

Intan School Bus Management System

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Abstract

The Intan School Bus specializes in providing transportation services for primary school students. This current process relies on a non-computerized system, leading to data loss, payment inefficiencies, and time-consuming processes. The project objectives involve designing a school bus management system using object-oriented approach, developing the system using web-based approach, and testing through system and user acceptance testing. The proposed system implements seven modules which are registration, login, manage profile, manage transportation, manage payment, track school bus, and generate report. The project uses prototyping methodology as the software development life cycle model. After system deployment, users can register for the Intan School Bus Management System, and administrator can manage user data through web browsers. The project completion aims to deliver a web-based system for Intan School Bus Management that facilitates the user registration process and ensures efficient data management for the school bus service.

1. Introduction

Transportation is an essential service in human life, allowing individuals to move from one place to another. There are various modes of transportation, including motorcycles, cars, and buses, to get around [1]. School transportation specifically refers to the means of transport used by students to commute to school [2]. Using private vehicles to and from school is the most common type of mode of travel among primary school children during weekdays of a school year [3]. In Malaysia, school buses serve as a means of student transportation within specific areas [4]. Yet, during school breaks or festive periods, these buses can be adapted for student or non-student transport activities outside of the authorized regions [4]. It is also important to note that school buses are motor vehicles registered and licensed for the exclusive purpose of transporting students or school staff to educational institutions. The types of school buses in operation across Malaysia vary, with seating capacities ranging from 8 seats to a maximum of 44 seats [4].

Currently, Intan school bus service relies on manual methods for school bus operations, involving paper forms for student registration, a central book for data transfer, and cash only payment which poses significant challenges. Firstly, administrative tasks like student registration, record-keeping, and payment details are managed manually, risking data loss due to misplaced or damaged documents. Secondly, the exclusive acceptance of cash payments creates difficulties in tracking payments accurately, leading to confusion and disputes. Customers' interest in online payments remains unmet due to the cash-only policy. Thirdly, transferring data to physical books and manually storing contact information is time-consuming and error-prone, impacting efficiency and resulting in mistakes. Lastly, the manual system exposes students and drivers to safety risks, as frequent calls from parents during transit divert the driver's attention. These manual processes which lacks digital infrastructure impacts the service efficiency.

Therefore, the objective of the project includes designing a school bus management system using object-oriented approach, developing the system using web-based approach, and testing through system and user acceptance testing. The proposed system will implement a total of seven modules which are registration, login, manage profile, manage transportation, manage payment, track school bus, and generate report. This project aims to deliver a web-based management system as the final product for Intan's school bus service, addressing current challenges faced by the stakeholder. The system is expected to reduce the risk of data loss, streamline student registration, facilitate online payment, offer real-time bus tracking, and eliminate manual data entry which saves time and ensures accuracy. Additionally, it facilitates hassle-free service continuation for students in subsequent academic years by allowing the use of previously registered data.

The rest of the paper is organized as follows. Section 1 introduces stakeholders, system issues, objectives, and the scope of Intan's School Bus Management System. Section 2 explains the domain background, management system and reviews existing systems. Section 3 outlines the methodology. Section 4 presents the result and discussion. Lastly, Section 5 concludes the project.

2. Related Work

In this section, the domain background of Intan School Bus management system, management system and the results of the comparative analysis are discussed.

2.1 Domain Background

Intan School Bus, a privately-owned service managed by Mr. Ahmad bin Khaharuddin, has been a trusted transportation provider for Sekolah Kebangsaan Setiawangsa in Taman Setiawangsa, Kuala Lumpur, Malaysia, since 2013. Currently serving around 50 students within the bus's seating capacity, this dedicated school bus operates on weekdays, Monday to Friday, from 6:00 a.m. to 6:00 p.m. The private service is exclusively operated by Mr. Ahmad, who manages vehicle registration, routine inspections, student registration, and payment collection all by himself.

Intan School Bus's current operational procedures rely on traditional methods, including paper forms, a centralized book, physical school bus cards, and cash-only payments. Mr. Ahmad handles administrative tasks like student registration, payment collection, and record-keeping.

In addition to the existing procedures, potential customers, often parents or guardians, need to visit the owner in person to inquire about the school bus service. If interested, a face-to-face conversation with the owner takes place, and the owner decides whether to accept or decline the service. Upon acceptance, a registration form is provided, requiring parents to fill in student and customer details. Mr. Ahmad manually transfers all information from these forms into a centralized book.

Following registration, each student is issued a school bus card with a unique number corresponding to the centralized book. This card contains crucial details about the student, contact information for parents or guardians, and a record of payments. Customers retain the card for their personal records. Payment structure is determined by the distance between students' homes and the school, with longer distances incurring higher fees. Currently limited to cash-only transactions, parents submit the monthly fee along with the card. Mr. Ahmad uses this information to identify paid students and records payment details in both the centralized book and the individual cards. Additionally, on an annual basis, returning students or those opting for the bus service again must repeat the form-filling process.

2.2 Management System

A management system is a fundamental framework that companies use to structure their processes and operations systematically. It plays a crucial role in enhancing business efficiency by streamlining processes and ensuring planned outcomes. By implementing the right management system and adhering to relevant standards, businesses not only improve performance but also integrate safe and sustainable practices. This, in turn, showcases the business's ability to meet customer needs, fostering better relationships. Effective management systems focus on risk management, performance enhancement, transparency, and a culture of continuous improvement. Meeting the standards for such systems aligns with customer expectations for quality and reliability in business [5].

The effectiveness of a management system lies in structured and optimized processes governing and enhancing operations. It establishes systematic and ongoing organizational improvement by implementing clear rules, roles, and processes. Management systems are applicable across various industries, such as transport, logistics, automotive, and healthcare, contributing to organized and goal-oriented operations [6]. These systems play a crucial role in facilitating an organization's commitment to continuous improvement in operational processes, a key element for long-term effectiveness and sustainability [7].

2.3 Comparative Analysis

This section provides a comparative analysis of three existing applications which are UTHM-KATSANA [8], Selangor Intelligent Transport System (SITS) [9], and redBus [10]. Table 1 shows the comparison between the three existing systems and the proposed system. The compared the system’s features including platform, customer registration, login, profile management, user management, payment management, generate report and real-time bus tracking.

Table 1 System’s Comparison

Features/System	UTHM-KATSANA	SITS	redBus	Intan School Bus Management System
Platform	Web-based	Application	Web-based, iOS and Android	Web-based
Register	Not available	Available	Available	Available
Login	Not available	Available	Available	Available
Profile Management	Not available	Available	Available	Available
User Management	Not available	Available	Available	Available
Payment Management	Not available	Not available	Available	Available
Generate Report	Not available	Not available	Not available	Available
Real-time Bus Tracking	Available	Not available	Not available	Available

Based on Table 1, Intan's School Bus Management System stands out with several advantages. Its web-based platform ensures accessibility, while features like user-friendly registration and login processes, efficient profile management, streamlined payment handling, robust user administration, insightful report generation, and advanced bus tracking contribute to its overall efficiency. Overall, the comparison highlights that the proposed system represents an improvement over existing systems, providing enhanced functionalities and a more robust solution for efficient school bus management.

3. Methodology

The methodology used for this project is prototyping model [11]. The prototyping model is an approach in software development that involves creating a simplified version of the proposed system with minimal features. In the evolutionary prototyping model, stakeholder requirements are gathered, a prototype is created, feedback is collected, and the prototype is refined. This cycle continues, gradually adding more features until the final system is achieved. The model emphasizes continuous improvement based on stakeholder engagement, allowing for trial-and-error and rapid development of prototypes for testing and feedback. Fig. 1 shows the phases involved in prototyping model, which include requirements, quick design, building the prototype, user evaluation, refining the prototype, implementation, and maintenance.

