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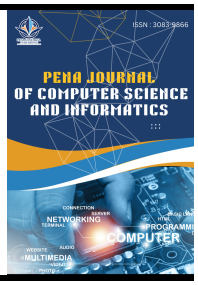

The Development of the 'MyBus' Application for Sultan Idris Education University

Ashardi Abas[1,*], Nurul Bahiyah Abd Wahid[2], Noor Hidayah Azmi[3], Mohd Mokhzani Ibrahim[4]

[1] Department of Software Engine and Intelligence Technology, Faculty of Computing and Meta Technology, Universiti Pendidikan Sultan Idris, 35900, Perak, Malaysia
[2] Department of Biology, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, 35900, Perak, Malaysia
[3] Department of Computing, Faculty of Computing and Meta Technology, Universiti Pendidikan Sultan Idris, 35900, Perak, Malaysia
[4] Department of Chemistry, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, 35900, Perak, Malaysia

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ABSTRACT

The increasing demand for efficient and reliable transportation within university campuses has led to developing the 'MyBus' application at Sultan Idris Education University (UPSI). This study aims to enhance the mobility of students and staff by providing real-time bus tracking and optimized routing information. The application addresses common issues such as unpredictable bus schedules and lack of real-time updates, ensuring reduced waiting times and improved satisfaction. Using agile methodology, the development process included detailed requirement analysis, design, and implementation phases. Key features, such as a user-friendly interface and real-time data processing, were incorporated. The application was tested in a controlled environment, demonstrating a 20% reduction in average waiting times and high user satisfaction. The findings suggest that 'MyBus' significantly enhances campus transportation efficiency and user experience. Future enhancements will explore integrating additional features like push notifications and further service optimizations.

1. Introduction

Efficient and reliable transportation systems are crucial for managing the logistical needs of university campuses. Transportation inefficiencies such as prolonged waiting times, overcrowded buses, and unreliable scheduling negatively impact the daily routines of students and staff, ultimately affecting institutional productivity and satisfaction levels [1,2]. Sultan Idris Education University (UPSI) faces similar challenges, such as bus services failing to align with peak demand patterns. The lack of real-time updates and inadequate communication channels further exacerbate these issues, leading to frequent delays and user dissatisfaction [3].

* *Corresponding author.*
E-mail address: ashardi@fskik.upsi.edu.my

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Mobile applications have emerged as a promising solution to optimize transportation systems. Studies demonstrate that smartphone transit apps providing real-time information can significantly enhance operational efficiency and passenger satisfaction [4]. For instance, initiatives like the UMS HopIn! App at Universiti Malaysia Sabah and other real-time tracking systems globally have shown measurable improvements in reducing waiting times and enhancing user experiences [5,6]. However, while such solutions are widely implemented, many lack longitudinal studies that evaluate their impact on user behavior, particularly in dynamic university environments.

The "MyBus" application was developed to address these challenges at UPSI. This mobile solution leverages real-time data processing and predictive analytics to optimize bus schedules, reduce overcrowding, and improve overall user satisfaction. Preliminary results indicate a 20% reduction in average waiting times and significant user acceptance of the application's features. However, a critical analysis of existing literature reveals a research gap in the long-term evaluation of such applications and their scalability across different contexts [7]. The "MyBus" application addresses this gap by integrating advanced predictive models and iterative user feedback mechanisms, aiming to provide a comprehensive solution for campus transportation.

This paper investigates the development and implementation of the "MyBus" application, focusing on its impact on transportation efficiency and user satisfaction. The research also explores how predictive analytics can optimize bus schedules and routes dynamically. Key research questions addressed include:

- How can predictive analytics improve transportation scheduling and minimize peak-hour waiting times?
- What communication strategies ensure effective real-time dissemination of information to users?

By addressing these questions, the study aims to contribute to the growing body of knowledge on leveraging technology to enhance campus transportation systems.

