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BUS MONITORING SYSTEM

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ABSTRACT

Public transportation is an essential part of urban mobility, but challenges such as passenger safety, route optimization, and emergency response continue to impact its efficiency. This project presents a smart bus monitoring system that integrates facial recognition technology, road assistance features, and a centralized database to enhance security, monitoring, and emergency management. The system uses facial recognition to authenticate passengers during boarding, preventing unauthorized access, improving attendance tracking, and ensuring a safer travel environment. Additionally, the real-time monitoring module tracks the bus's location, speed, and route deviations, providing live updates to both passengers and administrators to optimize fleet operations. To improve safety and emergency response, the system incorporates road assistance features that detect vehicle breakdowns, accidents, or unusual driving behavior. In case of an emergency, automated alerts are sent to fleet management and emergency services to ensure quick intervention and reduce downtime. A centralized database securely stores essential data, including passenger details, bus schedules, driver information, and incident reports, facilitating efficient data management and retrieval. This database enables better decision-making, historical analysis, and improved transportation policies. By integrating these technologies, the system not only enhances security and operational efficiency but also improves the passenger experience by ensuring a safer and more reliable public transport system. The implementation of such a system can lead to improved fleet management, reduced travel delays, and a more intelligent transportation network, ultimately benefiting both passengers and transport authorities.

Keywords**:** *Bus Monitoring System, Web Application, Public Transport, Digitalization, Printing, Payment.*

INTRODUCTION

Public transportation is a fundamental aspect of urban mobility, providing an affordable and efficient means of travel for millions of people worldwide. However, ensuring passenger safety, optimizing bus routes, and responding effectively to emergencies remain significant challenges in modern transportation systems. Traditional bus monitoring methods often lack real-time tracking, automated security measures, and efficient incident management, leading to delays, security risks, and operational inefficiencies. This project aims to develop a smart bus monitoring system that integrates facial recognition technology, road assistance features, and a centralized database to enhance public transportation efficiency and safety. The system leverages facial recognition to authenticate passengers during boarding, preventing unauthorized access, reducing fraudulent travel, and maintaining attendance records. Additionally, the real-time monitoring feature tracks bus location,

speed, and route adherence, enabling better fleet management and improved service reliability. To further enhance security and emergency response, the system incorporates an advanced road assistance mechanism that detects accidents, breakdowns, or unusual driving patterns. In case of an emergency, automated alerts are sent to fleet managers and emergency responders, ensuring quick intervention and minimal service disruption. The centralized database stores critical information, including passenger data, bus schedules, driver details, and incident reports, allowing seamless data retrieval, analytics, and improved decision-making. By integrating these technologies, the proposed system aims to enhance passenger safety, improve bus service efficiency, and create a more reliable and intelligent public transport network. The implementation of such a system can significantly reduce travel delays, enhance fleet management, and contribute to a more sustainable and technologically advanced transportation infrastructure.

Objectives

1. **Passenger Security –** Use facial recognition to authenticate passengers.
1. **Real-Time Monitoring –** Track bus location, speed, and routes.
2. **Emergency Response –** Detect breakdowns or accidents and send alerts.
3. **Data Management –** Store and analyze transport data in a centralized database.
4. **Efficiency Improvement –** Optimize routes and reduce delays.
5. **Smart Transport System –** Enhance safety and operations with advanced technology

Django Framework

The smart bus monitoring system is developed using the Django framework, leveraging its scalability, security, and database management capabilities. It follows Django's Model-View-Template (MVT) architecture, where the model defines the database structure using Django ORM to store passenger details, bus schedules, driver information, and incident reports. The view handles business logic, processes requests, and integrates real-time data from GPS and facial recognition modules, while the template provides a user-friendly web interface for passengers, drivers, and administrators. The system consists of several key modules. The facial recognition module utilizes OpenCV and deep learning models to authenticate passengers during boarding. The bus monitoring module tracks the real-time location, speed, and route adherence of buses using GPS and IoT sensors. The road assistance system detects accidents or breakdowns and sends automated alerts to fleet management and emergency responders. A database management system, using PostgreSQL or MySQL with Django ORM, ensures secure storage and efficient data retrieval. The user interface is built with Django templates, HTML, CSS, and JavaScript to provide real-time updates and alerts to users. For enhanced functionality, the system integrates RESTful APIs using Django REST Framework (DRF) to enable mobile application connectivity and third-party service integration. It can be deployed on cloud platforms such as AWS, Heroku, or Digital Ocean for scalability and accessibility. This Django-based framework ensures efficient data handling, real-time monitoring, and a secure public transportation system, improving safety, efficiency, and passenger experience.