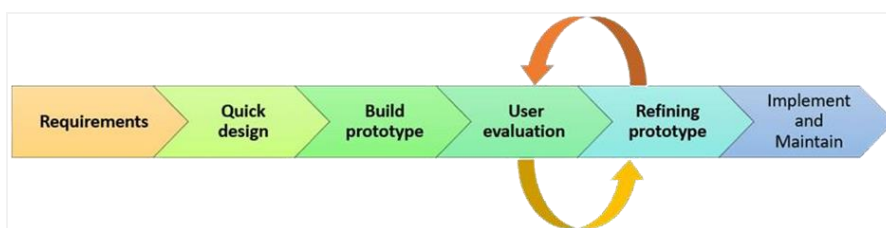


Fig. 1 Prototyping Model

3.1 Requirements Phase

The Requirement Phase initiates with detailed analysis and definition of system requirements, involving interviews with stakeholders. Project scope and objectives are established, and a Gantt Chart is created to outline the project timeline. UML diagrams and a requirement traceability matrix (RTM) are generated, along with a to-be model for the proposed system.

3.2 Quick Design Phase

In the Quick Design Phase, a brief system preview is crafted, incorporating database design and low-fidelity prototypes. The system architecture, database structure, and user interface are planned. The design is documented in a Software Design Document (SDD), serving as a crucial reference for subsequent development. **Appendix A** illustrates the SDD for the proposed system's general software architecture.

3.3 Build Prototype Phase

The Build Prototype Phase involves constructing the initial prototype using PHP, HTML, CSS, JavaScript, C, Laravel framework, and Arduino IDE for real-time bus tracking. Front-end and back-end programming are employed, ensuring accurate code testing using PHPMyAdmin as the application server. This phase sets the foundation for subsequent iterations.

3.4 User Evaluation Phase

In this phase, the stakeholders are presented with the initial prototype for evaluation. Feedback is gathered to identify strengths and weaknesses. The developer considers comments and suggestions for enhancements in subsequent phases. This phase ensures alignment with stakeholder expectations.

3.5 Refining Prototype Phase

In refining prototype phase, the prototype is refined and improved as a "second prototype" based on the previous stakeholder feedback. Following the refinement of the second prototype, it undergoes user evaluation, similar to the initial prototype in the user evaluation phase. This phase continues until all user-specified requirements are fulfilled. Once the user is satisfied with the refined prototype, the final system is developed based on the approved and finalized prototype.

3.6 Implementation and Maintenance Phase

After completing all the necessary phases and ensuring user satisfaction, the Intan School Bus Management System undergoes thorough testing by the stakeholders. Once validated successfully, the system is ready for real-world use. This involves uploading the system to a web hosting server for smooth interactions with school bus management services. Routine maintenance is conducted to fix bugs, prevent large-scale failures, and make enhancements over time.

3.7 System Development Workflow

Table 2 shows the system development workflow for the proposed system. There are a total of six phases from the evolutionary prototyping model. Each phase has its own assignment and output that is needed to produce during the entire project development. Besides that, the output was completed within the specific days that have been given.

Table 2 System Development Workflow

Phase	Task/Activities	Deliverable	Tool
Requirement	<ul style="list-style-type: none"> Initial meeting with the stakeholder Define project objectives, scopes and significances Determine the project schedule, activities and output Create project workflow and timeline Document the current business process and system Prepare interview questions Conduct interview session with Intan School Bus owner Analyze requirement Document requirements Create UML diagrams for the proposed system 	<ul style="list-style-type: none"> Project proposal Gantt Chart Functional and non-functional requirement Requirement Specification (SRS) Use case diagram Sequence diagram Activity diagram Requirement Traceability Matrix To-be model (swimlane diagram) 	<ul style="list-style-type: none"> WhatsApp Excel Draw.io Visual paradigm

Table 2: (cont)

Quick Design	<ul style="list-style-type: none"> Design the database structure Design the system's user interface Validate the system design with the owner Document the software design 	<ul style="list-style-type: none"> Class diagram Data dictionary Software Design Document User Interface Design 	<ul style="list-style-type: none"> Visual Paradigm Draw.io Figma
Build Prototype	<ul style="list-style-type: none"> Develop system prototype 	<ul style="list-style-type: none"> Initial system prototype 	<ul style="list-style-type: none"> Visual Studio Code Arduino IDE PhpMyAdmin Laragon Google Chrome
User Evaluation	<ul style="list-style-type: none"> Evaluate the system's functionality with stakeholder Gather feedback and improvement from stakeholder Document validation result 	<ul style="list-style-type: none"> First user evaluation Second user evaluation Final user evaluation 	<ul style="list-style-type: none"> Google Meet
Refining Prototype	<ul style="list-style-type: none"> Enhanced the initial prototype and Add missing features 	<ul style="list-style-type: none"> Second prototype Final prototype 	<ul style="list-style-type: none"> Visual Studio Code Arduino IDE PhpMyAdmin Laragon Google Chrome
Implementation and Maintenance	<ul style="list-style-type: none"> Conduct system testing and user acceptance testing Document test result Deploy system to web hosting server Fix bugs and errors 	<ul style="list-style-type: none"> Test cases System testing result Final system product 	<ul style="list-style-type: none"> Web server Google Chrome Visual Studio Code Arduino IDE PhpMyAdmin Laragon Google Chrome

4. Result and Discussion

This chapter explains the analysis and design of the proposed system. In Section 4.1, discusses the system requirement analysis, including user, functional, and non-functional requirements. Section 4.2 presents the use case diagram of the proposed system is presented while the domain class diagram will be discussed in Section 4.3. The user interface of the proposed system is showcased in Section 4.4, with Section 4.5 dedicated to system implementation. Finally, Section 4.6 discusses the results of system testing and user acceptance testing.

4.1 System Requirements Analysis

In this section, user requirements, functional requirements, and non-functional requirements will be presented and discussed. The system requirement analysis addresses the specific functionalities to be implemented in the proposed system. Table 3 shows the user requirements of the proposed system. Table 4 shows the functional requirements of the proposed system. Lastly, table 5 shows the non-functional requirements of the proposed system.

Table 3 User requirements of the proposed system

User	Requirements
Customer	Able to register, log in, manage profiles, add student details, request bus services, view schedules and payment records, pay fees, and track the bus.
Administrator	Able to log in, manage profiles, create driver profiles, delete users, handle service requests, update cash payment status, generate reports, and track the bus.
Driver	Able to log in, manage profiles, view student details, check bus schedules, and track the bus.

Table 4 *Functional requirements of the proposed system*

Modules	Requirements
Register	The system shall allow customers (parents or guardians) to register an account for school bus services.
Login	The system shall enable users, including customers, drivers, and the owner (administrator), to log in, and provide a password reset option.
Manage Profile	The system shall allow users to edit their profile details, including customers adding or editing student profiles, and the admin managing driver profiles.
Manage Transportation	The system shall enable customers to request, view, and cancel school bus services, and allow the admin to manage service requests and view student details. Additionally, the system shall allow drivers to view detailed information of students.
Manage Payment	The system shall allow users to view and pay student fees, providing options for cash, credit, or debit card payments, and the admin to update payment status manually.
Track School Bus	The system shall provide real-time tracking of the school bus during operational hours, allowing customers and admin to monitor the current location.
Generate Report	The system shall allow admins to generate various reports in PDF based on selected criteria, such as student reports and payment reports.

Table 5 *Non-functional requirements of the proposed system*

Modules	Requirements
Performance	The system shall load web pages within a maximum time of 3 seconds.
Security	The system shall authenticate and authorize users for security.
Compatibility	The system shall be compatible with all major web browsers for compatibility.
Availability	The system shall ensure high availability and be accessible to users 24/7 for availability.
Reliability	The system shall provide informative error messages and guidance to users for resolution. Additionally, the system shall include robust error-handling mechanisms to manage unexpected situations.

