EVXpert: AI-Powered EV Companion App Technical Documentation

EVXpert is an AI-driven companion application created for electric vehicle (EV) enthusiasts. It provides comprehensive battery health monitoring, predictive maintenance, trip-based battery planning, and cutting-edge security features to ensure optimal safety and efficiency for EV riders. The app gathers real-time data from bike sensors, which machine learning models then analyze to predict battery degradation, optimize trips, and enhance security protocols.

Battery Health Monitoring

Purpose

Track charge cycles, ride patterns, road conditions, and battery usage to predict degradation using advanced machine learning models.

Tech Used

Leverages Python, PostgreSQL, TensorFlow, and Scikit-learn for data processing, storage, and predictive analytics.

Execution Flow

Sensor data (temperature, voltage, current) is sent to the backend, stored in PostgreSQL & DynamoDB, analyzed by ML models, and displayed on the app's dashboard.

AI-Powered Predictive Maintenance

Purpose

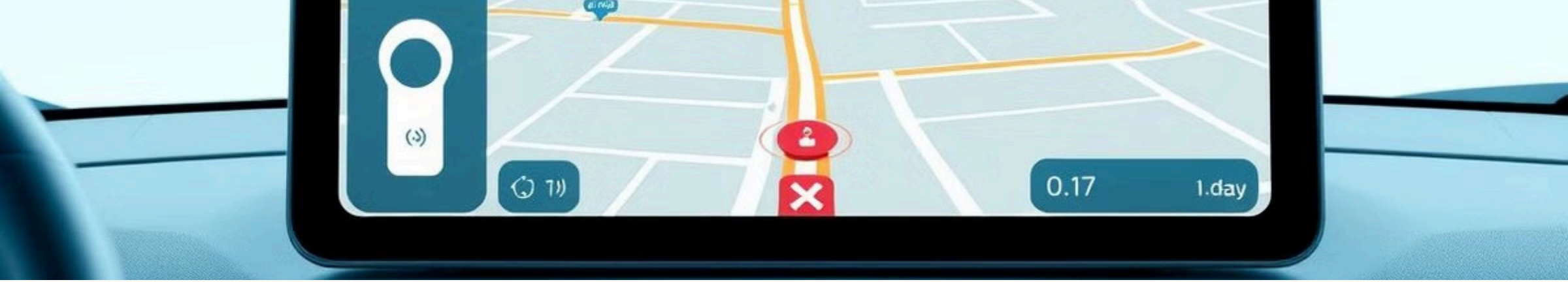
Uses machine learning algorithms to detect early signs of potential battery failure and sends timely maintenance alerts to the user.

Tech Used

Utilizes Python, TensorFlow, Scikit-learn, and DynamoDB for continuous monitoring and anomaly detection.

Execution Flow

Sensor data is continuously monitored. AI models trained on historical battery failure cases detect anomalies. Users receive maintenance alerts in the app.



Trip-Based Battery Planning

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Purpose

Ensures the bike reaches a charging station safely by adjusting speed when the battery is critically low using intelligent energy management.

Tech Used

Employs Python, HTML, Tailwind CSS, and Node.js for real-time energy consumption calculation and trip simulation.

Execution Flow

Calculates real-time energy consumption, recommends optimal speed to reach the nearest charging station, and automatically sets a speed bottleneck.

Advanced Bike Security

Purpose

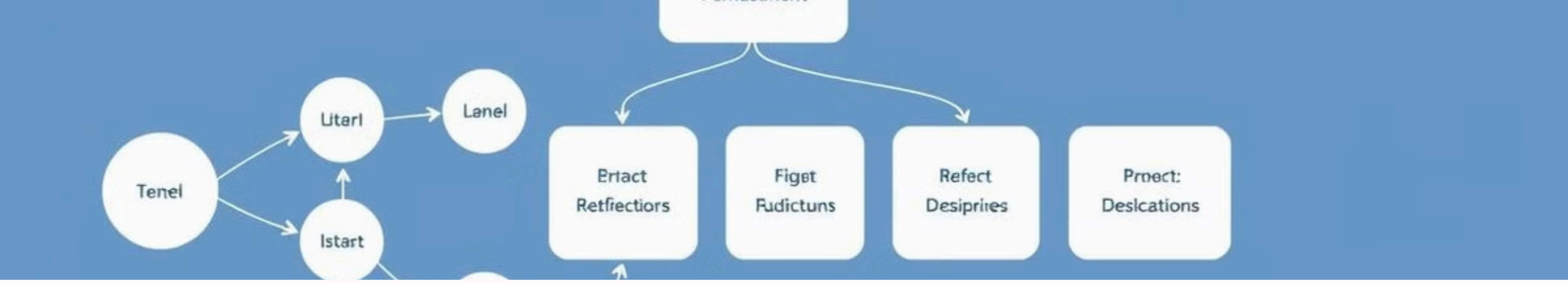
Prevents unauthorized access and effectively immobilizes the bike in the event of a theft attempt using robust security measures.

Tech Used

Implements Python, React Native, AES Encryption, and Socket Programming for secure communication and access control.