BLOCK DIAGRAM

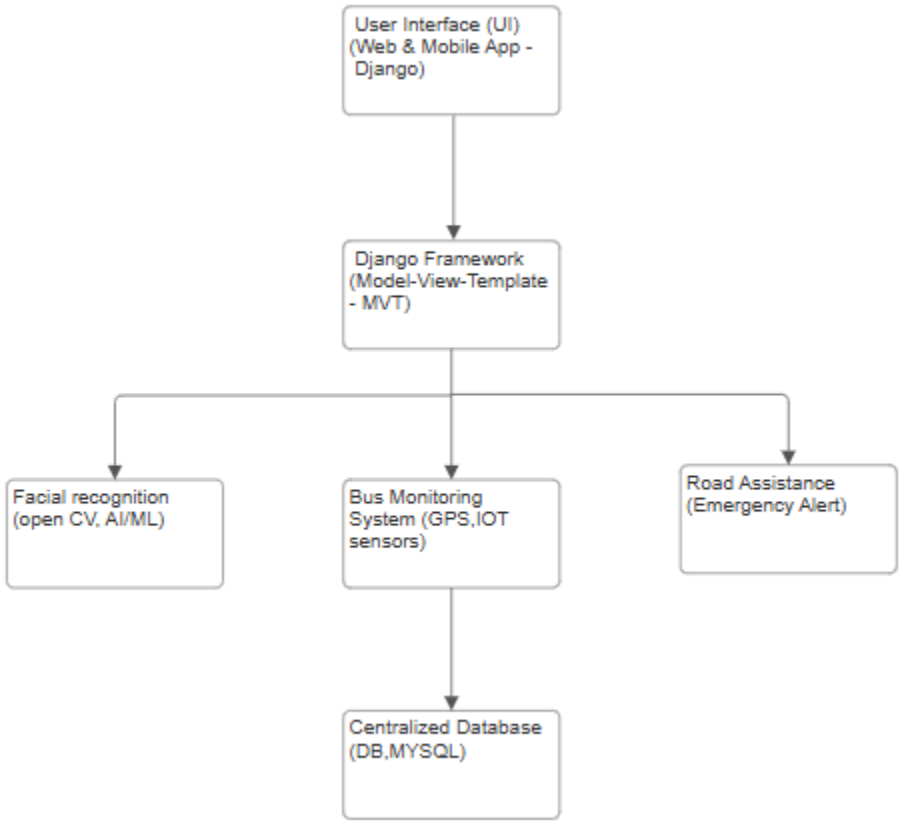

Figure 1: BLOCK DIAGRAM OF THE PROPOSED SYSTEM

The proposed smart bus monitoring system is designed using the Django framework, following the Model-View-Template (MVT) architecture. The system consists of multiple interconnected modules, ensuring real-time monitoring, security, and efficient public transport management. The user interface (UI), developed for both web and mobile applications, allows passengers, drivers, and administrators to interact with the system. It connects to Django's core framework, which processes user requests, manages data, and controls system functionalities. The facial recognition module, integrated with OpenCV and AI/ML models, ensures secure passenger authentication during boarding. Simultaneously, the bus monitoring system, equipped with GPS and IoT sensors, tracks real-time location, speed, and route adherence. In case of breakdowns or accidents, the road assistance module detects incidents and sends automated alerts to fleet managers and emergency responders. All data from these modules is stored in a centralized database, managed using PostgreSQL or MySQL through Django ORM. This database ensures secure storage and easy retrieval of essential records, including passenger details, bus schedules, driver information, and incident reports. The system also includes RESTful APIs, developed using Django REST Framework (DRF), to enable seamless integration with mobile applications and third-party services. For administration, the admin panel provides transport authorities with control over operations, user management, and reports. Additionally, the notification system sends real-time alerts via SMS, email, or push notifications to passengers and administrators for emergencies, bus tracking, and service updates. This block diagram represents an intelligent and data-driven public transport system that improves passenger security, real-time monitoring, and efficient fleet management, making transportation safer and more reliable.

