**Semester Project Report**

**Project Name: AI For Tracking Missing People**

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**Session**

**Fall 2024**

**University of Management and Technology**

**C-II Johar Town Lahore Pakistan**

**Dedication:**

This project is dedicated to our parents, professors, and peers who have supported us throughout our academic journey and have been a source of constant motivation.

**Final Approval**

* **Head of Department \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Department of Informatics & Systems

School of Systems & Technology

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UMT Lahore

* **Co-Supervisor \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Acknowledgment**

We sincerely thank our mentors and peers for their guidance throughout this project. Their valuable input and feedback have allowed us to achieve this milestone. We are grateful to the University of Management and Technology for providing the resources and a conducive learning environment for innovation and creativity.

**Project Title:**  AI for Tracking Missing People

**Objective:**

The primary goal of this project is to develop a robust AI-based system that assists in identifying and tracking missing individuals. By leveraging cutting-edge technologies such as facial recognition and real-time analytics, this system aims to bridge the gap between advanced technology and public safety.

**Undertaken by:**

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**Supervised by:**  Shahbaz Qadeer

**Starting Date:** Janurary 1, 2025

**Completion Date:** Janurary 24, 2025

**Tools Used:**

* Lucid chart
* Microsoft visio

**Abstract**

The proposed system is an advanced AI solution designed to identify and track missing individuals. Using facial and attribute recognition, the system processes surveillance data to match individuals against a centralized database. Features like real-time alerts, attribute-based search, and integration with public datasets enhance the system's utility for law enforcement and rescue teams. By leveraging state-of-the-art AI technologies, the system ensures over 98% accuracy, scalability, and reliability in high-pressure scenarios. Our goal is to provide a proactive solution for improving public safety.

**Revision Chart**

|  |  |  |  |
| --- | --- | --- | --- |
| **Version** | **Primary Author(s)** | **Description of Version** | **Date Completed** |
| 1.0 | Nimra,Noor,Khuzaima, | Initial Draft with 4 Chapters | Jan 20, 2025 |
| 2.0 | Nimra,Noor,Khuzaima, | Final Draft with 4 Chapters | Jan 24, 2025 |

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**Introduction**

**Motivations**

The increasing number of missing person cases globally highlights the need for innovative solutions. Existing methods often rely on manual processes, which are time-consuming and prone to errors. By combining AI with public safety measures, we aim to revolutionize how missing individuals are located.

**Project Overview**

This project introduces an AI-driven platform that integrates facial recognition, real-time alerts, and attribute-based search. The system leverages high-resolution cameras, advanced algorithms, and centralized databases to ensure efficient tracking and identification.

**Problem Statement**

Traditional methods for locating missing persons are resource-intensive and inefficient. Law enforcement agencies often struggle with data management and real-time tracking. Our solution addresses these issues by automating the process using AI, enabling faster identification and improved outcomes.

**Objectives**

* Develop a scalable and reliable AI-based tracking system.
* Ensure real-time processing with minimal delay.
* Integrate facial and attribute recognition for improved accuracy.
* Provide detailed reporting and analytics for informed decision-making.

**Domain Analysis**

**Stakeholders**

* **End Users (Families, Law Enforcement, NGOs):** Responsible for inputting data and monitoring system outputs to locate missing individuals.
* **System Administrators:** Manage and maintain the platform's backend infrastructure.
* **AI Developers:** Continuously improve the algorithms and models to enhance system performance.
* **Policy Makers:** Utilize the system's analytics for informed decision-making and resource allocation.

**Dependencies**

* **Hardware Requirements:**
  + Surveillance cameras with high resolution.
  + GPUs for deep learning computations.
  + Reliable storage solutions for database management.
* **Software Tools:**
  + AI libraries like TensorFlow and OpenCV.
  + Cloud platforms such as AWS Rekognition for advanced recognition features.
  + Integration with public databases for enhanced search capabilities.
* **Networking Requirements:**
  + High-speed internet for real-time processing and communication between system components.

**Reference Projects**

* **Amber Alert System:** A child abduction alert system used in the United States that provides rapid dissemination of information.
* **AWS Rekognition Demos:** Demonstrates the potential of cloud-based facial recognition solutions.

**Requirements Analysis**

**Functional Requirements**

1. **Facial Recognition:**
   * Accurately identify individuals with 98% precision.
   * Adapt to changes in appearance due to aging or other factors.
2. **Attribute Recognition:**
   * Identify individuals based on clothing, accessories, or physical traits.
   * Enable descriptive searches like "blue shirt, black backpack."
3. **Real-Time Alerts:**
   * Notify users immediately upon a match.
   * Integrate GPS trackers for real-time location monitoring.
4. **Database Integration:**
   * Centralized storage for images, videos, and identification data.
   * Allow connection with government datasets for comprehensive searches.
5. **Reporting & Analytics:**
   * Generate visual insights like heatmaps for common routes and high-activity zones.

