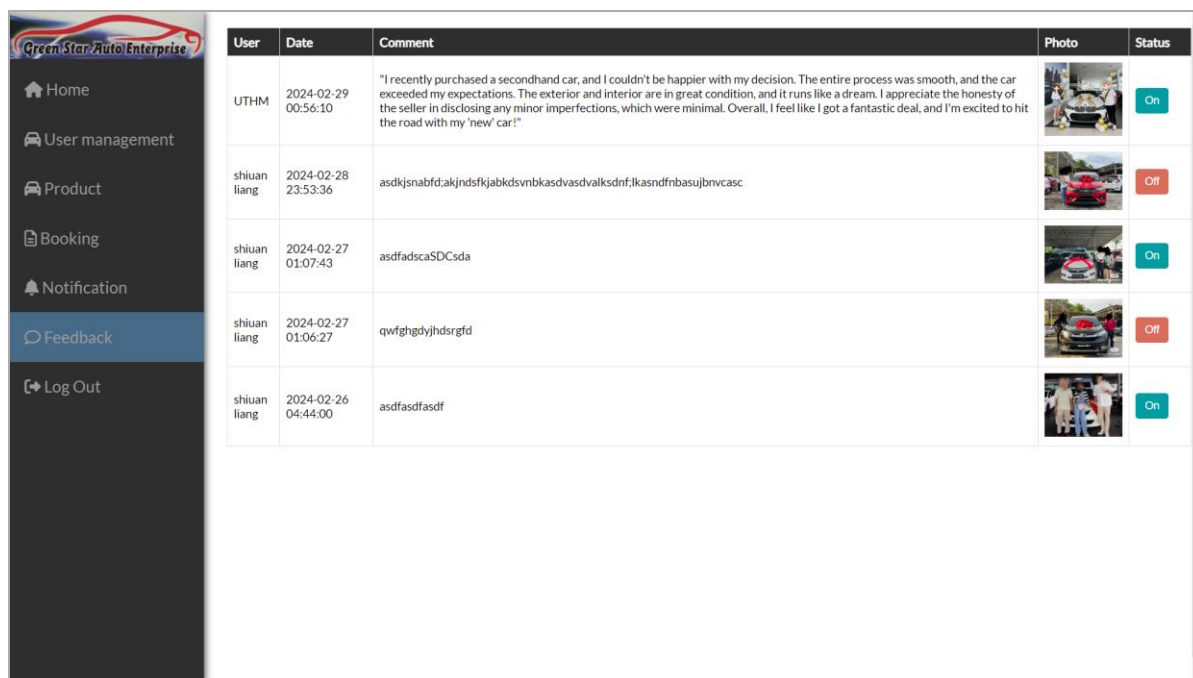


Fig. 13 Feedback page

5.8 Testing

Testing phase is conducted to perform functional testing. The primary objective of functional testing is to verify that each function of the software operates according to the specified requirements. This phase aims to identify syntax errors, bugs, security gaps, and evaluate the system's usability, functionality, and overall user experience. Table 4 shows the test case of the modules.

Table 4 Test cases of modules

No	Test cases	Description	Expected result
User authentication and registration			
1.	Registration	Verify that users can successfully register with valid information.	PASS
2.	Non-repeated email	Test the uniqueness of email addresses to prevent duplication.	PASS
3.	Login	Validate that registered user can log in successfully with their credentials.	PASS
4.	Display error messages	Test login with incorrect email and password combinations to verify error handling.	PASS
5.	Login with different type of user	Test login with different type of user which is admin and client.	PASS
6.	Verification of reCAPTCHA	Verify that the registration form and login form included the reCAPTCHA widget to prevent automated attacks and abuse.	PASS
Inventory management			
1.	Manage car information	Admin can add, edit and delete all the information of the car.	PASS
2.	Search car information	Admin can search the car information based on the brand and model.	PASS
Buying			
1.	Display car	All the information of car is displayed successfully in the website.	PASS
2.	Book car	User can book the car by clicking on the 'Book Now' button.	PASS

Table 4 Test cases of modules (cont.)