4.2 Use Case Diagram

Fig. 2 shows the use case diagram of the Intan School Bus Management System. The use case illustrates seven main features or modules in the proposed system which are register, login, manage profile, manage transportation service, manage payment, track school bus, and generate report. There are three actors involved in the system which are customers (parents or guardians), drivers, and the owner (administrator). The administrator has access to and can perform all functions across the seven use cases. Drivers are involved in login, manage profile, manage transportation, and track school bus while customers participate in all use cases except for generating reports. Association lines signify the relationships between actors and use cases.

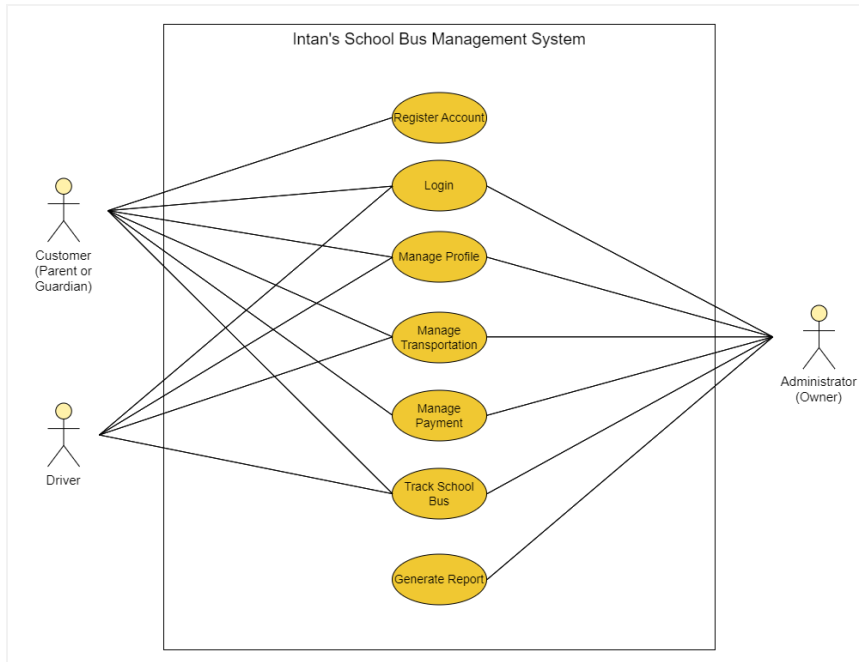


Fig. 2 Use Case Diagram of the Intan School Bus Management System

4.3 Domain Class Diagram

A domain class diagram is a static representation utilized to visualize, describe, and document various aspects of a system. Fig. 3 shows the class diagram for Intan School Bus Management System. The domain class diagram includes the customer, admin, driver, student, address, school, transportation service, payment, location, and report of the database tables. Based on Fig. 3, one Customer can have one or more Students and one or more Addresses. Each Student can have only one School but can have one or more Addresses. A Customer can also request one or many Transportation services. An Administrator and a Driver can each have only one Address. Each School can have multiple Students, and each Student belongs to one School. Each Report can be associated with one or many Customers, Drivers, Schools and Payments. Finally, each Driver can provide one or more Locations based on their driving route.

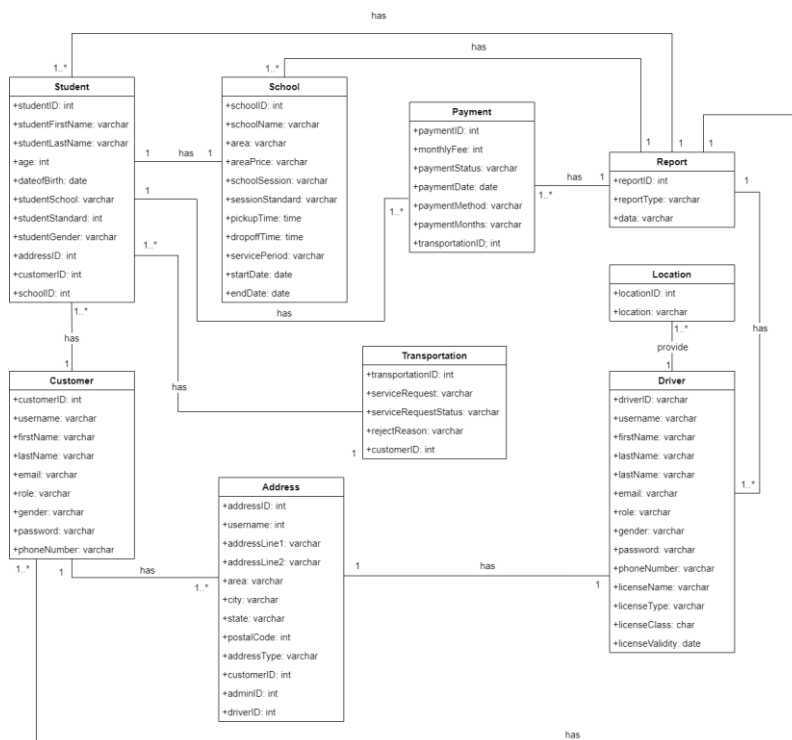


Fig. 3 Class Diagram of the Intan School Bus Management System

4.4 User Interface Design

In this section, each interface of the system module will be shown. The interfaces shown in each system module are wireframes that represent the illustration of each page interface. The main user interface for each of the seven modules in the system is attached to **Appendix B**.

Based on Appendix C, Fig. 4 shows the main interface for registration module, Fig.5 shows the main interface for login module, Fig. 6 shows the main interface for managing profile details module, Fig. 7 shows the interface for user's dashboard for bus tracking, Fig. 8 shows the main interface for transportation module, Fig. 9 shows monthly fee online payment interface and lastly Fig. 10 shows the main user interface for generate report modules.

4.5 Implementation

In this section, the user interface and code segment of each module will be explained. There are a total of seven modules in the Intan School Bus Management System, which are registration, login, manage profile, manage transportation, manage payment, track school bus and generate report.

4.5.1 Registration Module

Fig. 11 displays the registration interface where parents or guardians can create an account by entering details like username, email, first name, last name, gender, role, password, and confirm password while Fig. 12 shows the code for this module, which captures and validates the user's input, ensuring fields are filled correctly and passwords match. Upon successful registration, the user's details are saved to the database, and they are redirected to the dashboard. If there's an error, a message prompts the user to correct their input.

Fig. 11 Register Account Interface

```
public function store(Request $request): RedirectResponse
{
    $request->validate([
        'first_name' => ['required', 'string', 'max:255'],
        'last_name' => ['nullable', 'string', 'max:255'],
        'email' => ['required', 'string', 'lowercase', 'email', 'max:255', 'unique:'. User::class],
        'status' => ['required', 'string', 'max:255'],
        'gender' => ['required', 'string', 'max:255'],
        'password' => ['required', 'confirmed', Rules\Password::defaults()],
        'terms_and_conditions' => ['accepted'],
    ]);

    $user = User::create([
        'email' => $request->email,
        'password' => Hash::make($request->password),
        'role' => "customer",
    ]);

    $userDetails = new UserDetails();
    $userDetails->user_id = $user->id;
    $userDetails->first_name = $request['first_name'];
    $userDetails->last_name = $request['last_name'];
    $userDetails->status = $request['status'];
    $userDetails->gender = $request['gender'];
    $userDetails->default = true;
    $userDetails->save();
    $userDetails->save();

    event(new Registered($user));

    Auth::login($user);

    return redirect(RouteServiceProvider::HOME);
}
```

Fig. 12 Register Module Code Segment

4.5.2 Login Module

Fig. 13 shows the interface of the login module. This interface allows existing users, specifically parents or guardians, as well as admins and drivers, to log into their accounts by entering their username and password. Fig. 14 shows the code segment for the login module. It is responsible for capturing the user's input from the login form, validating the information provided (for example, ensuring the username and password fields are filled), and then interacting with the database to verify the user's credentials. If the login is successful, the user is redirected to the dashboard. Otherwise, an error message is displayed, prompting the user to re-enter their login details correctly.