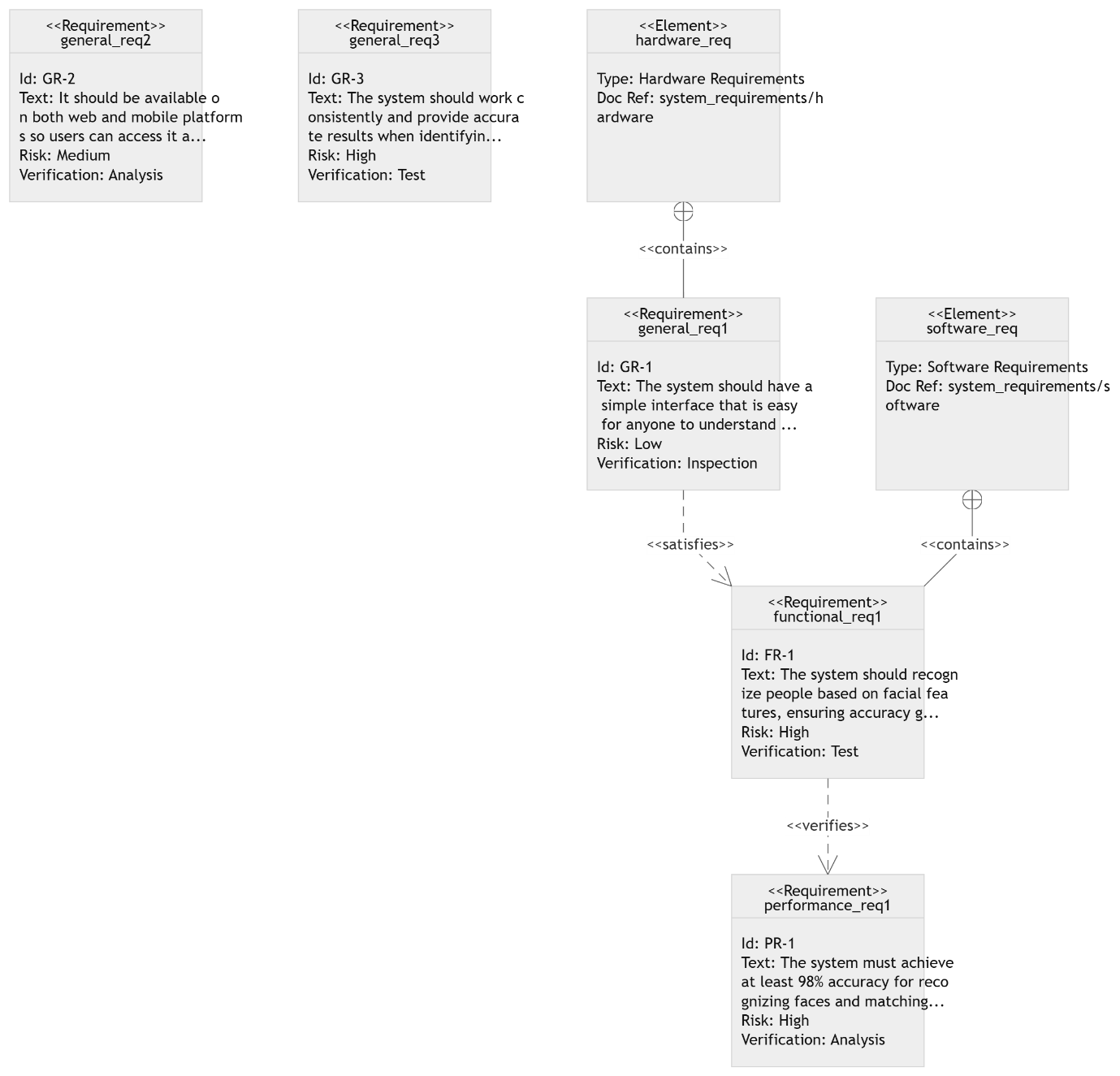
**Non-Functional Requirements**

* **Performance:**
  + Response time of less than 5 seconds for processing.
  + Support for large-scale operations.
* **Reliability:**
  + Ensure 99.9% uptime.
* **Usability:**
  + Simple and intuitive interface for diverse users.
* **Security:**
  + Implement end-to-end encryption for data protection.

**System Design**

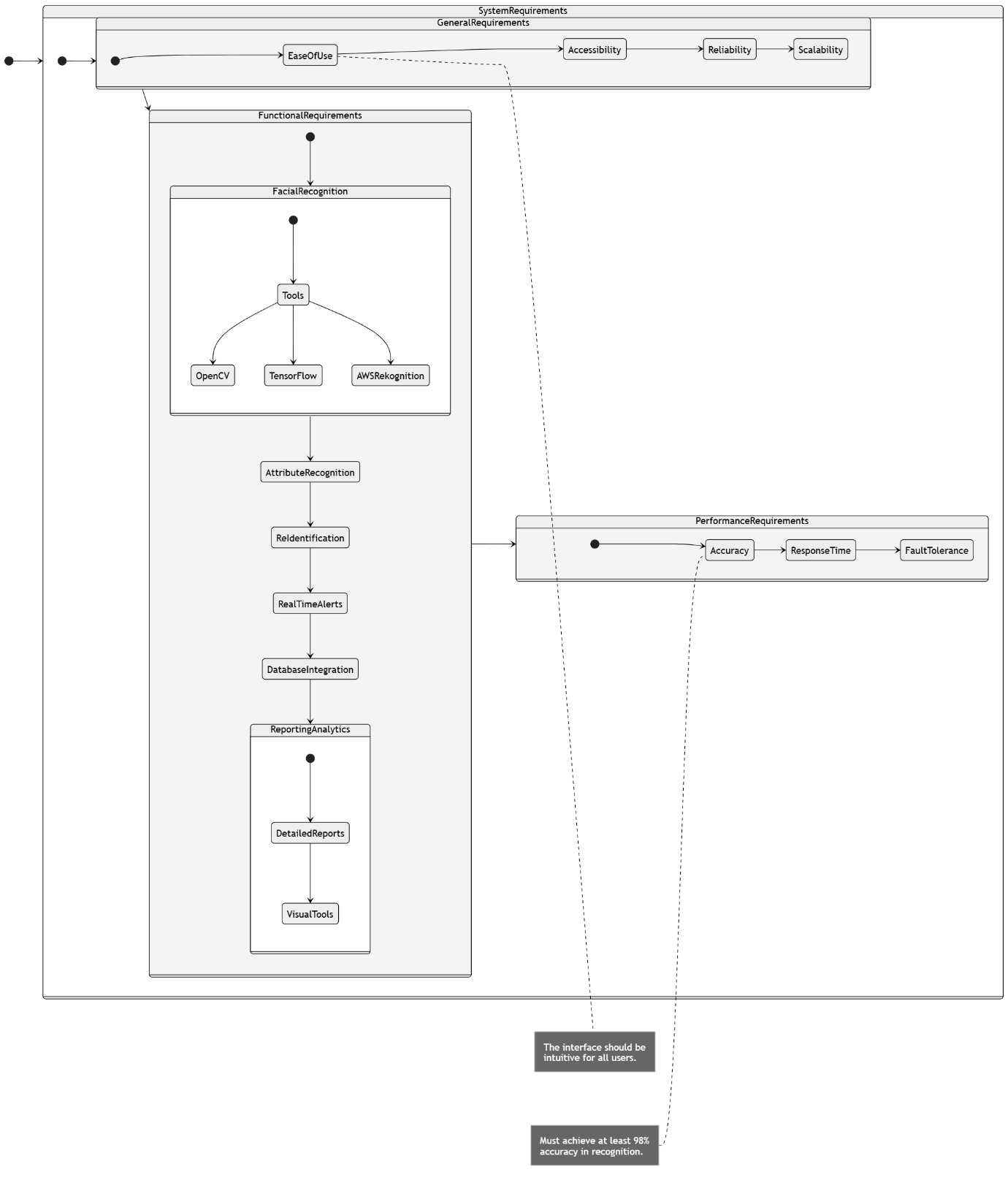
**Activity Diagram:**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | **Component** |  |  |  |  | | --- | --- | --- | --- | --- | | **Requirement Type** | **Details** | **Risk** | **Verification Method** |
| **General Requirements** | Usability, Accessibility  Reliability, Scalability | Simple interface, platform availability (web and mobile), consistent and accurate results  System must handle growing demands and maintain consistent performance | Low or Medium or High  Medium  Or High | Inspection, Analysis, Test  Test |
| **Functional Requirements** | Facial Recognition  Real-Time Alerts  Database Integration | Identify individuals accurately using tools like OpenCV, TensorFlow, AWS Rekognition  Notifications based on specific events  Effective storage and retrieval | High  Medium or high  Medium | Test  Analysis  Test |
| **Performance Requirements** | Accuracy, Response Time  Fault Tolerance | Achieve 98% accuracy and provide quick feedback  Operate smoothly despite partial system failures | High  high | Analysis, Test  test |
| **Hardware Requirements** | Surveillance Cameras  Computing Power | Capture images for processing  AI and processing support | Medium  high | Inspection  Analysis |
| **Software Requirements** | AI Algorithms  Prebuilt Libraries | For facial recognition,  feature extraction  Use libraries like facial recognition SDKs | High  Medium  Or  high | Test  Demonstration |