3.	View car	User can view the details of the car by clicking on the 'Explore More' button.	PASS
4.	Search car	User can search the car information based on the brand, body type, year and price range.	PASS
Transaction verification			
1.	Submit payment	Client is able to fill in all the information in the payment form and submit.	PASS
2.	View payment	Admin can view the booking details.	PASS
3.	Verify payment	Admin can verify the payment by click the status button after the confirmation of transaction.	PASS
Notification			
1.	Input notice	Admin can insert the information of the notice in the form.	PASS
2.	Send email	Admin can send the notice to the clients' email by clicking the 'Submit' button.	PASS
Feedback			
1.	Submit feedback	Client can insert the information of the feedback in the form.	PASS
2.	View feedback	Admin can view the clients' feedback.	PASS

6. Conclusion

The Green Star Auto Enterprise Car Selling System effectively fulfills its objectives by integrating essential modules. Key features such as user authentication, registration, profile management, buying, inventory management, transaction verification processing, and notifications work together seamlessly to provide a secure and user-friendly experience for both administrators and clients.

This system boasts several advantages that contribute to its effectiveness. Firstly, it enhances the user experience through advanced search filters, detailed product listings, and a simplified checkout process, making car browsing and purchasing intuitive and efficient. Secondly, the inventory management functionality empowers administrators to effortlessly manage car listings, ensuring that the inventory remains accurate and up-to-date at all times. Thirdly, robust user authentication and registration processes, coupled with the implementation of reCAPTCHA, prevent unauthorized access and protect user information from bots.

However, there are several disadvantages that could be identified in the system. Users are able to register accounts using verified or unverified emails, which can lead to many fake accounts and degrade the quality of the user base. Admins require the help of third-party tools, such as WhatsApp, for further communication in case of technical problems and refund requests. The payment transaction requires verification by the admin or accountant to ensure its success.

For future system development, the car selling platform can be significantly enhanced with several robust features. First, implementing email verification for user accounts can enhance account authenticity and mitigate the risk of fake registrations. Second, integrating a built-in messaging system within the platform can facilitate direct communication between administrators and users. Finally, adopting real payment gateways such as PayPal or Stripe can streamline payment processes, automate verification procedures, and enhance transaction security.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

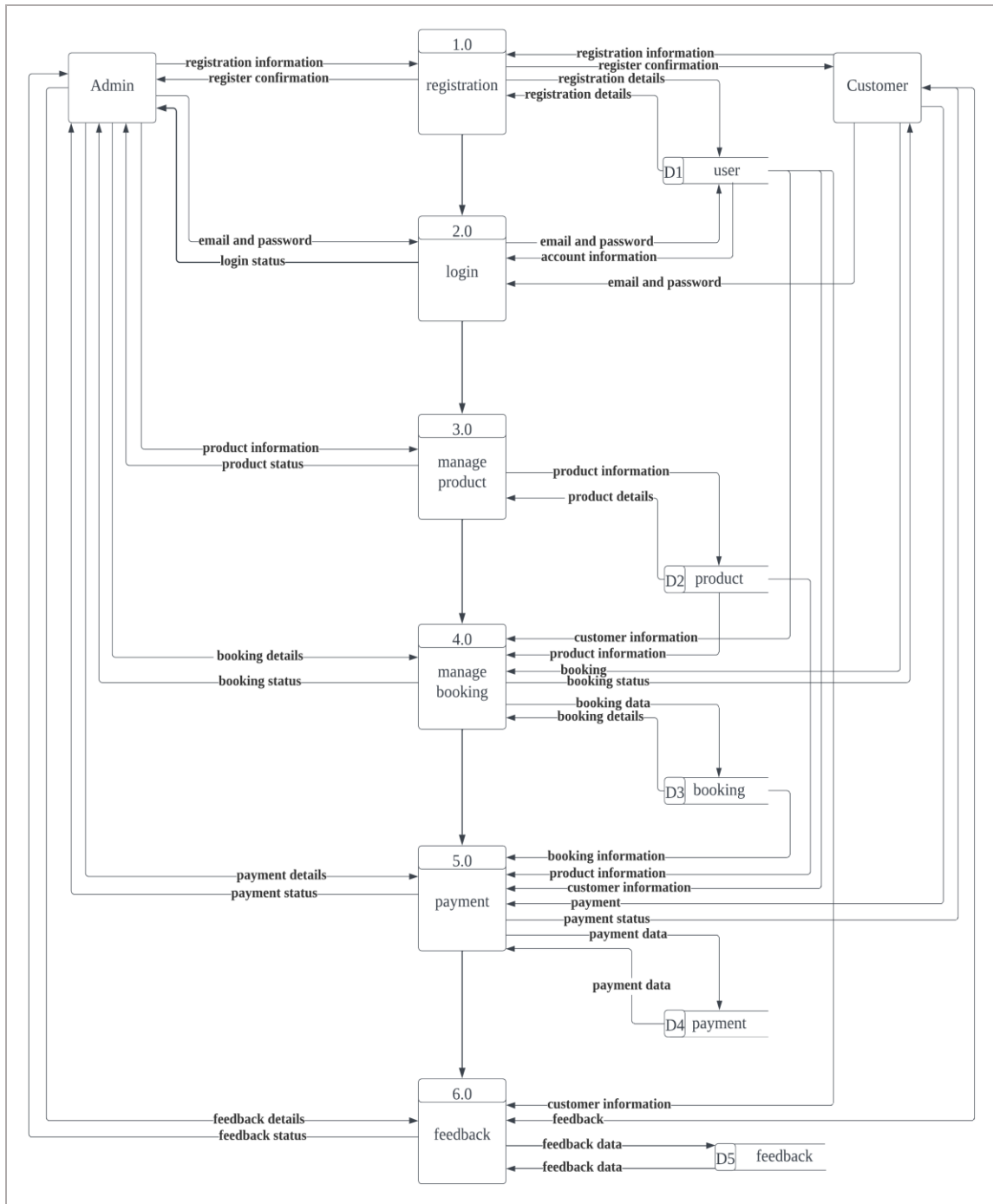
Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Tang Shiuan Liang, Noryusliza binti Abdullah; **data collection:** Tang Shiuan Liang; **analysis and interpretation of results:** Tang Shiuan Liang, Noryusliza binti Abdullah; **draft manuscript preparation:** Tang Shiuan Liang, Noryusliza binti Abdullah. All authors reviewed the results and approved the final version of the manuscript.

