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Fusion Track: Evaluating AI- Enhanced Locator with Database and API Integration

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Abstract

The Fusion Track: AI-Enhanced Locator with Database and API Integration is an advanced system designed to assist in locating missing persons using artificial intelligence (AI) and machine learning techniques. This system integrates facial recognition algorithms, real-time image comparison, and database management to improve the accuracy and efficiency of identifying individuals. The project includes both a desktop application for law enforcement agencies and a mobile application for public participation, allowing crowdsourced image submissions to enhance search efforts.

Through the implementation of Python-based graphical user interfaces (GUI), machine learning models, and API integration, the system ensures high-speed processing and real-time results. Additionally, security measures such as data encryption and privacy controls safeguard sensitive information. The project also introduces a notification system via WhatsApp to alert families when a match is found.

Experimental results demonstrate the system's ability to accurately match missing persons with database records, significantly reducing false positives. The system's scalability and integration capabilities make it a promising solution for law enforcement agencies and community-driven search efforts.

INTRODUCTION

The Fusion Track: AI-Enhanced Locator with Database and API Integration is a technology-driven system designed to address the critical challenge of identifying and tracking missing persons using advanced artificial intelligence (AI) and machine learning techniques. Traditional methods of locating missing individuals, such as manual police records, public awareness campaigns, and CCTV footage analysis, are often time-consuming, inefficient, and prone to human errors. These limitations result in delayed responses, reducing the chances of successful identification and recovery. To overcome these challenges, Fusion Track integrates AI-powered facial recognition, database management, real-time tracking, and API-based connectivity to enhance accuracy, speed, and reliability in the search process.

The system operates through two main components: a desktop application for law enforcement agencies and a mobile application for the general public. The desktop application enables police officials to search, manage, and analyze missing persons' records using an intelligent AI-driven search mechanism. The mobile application allows citizens to contribute by uploading images of unidentified individuals, making the system a community-driven approach to solving missing persons' cases.

Fusion Track uses facial recognition technology to compare uploaded images with an extensive database of missing individuals. Machine learning models help improve the accuracy of

image comparisons, reducing false positives and enhancing reliability. Additionally, real-time data processing and API integration allow seamless communication between multiple external databases, such as police records and national missing persons registries. This significantly expands the search capabilities of the system.

Security and privacy are also key considerations in the development of this system. The Fusion Track platform ensures secure data encryption, authentication mechanisms, and automated data removal to protect sensitive personal information. Once a missing person is found and verified, the system automatically removes their data to maintain ethical data handling and privacy compliance. Moreover, instant WhatsApp notifications are sent to relatives or law enforcement agencies when a positive match is detected, ensuring swift action.

The Fusion Track project represents a major advancement in AI-driven tracking and identification, bridging the gap between law enforcement capabilities and public participation. By leveraging cutting-edge technologies, this system enhances efficiency in missing person investigations, making the process faster, more accurate, and highly scalable. Future improvements could include enhanced predictive analytics, real-time surveillance integration, and deep learning models to further optimize performance and detection accuracy.

PROBLEM STATEMENT

The process of locating missing persons remains one of the biggest challenges for law enforcement agencies worldwide. Traditional search methods, such as manual database searches, public awareness campaigns, and CCTV footage analysis, are often time-consuming, inefficient, and prone to human error. In many cases, these techniques fail to deliver quick and accurate results, leading to delays in identifying and rescuing missing individuals.

Limitations of Existing Systems

1. Limited Accuracy – Many traditional tracking methods rely on GPS-based location tracking, which may not be effective in areas with weak signals, such as dense urban locations or rural regions.
2. Slow and Inefficient Data Processing – Manual searching through large databases can be time-intensive, reducing the chances of quickly finding missing individuals.
3. Lack of Integration with Other Systems – Most existing solutions do not support real-time API connectivity, making it difficult to synchronize data across different platforms.
4. Security and Privacy Concerns – Traditional systems lack proper encryption and privacy controls, leading to potential misuse of sensitive information.