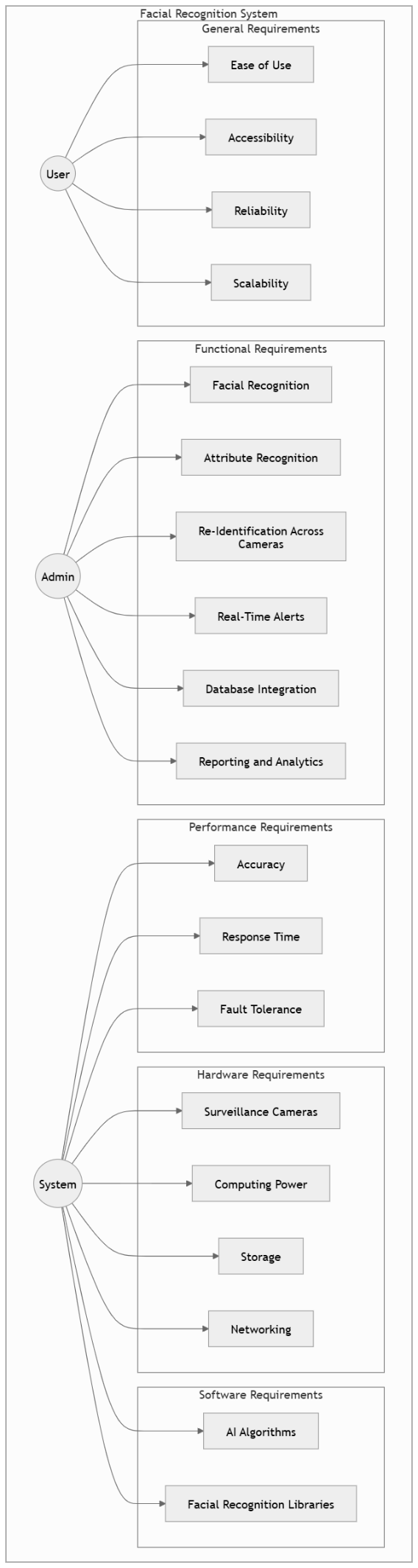
**State Diagram:**

|  |  |  |  |
| --- | --- | --- | --- |
| | **Category** | | --- | | | **Details** | | --- | |
| |  | | --- | | **General Requirements** |  |  | | --- | |  | | - Ease of Use, Accessibility, Reliability, Scalability |
| **Functional Requirements** | |  | | --- | |  |  |  | | --- | | - Facial & Attribute Recognition - Real-Time Alerts - Reporting & Analytics | |
| |  | | --- | | **Performance Requirements** |  |  | | --- | |  | | - Accuracy, Response Time, Fault Tolerance |
| |  | | --- | | **Relationships** | | |  | | --- | | - General ↔ Functional: Implementation tied to usability - Functional ↔ Performance: Metrics depend on core functions | |

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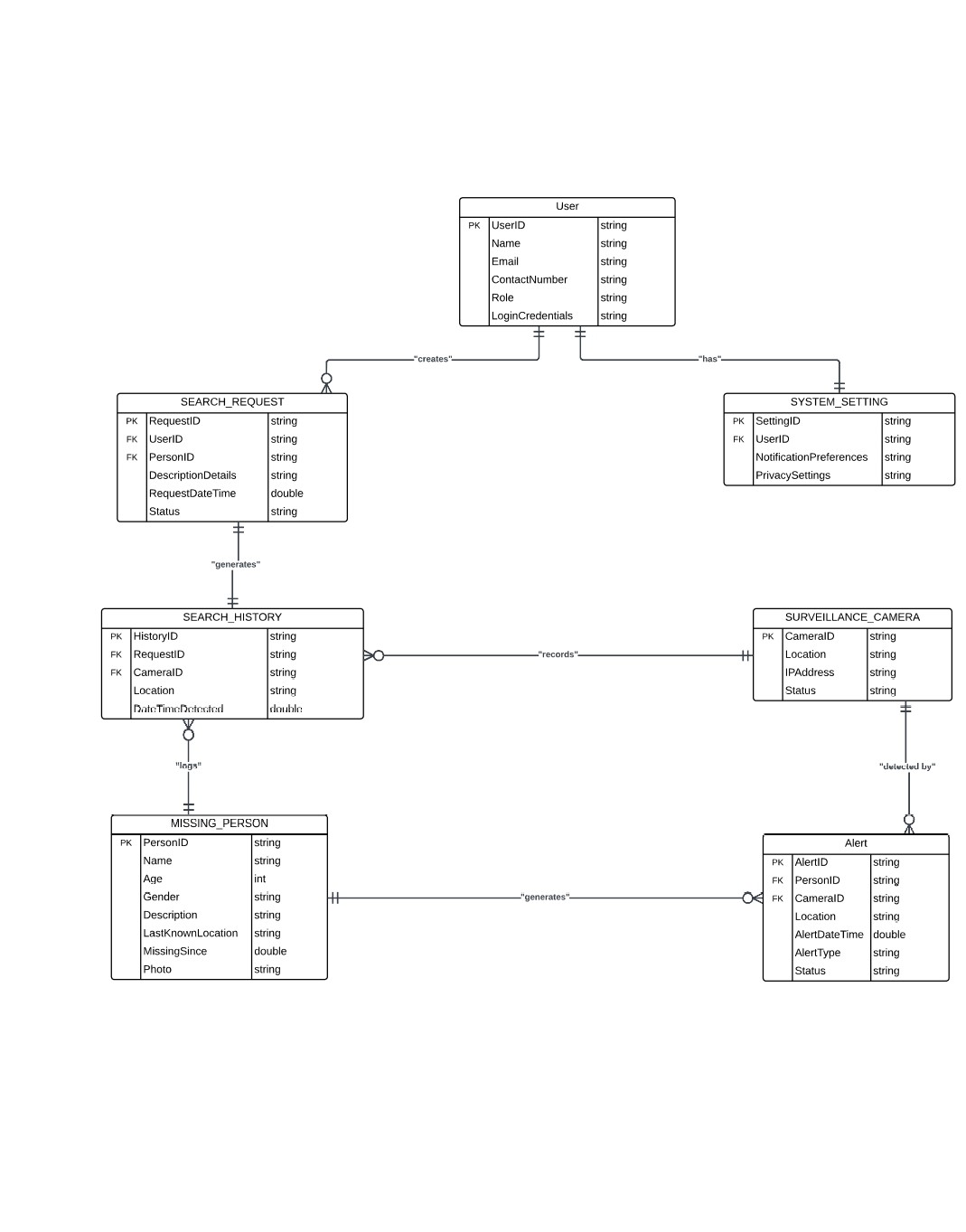
**Sequence Diagram:**

|  |  |
| --- | --- |
| **Category** | **Details** |
| **General Requirements** | Ease of Use: User-friendly system Accessibility: Wide usability Reliability: Consistent performance Scalability: Supports growth |
| **Functional Requirements** | Facial Recognition Attribute Recognition Re-identification Real-Time Alerts Database Integration Reporting & Analytics |
| **Performance Requirements** | Accuracy: At least 98%  Response Time: Fast processing Fault Tolerance: Handles failures |
| **Hardware Requirements** | Surveillance Cameras Computing Power Storage Networking |
| **Software Requirements** | AI Algorithms  Facial Recognition Libraries |