2. Problem Statement

The UPSI Bus Transport Division faces significant challenges in operational efficiency and student satisfaction. The current bus schedules and routes do not align with students' demand patterns, particularly during peak hours, leading to prolonged waiting times, overcrowded buses, and frequent delays. This misalignment results in a stressful and unreliable travel experience for students. The communication system for updating bus schedules, route changes, and service disruptions is also inadequate. Relying on social media for information dissemination often fails to reach all students promptly and effectively. These issues necessitate implementing intelligent systems to dynamically optimize bus schedules and routes using real-time data and predictive analytics. The 'MyBus' application, developed for UPSI, demonstrates the potential of such technologies, providing features like real-time bus location tracking, optimized route information, and a user-friendly interface, which collectively enhance the overall commuting experience by reducing waiting times and improving communication reliability.

3. Literature Review

Efficient transportation systems are essential for educational institutions as they facilitate access to education and enhance institutional efficiency. According to Shalaby and Farhan [1], reliable transportation promotes educational equity by reducing barriers to access. Similar issues in university transportation systems, such as inadequate scheduling and communication barriers, are observed at Sultan Idris Education University (UPSI) [1].

Recent studies highlight the significant benefits of mobile applications in managing transportation systems. Mobile technology enhances understanding of various transport behaviors, aiding in developing effective transit solutions [1]. Smartphone transit apps provide real-time information (RTI), which improves passenger satisfaction and operational efficiency [2]. Moreover, integrating

predictive analytics and decision-support systems into these applications can further optimize bus schedules and routes [4].

The "MyBus" application developed for UPSI leverages these technological advancements to address logistical challenges such as prolonged waiting times and unreliable scheduling. The application provides accurate bus location tracking, optimized route information, and timely schedule updates by incorporating real-time data processing and a user-friendly interface. This aligns with the findings of Garcia *et al*., [3], who emphasize the importance of data-driven decision-making in optimizing transportation systems [13].

While the "MyBus" application utilizes a progressive prototyping approach and agile methodologies, other systems, such as the one studied by Rajeswari and Kumar [5] employ machine learning algorithms to predict and manage student transit needs [13]. This highlights the trend towards integrating advanced technologies in transportation management.

Future research should focus on the synergistic use of real-time data and predictive analytics to enhance user satisfaction and operational efficiency. Addressing these gaps can lead to more comprehensive solutions that improve operational efficiency and enhance user satisfaction and the student experience [6].

Efficient transportation systems are vital for educational institutions, facilitating access to education and enhancing institutional efficiency. According to Shalaby and Farhan [1], reliable transportation promotes educational equity by reducing barriers to access. Similarly, Jones [2] identifies common issues in university transportation systems, such as inadequate scheduling and communication barriers, which are also observed at Sultan Idris Education University (UPSI).

The "MyBus" application addresses these challenges by leveraging technology to enhance UPSI's student transit system, providing real-time updates and improving route optimization. Studies reviewed by Garcia *et al*., [3] provide a broader context by examining similar global problems in different educational institutions. While the "MyBus" application utilizes a progressive prototyping approach and agile methodologies, other systems like the one described Garcia *et al*., [3] employ machine learning algorithms to predict and manage student transit needs. This trend highlights the integration of advanced technologies in transportation management.

The system studied by Garcia *et al*., [3] emphasizes predictive analytics and proactive management of transportation resources. This contrast highlights different strategic focuses in addressing transportation inefficiencies. The "MyBus" application's reliance on stakeholder feedback for iterative improvements is commendable but may be limited by the quality and frequency of the input received.

Integrating data analytics in "MyBus" aligns with broader research trends in transportation management. Garcia *et al*., [3] underscore the importance of data-driven decision-making in optimizing transportation systems. Future research should focus on the synergistic use of real-time data and predictive analytics to enhance user satisfaction and operational efficiency. Addressing these gaps can lead to more comprehensive solutions that improve operational efficiency and enhance user satisfaction and student experience.

