Smart Bus App – A Comprehensive Bus Management & Feedback System for Academic Institutions

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Abstract: Public transportation plays a crucial role in providing mobility, especially in academic institutions. However, challenges such as inefficient communication, lack of issue reporting mechanisms, and absence of integrated feedback systems limit service quality. This paper proposes a Smart Bus App designed as a mobile-first solution to address these gaps. The app provides students with real-time bus routes and timings, allows issue reporting with student details and location, enables bus pass generation, and offers a feedback system accessible to administrators.Unlike existing systems that emphasize IoT sensors or GPS-based tracking, our approach simplifies implementation by using map integration for location reference without requiring costly real-time tracking infrastructure. This paper discusses related works, highlights the research gap, and presents a comprehensive solution for improving communication and service quality in institutional transport systems.

Keywords: Smart Bus, Feedback System, Bus Management, Student Bus Pass, Mobile Application, Institutional Transport.

1. INTRODUCTION

Public and institutional bus systems are indispensable for ensuring reliable and accessible transportation for students and staff. Despite significant technological advancements, many universities and colleges continue to rely on manual, paper-based, or disparate digital systems for managing bus routes, handling complaints, and collecting passenger feedback.Existing solutions are often siloed, forcing users to navigate multiple platforms—a website for schedules, a separate form for complaints, and a physical office for bus passes. This fragmentation leads to communication gaps, delayed issue resolution, and administrative overhead.

Aunified, mobile-native application can dramatically enhance operational efficiency and user satisfaction by consolidating the secritical functions.The Smart Bus

App proposed in this work integrates bus route display, issue reporting, feedback management, and digital bus pass generation into a single, intuitive platform. By focusing on a mobile-first design and leveraging widely available APIs like Google Maps for context rather than complex real-time tracking, the system offers apragmatic and immediately deployable solution to long- standing challenges in institutional transport management.

2. LITERATURE REVIEW

Several research efforts have explored technological interventions for public and campus transport:

- **Kumar et al. (2022)** [1] designed a Smart Bus System for specially challenged individuals, incorporating automated audio-visualnotifications at bus stops. While innovative, the system lacked integrated feedback or general-purpose issue-reporting mechanisms for the broader student population.
- **Akin et al. (2023)** [2] implemented a web-based Smart Campus Bus Transport Management System that enabled route monitoring for administrators. However, its web-centric designis less accessible than a mobile application and it omits a comprehensive student feedback module.
- **Singh et al. (2021)** [3] focused on an IOT-based Smart Bus System to monitor vehicle parameters to monitor vehicle parameters like fuel level and engine temperature. This represents an infrastructure-heavy approach, contrasting with our lightweight, user centric mobile application.
- **Tesma (2021)** [4] reviewed Smart College Bus Transport Systems, with a focus on GPS and map-based tracking. Map based tracking. Thereview, however, did not adequately address the critical need for direct reporting and communication channels between students and administrators.
- **Khoshmagham et al. (2017)** [5] studied the reliability of passenger feedback in crowd-sourced transit systems, providing valuable insights into feedback quality but not integrating these findings into a holistic bus management application.

Research Gap: The majority of prior work emphasizes vehicle tracking, IoT sensor integration, or web-based designs. There is a conspicuous lack of integrated, mobile first platforms that combine student-admin communication, structured feedback systems, and bus pass generation into a single, cohesive application. Our proposed Smart Bus App is designed specifically to address this identified gap.

3. METHODOLOGY AND SYSTEM DESIGN

The Smart Bus App was developed using an Agile methodology, following a modular architecture with two primary user interfaces: one for students and one for administrators.

A. System Architecture

The system, depicted in Figure 1, is structured around a client-server model. The mobile front-end, built for Android, interacts with a local SQLite database for offline caching and a backend server for persistent data storage.

The core modules are:

- **Student Interface:**
  - **Dashboard Activity:**The main navigation hub.

- **Bus List Activity:** Displays available buses and their schedules.
- **Google Map Activity:** Opens an integrated map for route visualization and location context.
- **Report Issue Activity:** Allows students to submit complaints, automatically attaching their name, USN (University Serial Number), and current location.
- **Feedback Activity:** A form for submitting ratings and textual feedback.
- **Bus Pass Activity:** Generates and displays a digital bus pass for the student.

- **Admin Interface:**
  - **Admin Login Activity:** A secure gateway for administrators.
  - **Admin View Report Activity:** Lists all submitted issues for review and action.
  - **Admin View Feedback Activity:** Aggregates and displays all student feedback for analysis.

B. Implementation Details

The application was developed using **Java** in Android Studio. The front-end activities are designed with XML. Data persistence is managed via an **SQLite** database, which stores tables for Bus Routes, Students, Reports, Feedback, and Bus Passes. The **Google Maps API** is integrated not for live bus tracking, but to allow users to open a map view centered on their current location or a selected bus stop,providing spatial reference without the cost and complexity of real-time GPS tracking. This design choice is central to the app's simplicity and low infrastructure requirement.