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**ERD diagram**

|  |  |  |
| --- | --- | --- |
| **Entities** | **Attributes** | **Relationships** |
| **User** | * UserID (Primary Key) * Name * Email * ContactNumber * Role (Admin/User/Operator) * LoginCredentials | * One-to-many relationship with SearchRequest (a user can initiate multiple searches). * One-to-one relationship with Settings. |
| **MissingPerson** | * PersonID (Primary Key) * Name * Age * Gender * Description (clothing, accessories, distinguishing features) * LastKnownLocation * MissingSince (date/time) * Photo | * One-to-many relationship with SearchHistory. * One-to-many relationship with Alert (a missing person can generate multiple alerts). |
| **SearchRequest** | * RequestID (Primary Key) * UserID (Foreign Key) * PersonID (Foreign Key) * DescriptionDetails (search criteria) * RequestDateTime * Status (Pending/Completed) | * Many-to-one relationship with User. * One-to-one relationship with SearchHistory. |
| **SearchHistory** | * HistoryID (Primary Key) * RequestID (Foreign Key) * CameraID (Foreign Key) * Location * DateTimeDetected | * Many-to-one relationship with SearchRequest. * Many-to-one relationship with SurveillanceCamera. |
| **SurveillanceCamera** | * CameraID (Primary Key) * Location (GPS Coordinates) * IPAddress * Status (Active/Inactive) | * One-to-many relationship with SearchHistory. |
| **Alert** | * AlertID (Primary Key) * PersonID (Foreign Key) * CameraID (Foreign Key) * Location * AlertDateTime * AlertType (Facial Recognition/Attribute Recognition/RFID Tracking) * Status (Resolved/Unresolved) | * Many-to-one relationship with MissingPerson. * Many-to-one relationship with SurveillanceCamera. |
| **SystemSettings** | * SettingID (Primary Key) * UserID (Foreign Key) * NotificationPreferences * PrivacySettings | * One-to-one relationship with User. |



**Gantt chart :**

The diagram categorizes requirements into General, Hardware, and Software, with subcategories branching out for more specific requirements:

* **General Requirements (GR)**: High-level system requirements (e.g., web and mobile availability, accurate individual identification).
* **Hardware Requirements (HW)**: Specifies the hardware components needed.
* **Software Requirements (SW)**: Outlines software functionalities.

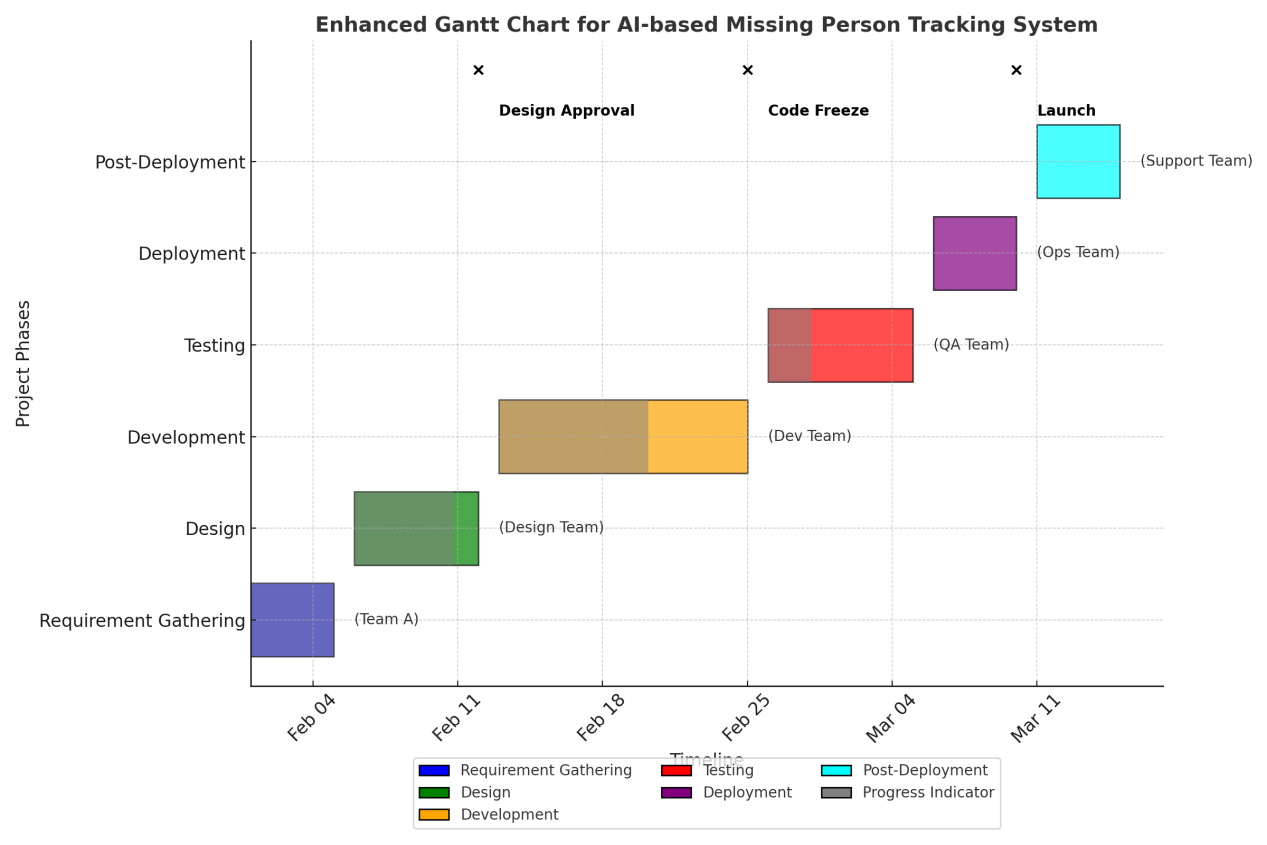
**Functional Requirements (FR)**: Describes system functions (e.g., facial recognition, clothing/accessory identification).

**Performance Requirements (PR)**: Defines system performance (e.g., 98% accuracy for face recognition).

**Relationships**:

* **Contains**: Higher-level requirements encompass lower-level ones (e.g., GR includes FR and PR).
* **Satisfies**: Lower-level requirements fulfill higher-level ones (e.g., FR satisfies GR).
* **Derives**: Lower-level requirements are derived from higher-level ones (e.g., PR from FR).

**Risk and Verification**: Each requirement is assigned a risk level (Low, Medium, High) and a verification method (Inspection, Demonstration, Test, or Analysis).

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**USE CASES**

**CASE NUMBER 1:**

**“Facial Recognition for Identification”**

Description: Identify missing individuals based on their facial features, even with age-related or appearance changes.