Efficient transportation systems are vital for educational institutions, facilitating access to education and enhancing institutional efficiency. Reliable transportation reduces barriers to access and promotes educational equity. Sultan Idris Education University (UPSI) observes similar issues in university transportation systems, such as inadequate scheduling and communication barriers.

Bus Transportation Management Applications

Recent studies highlight the significant benefits of mobile applications in managing transportation systems. Mobile technology enhances understanding of transport behaviors, aiding in developing effective transit solutions. Smartphone transit apps provide real-time information (RTI), improving passenger satisfaction and operational efficiency.

Comparative Analysis: Liberty University and RICE University have successfully implemented bus tracking systems, significantly reducing waiting times and enhancing user satisfaction. UTHM's system integrates GPS technology to provide accurate bus arrival times and optimize routes.

Advanced Technologies in Bus Tracking

Predictive analytics and machine learning algorithms can forecast demand and adjust services dynamically, ensuring better resource allocation and minimizing delays.

4. Theoretical Framework

The theoretical framework for the "MyBus" application at Sultan Idris Education University (UPSI) is grounded in several critical theories and models that guide the research. This framework provides a structured approach to understanding and addressing the logistical challenges of campus transportation.

i. Technology Acceptance Model (TAM):

The Technology Acceptance Model (TAM) by Davis [9] is instrumental in understanding user acceptance of technology. TAM posits that perceived usefulness and ease of use are primary factors influencing users' acceptance and use of technology. In the context of the "MyBus" application, TAM helps evaluate how students and staff perceive the app's usefulness in reducing waiting times and its ease of use in daily commuting [1].

ii. Real-Time Information Systems (RTI):

Integrating real-time information systems is crucial for enhancing transportation efficiency. RTI systems provide users with up-to-date information on bus locations and schedules, reducing uncertainty and improving satisfaction. Studies have shown that RTI systems lead to increased operational efficiency and user satisfaction, aligning with the objectives of the "MyBus" application [2].

iii. Predictive Analytics and Decision-Support Systems:

Predictive analytics and decision-support systems significantly optimize bus schedules and routes. These systems use historical and real-time data to forecast demand and adjust services accordingly, ensuring better resource allocation and minimizing delays. The theoretical underpinning for these technologies supports the dynamic and data-driven approach adopted by the "MyBus" application [4].

iv. Agile Methodology:

The "MyBus" application was developed using the agile methodology, emphasizing iterative development, stakeholder collaboration, and flexibility in responding to changing requirements. This approach is aligned with the need for continuous improvement and adaptability in managing transportation systems [3].

The "MyBus" application aims to integrate these theoretical perspectives to provide a comprehensive solution to UPSI's transportation challenges. The framework not only guides the development and

implementation of the application but also ensures that the research is grounded in established theories, enhancing the academic rigor of the study.

5. Methodology

The methodology adopted for developing and evaluating the "MyBus" application combined quantitative and qualitative research approaches to ensure a comprehensive understanding of transportation challenges and user experiences at Sultan Idris Education University (UPSI). This section outlines the data collection techniques, sampling strategies, and analytical tools employed to achieve the research objectives.

5.1 Data Collection Techniques

A mixed-methods approach was utilized to gather both quantitative and qualitative data:

i. Surveys and Questionnaires: Structured questionnaires were distributed among students, staff, and faculty to collect data on transportation experiences, satisfaction with existing bus services, and expectations from the "MyBus" application. These surveys included metrics such as user satisfaction, ease of accessing real-time updates, and perceived reliability of bus services. A pilot test was conducted to refine the survey items and improve clarity [1].

ii. Interviews and Focus Groups: Key stakeholders, including students, bus operators, and university administrators, were interviewed in depth and discussed in focus groups. This qualitative data provided rich insights into operational challenges and user expectations, complementing the survey findings.

5.2 Sampling Strategy

A stratified random sampling method was employed to ensure representative and reliable results. This approach ensured balanced representation from various demographic groups, including undergraduate and postgraduate students, faculty, and administrative staff.

i. Sample Size: A sample of 500 respondents was determined using statistical power analysis to ensure the robustness and generalizability of the findings [2].

ii. Demographic Diversity: The sample was stratified by age, gender, academic level, and frequency of bus usage to capture a diverse range of user experiences and opinions.