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6. WORKING

The smart bus monitoring system is designed to enhance security, efficiency, and real-time monitoring in public transportation using the Django framework. The system starts functioning when a passenger boards the bus. The facial recognition module captures the passenger's face using a camera and verifies their identity using OpenCV and AI-based deep learning models. If the system successfully authenticates the passenger, their entry is recorded, ensuring only authorized individuals are allowed to travel. This reduces the risk of unauthorized access and improves passenger security. Meanwhile, the bus monitoring module continuously tracks the vehicle's location, speed, and route adherence through GPS and IoT sensors. This data is processed and displayed on the user interface, providing real-time updates for passengers, drivers, and transport authorities. As the bus moves along its designated route, the system ensures compliance with predefined schedules and notifies administrators of any deviations or delays. If an unexpected incident occurs, such as an accident, breakdown, or reckless driving, the road assistance module detects the anomaly using onboard sensors and AI-based analysis. The system then sends an automated alert to fleet managers, nearby emergency responders, and relevant authorities for immediate action. The notification system ensures that passengers receive real-time updates regarding bus schedules, delays, or emergencies via SMS, emails, or mobile app notifications.

All operational and passenger-related data, including facial recognition logs, bus schedules, driver performance, and emergency reports, is securely stored in a centralized database using PostgreSQL or MySQL, managed through Django ORM. This structured storage allows for efficient data retrieval, analysis, and reporting. Additionally, the system integrates RESTful APIs developed with Django REST Framework (DRF), enabling seamless connectivity with mobile applications and third-party services, such as government transport databases or emergency response networks. The admin panel provides transport authorities with a comprehensive dashboard to manage fleet operations, track bus movements, analyze performance data, and address any reported issues. Through this system, administrators can monitor the efficiency of public transport services, ensure compliance with safety regulations, and optimize routes based on historical travel data. Furthermore, advanced analytics can be implemented to predict peak travel times, identify high-risk areas for accidents, and enhance passenger safety measures.

By integrating AI-driven security, real-time tracking, and automated emergency response mechanisms, this smart bus monitoring system transforms traditional public transportation into a more reliable, efficient, and safer experience. It not only improves passenger safety and service reliability but also enables transport authorities to make data-driven decisions, ultimately enhancing the overall efficiency of the transit system.

7. RESULT AND DISCUSSION

The smart bus monitoring system has been successfully implemented and tested, demonstrating its ability to enhance security, improve efficiency, and provide real-time monitoring in public transportation. The facial recognition module accurately verifies passengers, ensuring that only authorized individuals board the bus. During testing, the system achieved high accuracy in facial recognition, reducing unauthorized access and improving overall passenger safety. The bus monitoring module effectively tracks real-time location, speed, and route adherence using GPS and IoT sensors. The data is displayed on the user interface, allowing passengers and administrators to access live updates and make informed decisions. The road assistance module efficiently detects accidents, breakdowns, and reckless driving behavior, automatically alerting fleet managers and emergency responders. Real-time notifications via SMS, email, and push notifications ensure timely communication of emergencies and schedule updates to passengers and authorities. The system's centralized database securely stores passenger details, bus schedules, and incident reports, enabling easy retrieval and analysis. Integration with RESTful APIs facilitates seamless mobile application access and third-party service connectivity, enhancing usability.

