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Web-Based Design for Vehicle Management Information System of Widyatama University

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ABSTRACT

Efficient vehicle management is essential for supporting campus operations and resource utilization at academic institutions. This paper presents the design and development of a web-based Vehicle Management Information System (VMIS) for Widyatama University. The system is designed to streamline the administration of university-owned vehicles, including scheduling, maintenance tracking, usage reporting, and driver assignment. Built using modern web technologies and a relational database, the system provides real-time access, user role management, and data analytics features to enhance decision-making. The design follows a modular and scalable architecture to support future enhancements and integrations. Usability testing and feedback from university staff demonstrate that the system improves operational efficiency, transparency, and accountability in managing vehicle-related activities.

Keywords: Vehicle Management System, Web-Based Application, Information System Design, University Logistics, Campus Fleet Management, System Architecture, PHP, MySQL, Widyatama University, Digital Transformation.

INTRODUCTION

Vehicle management within a higher education institution like Widyatama University is a crucial aspect that supports the smooth operation of academic and non-academic activities. Official vehicles, ranging from daily operational vehicles to transportation for special events, require systematic and efficient management. Without a structured system, this management can lead to various problems, such as a lack of accurate information regarding vehicle status, missed maintenance schedules, sub-optimal allocation, difficulties in tracking usage, and potential misuse of assets. Ultimately, this can result in increased operational costs and decreased efficiency [14, 2].

Manual vehicle management systems, often relying on physical records or simple spreadsheets, are prone to human error, data duplication, and information inaccuracies. Processes such as borrowing, returning, scheduling maintenance, and reporting become slow and non-transparent. Limited access to historical data also complicates strategic decision-making regarding fleet procurement or renewal [8, 9]. Various studies have shown the importance of information systems in improving organizational efficiency and competitiveness, including in logistics and asset management [10, 15].

The adoption of information technology has become an unavoidable solution to overcome these challenges. A web-based vehicle management information system offers accessibility from anywhere and anytime, allows real-time data updates, and facilitates integration between departments. The web-based approach also promises better scalability compared to desktop applications, allowing the system to evolve with the institution's needs. With a computerized system, Widyatama University is expected to achieve more effective, efficient, and accountable vehicle management [7].

The objective of this research is to design and develop a functional and intuitive web-based vehicle management information system for Widyatama University. This system is designed to automate key vehicle management processes, from vehicle registration, maintenance scheduling, usage recording, to reporting, thereby improving operational efficiency and supporting better decision-making.

METHODS

The system development approach used in this research is a modified Waterfall model of the Software Development Life Cycle (SDLC), covering the stages of requirements analysis, system design, implementation, and testing. This approach was chosen because it provides a clear and sequential structure, ensuring each phase is completed before moving to the next.

Requirements Analysis

In this stage, data collection was carried out through interviews with administrative staff responsible for vehicle management at Widyatama University, direct observation of current vehicle management workflows, and analysis of relevant documents such as vehicle logbooks, maintenance records, and borrowing forms. The focus of the analysis was to identify key problems in the manual system and the functional needs expected from the new system, such as vehicle registration features, maintenance scheduling, usage recording, and reporting.

System Design

System design involved planning the system architecture, database design, and user interface (UI/UX) design.

- System Architecture: The system is designed with a web-based client-server architecture, where users access the system via a web browser.

- Database Design: A relational database is used to store all information related to vehicles, drivers, loans, maintenance, and usage history. MySQL was chosen as the database management system (DBMS) due to its popularity, strong performance, and broad support for web applications [1]. Key entities in the database include Vehicle (with attributes such as license plate number, make, model, year, passenger capacity, status), Driver (name, NIK, license), Loan (borrow date, return date, purpose, vehicle, driver), and Maintenance (maintenance type, date, cost).

- User Interface (UI/UX) Design: The interface design was made to be intuitive and user-friendly, considering efficient user workflows. Mockups and wireframes were created for each main page of the system, including the dashboard, vehicle registration form, loan form, and report pages.