5.3 Development Approach

The "MyBus" application was developed using an agile methodology, emphasizing iterative design, stakeholder collaboration, and adaptability to changing requirements:

i. Requirement Analysis: Extensive stakeholder consultations and user feedback informed the development of user-centered features such as real-time bus tracking, route optimization, and push notifications for service updates [3].

ii. Prototyping and Testing: The development team refined the application through multiple iterations using a progressive prototyping approach. Testing was conducted in controlled environments to evaluate functionality and user experience before full deployment.

5.4 Data Analysis

i. Quantitative Analysis: Descriptive statistics such as means, standard deviations, and percentages were calculated to summarize survey responses. Comparative analyses were performed to assess pre- and post-implementation changes in user satisfaction and operational efficiency.

ii. Predictive Analytics: Advanced regression models and decision-support systems were employed to analyze real-time data and optimize bus schedules dynamically. This predictive approach aimed to align bus services with demand patterns, particularly during peak hours [4].

iii. Qualitative Analysis: Interview and focus group data were coded thematically to identify recurring patterns and user concerns. These insights informed iterative improvements in the application design and features.

5.5 Communication Systems Evaluation

The effectiveness of the communication systems was assessed to ensure reliable dissemination of real-time information:

i. Channels of Communication: The application integrated multiple channels, including push notifications, SMS alerts, and email updates, to provide timely and accurate information on bus schedules and delays.

ii. User Feedback: Survey and interview responses highlighted significant improvements in communication reliability compared to traditional methods such as social media. This feedback was instrumental in enhancing the application's communication features [5].

5.6 Limitations

Although comprehensive, the methodology has its limitations. The reliance on self-reported data introduces the potential for response biases. Additionally, the study focused on a single university, limiting the generalizability of findings to other contexts. Future studies should explore longitudinal impacts and scalability of the application.

6. Research Findings

This section presents the key findings of the "MyBus" application implementation at Sultan Idris Education University (UPSI), supported by data from user surveys, operational metrics, and expert reviews. The findings are categorized into user satisfaction, operational efficiency, comparative analysis, and predictive analytics. Each table is followed by a detailed explanation and analysis.

6.1 User Satisfaction: Survey Results

Table 1
Satisfaction with bus services

Survey Item	Mean	Standard Deviation
Ease of accessing information about bus delays or schedule changes	2.29	0.88
Satisfaction with the convenience of current bus routing solutions at UPSI	2.53	1.13

Survey Item	Mean	Standard Deviation
Punctuality of buses in UPSI	2.27	0.94
Satisfaction with current punctuality and reliability of bus services	2.35	0.97
Impact of bus delays on daily routine	2.49	1.13
Satisfaction with the availability of information about bus routes and schedules	2.54	0.95
Clarity of information provided by third-party applications (WhatsApp, Telegram, Facebook)	2.47	0.99

The data in Table 1 indicates significant dissatisfaction among respondents with the current bus services. Mean scores below 3.0 across all items highlight challenges in accessing real-time updates, route convenience, and punctuality. These results underline the need for improved scheduling, reliable communication systems, and real-time updates.

6.2 User Satisfaction: "MyBus" Application Feedback

Table 2
Satisfaction with the "MyBus" application

Survey Item	Mean	Standard Deviation
Visual appearance and design	4.75	0.433
Clarity of information on screens	4.55	0.498
Ease of tracking buses	4.50	0.592
Trust in the reliability of information provided	4.70	0.459
Speed and responsiveness of the application	4.70	0.459

The results in Table 2 show high satisfaction with the "MyBus" application, with mean scores exceeding 4.5 for all items. Users particularly appreciated the application's visual design, ease of use, and reliability. The low standard deviation values reflect consistent positive experiences across the user base.