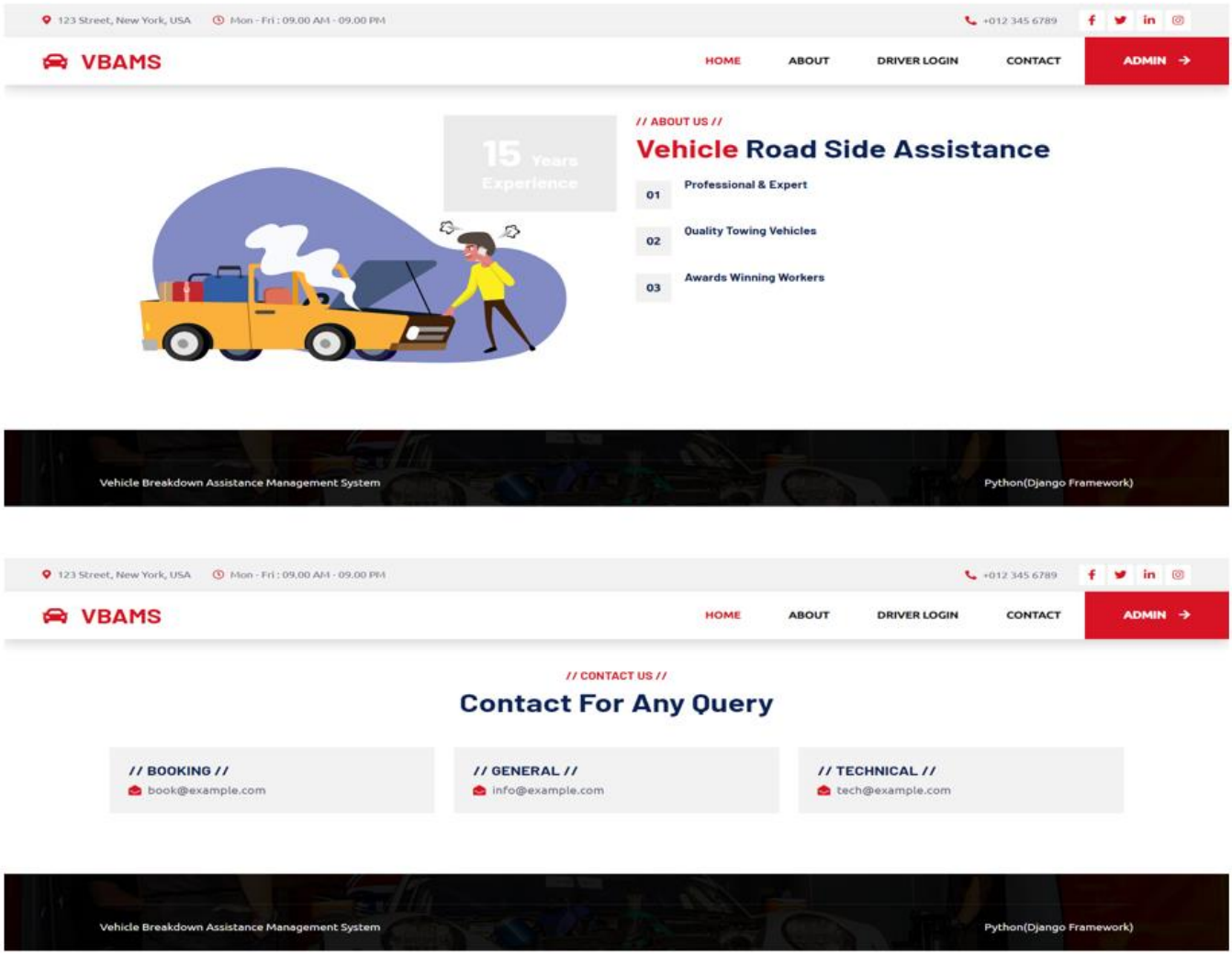

Figure 2. OUTPUT

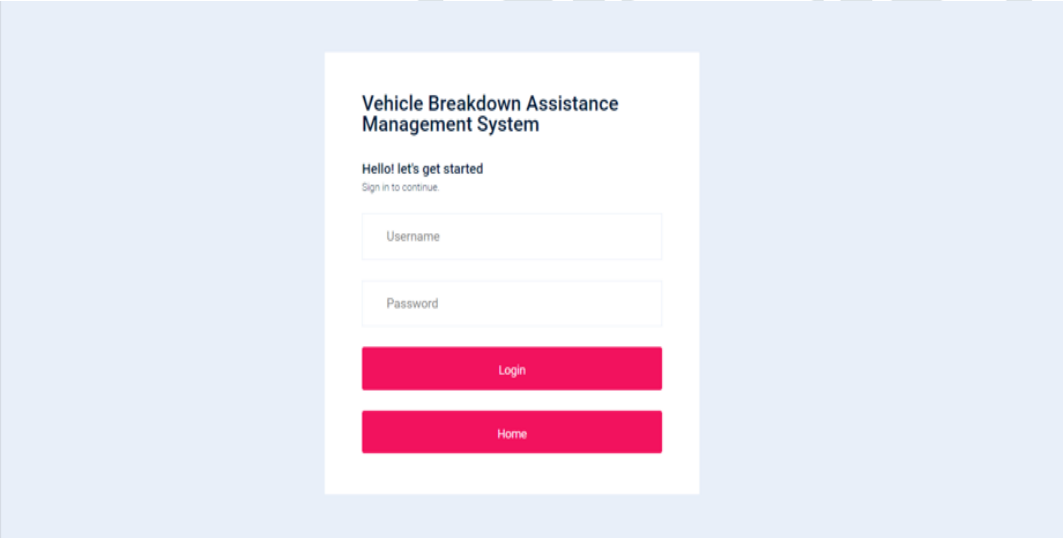

Figure 3. Login

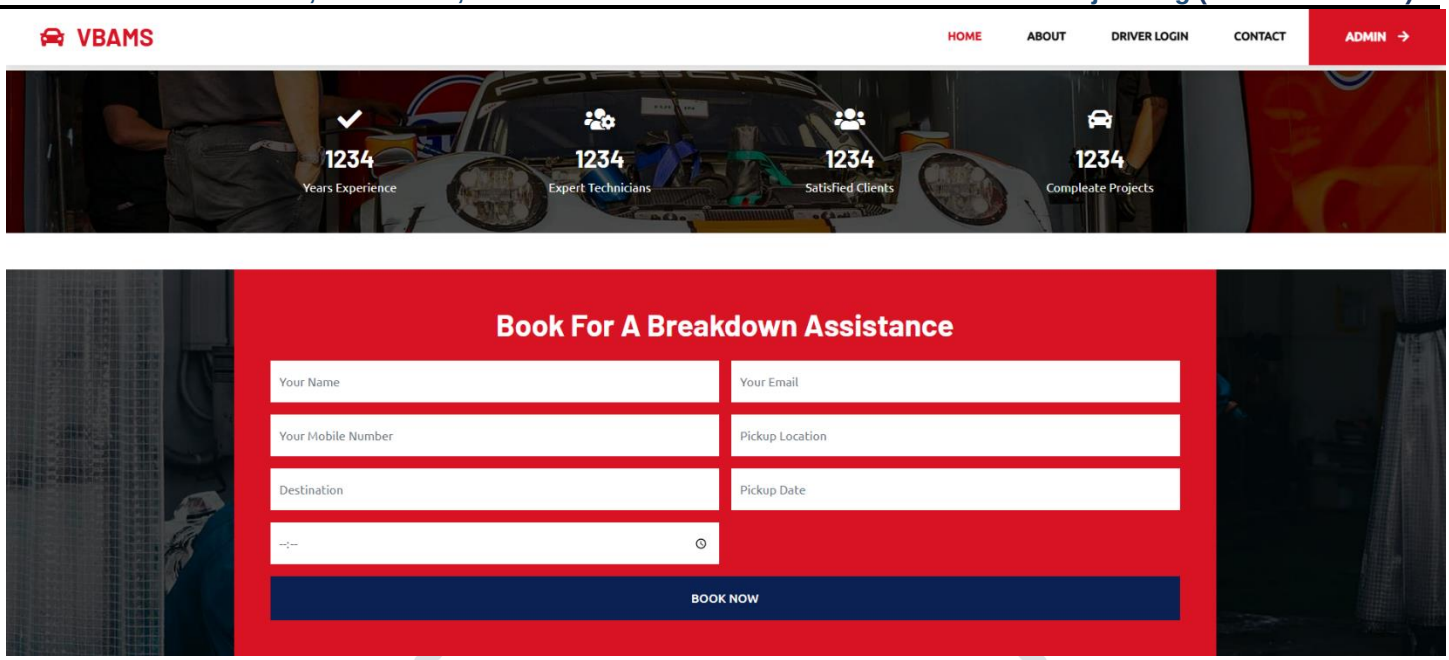

Figure 4. Registration

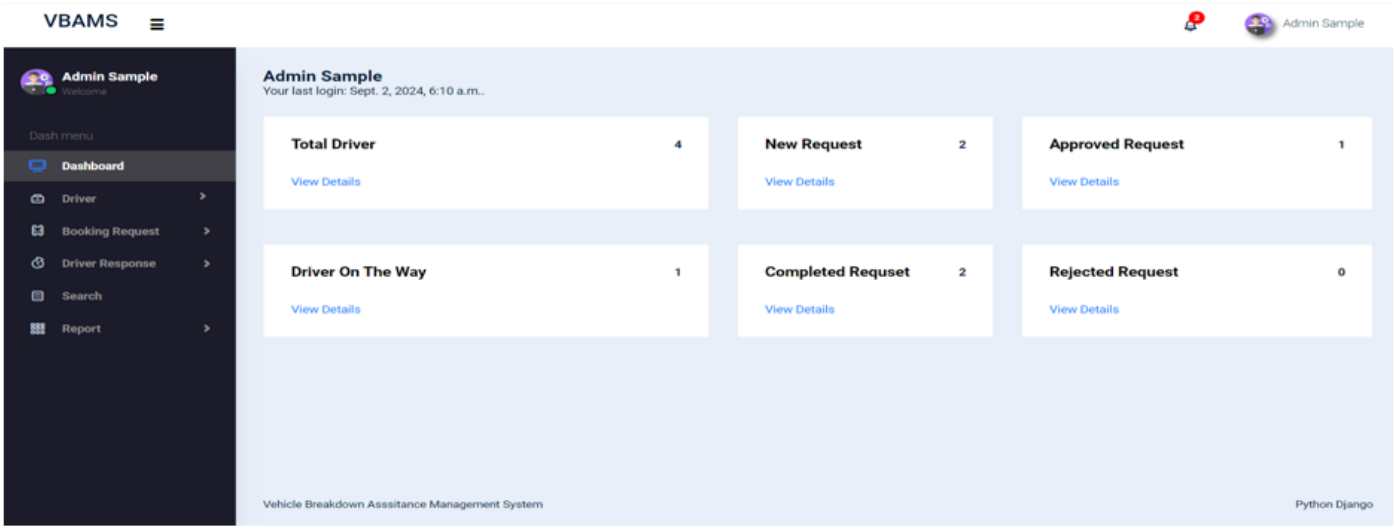

Figure 5. Dashboard

Figure 6. User Details

Overall Purpose:

1. **Passenger Security** – Implements facial recognition technology to verify and authenticate passengers before boarding, preventing unauthorized access and enhancing overall security.

2. **Real-time Tracking** – Uses GPS and IoT sensors to continuously monitor the bus's real-time location, speed, and route adherence, ensuring accurate tracking for passengers and administrators.

3. **Incident Detection** – Employs AI-based road assistance to detect accidents, sudden breakdowns, and reckless driving behavior. The system automatically triggers alerts to fleet managers and emergency responders for immediate action.

4. **Instant Notifications** – Sends real-time alerts via SMS, email, and mobile applications to inform passengers and authorities about bus schedules, unexpected delays, and emergency situations, improving communication and response times.

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