Tswane university of technology

GPS System

CAR THEFT ALERT SYSTEM

by: sibuyi cs

Project Overview

Objective:

- Protect vehicles using smart sensors and IoT technology.
- Provide real-time notifications and a comprehensive dashboard for user monitoring.

Key Features:

- Presence detection using LD2410.
- Picture capture upon detection.
- Cloud storage for images.
- GPS tracking for location updates.
- User notifications via Twilio (SMS & WhatsApp).
- Historical data analysis and reporting.

Hardware Components

1. Raspberry Pi:
   - Central control unit for data processing and system operations.
2. STM32F411 Microcontroller:
   - Interface for sensors and efficient data handling.
3. LD2410 Sensor:
   - Detects presence and measures distance.
4. Webcam:
   - Captures images when detection triggers.
5. GPS Module:
   - Tracks vehicle location.

Software Architecture

1. Cloud Storage:
   - Dropbox for storing captured images securely.
2. Database:
   - Supabase for managing metadata, GPS data, and image links.
3. Application Hosting:
   - Bolt.new for hosting the web application.
4. Notifications:
   - Twilio for sending alerts (SMS & WhatsApp).

System Workflow

1. Detection & Trigger:
   - LD2410 detects presence & distance.
   - If threshold distance is met, system triggers webcam to capture images.
2. Data Processing:
   - Images are uploaded to Dropbox.
   - GPS coordinates are captured and sent to Supabase.
3. User Notification:
   - Twilio sends alert with links to images and GPS location.
4. User Dashboard:
   - View GPS data on map.
   - Access pictures and history reports.

User Features

1. Real-Time Monitoring:
   - Notifications for presence detection and image capture.
2. Map Integration:
   - Track vehicle location using GPS data on an interactive map.
3. History & Reports:
   - View travel distance, active hours, and events history.
4. Image Access:
   - View/download images stored in Dropbox.

implementation Details

Programming Languages & Tools:

- Python: Main logic and Raspberry Pi programming.
- C++: STM32F411 microcontroller programming.
- Node.js: Backend for hosting app and integrating APIs.
- JavaScript/HTML/CSS: Frontend for user dashboard.

APIs:

- Dropbox API: Image storage.
- Supabase API: Database operations.
- Twilio API: Notifications.

Benefits

Enhanced Security

Real-time alerts and monitoring ensure vehicle safety.

Remote Accessibility

Users can monitor their vehicle from anywhere.

Data Insights

Comprehensive reports provide valuable insights into vehicle activity.

Scalable System

Can integrate additional sensors or features in the future.

implementation Details

Programming Languages & Tools:

- Python: Main logic and Raspberry Pi programming.
- C++: STM32F411 microcontroller programming.
- Node.js: Backend for hosting app and integrating APIs.
- JavaScript/HTML/CSS: Frontend for user dashboard.

APIs:

- Dropbox API: Image storage.
- Supabase API: Database operations.
- Twilio API: Notifications.

Challenges & Solutions

Reliable Detection Accuracy

- Challenge: Ensuring accurate and consistent detection of presence and distance by the LD2410 sensor.
- Solution:
- Fine-tune the LD2410 sensor configuration parameters, including sensitivity and detection range.
- Conduct extensive testing in real-world scenarios to optimize accuracy.

Real-Time Image Upload and Notification

- Challenge: Maintaining low latency while uploading images and sending notifications.
- Solution:
- Optimize image compression to reduce file size without compromising quality.
- Use efficient API integrations for Dropbox and Twilio to minimize delays.
- Implement asynchronous processing for parallel uploads and notifications.

Challenges & Solutions

GPS Data Precision

- Challenge: Capturing accurate and reliable GPS coordinates.
- Solution:
- Utilize high-quality GPS modules for enhanced location accuracy.
- Implement data filtering techniques to eliminate outliers and refine GPS readings.
- Optimize the frequency of GPS updates to balance precision and power efficiency.

Scalability and Performance

- Challenge: Ensuring the system remains scalable for additional features or users.
- Solution:
- Design a modular architecture for seamless integration of new functionalities.
- Leverage cloud-based hosting (Bolt.new) to scale resources dynamically.

Future Improvements

Offline Capabilities

Introduce local storage to save images and GPS data temporarily when the internet is unavailable, ensuring continuous functionality.

Advanced GPS Analytics

Provide route optimization and geofencing to notify users when the vehicle enters or leaves predefined areas.

Expand Notifications

ntegrate push notifications alongside SMS and WhatsApp to provide more notification options through mobile and web applications.

Add AI Integration

Utilize artificial intelligence to analyze captured images for enhanced security alerts, such as detecting unauthorized personnel or recognizing familiar faces.