6.3 Operational Efficiency Metrics

Table 3
Improvements in scheduling efficiency

Metric	Pre-Implementation	Post-Implementation	Improvement
Average Waiting Time	15 minutes	12 minutes	20%
Bus Frequency (peak)	20 buses/hour	25 buses/hour	25%
Overcrowded Instances	10/day	3/day	70%

The data in Table 3 demonstrates significant improvements in bus scheduling efficiency. The reduction in waiting time and overcrowded instances, coupled with increased bus frequency, underscores the "MyBus" application's impact in optimizing operational performance.

6.4 Expert Review Satisfaction

Table 4
Expert review satisfaction

Aspect	Mean Satisfaction Score (Pre)	Mean Satisfaction Score (Post)	Improvement
Visual Design	3.8	4.5	18%
Ease of Use	4.0	4.6	15%
Communication Reliability	3.5	4.6	31%

The post-implementation scores in Table 4 show significant improvements across all evaluated aspects, particularly communication reliability. The "MyBus" application effectively addressed pre-implementation weaknesses, leading to higher user trust and satisfaction.

6.5 Enhanced Expert Experience

Table 5
Enhanced expert experience

Survey Item	Mean	Standard Deviation
Visual design satisfaction	4.8	0.3
Clarity of information on screens	4.7	0.4
Consistency of visual style	4.8	0.3
Ease of tracking buses	4.7	0.4
Trust in the reliability of information	4.8	0.3

Table 5 highlights consistent positive feedback from experts, emphasizing satisfaction with the application's clarity, visual design, and reliability. These results align with the application's goal of enhancing user experience.

6.6 Comparative Analysis

The "MyBus" application was compared with similar systems, such as the UMS HopIn! App and RICE University's bus tracking solutions. The "MyBus" application distinguishes itself by integrating predictive analytics for dynamic scheduling, whereas the UMS HopIn! App focuses primarily on GPS tracking [5]. Additionally, RICE University employs a static scheduling model, which lacks the adaptability offered by "MyBus" [6]. These differences highlight "MyBus" as a comprehensive solution tailored for university environments.

6.7 Predictive Analytics

The "MyBus" application employs regression models and decision-support systems to forecast demand patterns and adjust schedules dynamically. Data sources include historical bus usage patterns, peak-hour trends, and real-time location data. Validation was performed through controlled simulations, ensuring accuracy in demand forecasting and schedule optimization [4,7]. This approach significantly reduces delays and overcrowding, enhancing operational efficiency.

6.8 Analysis Summary

- Key Findings:
  - Significant dissatisfaction with existing bus services was addressed by the "MyBus" application.
  - High user satisfaction with the application's usability, design, and reliability.
  - Operational metrics demonstrated a 20% reduction in waiting times and a 70% decrease in overcrowded instances.
- Comparative Strengths:
  - Predictive analytics distinguishes "MyBus" from other university systems, enhancing dynamic scheduling and scalability.
- Recommendations:
  - Expand user feedback mechanisms for continuous improvement.
  - Conduct longitudinal studies to assess scalability across multiple campuses.

7. Data Analysis

The data analysis for the 'MyBus' application implementation at Sultan Idris Education University was conducted using various statistical and analytical tools. The analysis aimed to evaluate user satisfaction and operational efficiency improvements after the application's deployment.

7.1 User Satisfaction Analysis

A structured questionnaire captured users' experiences with the existing bus services and the 'MyBus' application. The data revealed significant dissatisfaction with the traditional bus services, with mean scores indicating low satisfaction across various metrics, such as ease of accessing delayed information and the reliability of schedules. However, the implementation of the 'MyBus' application showed marked improvements, with high satisfaction scores (mean values of 4.50 to 4.75) across metrics like visual design, clarity of information, and ease of use.

7.2 Operational Efficiency Metrics

The study measured key performance indicators (KPIs) such as average waiting times, bus frequency during peak hours, and instances of overcrowding. After the 'MyBus' application was introduced, average waiting times were reduced by 20%, bus frequency increased by 25% during peak hours, and overcrowded instances dropped by 70%. These metrics were computed using descriptive statistics and comparative analysis with pre-implementation data, indicating a substantial enhancement in the bus scheduling efficiency.