Implementation

System development was carried out using a combination of standard web technologies.

- Programming Language: PHP was chosen as the server-side programming language due to its ability to interact with MySQL databases and its popularity in web application development [7].

- Frontend: HTML, CSS, and JavaScript were used to build an interactive and responsive user interface. The use of a CSS framework (e.g., Bootstrap) was applied to ensure a consistent and adaptive display across various devices.

- Database: MySQL was used to manage and store all system data.

System Testing

System testing was conducted to ensure that the system functions according to the defined requirements specifications. The primary testing method used was Black Box Testing. Black Box testing focuses on the system's functionality without considering its internal structure or source code [3, 4, 5]. This testing was performed by testing each feature based on predetermined usage scenarios, such as:

- Data input validation on the vehicle registration form.

- Vehicle loan recording function.

- Vehicle status update function after return.

- Maintenance scheduling and history recording function.

- Report output validation.

The Equivalence Partitioning technique was applied to reduce the number of redundant test cases by dividing input data into equivalent partitions, where each value within a partition is expected to behave similarly [4]. For example, for the "number of passengers" input field, partitions could include "valid number (1-capacity)," "zero," "negative number," or "not a number."

RESULTS

The development of a web-based vehicle management information system for Widyatama University has resulted in a functional application with main modules designed to automate and simplify vehicle management processes.

System Design and Key Functionalities

The system has several core modules designed to meet vehicle management needs:

1. Dashboard Module: The main page presenting a

summary of important information, such as the number of active vehicles, vehicles currently on loan, vehicles requiring maintenance, and monthly vehicle usage graphs. The informative dashboard design allows administrators to quickly get an overview of the fleet status.

2. Vehicle Management Module: Allows administrators to add, edit, delete, and view detailed vehicle data. Each vehicle has complete attributes such as license plate number, make, model, year, fuel type, passenger capacity, chassis number, engine number, and availability status (available, on loan, under maintenance). The system also supports uploading vehicle-related documents (e.g., STNK, KIR) for easy access.

3. Driver Management Module: Manages driver data, including name, identification number, address, phone number, and availability status. This module is essential for tracking drivers responsible for each trip.

4. Vehicle Loan/Usage Module: This is a central module that manages the vehicle loan cycle.

o Loan Request: Users can submit vehicle loan requests by filling out a form that includes the loan date and time, return date and time, purpose of use, and estimated mileage.

o Approval/Rejection: Administrators can review and approve or reject requests. The system automatically checks vehicle availability for the requested period.

o Usage Recording: Once approved, the system allows recording of usage details, including starting and ending mileage, driver's name, and fuel consumption.

o Vehicle Return: The return process is marked in the system, changing the vehicle status back to 'available'.

5. Vehicle Maintenance Module: The system allows for scheduling and recording vehicle maintenance history.

o Maintenance Scheduling: Administrators can schedule routine maintenance (e.g., oil changes, periodic servicing) based on time or mileage. The system can provide automatic notifications before maintenance is due.

o Maintenance History: Every maintenance performed is recorded, including the type of maintenance, date, workshop, cost, and repair details. This helps in analyzing operational costs and maintaining optimal vehicle condition.

6. Reporting Module: The system provides various reports for analysis and auditing, such as loan history reports per vehicle or per driver, maintenance cost reports, and vehicle usage statistics reports. Reports can be filtered by time range or specific criteria and can be exported to common formats.

Black Box Testing Results

Black Box testing was performed on each system functionality. The testing results show that the system generally functions according to requirements. The majority of test scenarios yielded expected results, proving that core functionalities such as registration, loan, return, and maintenance recording work well.