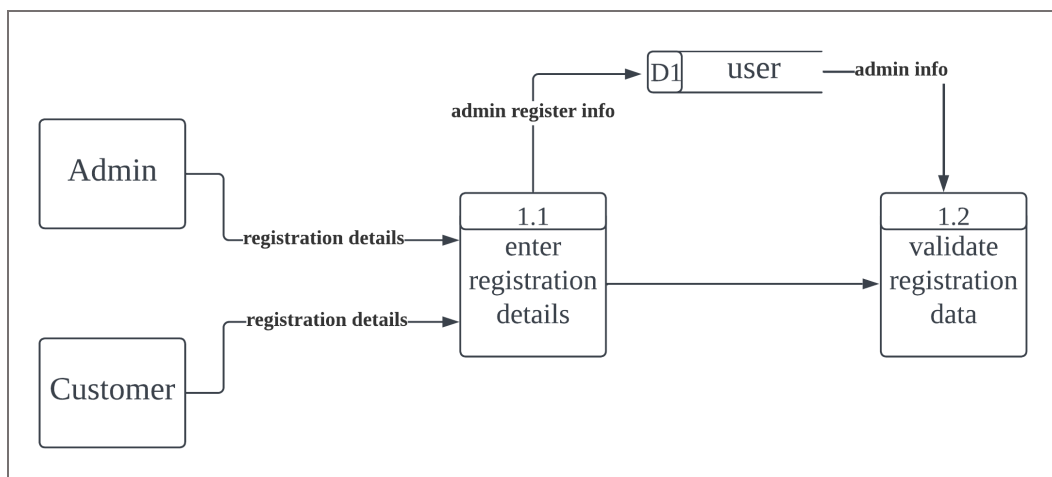
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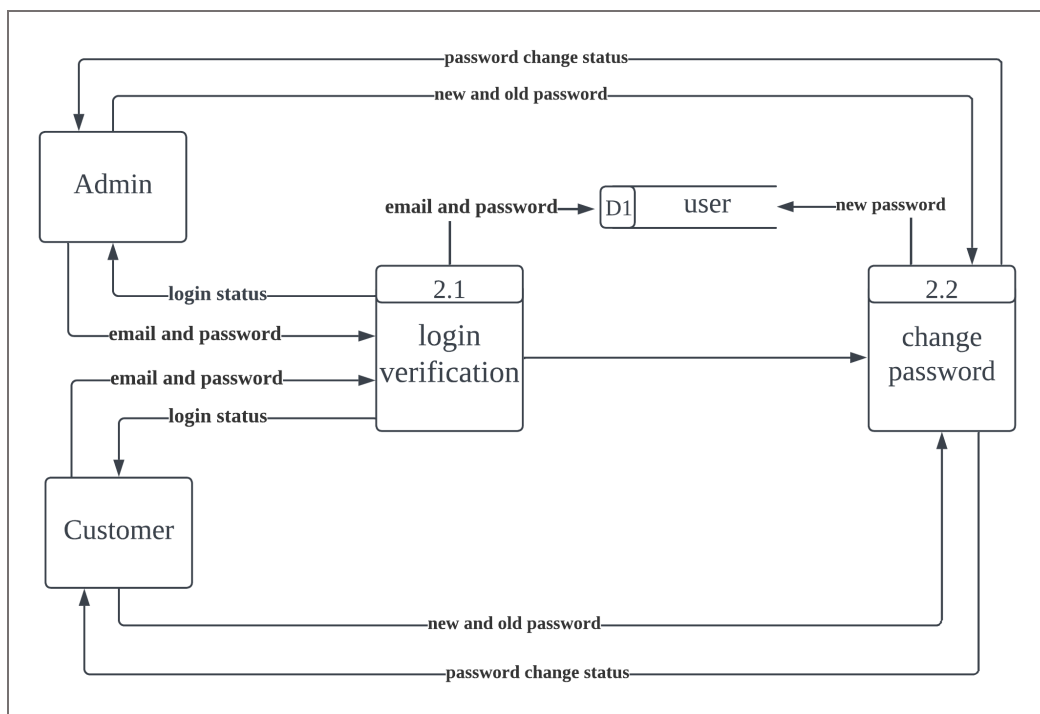
Appendix A: Data Flow Diagram (DFD) level 0