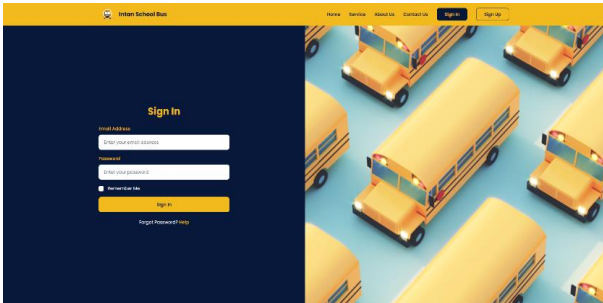


Fig. 13 Login Account Interface

```
/**
 * Handle an incoming authentication request.
 */
public function store(LoginRequest $request): RedirectResponse
{
    $request->authenticate();

    $request->session()->regenerate();

    return redirect()->intended(RouteServiceProvider::HOME);
}
```

Fig. 14 Login Module Code Segment

4.5.3 Manage Profile Module

Fig. 15 shows interface for user profile. Users can update their personal information, such as their name and contact details. Additionally, users can add parent or guardian information and multiple addresses for students' registration use later. As illustrated in Fig. 16 this code segment handles the logic for updating a user's profile details. It collects the user's input from the interface, validates it to ensure accuracy and completeness, and then updates the database with the new information.

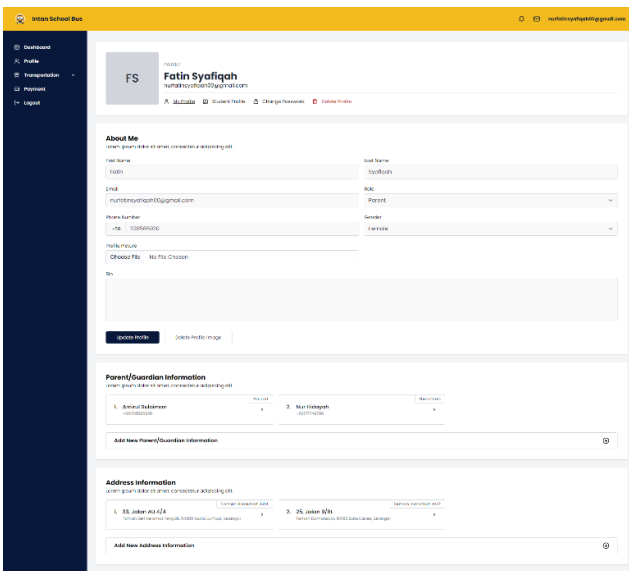


Fig. 15 Manage Profile Details Interface

```
public function patchAboutMe(Request $request, string $id): RedirectResponse
{
    $userDetails = UserDetails::findOrFail($id);

    // Get input
    $this->validate($request, [
        'first_name' => ['required', 'string', 'max:255'],
        'last_name' => ['nullable', 'string', 'max:255'],
        'email' => ['required', 'string', 'lowercase', 'email', 'max:255', 'unique:User:class->ignore($request->user()->id)],
        'status' => ['nullable', 'string', 'max:255'],
        'phone_no' => ['nullable', 'string', 'max:255'],
        'gender' => ['nullable', 'string', 'max:255'],
        'profile_img' => ['nullable', 'mimes:jpeg,jpg,png', 'max:10000'],
        'bio' => ['nullable', 'string', 'max:255'],
    ]);

    // Save profile picture
    if ($request->hasFile('profile_img')) {
        $image = $request->file('profile_img');
        $filename = 'user-' . $request->user()->id . '-' . time() . '.' . $image->getClientOriginalExtension();

        // Ensure the directory exists
        $path = public_path('images/users');
        if (!File::isDirectory($path)) {
            File::makeDirectory($path, 0777, true, true);
        }

        Image::make($image)->resize(300, 300)->save($path . '/' . $filename);
        $userDetails->update(['profile_img' => $filename]);
    }

    $userDetails->update([
        'first_name' => $request['first_name'],
        'last_name' => $request['last_name'],
        'status' => $request['status'],
        'phone_no' => $request['phone_no'],
        'gender' => $request['gender'],
        'bio' => $request['bio'],
    ]);

    if ($request->user()->isDirty('email')) {
        $request->user()->email_verified_at = null;
    }

    $userDetails->user()->update([
        'email' => $request['email'],
    ]);

    return Redirect::route('profile.my-profile')->with('status', 'profile-updated');
}
```

Fig. 16 Update Profile Code Segment

4.5.4 Manage Transportation Module

In Fig. 17 shows the interface for requesting school bus services. Users can select preregistered student profiles and see a summary of the monthly fee based on pick-up and drop-off areas before submitting their requests. Fig. 18 shows the status page for bus service requests, indicating whether requests are pending, approved, or rejected while Fig. 19 shows the code that handles bus service requests. It verifies the 'student_id', ensures all details are complete, calculates the fee, and saves the request to the database. Fig. 20 shows the code for updating the status of bus service requests by the administrator.