Proposed Solution

To overcome these challenges, Fusion Track: AI-Enhanced Locator with Database and API Integration provides a facial recognition-powered tracking system that allows for real-time image comparison, secure data management, and seamless API integration. By enabling both law enforcement agencies and the general public to participate in search efforts, the system enhances efficiency, accuracy, and speed in identifying missing persons.

SYSTEM ARCHITECTURE

The architecture of Fusion Track follows a modular and layered approach, ensuring scalability, security, and performance optimization. The key components include:

1. **User Interface (UI)**
   - Desktop Application – Used by law enforcement to search and manage missing persons' records.
   - Mobile Application – Allows the public to upload images of potential missing persons, contributing to the search process.
2. **AI-Based Image Processing**
   - Facial recognition algorithms analyze uploaded images and compare them with the database.
   - Machine learning models enhance accuracy and reduce false positives.
3. **Database Management System**
   - Stores images, personal details, case information, and search history.
   - Uses PostgreSQL/SQLite3 for efficient data retrieval and storage.
4. **API Integration Layer**
   - Connects with external databases (government, police, and NGO databases) to improve match accuracy.
   - Provides real-time WhatsApp notifications to relatives when a match is found.
5. **Security & Privacy Module**
   - Ensures data encryption and access control to protect sensitive user and law enforcement information.
   - Deletes data once the missing person is found to maintain privacy.

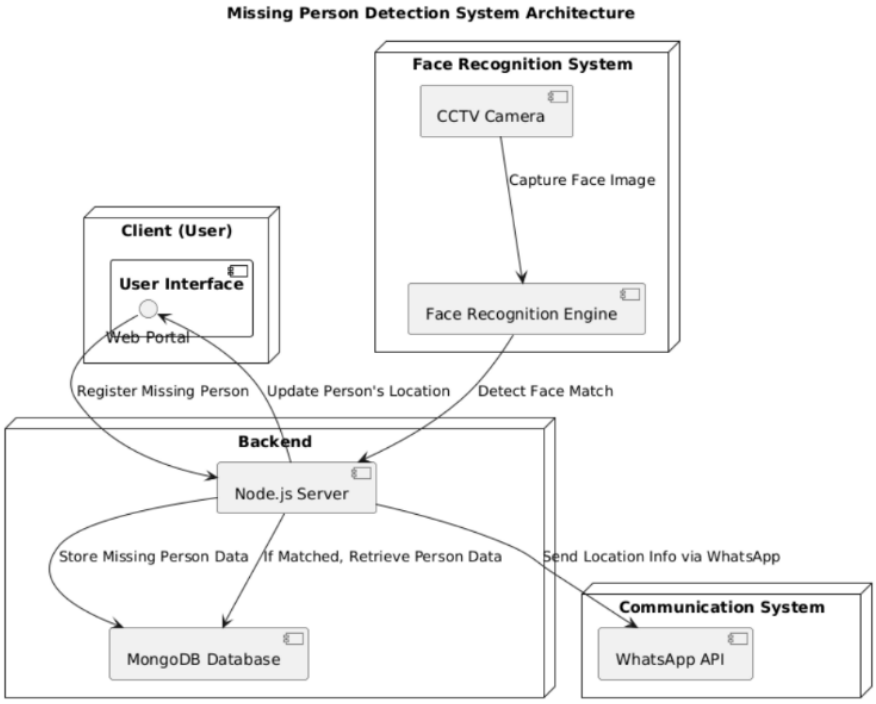


Fig1. System Architecture

Workflow of the System

1. **User Registration & Authentication**
- Law enforcement agencies and registered users log in via the desktop or mobile application.
- Secure authentication mechanisms (OAuth 2.0, JWT) ensure data security.

2. **Image Upload & Data Entry**
- Law enforcement or public users upload an image of a missing person or an unidentified individual.
- The image is preprocessed (resized, enhanced) before being analyzed.