Conclusion

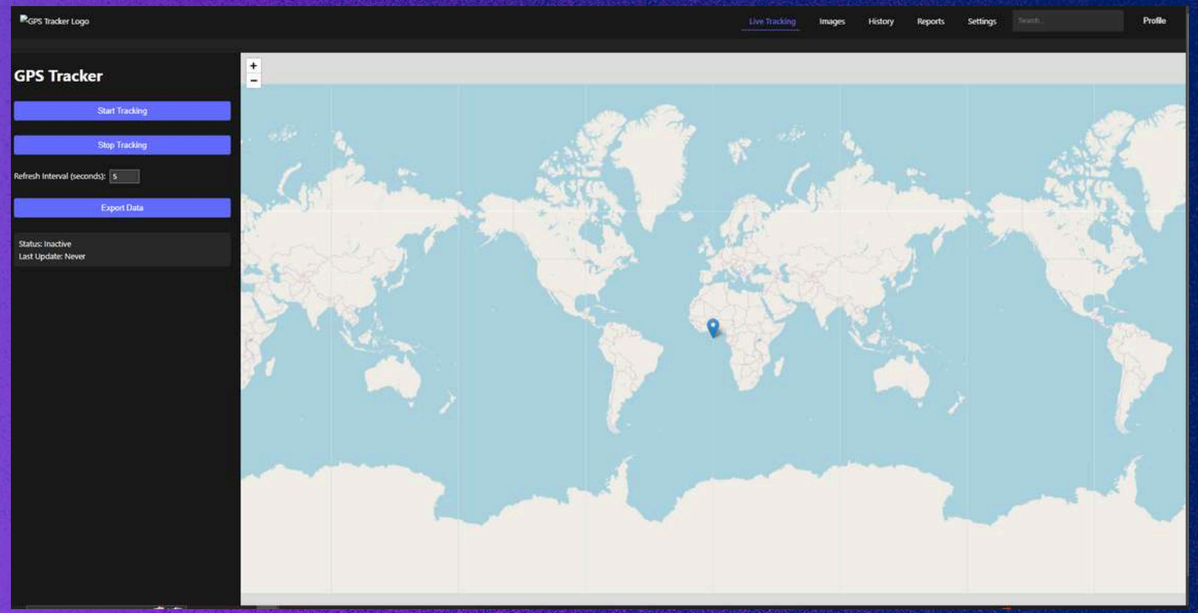
Summary

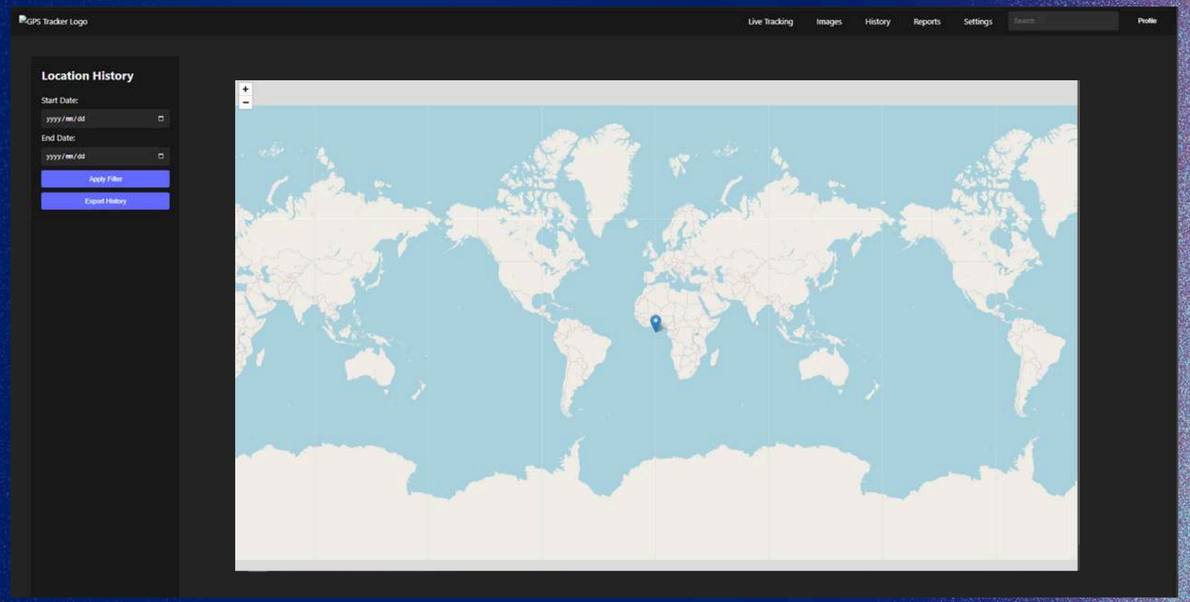
- A Robust IoT Solution: Designed to enhance vehicle security using smart technology.
- Integrated Features: Combines advanced sensors (LD2410), cloud storage (Dropbox), and real-time notifications (Twilio) for seamless and efficient monitoring.
- User-Centric Design: Provides a user-friendly interface with actionable insights, including GPS tracking, image access, and detailed reports.