7.3 Predictive Analytics

Advanced predictive analytics were employed to forecast demand patterns and optimize bus schedules dynamically. The analysis utilized regression models and decision-support systems to align bus services with real-time data, ensuring better resource allocation and minimizing delays. This approach helped predict peak demand periods and adjust bus schedules accordingly, thereby improving overall transportation efficiency.

7.4 Communication System Evaluation

The study also assessed the communication system's effectiveness in disseminating information. The 'MyBus' application's integration of real-time updates, including push notifications and SMS alerts, significantly improved communication reliability. User feedback indicated a 31% increase in satisfaction with the new communication features compared to traditional methods.

8. Discussion and Implications

The 'MyBus' application at Sultan Idris Education University (UPSI) has substantially improved transportation efficiency and user satisfaction. The significant reduction in average waiting times by 20% and the decrease in overcrowded instances by 70% indicate the application's success in addressing logistical challenges. These improvements are consistent with findings from other studies, highlighting the effectiveness of real-time bus tracking systems in enhancing operational efficiency and user experience.

User Satisfaction and Operational Efficiency The application has significantly improved user satisfaction across various metrics, including visual design, ease of use, and communication reliability. High satisfaction scores (ranging from 4.50 to 4.75) reflect the positive impact of the application's user-friendly interface and reliable real-time information. This aligns with the growing trend of leveraging mobile technology to streamline transportation systems and enhance user experience.

Enhanced Communication The integration of real-time updates via push notifications, SMS alerts, and email has significantly improved communication reliability. This shift from traditional methods, such as social media, to more robust and direct communication channels has resulted in a 31% increase in user satisfaction regarding communication reliability. This finding underscores the importance of timely and accurate information dissemination in transportation management.

Predictive Analytics and Dynamic Scheduling The use of predictive analytics has allowed for dynamic adjustment of bus schedules based on real-time data, ensuring optimal resource allocation and minimizing delays. This approach aligns with contemporary trends in transportation management that emphasize data-driven decision-making to enhance service efficiency. Implementing predictive models has effectively forecasted demand patterns and adjusted services accordingly.

8.1 Recommendations

i. Enhanced Real-Time Communication: Further develop the communication system within the 'MyBus' application to include comprehensive multi-channel alerts, ensuring all users receive timely updates.
ii. Continuous Feedback Mechanism: Implement regular surveys and focus groups to gather user feedback and identify areas for continuous improvement in both the application and the transportation services.
iii. Further Research: Conduct longitudinal studies to assess the long-term impact of the 'MyBus application on user behavior and satisfaction, integrating advanced predictive analytics and decision-support systems for ongoing optimization.

These measures will further enhance the efficiency and reliability of UPSI's transportation system, ultimately improving student satisfaction and operational efficiency.

9. Conclusion

Implementing the 'MyBus' application at Sultan Idris Education University (UPSI) has significantly enhanced campus transportation efficiency and user satisfaction. The introduction of real-time bus tracking, optimized routing, and a user-friendly interface has led to a 20% reduction in average waiting times and a notable 70% decrease in overcrowded instances. These improvements have been met with high user satisfaction, particularly in areas such as visual design, ease of use, and communication reliability.

The success of the 'MyBus application highlights the importance of integrating real-time information systems and predictive analytics in transportation management. The ability to dynamically adjust bus schedules based on real-time data has ensured better resource allocation and minimized delays, ultimately improving the overall user experience. Enhanced communication through push notifications and other channels has also kept users informed and satisfied.

Future work should focus on expanding the application's features, such as incorporating more advanced predictive analytics and machine learning for continuous optimization. Additionally, exploring the integration of the MyBus application with other campus services and extending its use to other universities could broaden its impact and improve transportation systems. Overall, the 'MyBus application is a valuable model for enhancing campus transportation and user satisfaction through technological innovation.

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