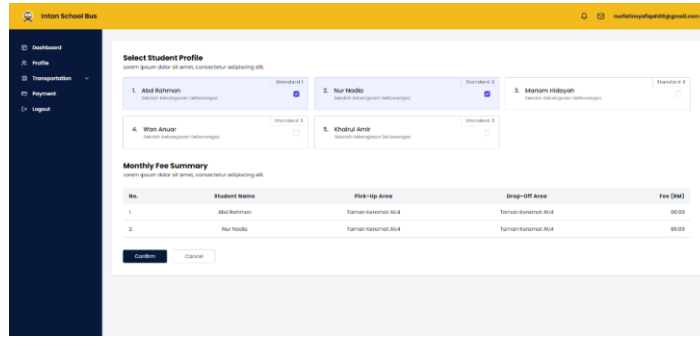


Fig. 17 Request Bus Service Interface

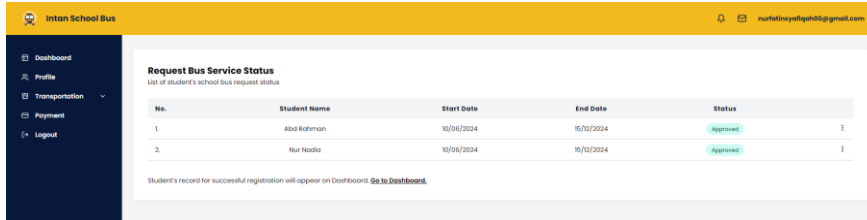


Fig. 18 Request Bus Service Status Interface

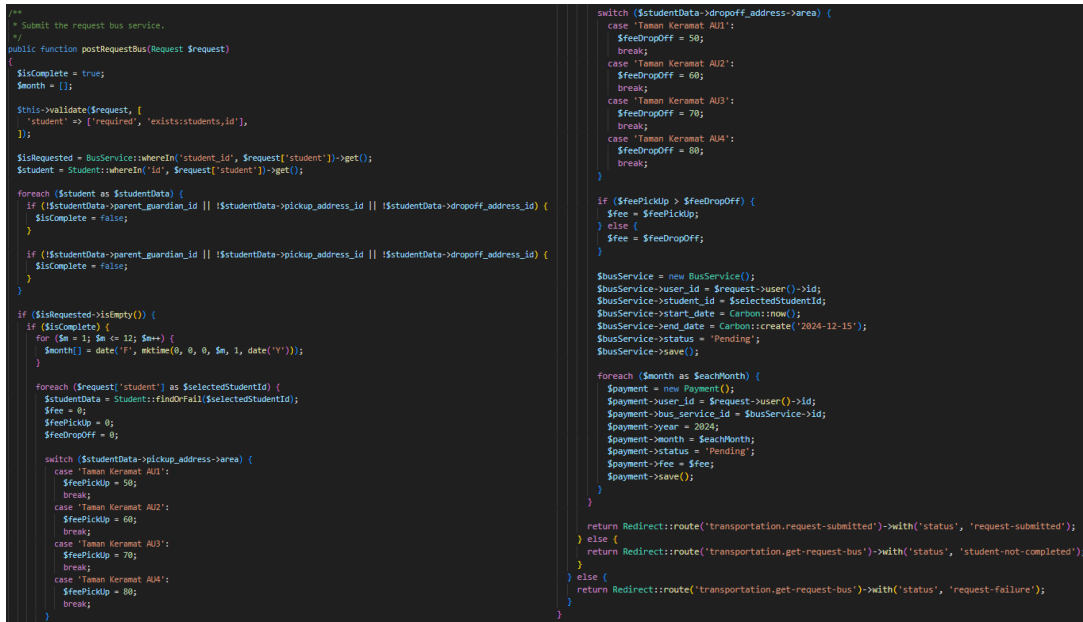


Fig. 19 Request Bus Service Code Segment



Fig. 20 Update Request Bus Service Status Code Segment

4.5.5 Manage Payment Module

Fig. 21 shows the online payment interface, where customers can view pending fees and make payments for bus services. It displays the total amount due and offers payment options such as cash or online payment, allowing

customers to pay for multiple months at once. Fig. 22 shows the online payment gateway interface, which uses Stripe to process payments via debit or credit card. As illustrated in Fig. 23, this code segment handles the integration with Stripe for processing payments. The code captures payment details entered by the user, securely sends them to Stripe, and processes the transaction. If the payment is successful, the system updates the user's payment status and records the transaction in the database.

Month	Payment Status	Payment Date	Payment Method	Monthly Fee (RM)	Select Month to Pay
January	Pending	-	-	80.00	<input checked="" type="checkbox"/>
February	Pending	-	-	80.00	<input type="checkbox"/>
March	Pending	-	-	80.00	<input type="checkbox"/>
April	Pending	-	-	80.00	<input type="checkbox"/>
May	Pending	-	-	80.00	<input type="checkbox"/>
June	Pending	-	-	80.00	<input type="checkbox"/>
July	Pending	-	-	80.00	<input type="checkbox"/>
August	Pending	-	-	80.00	<input type="checkbox"/>
September	Pending	-	-	80.00	<input type="checkbox"/>
October	Pending	-	-	80.00	<input type="checkbox"/>
November	Pending	-	-	80.00	<input type="checkbox"/>
December	Pending	-	-	80.00	<input type="checkbox"/>

Fig. 21 Student's Payment Record Interface

Fig. 22 Online Payment Interface

```

Stripe::setApiKey(env('STRIPE_SECRET'));
$session = Session::create([
    'line_items' => [
        [
            'price_data' => [
                'currency' => 'myr',
                'product_data' => [
                    'name' => $busServiceData->student->first_name . ' ' . $busServiceData->student->last_name . ' Payment',
                ],
                'unit_amount' => $totalFee * 100,
            ],
            'quantity' => 1,
        ],
    ],
    'mode' => 'payment',
    'success_url' => route('payment.success', ['id' => $id, 'selectedMonth' => $selectedMonth]),
    'cancel_url' => route('payment.failure', $id),
]);
return redirect()->away($session->url);
    
```

Fig. 23 Stripe Payment Gateway Code Segment

4.5.6 Track School Bus Module

In Fig. 24 shows the interface for viewing the school bus's live location on Google Maps, updated every 10 seconds with a red marker indicating the bus's position while Fig. 25 shows the code for managing the live location data. When the bus's tracking device is activated, it sends location data to the database. The system retrieves this data every 10 seconds to update the map on the dashboard for customers and admins.

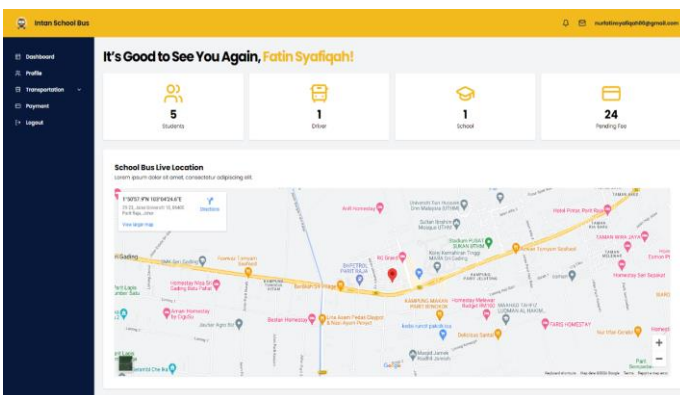


Fig. 24 Dashboard Interface for Live Location Viewing

```

public function storeGPS(Request $request)
{
    $request->validate([
        'lat' => ['required', 'numeric'],
        'lng' => ['required', 'numeric'],
    ]);

    $gpsData = new GPS();
    $gpsData->lat = $request->lat;
    $gpsData->lng = $request->lng;
    $gpsData->save();

    return response()->json(['message' => 'GPS data saved successfully'], 200);
}

public function getLatestGPS()
{
    // Fetch the latest GPS data from the database
    $latestGPS = GPS::latest()->first();

    // Return the latest GPS data as JSON response
    return response()->json($latestGPS);
}
    
```

Fig. 25 Storing and Retrieving Live Location Code Segment

4.5.7 Generate Report Module

Fig. 26 the interface for generating reports. Admins can create reports for users, students (by area), and schools (yearly summary of students and fees). Fig. 27 shows the user report interface, where admins can export reports to Excel by clicking "Export Excel". Fig. 28 shows the code for exporting reports to Excel, ensuring all report data is downloadable as an Excel file for administrators and staff.

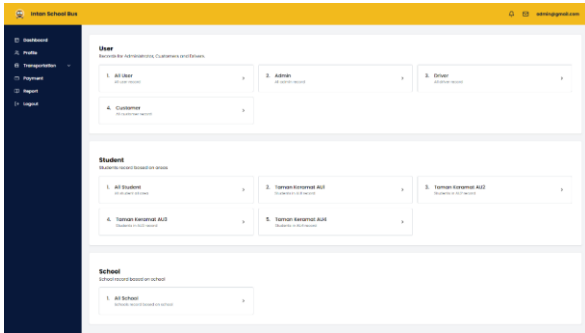


Fig. 26 Generate Report Interface

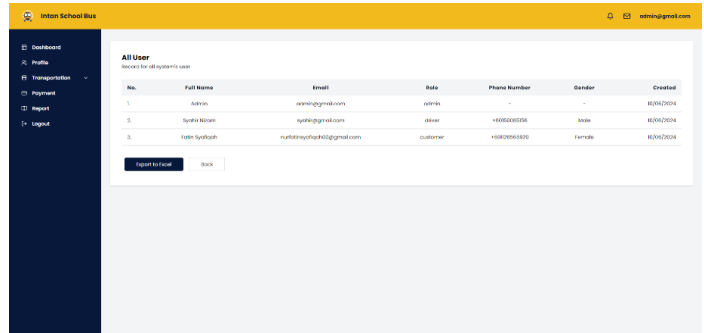


Fig. 27 Generate Report Interface for All User

```

/**
 * Export all user.
 */
public function exportAllUser()
{
    return Excel::download(new AllUserExport, 'all-user.xlsx');
}
    
```

Fig. 28 Generate Report Code Segment

4.6 Testing

The testing phase is focused on checking the system's functionality. This section includes two testing methods: system testing and user acceptance testing.

4.6.1 System Testing

System testing is performed to verify that the developed system meets both functional and non-functional requirements. This testing phase is complete when all modules function correctly and align with the specified requirements. The test case details and results are shown in Table 5.