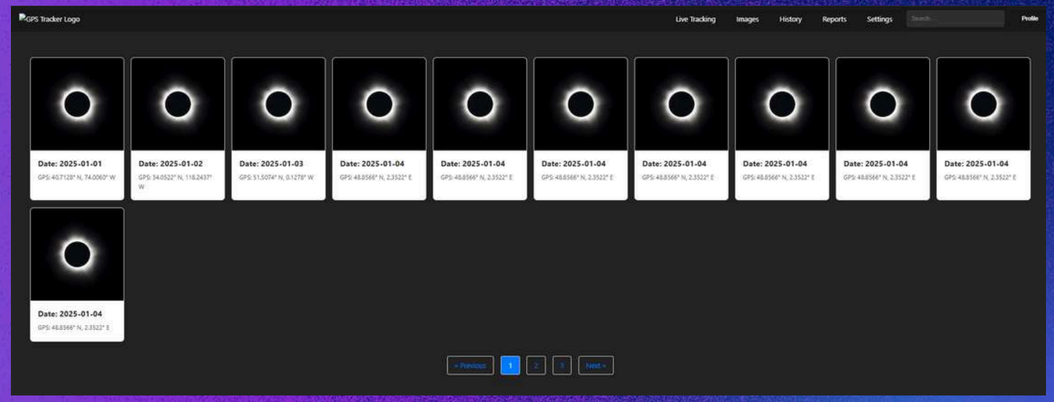
Key Takeaways:

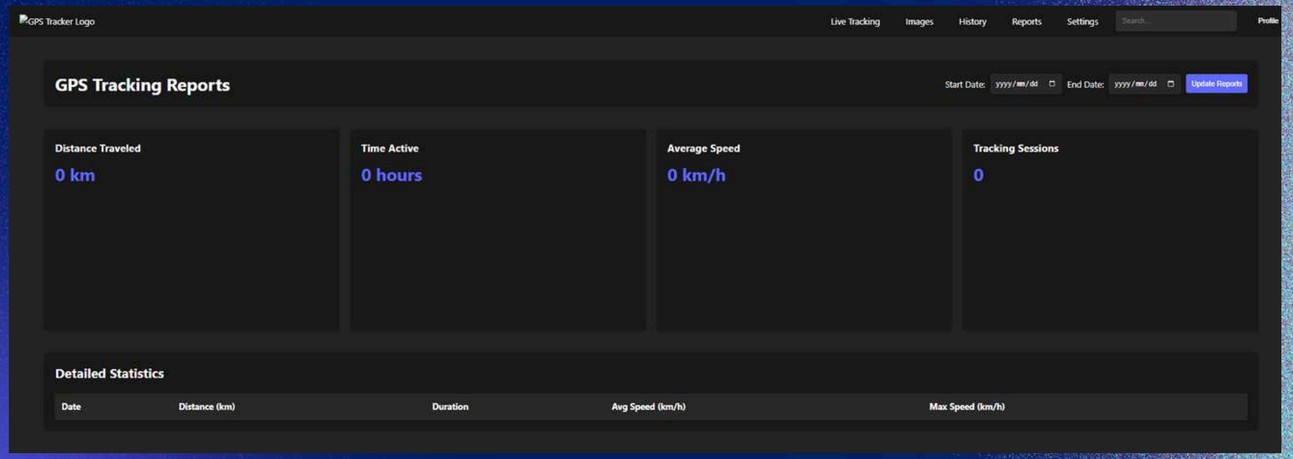
- Real-time monitoring ensures prompt user notifications in case of potential threats.
- Comprehensive reporting tools offer valuable data insights like travel history and active hours.
- Scalable and flexible system capable of future improvements and expansions.

Pictures


GPS Tracker Logo
Live Tracking
Images
History
Reports
Settings
Search...
Profile
GPS Tracker
Start Tracking
Stop Tracking
Refresh Interval (seconds):
5
Export Data
Status: Inactive
Last Update: Never


GPS Tracker Logo
Live Tracking
Images
History
Reports
Settings
Search...
Profile
Location History
Start Date:
yyyy/mm/dd
End Date:
yyyy/mm/dd
Apply Filter
Export History


GPS Tracker Logo
Live Tracking
Images
History
Reports
Settings
Search...
Profile
Date: 2025-01-01
Date: 2025-01-02
Date: 2025-01-03
Date: 2025-01-04
« Previous
Next »


GPS Tracker Logo
Live Tracking
Images
History
Reports
Settings
Search...
Profile
GPS Tracking Reports
Start Date:
yyyy/mm/dd
End Date:
yyyy/mm/dd
Update Reports
Distance Traveled
0 km
Time Active
0 hours
Average Speed
0 km/h
Tracking Sessions
0
Detailed Statistics
Date
Distance (km)
Duration
Avg Speed (km/h)
Max Speed (km/h)

Pictures