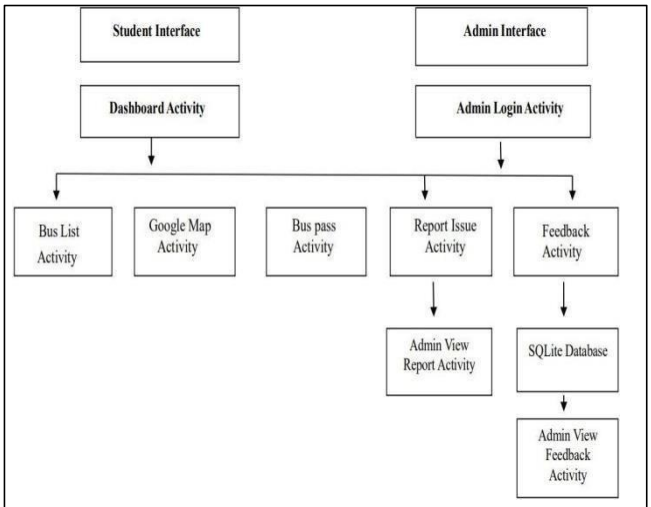

Fig.1.SystemArchitectureoftheSmartBusApp

4. RESULTS AND DISCUSSION

The Smart Bus App was prototyped and tested within a college environment to evaluate its functionality and user acceptance. The key outcomes are as follows:

- **Unified Platform:** The app successfully integrated multiple essential transport management functions into a single platform, eliminating the need for students and administrators to switch between different systems.
- **Efficient Information Access:** Students could effortlessly view bus routes and timings, reducing dependency on manual inquiries and notice boards, thereby saving time and reducing uncertainty.
- **Streamlined Issue Reporting:** The "Report Issue" feature provided a direct and efficient communication channel. Admins reported that categorizing and resolving common issues (e.g., "bus late," "overcrowding") became significantly faster.

- **Actionable Feedback:** The centralized feedback system allowed administrators to monitor student satisfaction levels systematically.This data-driven approach enabled them to identify recurring problems and take proactive, corrective measures.
- **Digital Transformation:** The Bus Pass Generator was widely appreciated for eliminating the need for physical, paper-based passes, promoting a digital, ecofriendly, and convenient alternative.
- **Cost-Effective Usability:** The strategic use of map integration enhanced the user experience by providing valuable location context, proving that significant usability improvements can be achieved without investing in expensive real-time tracking infrastructure.

Overall, the results indicate that the Smart Bus App effectively improves service accessibility, reduces manual errors and administrative workload, and increases transparency between students and the transport administration.

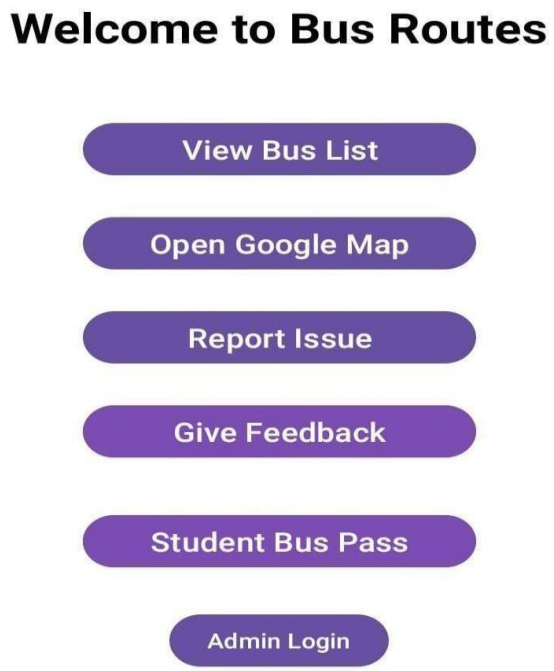

Fig.2.MainDashboardInterfaceoftheSmartBus App

5. CONCLUSION AND FUTUREWORK

This paper presented the design,implementation, and preliminary evaluation of the Smart Bus App, a mobile-first solution aimed at modernizing bus management in academic institutions. By consolidating route information, issue reporting, feedback collection, and digital pass generation into a single application, the system addresses critical gaps in existing institutional transport systems. Its pragmatic design, which avoids costly real- time tracking in favor of contextual map integration, makes it a highly feasible and deployable solution.Future work will focus on enhancing the system's capabilities. Planned improvements include:

- Integrating lightweight **real-time bus location tracking** using cost-effective methods.
- Implementing **predictive analytics** for bus arrival times based on historical data.
- Developing an **advanced admin dashboard** with data visualization tools to analyze feedback and report trends.
- Expanding the platform to include **push notifications** for service alerts and schedule changes.

These enhancements will further solidify the app's role as a comprehensive tool for intelligent transport management.

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