Table 5 List of Test Cases

Test Case ID	Requirement ID	Description	Test Status
TC_100	REQ_100	Register	
TC_100_1	REQ_101	The system shall display the registration page	PASS
TC_100_2	REQ_102	The system shall allow customers to input their registration details	PASS
TC_100_3	REQ_103	The system shall allow customers to submit their registration details	PASS
TC_100_4	REQ_104	The system shall be able to verify customer registration details	PASS
TC_100_5	REQ_105	The system shall save customer's registration details	PASS
TC_100_6	REQ_106	The system shall display error message if the registration details is invalid	PASS
TC_100_7	REQ_107	The system shall save customer's registration details	PASS
TC_200	REQ_200	Login	
TC_200_1	REQ_201	The system shall display the login page	PASS
TC_200_2	REQ_202	The system shall allow customer, admin, and driver to input login details in the login interface	PASS
TC_200_3	REQ_203	The system shall allow customer, admin, and driver to submit login details.	PASS
TC_200_4	REQ_204	The system is able to verify the login details from customer, admin, and driver	PASS
TC_200_5	REQ_205	The system shall display error message if the login details is invalid	PASS

Table 5: (cont)

TC_200_6	REQ_206	The system shall allow customer, admin and driver to reset password through registered email	PASS
TC_200_7	REQ_207	The system shall display error message if the email used for password reset is not registered	PASS
TC_300	REQ_300	Manage Profile	
TC_300_1	REQ_301	The system shall display the user profile page	PASS
TC_300_2	REQ_302	The system shall allow customer, admin, and driver to make changes to their details in the user profile interface	PASS
TC_300_3	REQ_303	The system shall be able to verify the user details input from customer, admin, and driver	PASS
TC_300_4	REQ_304	The system shall allow customer, admin, and driver to save updated details into the system	PASS
TC_300_5	REQ_305	The system shall allow customer and driver to change their password	PASS
TC_300_6	REQ_306	The system shall verify new passwords and confirm password input from customer and driver.	PASS
TC_300_7	REQ_307	The system shall be able to save the new password entered by customer and driver	PASS
TC_300_8	REQ_308	The system shall allow customer to add new student details, verify student detail input and save new student details into the system	PASS
TC_300_9	REQ_309	The system shall allow admin to add new driver details, verify driver details input and save new driver details into the system	PASS
TC_300_10	REQ_310	The system shall allow the admin to delete the driver's account from the system	PASS
TC_300_11	REQ_311	The system shall allow customer to delete their profile and delete student profile from the system	PASS
TC_300_12	REQ_312	The system shall not allow delete on any student profile, parent information or address information if it is being used for bus service registration.	PASS
TC_400	REQ_400	Manage Transportation	
TC_400_1	REQ_401	The system shall display school bus service request page	PASS
TC_400_2	REQ_402	The system shall allow customers to request for school bus service	PASS
TC_400_3	REQ_403	The system shall be able to display student list from customer's student profile	PASS
TC_400_4	REQ_404	The customer shall be able to select student's name for school bus service request purpose	PASS
TC_400_5	REQ_405	The system shall display the school bus service request status page.	PASS
TC_400_6	REQ_406	The system shall allow customers to view request status either pending, accepted or rejected	PASS
TC_400_7	REQ_407	The system shall allow customers to cancel pending service requests	PASS
TC_400_8	REQ_408	The system shall allow customer to view reason for rejected request	PASS
TC_400_9	REQ_409	The system shall allow customer to view student dashboard upon successful service request.	PASS

Table 5: (cont)

TC_400_10	REQ_410	The system shall allow admin to update, add or delete school bus schedule information including school and area information	PASS
TC_400_11	REQ_411	The system shall allow admin to view students detail before accepting or rejecting service requests	PASS
TC_400_12	REQ_412	The system shall allow admin to state reason for rejected request	PASS
TC_400_13	REQ_413	The system shall allow driver and admin to view student list page according to selected school and area	PASS
TC_400_14	REQ_414	The system shall be able to save updated details after adding or editing process	PASS
TC_500	REQ_500	Manage Payment	
TC_500_1	REQ_501	The system shall display payment record page.	PASS
TC_500_2	REQ_502	The system shall allow customers and admin to view payment record for accepted students.	PASS
TC_500_3	REQ_503	The system shall allow customer to select payment method either cash or online.	PASS
TC_500_4	REQ_504	The system shall allow customer to pay fee for single or multiple months.	PASS
TC_500_5	REQ_505	The system shall be able to calculate and display the total monthly fee to be paid based on selected months.	PASS
TC_500_6	REQ_506	The system shall allow customer to make online payment through Stripe checkout page.	PASS
TC_500_7	REQ_507	The system shall automatically update the student's payment status for online payment.	PASS
TC_500_8	REQ_508	The system shall allow administrator to update student's payment status manually for cash payment.	PASS
TC_600	REQ_600	Track School Bus	
TC_600_1	REQ_601	The system shall display Google Maps with location marker in user's dashboard.	PASS
TC_600_2	REQ_602	The system shall be able to retrieve latest location from the system's database and display the location to user interface.	PASS
TC_600_3	REQ_603	The system shall be able to read and save the real-time location data from tracking device directly to the database.	PASS
TC_700	REQ_700	Generate Report	
TC_700_1	REQ_701	The system shall allow administrator to view report page	PASS
TC_700_2	REQ_702	The system shall allow administrator to filter report by selecting report type, school, area and year.	PASS
TC_700_3	REQ_703	The system shall be able to generate report and display data based on selected option.	PASS
TC_700_4	REQ_704	The system shall allow the generated report to be exported into Excel sheet.	PASS

4.6.2 Overall System Testing Results

This section summarizes the test results. A total of seven modules with 56 test cases were tested in the system. Table 6 presents the overall results of these test cases. All 56 test cases passed successfully, indicating that the system is functioning as expected without any issues.

Table 6 Overall Result of Test Cases

Test Case ID	Total Test Cases	Total Success	Test Failed
TC_100	7	7	0
TC_200	7	7	0
TC_300	12	12	0
TC_400	14	14	0
TC_500	8	8	0
TC_600	4	4	0
TC_700	4	4	0
Total	56	56	0

4.6.3 User Acceptance Testing

User Acceptance Testing (UAT) is an important step in software engineering where end-users and stakeholders review the software. This testing aims to ensure that the system design and development meet user needs. The test was distributed to ten selected users including the owner of Intan School Bus. There were 12 questions analyzed, divided into three parts: Part A for system’s functionality satisfactory, Part B for system’s usability satisfactory and Part C for system’s user interface design. These criteria were determined on a scale of 1 to 5, where 1 strongly disagree, 2 disagree, 3 neutral, 4 agree, and 5 strongly agree.

Fig. 29 shows the results for the Part A questions, which evaluate users' satisfaction with the system's functionality. The chart indicates that all 10 respondents strongly agree that the system functions well and meets user needs. For the statement regarding reducing data entry errors, 6 respondents strongly agree and 4 agree. Regarding the system making all registration-related processes easier, all 10 respondents strongly agree. Finally, for the statement about the system performing tasks quickly without significant delays, 6 respondents agree and 4 strongly agree.

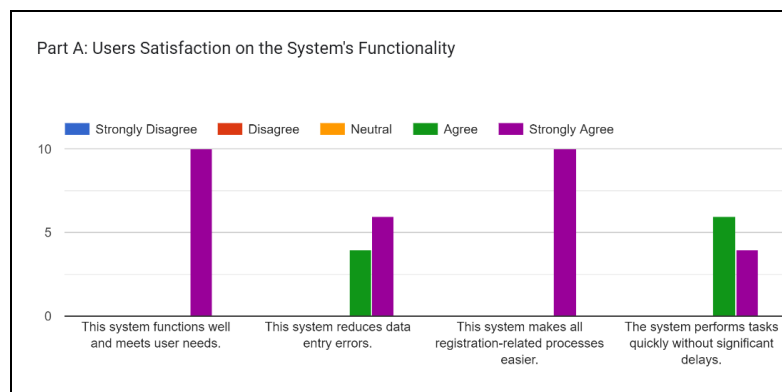


Fig. 29 Part A: Satisfactory on the System’s Functionality Results

Fig. 30 shows the results for the Part B questions, which are to evaluate user’s satisfaction on the system’s usability. The chart indicates that 7 out of 10 respondents strongly agree that the system is easy to understand and use, while 3 respondents agree. Similarly, 7 respondents strongly agree that the website allows easy navigation to other pages, and 3 agree. For the sufficiency of information provided on the website, 8 respondents strongly agree, and 2 agree. Finally, when asked if users can complete tasks without needing extensive support, 5 respondents strongly agreed, and 5 agreed. This overall indicates high user satisfaction with the system's usability.