Here is a summary of the testing results:

Module	Test Scenario	Result	Status
Vehicle Management	Adding new vehicle data with valid input.	Vehicle data successfully added, and appears in the list.	Pass
	Attempting to add vehicle data with a duplicate license plate number.	The system displays an error message "License plate number already registered".	Pass
	Editing vehicle information.	Vehicle data changes successfully saved and reflected in the detailed view.	Pass
	Deleting vehicle data.	Vehicle data successfully deleted from the	Pass

		system.	
Driver Management	Adding new driver data.	Driver data successfully added and appears in the list.	Pass
	Editing driver information.	Driver data changes successfully saved.	Pass
Vehicle Loan	Submitting a loan request with an available date.	Request successfully submitted, vehicle status changes to 'on loan' after approval, and loan history is recorded.	Pass
	Submitting a loan request with an already reserved date.	The system displays an error message "Vehicle not available on that date".	Pass
	Confirming vehicle return.	Vehicle status returns to 'available', and ending mileage is recorded.	Pass
Vehicle Maintenance	Scheduling new maintenance.	Maintenance data successfully added to history.	Pass
	Viewing specific vehicle maintenance history.	All maintenance records for that vehicle are displayed correctly.	Pass
Reports	Generating monthly vehicle usage report.	Report displayed with accurate data according to time filter.	Pass
	Downloading report in a specific format.	Report file successfully downloaded.	Pass

Although most functions passed the tests, there were some minor findings related to input validation in several fields (e.g., inconsistent date format in one place, or less specific validation messages). However, these do not interfere with core functionality and can be fixed in subsequent iterations. Overall, the system proved stable and met the basic functional needs of vehicle management.

DISCUSSION

The development of this web-based vehicle management information system for Widyatama University is a significant step in modernizing the institution's asset management. The testing results indicate that the designed system has met the functional requirements identified during the analysis phase, providing a comprehensive solution for automating key vehicle management processes.

Improved Efficiency and Accountability:

With this system, Widyatama University can reduce its reliance on error-prone manual record-keeping. The vehicle loan process becomes faster and more transparent, as vehicle availability can be checked in real-time. Tracking vehicle usage, including mileage and fuel consumption, can now be accurately recorded, supporting accountability and operational cost analysis. Automated maintenance scheduling also helps ensure vehicles are always in prime

condition, minimizing the risk of sudden breakdowns and extending fleet lifespan [9]. This approach aligns with the goal of information systems to enhance efficiency and control in asset management [6].

Comparison with Similar Systems:

This system shares functional similarities with vehicle management systems developed for the Salatiga City Government [2] and an official vehicle management information system [6], both of which also aim to manage and monitor vehicle usage. The main difference lies in its application context, specifically a university environment with its unique needs for academic and administrative operational vehicles. Compared to Android-based vehicle management applications [16], this system emphasizes multi-platform accessibility via web browsers, which eliminates the need for application installation on each device and allows access from various devices (desktops, laptops, tablets). The web-based focus also aligns with the trend of information system development leveraging the internet for wider reach [10].

Advantages of Web-Based:

The choice to develop a web-based system offers several significant advantages. The flexibility of access from anywhere and anytime allows authorized staff to manage vehicles even when not in the office. System updates and maintenance also become easier as they only need to be done on one server, without the need for updates on every user's computer. This is particularly important for large institutions like universities.

Limitations and Future Development:

Although the system functions well, there are some limitations that can be the focus of future development. First, the current system is not yet integrated with automatic identification technologies such as QR codes for faster vehicle or driver identification during loan or return [12, 13]. This integration could speed up vehicle check-in and check-out processes. Second, the reporting module could be expanded to include predictive analysis of maintenance costs or vehicle usage patterns. Third, the implementation of more advanced real-time notifications (e.g., via SMS or automatic email) to remind of impending vehicle maintenance or loan approvals. Finally, although black box testing has been conducted, white box testing could also be performed to ensure internal code quality and system security [5].

Overall, this web-based vehicle management information system is expected to be an effective tool for Widyatama University to manage its vehicle fleet more efficiently, transparently, and accountably, supporting better operations and data-driven decision-making.

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