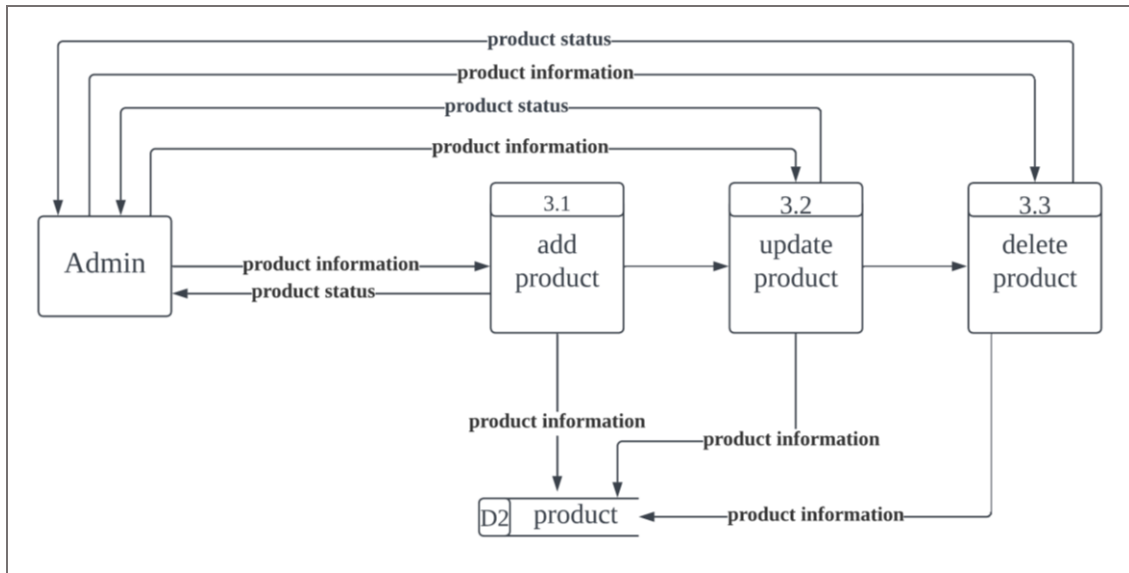
Appendix B: DFD level 1 Process 1.0 Registration