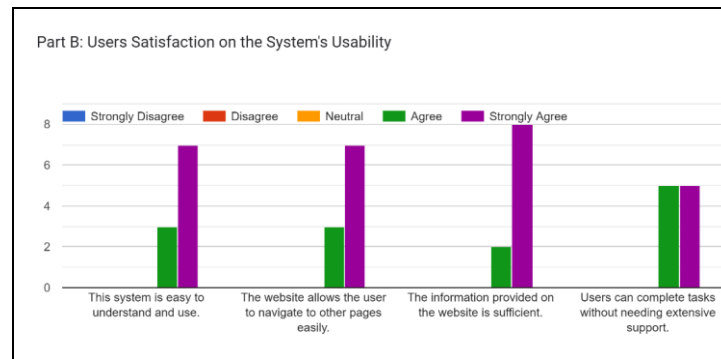


Fig. 30 Part B Satisfactory on the System's Usability Results

Fig. 31 shows the results for the Part C questions, which are to evaluate users' satisfaction with the system's user interface design. The chart indicates that 10 out of 10 respondents strongly agree that the system uses themes and colors consistently. When evaluating the attractiveness of the user interface, 7 respondents strongly agree, and 3 respondents agree. For the readability of the font size and type used in the system, 9 respondents strongly agree, while 1 respondent agrees. Finally, when asked about the clarity and organization of the system's layout, 7 respondents strongly agreed, and 3 agreed. This overall indicates high user satisfaction with the system's user interface design.

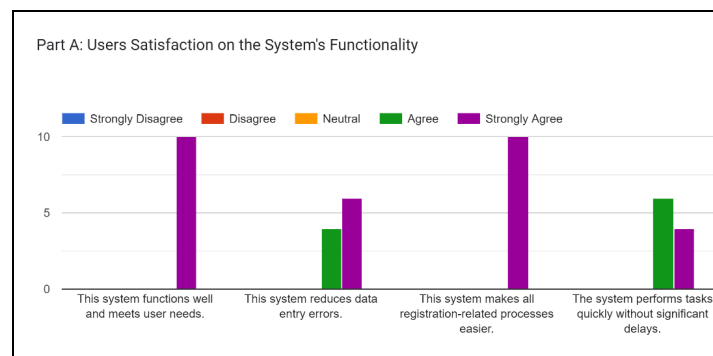


Fig. 31 Part C Satisfactory on the System's Interface Design Results

5. Conclusion

The Intan School Bus Management System significantly improves the management and organization in managing and organizing school bus services. This system successfully achieves its primary objectives, providing a robust platform that enhances efficiency, security, and customer satisfaction in student registration, payment, and bus tracking processes.

Key advantages of the Intan School Bus Management System include simplified student registration, flexible payment options and comprehensive report generation for administrators. The user-friendly interface and scalability further enhance the system's utility, allowing for future expansions and additional schools. Furthermore, real-time bus tracking enhances student safety, and automated profile management adds to the user-friendly experience.

However, there are some limitations. The system currently supports only Visa and Mastercard for online payments and is available only in English. The tracking device's functionality is affected by environmental factors, and data saving to the database can be challenging. Future improvements are needed to address these limitations. Expanding payment options to include FPX, Touch 'n Go, or Shopee Pay will provide users with greater flexibility. Introducing multilingual support will make the system more accessible and user-friendly for a diverse user base. Enhancing the integration between the tracking device and the system will ensure that GPS data is accurately and reliably saved directly to the database, improving real-time data accuracy.

In conclusion, the Intan School Bus Management System marks a substantial improvement in school bus service management. While it already offers numerous benefits, addressing its limitations through future enhancements will further elevate its functionality and user experience. This system is well-positioned to significantly enhance the efficiency and effectiveness of school bus management, making the process more convenient and satisfactory for all users involved.

Acknowledgement

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Conflict of Interest

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

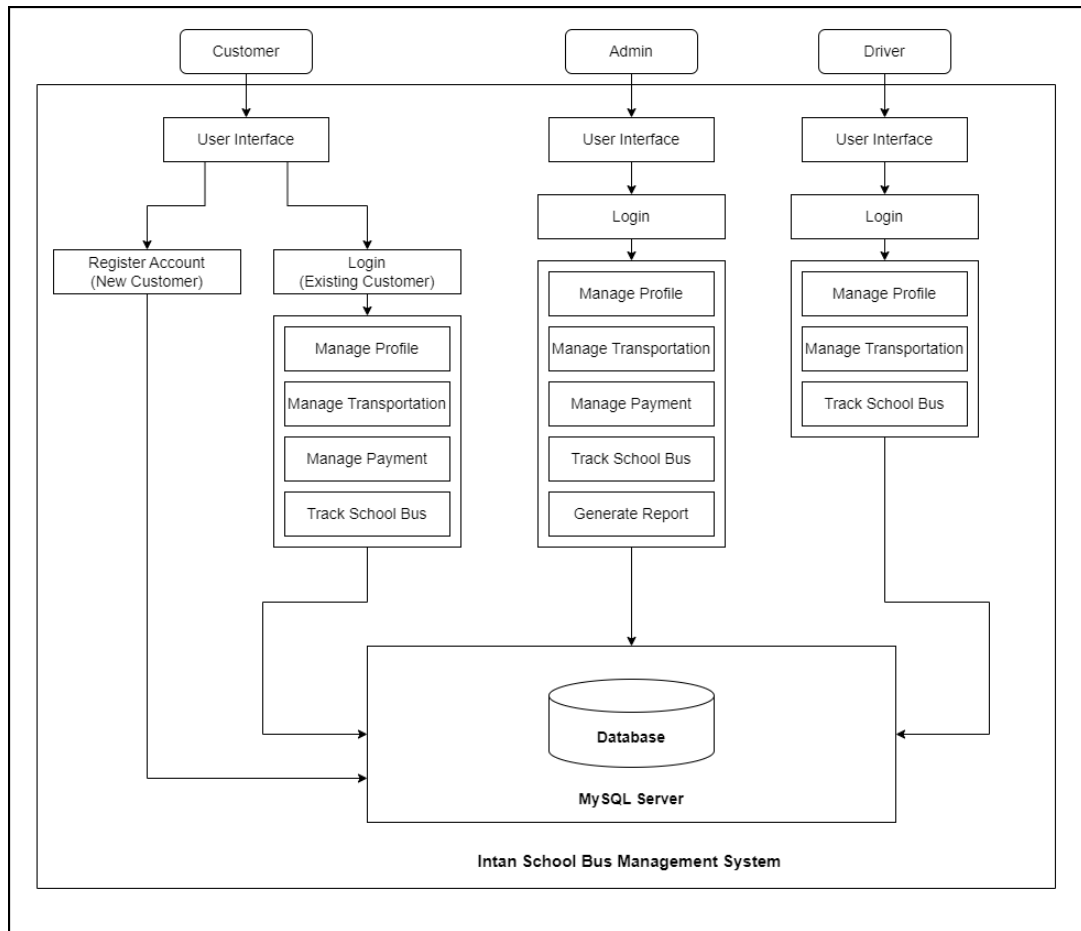
Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Nur Fatin Syafiqah Ahmad, Mohd Zainuri Saringat; **data collection:** Nur Fatin Syafiqah Ahmad, Mohd Zainuri Saringat; **analysis and interpretation of results:** Nur Fatin Syafiqah Ahmad, Mohd Zainuri Saringat; **draft manuscript preparation:** Nur Fatin Syafiqah Ahmad, Mohd Zainuri Saringat. All authors reviewed the results and approved the final version of the manuscript.