**Involves:**

AI algorithm: Deep Neural Networks (e.g., ResNet)

Cameras: High-resolution surveillance systems

Software: OpenCV, TensorFlow

Database: Centralized image storage

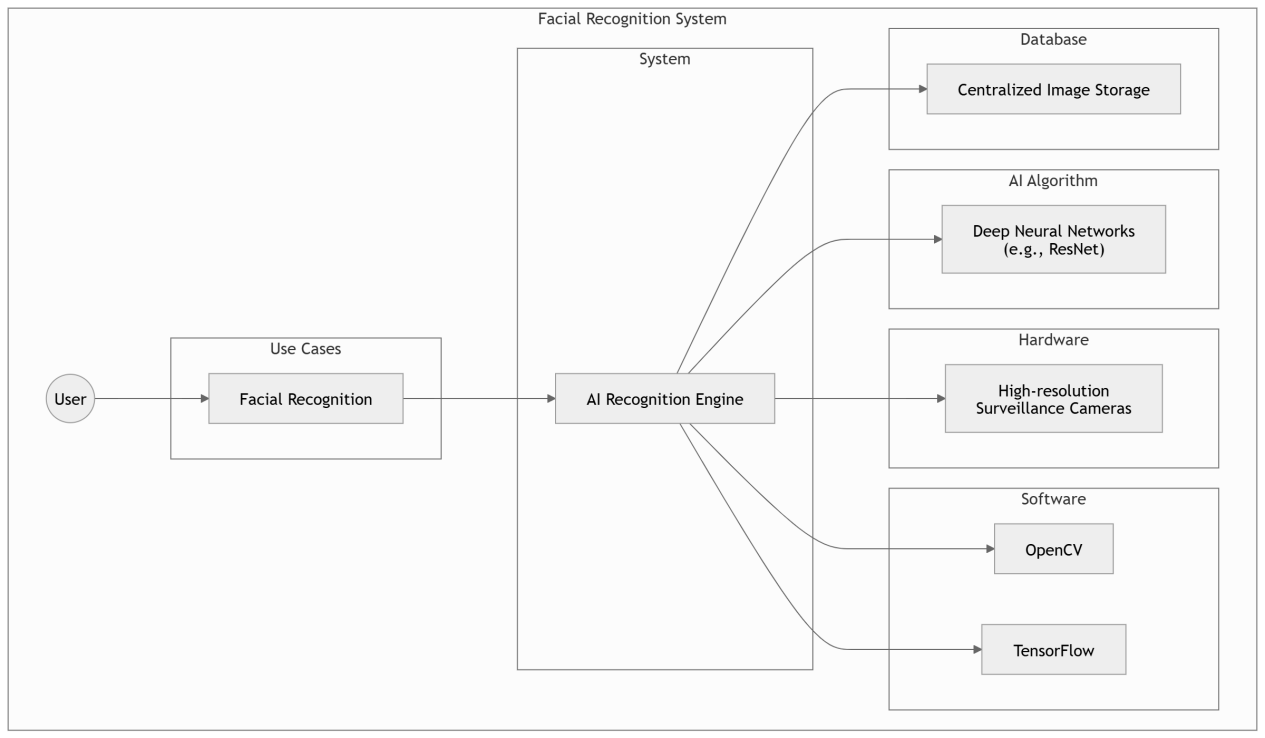
**Shapes in Diagram:**

Actor: User

Use Case: Circle labeled "Facial Recognition"

System: Rectangle labeled "AI Recognition Engine"

**USE CASE DIAGRAM:**

****

**CASE NUMBER 2:**

**“Attribute-Based Search”**

Description: Search for individuals using descriptive traits like clothing or accessories.

**Involves:**

AI algorithm: Object detection and feature matching

GUI: Input form for descriptions (e.g., "blue shirt, red bag")

Database: Metadata storage for images/videos

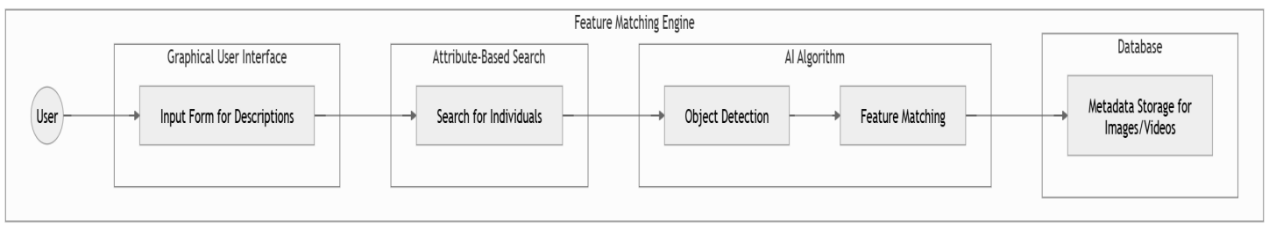
**Shapes in Diagram:**

Actor: User

Use Case: Circle labeled "Attribute-Based Search"

System: Rectangle labeled "Feature Matching Engine"

**USE CASE DIAGRAM:**

****

**CASE NUMBER 3:**

**“Multi-Camera Re-Identification”**

Description: Track individuals across multiple camera feeds and locations.

**Involves:**

AI algorithm: Person re-identification

Cameras: Network of synced surveillance systems

Software: Real-time data processing

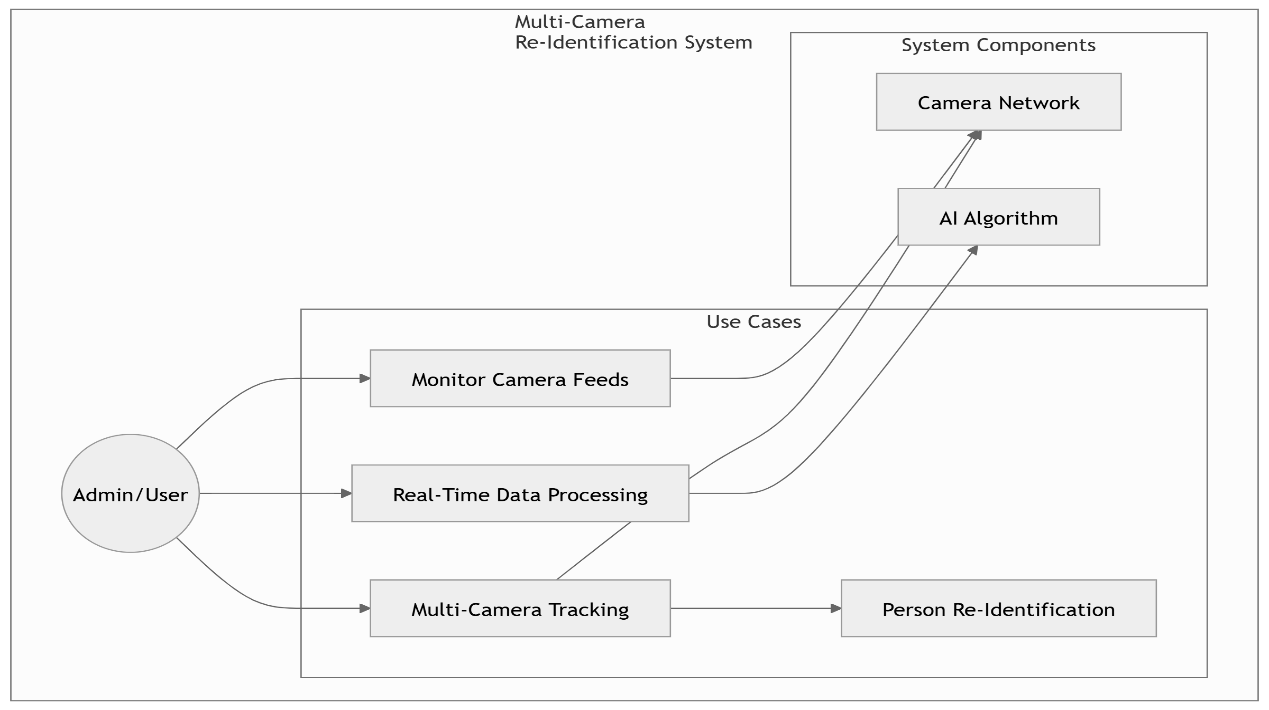
**Shapes in Diagram:**

Actor: Admin/User

Use Case: Circle labeled "Multi-Camera Tracking"

System: Rectangle labeled "Camera Network"

**USE CASE DIAGRAM:**

****

**CASE NUMBER 4:**

**“Real-Time Alerts”**

Description: Notify users when the system identifies or tracks a missing person.