Execution Flow

Sends an alert on unauthorized movement, prompts the user to enter a 3-word AES-encrypted rolling passkey, and locks the bike using reverse torque.



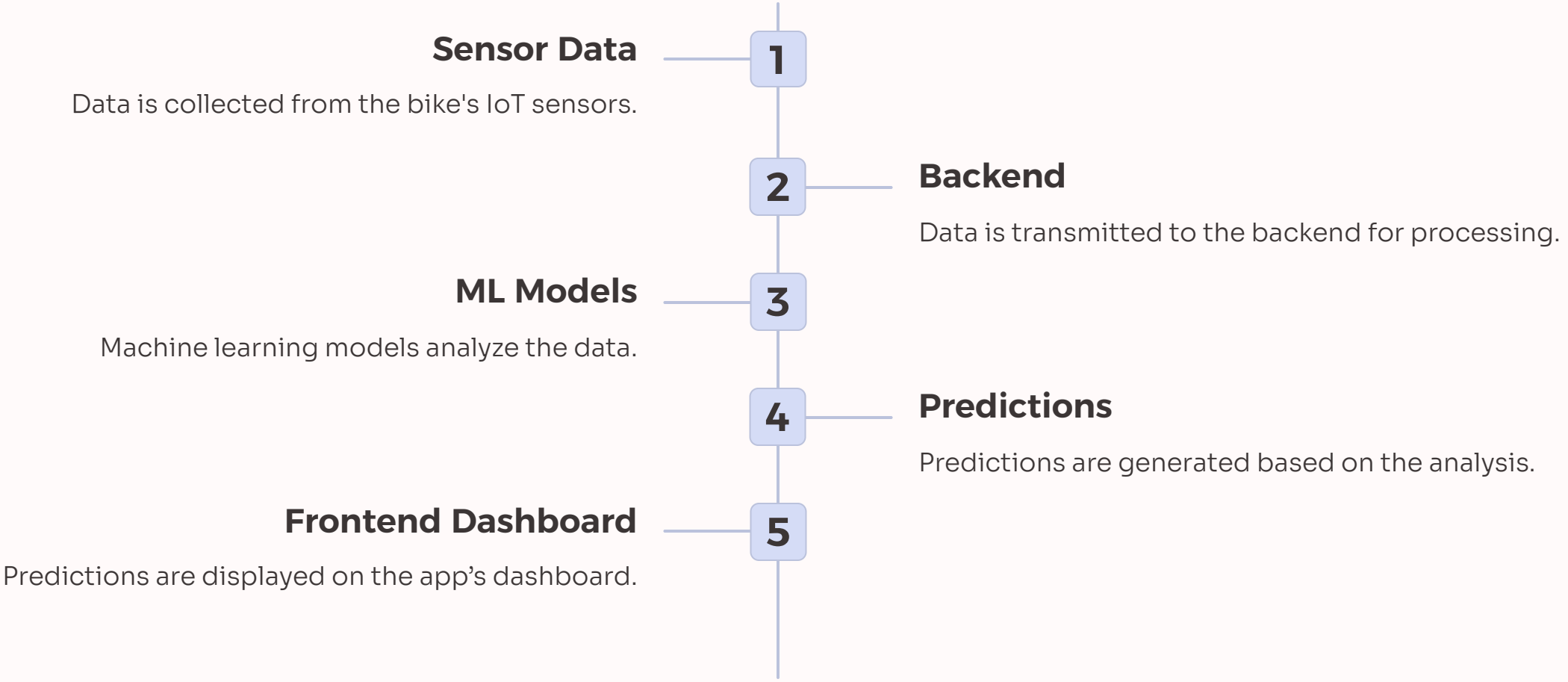
Tech Stack Overview

Component	Technology Used
Backend	Python, JSON
Database	PostgreSQL, DynamoDB
AI/ML	TensorFlow, Scikit-learn
Mobile App	React Native
Website	HTML, Tailwind CSS, Node.js
Security	AES Encryption, Rolling Keys
Hosting	Vercel, Netlify

System Architecture

A diagram showcasing the seamless interaction between sensors, backend, ML models, and the mobile application. This integration enables real-time data processing and predictive analytics, enhancing the user experience. The system is designed for scalability and reliability.

Data Flow & API Integration



APIs connect the bike’s IoT sensors to EVXpert for real-time updates. This enables users to monitor and manage their EV's performance effectively.

Conclusion

EVXpert provides comprehensive solutions for electric vehicle riders, from real-time monitoring to advanced security features. Its AI-driven approach ensures the bike reaches a charging station safely by adjusting speed when the battery is critically low. With its robust features and innovative technology, it sets a new standard for EV companion apps.

Future Scope

1 Real-World Integration with EVs

Expanding the app’s compatibility to seamlessly integrate with a broader range of electric vehicle models and manufacturers for enhanced functionality.

2 Expansion to More Vehicle Types

Extending EVXpert's capabilities beyond bikes to include other electric vehicle types such as cars, scooters, and drones, broadening the user base.

3 More AI-Driven Insights

Incorporating advanced artificial intelligence to deliver deeper, more insightful analytics, predictions, and personalized recommendations for users.

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