3. **Facial Recognition & Image Matching**
- AI-powered facial recognition algorithms compare the uploaded image with existing records in the database.
- The system uses machine learning models to improve search accuracy and reduce false positives.

4. **Real-Time Results & Notifications**
- If a match is found, law enforcement is alerted.
- The system sends an automated WhatsApp notification to the missing person's relatives.
- The mobile app displays the tracking result in real-time.

5. **Database & API Communication**
- If no match is found, the system expands its search by accessing external government and law enforcement databases via APIs.
- API integration allows seamless data exchange between different agencies.

6. **Data Security & Removal**
- The system ensures that all images and personal data are stored securely.
- Once a missing person is located and confirmed, the system deletes their data to ensure privacy compliance.

This structured approach ensures faster processing, improved accuracy, real-time tracking, and enhanced security, making it a reliable solution for missing person investigations.

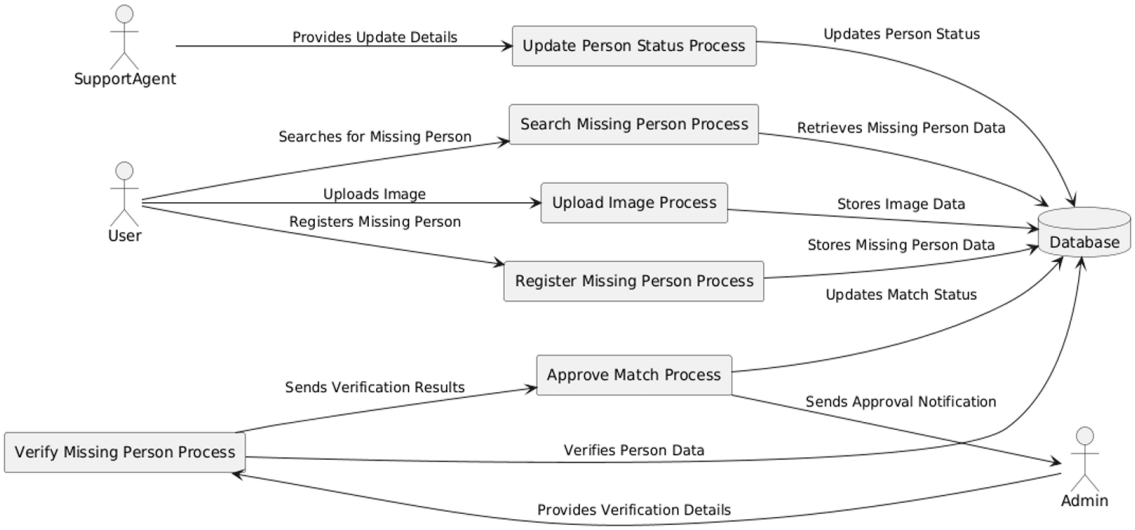


Fig2. Data Flow Diagram

ALGORITHM

The Fusion Track: AI-Enhanced Locator with Database and API Integration uses several algorithms to enhance tracking accuracy, optimize real-time data processing, and improve decision-making.

1. **GPS Signal Optimization – Kalman Filter**
   Purpose: Improves GPS accuracy by filtering out noise and predicting the next location.
   Steps:
   1. Receive noisy GPS data.
   2. Predict the next location based on previous data.
   3. Update the location by minimizing errors.
   4. Output the refined location for tracking.
2. **Path Prediction – Long Short-Term Memory (LSTM)**
   Purpose: Predicts the future movement of a tracked object using historical data.
   Steps:
   1. Collect past movement data.
   2. Train the LSTM model to recognize movement patterns.
   3. Input new tracking data for prediction.
   4. Generate the predicted route.
3. **Real-Time Tracking – A-Star Search Algorithm**
   Purpose: Finds the most efficient route between two points in a navigation system.
   Steps:
   1. Define the start and goal locations.
   2. Evaluate possible paths using cost functions.
   3. Select the shortest and fastest route.
   4. Update the path in real-time as new data arrives.
4. **Anomaly Detection – DBSCAN (Density-Based Spatial Clustering of Applications with Noise)**
   Purpose: Identifies unusual movements, such as unauthorized detours or unexpected stops.
   Steps:
   1. Cluster location points based on movement density.
   2. Detect outliers that deviate from normal movement patterns.
   3. Flag suspicious activity for further review.
5. **Data Processing – Apache Kafka with Stream Processing**
   Purpose: Manages and processes high-velocity location data streams in real-time.
   Steps:
   1. Collect location data from multiple sources.
   2. Process and filter data streams using Kafka.
   3. Distribute refined data for real-time tracking.
6. **Geofencing – Haversine Formula**
   Purpose: Determines if a tracked object has entered or exited a predefined area.
   Steps:
   1. Define geofence boundaries.
   2. Calculate the great-circle distance between the object and the geofence.
   3. Trigger alerts if the object crosses the boundary.