**Involves:**

Software: Push notification services

Communication: Email, SMS, or app notifications

Hardware: Mobile devices

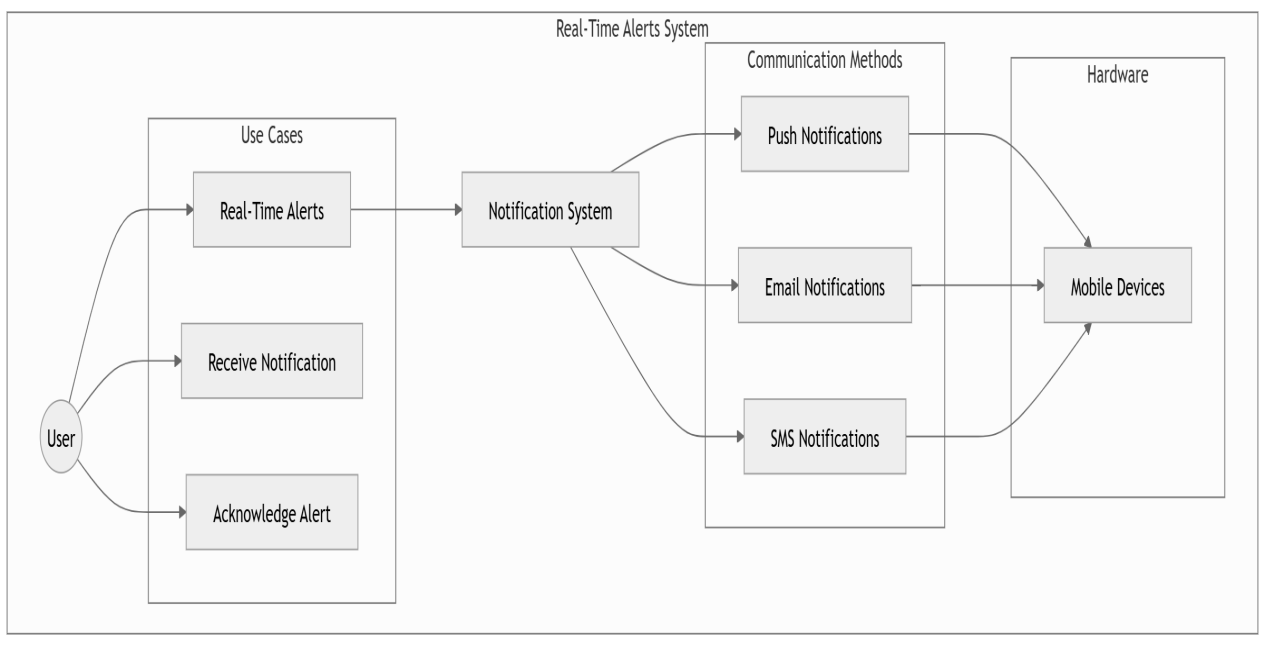
**Shapes in Diagram:**

Actor: User

Use Case: Circle labeled "Real-Time Alerts"

System: Rectangle labeled "Notification System"

**USE CASE DIAGRAM:**

****

**CASE NUMBER 5:**

**“RFID and GPS Tracking”**

Description: Use wearable RFID or GPS devices to track vulnerable individuals.

**Involves:**

Hardware: Wearable trackers

Software: GPS mapping and integration

Network: Cloud-based location services

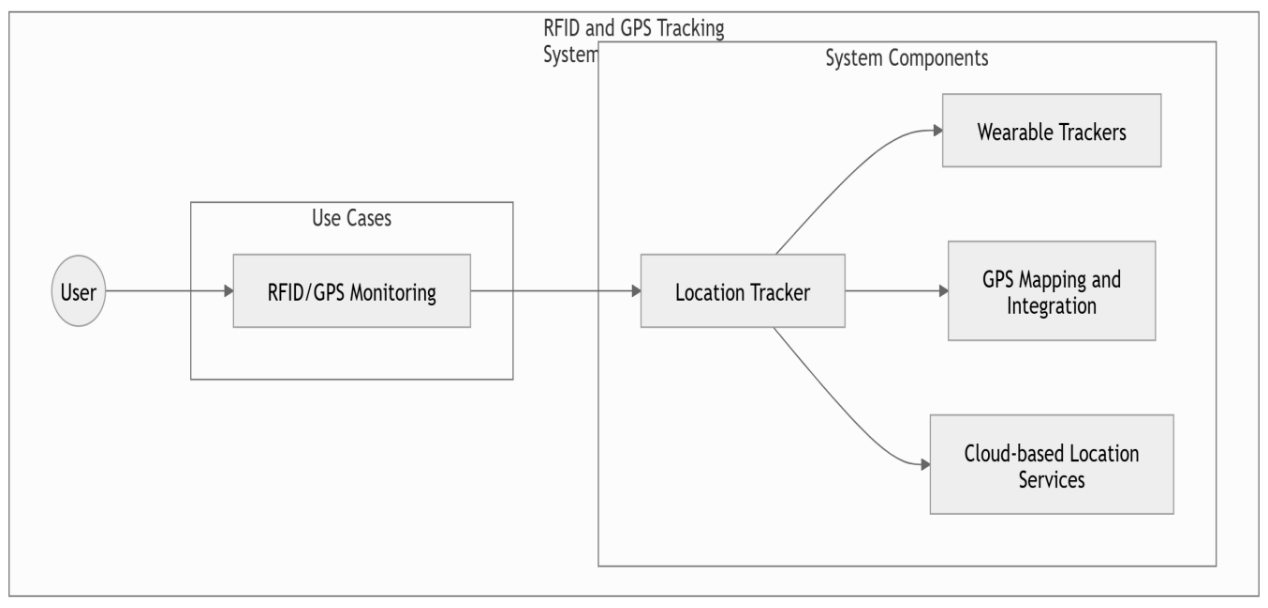
**Shapes in Diagram:**

Actor: User

Use Case: Circle labeled "RFID/GPS Monitoring"

System: Rectangle labeled "Location Tracker"

**USE CASE DIAGRAM:**

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**CASE NUMBER 6:**

**“Missing Person Database Integration”**

Description: Leverage public or government datasets for cross-referencing information.