References

- [1] M. Azmi et al., "Faktor-Faktor Penggunaan Bas Sekolah dalam Kalangan Pelajar: Kajian Kes di Sebuah SMK di Sungai Besar, Selangor," *Tinta Artikulasi Membina Ummah*, vol. 4, no. 2, pp. 2289–960, 2018, Available: <http://www.journaltamu.com/wp-content/uploads/2018/12/TAMU-Vol-42-December-2018-61-71.pdf>
- [2] Marzuki, M. & Tajudin, N. (2004). Pengangkutan Sekolah: Antara Kemudahan atau Kemudaratan Kepada Pelajar: Kajian Kes di Tanjongv Malim. Dlm Nizamuddin Zainuddin, Kadzrina Abdul Kadir & Mohd Noor Mohd Shariff. (ed). *Transportation Management*. Kuala Lumpur; Penerbit Universiti Malaya (UM).
- [3] Osman, N., Nasrudin, N., Abdullah, Y. A., & Khalid, N. S. (2020). Factors Influencing Active Travel Mode to School for Primary School Children. Case Study: Shah Alam City, Malaysia. *Environment-Behaviour Proceedings Journal*. 5. 10.21834/e-bpj.v5i13.2089. <https://doi.org/10.21834/e-bpj.v5i13.2089>.
- [4] Rohani, M., Wijeyesekera, D., & Karim, A. A. (2013). Bus Operation, Quality Service and The Role of Bus Provider and Driver. *Procedia Engineering*, vol. 53, pp. 167–178, 2013, doi: <https://doi.org/10.1016/j.proeng.2013.02.022>.
- [5] SAI . (2022, January 18). Why You Should Adopt A Management System. *Intertek SAI Global Australia*. November 22, 2023, <https://saassurance.com.au/news-resources/blog/why-you-should-adopt-a-management-system>
- [6] Dqs. (2015). *What is a management system?*. DQS Inc. <https://www.dqsglobal.com/en-my/learn/dqs-knowledge-center/what-is-a-management-system>
- [7] Kazmi, A., & Naaranoja, M. (2014, March). (PDF) *significance of management system for effective ... - researchgate*. Significance of Management System for Effective Organizational Management. https://www.researchgate.net/publication/276338459_Significance_of_Management_System_for_Effective_Organizational_Management
- [8] Adnan, N. S. I., & hamid Ali, F. A. (2021). UTHM Shuttle Bus Application: UTHM Shuttle Bus Application. *Applied Information Technology And Computer Science*, 2(1), 196-202.
- [9] MyGovernment. (n.d.). *Selangor Intelligent Transport System (SITS)*. Mygov - the government of Malaysia's Official Portal. <https://www.malaysia.gov.my/portal/content/30745>
- [10] redBus. (2023). Bus Tickets Online | Best Bus Ticket Booking Platform - redBus Malaysia. redBus Malaysia. Retrieved November 21, 2023, from <https://www.redbus.my/>
- [11] Senarath, U. S. (2021). Waterfall methodology, prototyping and agile development. *Tech. Rep.*, 1-16.

Appendix A: System Design Diagram



Appendix B: User Interface Design Prototype

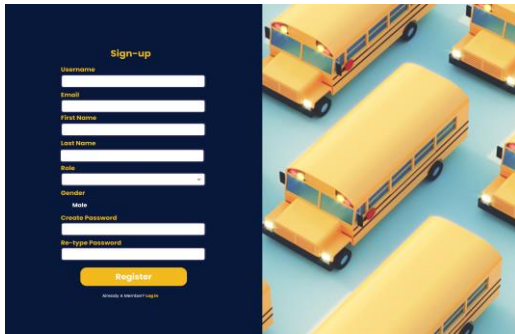


Fig. 4 User Interface for Registration Page

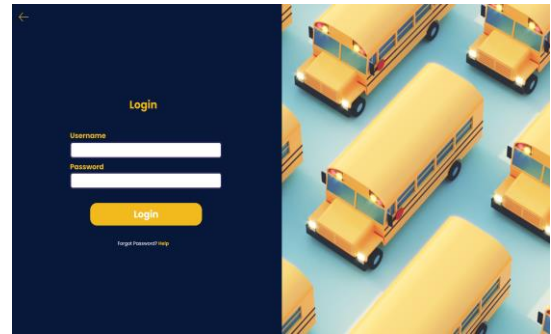


Fig. 5 User Interface for Login Page

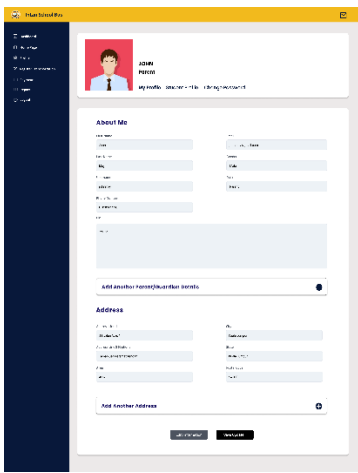


Fig. 6 User Interface for Manage Profile Page

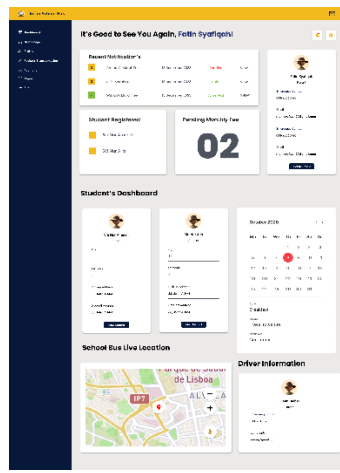


Fig. 7 User Interface for Dashboard Page

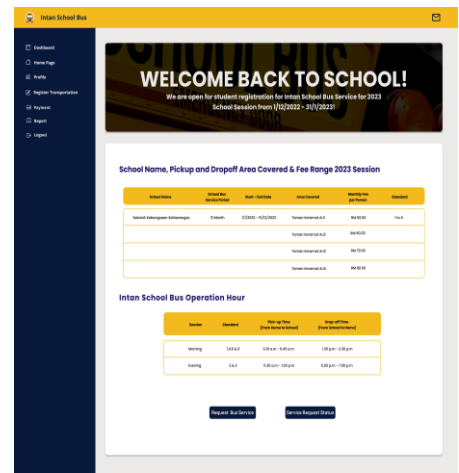


Fig. 8 User Interface for Transportation Page

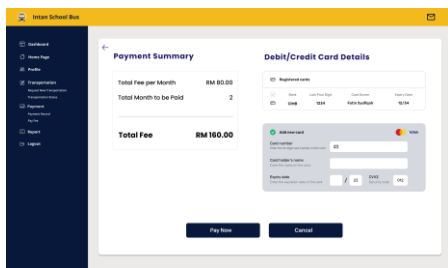


Fig. 9 User Interface for Payment Page

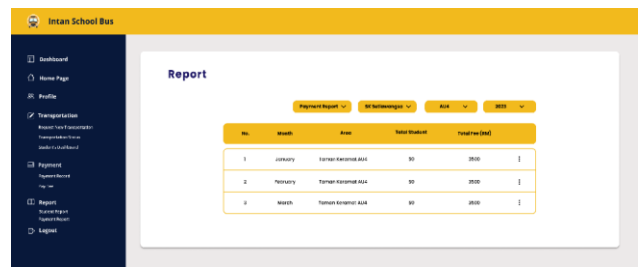


Fig. 10 User Interface for Report Page