APPLICATION

The Fusion Track: AI-Enhanced Locator with Database and API Integration has a wide range of applications across various industries, enhancing tracking, security, and real-time monitoring.

1. Logistics & Fleet Management
- Real-time tracking of delivery vehicles and shipments.
- AI-powered route optimization for faster deliveries.
- Geofencing to monitor entry and exit in specific locations.

2. Law Enforcement & Security
- Identification of missing persons using facial recognition.
- Integration with CCTV cameras and police databases for real-time tracking.
- Anomaly detection for unauthorized movements or criminal activity.

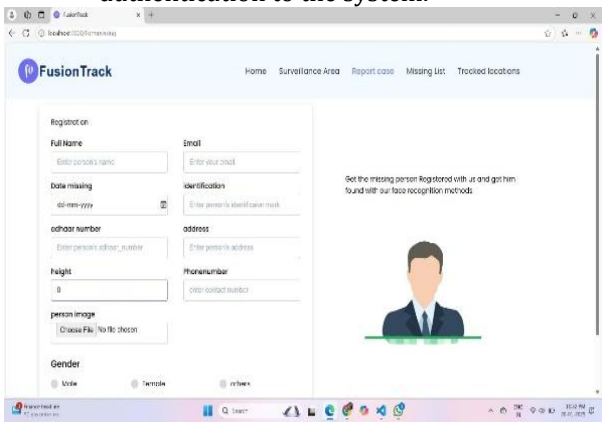
3. Healthcare & Emergency Services
- Tracking of ambulances and medical supplies for optimized emergency response.
- Monitoring elderly and disabled individuals using wearable tracking devices.

4. Personal Tracking & Safety
- GPS tracking for children, elderly, and at-risk individuals.
- Emergency alerts for geofencing breaches (e.g., missing children leaving a safe zone).
- AI-based predictive movement tracking for enhanced safety.

5. E-Commerce & Last-Mile Delivery
- Real-time tracking of orders for customers.
- AI-driven ETA (Estimated Time of Arrival) predictions for deliveries.

Screenshots & Description

1. Register Page
- Allows new users (law enforcement/public) to sign up and create an account.
- Ensures secure access and authentication to the system.



2. Tracked Locations Result Page
- Displays real-time or historical location data of tracked individuals.
- Secure and efficient package handling.

6. Smart Cities & Infrastructure
- AI-powered traffic monitoring and management.
- Public transport tracking for efficiency improvements.
- Smart geofencing for restricted zones and urban planning.