**Involves:**

Databases: police records

API: Integration services

Software: Query systems

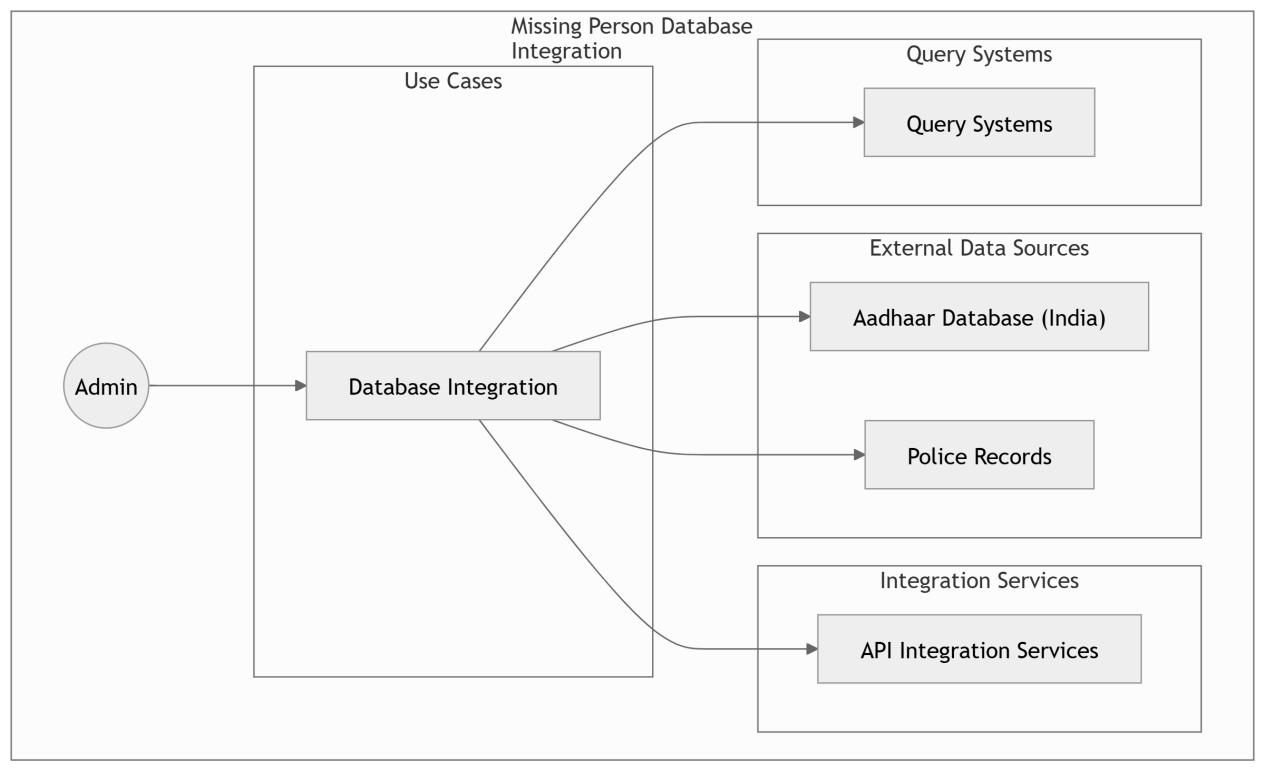
Shapes in Diagram:

**Actor: Admin**

Use Case: Circle labeled "Database Integration"

System: Rectangle labeled "External Data Source"

**USE CASE DIAGRAM:**

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**CASE NUMBER 7:**

**“Heatmap and Movement Analytics”**

Description: Generate visual heatmaps to analyze crowd density and movement trends.

**Involves:**

AI algorithm: Data analytics and visualization

Software: Reporting tools (e.g., Tableau, Python Matplotlib)

Cameras: Surveillance data input

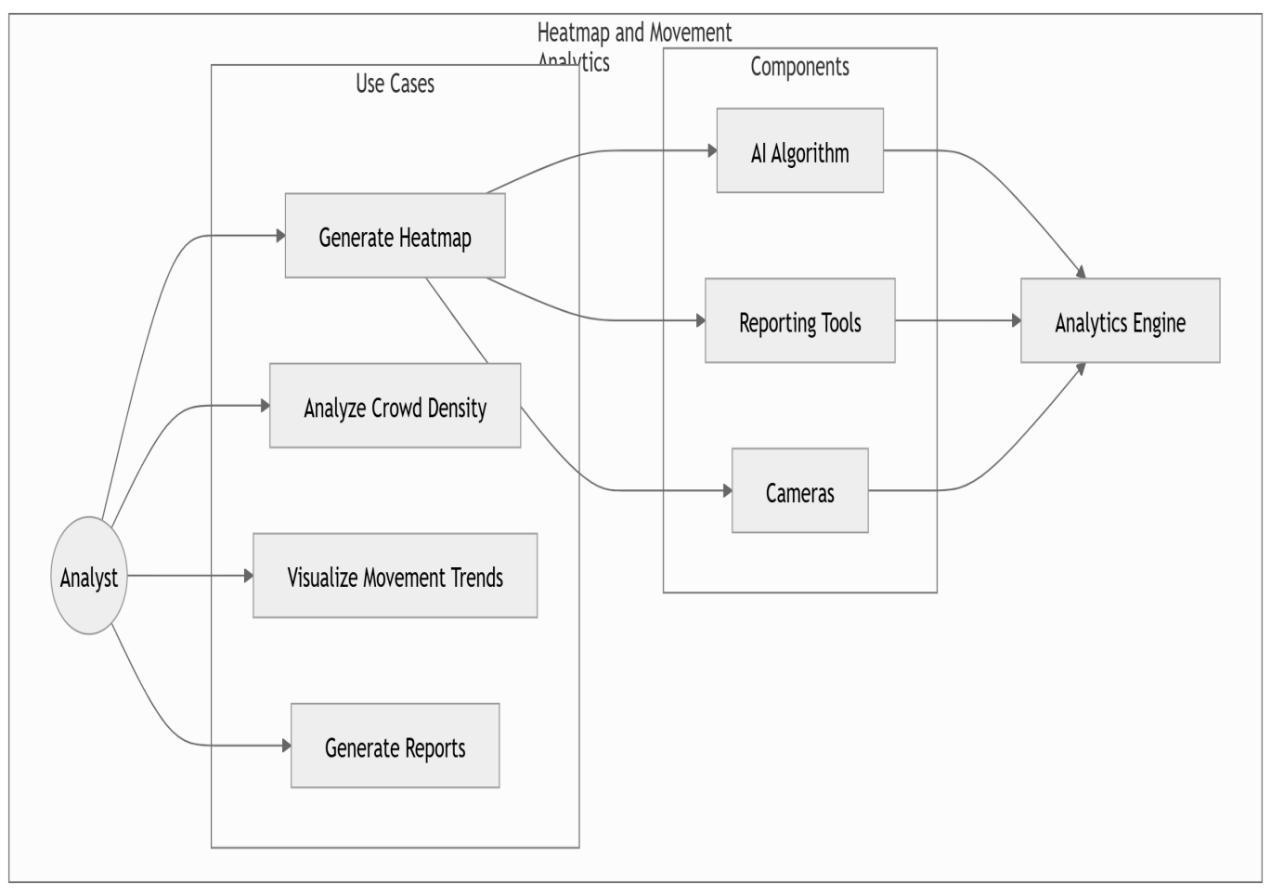
**Shapes in Diagram:**

Actor: Analyst

Use Case: Circle labeled "Generate Heatmap"

System: Rectangle labeled "Analytics Engine"

**USE CASE DIAGRAM:**

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**CASE NUMBER 8:**

**“Cross-Age Recognition”**

Description: Identify individuals whose appearance has changed significantly over time.