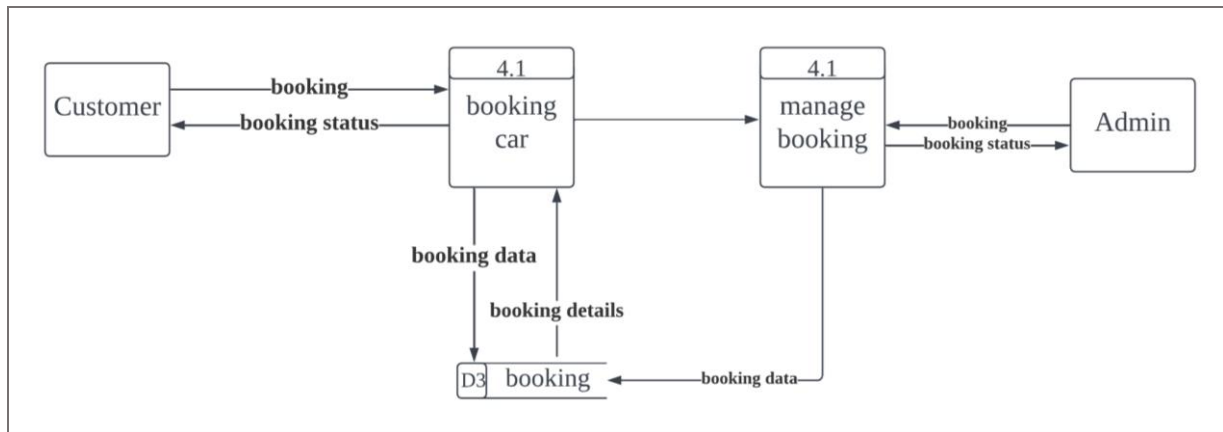
Appendix C: DFD level 1 Process 2.0 Login



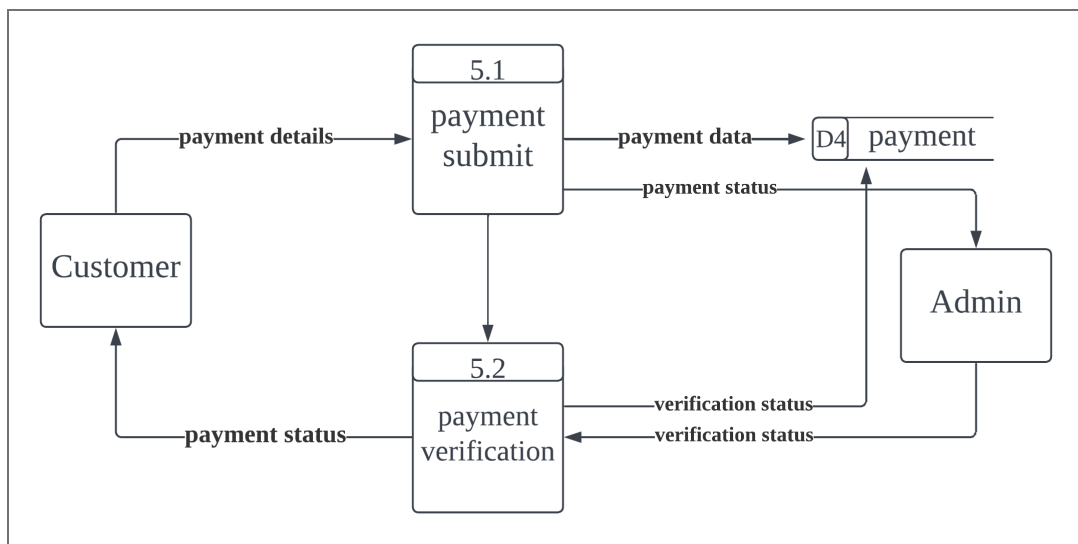
Appendix D: DFD level 1 Process 3.0 Manage Product



Appendix E: DFD level 1 Process 4.0 Manage Booking



Appendix F: DFD level 1 Process 5.0 Payment



Appendix G: DFD level 1 Process 6.0 Payment