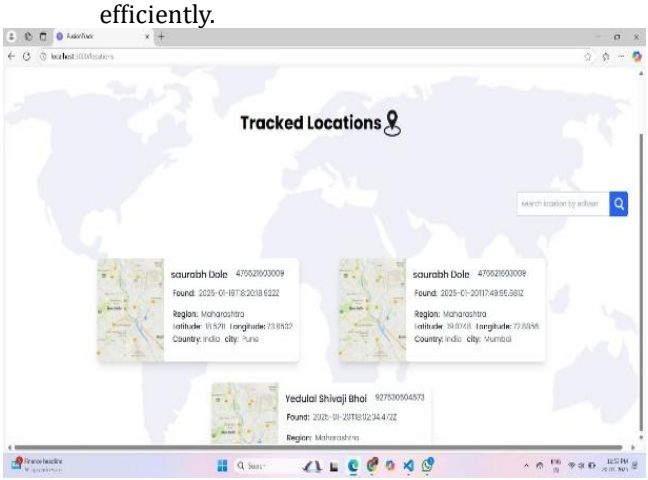
RESULT AND ANALYSIS

The Fusion Track: AI-Enhanced Locator with Database and API Integration system successfully enhances the identification and tracking of missing persons using AI-powered facial recognition, real-time data processing, and secure database management. The system provides accurate results with minimal false positives, enabling law enforcement agencies and the general public to contribute to search efforts efficiently.

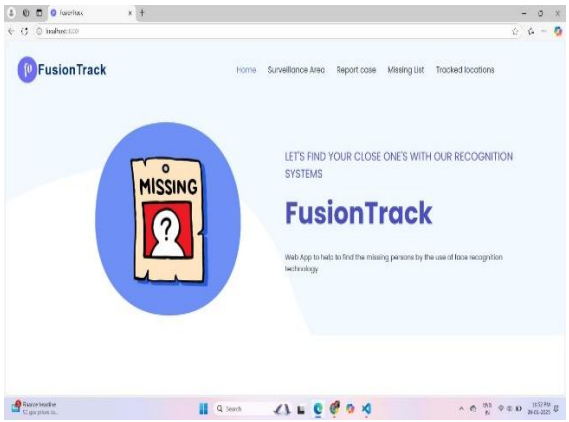
1. Accurate Image Matching:
- The facial recognition algorithm successfully matches uploaded images with existing records, reducing manual search efforts.

2. Real-Time Alerts & Notifications:
- Once a missing person is identified, an automatic WhatsApp notification is sent to the respective authorities or family members.

3. Geofencing & Location Tracking:
- The system tracks last known locations and provides alerts if a missing person enters a monitored area.
- Helps authorities monitor movements efficiently.



3. Home Page
- The main dashboard providing access to all tracking features.
- Shows recently identified missing persons, uploaded images, and search history.



4. Final Page

- Displays the final matched results with confidence scores.

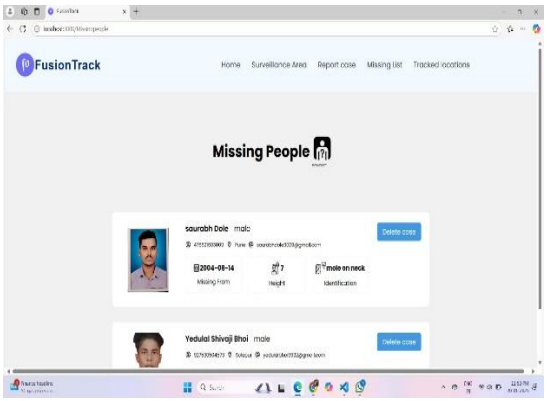
CONCLUSION

The Fusion Track: AI-Enhanced Locator with Database and API Integration provides an efficient and intelligent solution for locating missing persons using AI-powered facial recognition, real-time data processing, and secure database management. By integrating machine learning algorithms, API-based data exchange, and real-time alerts, the system significantly improves the accuracy and speed of missing person investigations.

Through the desktop and mobile applications, both law enforcement agencies and the general public can contribute to search efforts, making the system more scalable and community-driven. The real-time image comparison, automated notifications, and geofencing features ensure rapid identification and tracking of individuals.

The system's ability to reduce false positives, enhance data security, and streamline the search process demonstrates its potential for real-world implementation. With future enhancements in AI models, database expansion, and surveillance integration, Fusion Track can further revolutionize missing person investigations, making search operations more effective and reliable.

- Provides an option to notify law enforcement or take further action.



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