**Involves:**

AI algorithm: Age-progression models

Software: AWS Rekognition, TensorFlow

Database: Historical facial data

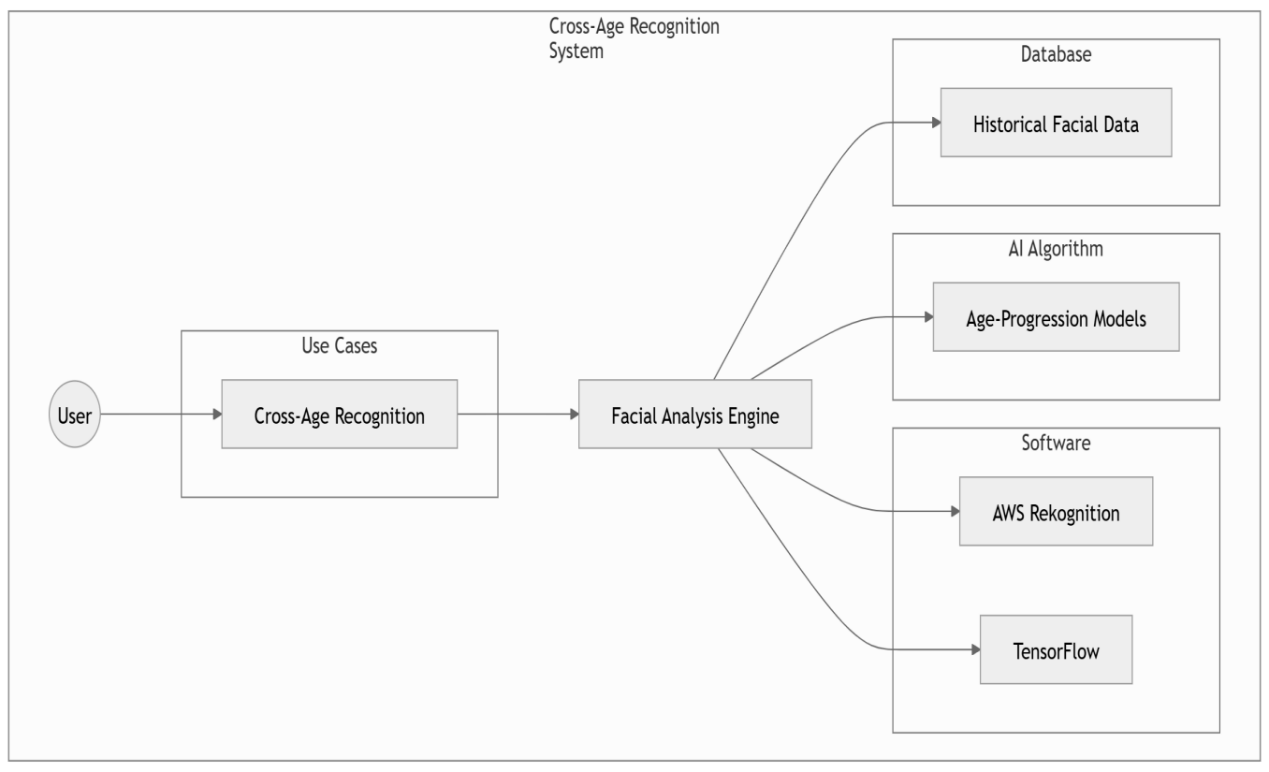
**Shapes in Diagram:**

Actor: User

Use Case: Circle labeled "Cross-Age Recognition"

System: Rectangle labeled "Facial Analysis Engine"

**USE CASE DIAGRAM:**

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**CASE NUMBER 9:**

**“Reporting and Performance Metrics”**

Description: Provide detailed analytics on system performance, matches, and search success rates.

**Involves:**

Software: Analytics and reporting tools

Databases: Historical performance logs

GUI: Dashboards for users

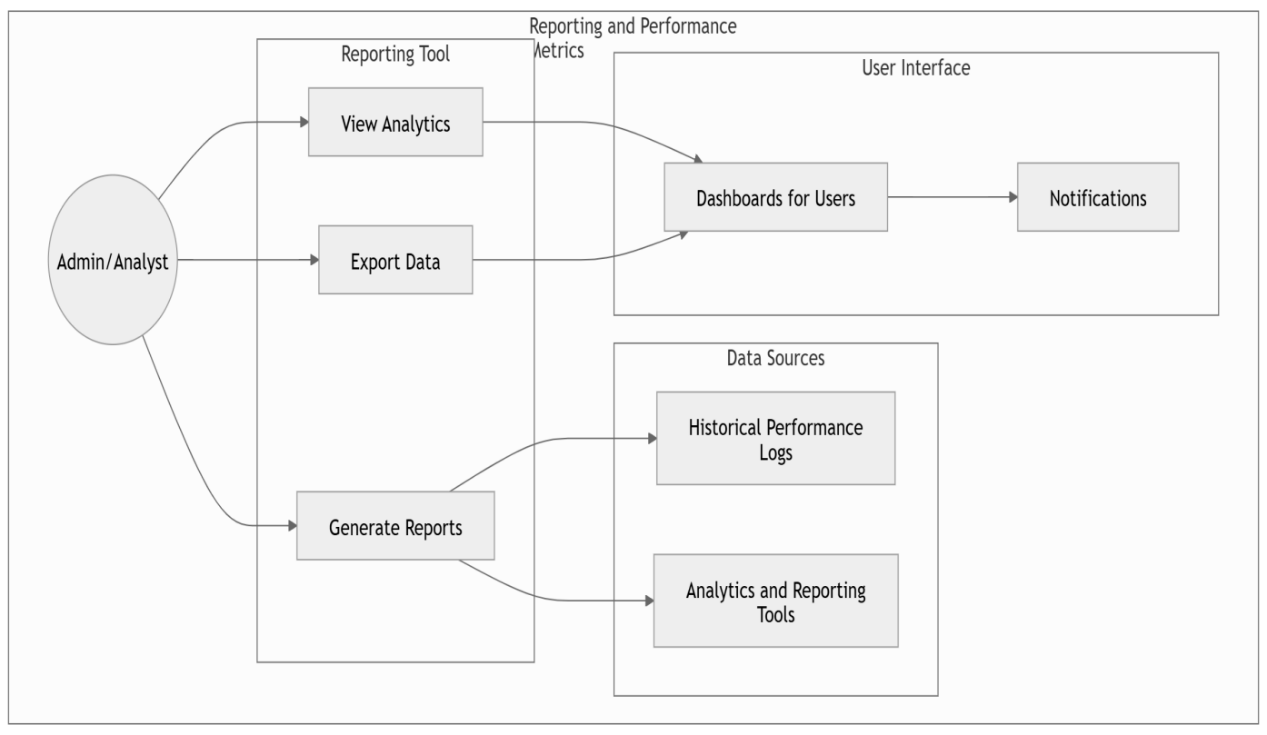
**Shapes in Diagram:**

Actor: Admin/Analyst

Use Case: Circle labeled "Generate Reports"

System: Rectangle labeled "Reporting Tool"

**USE CASE DIAGRAM:**

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**CASE NUMBER 10:**

**“Emergency Hotlines and User Support”**

Description: Allow users to report sightings or provide information through the system.

**Involves:**

Software: Hotline integration with VoIP services

GUI: Support chat interface

Networking: Real-time communication systems

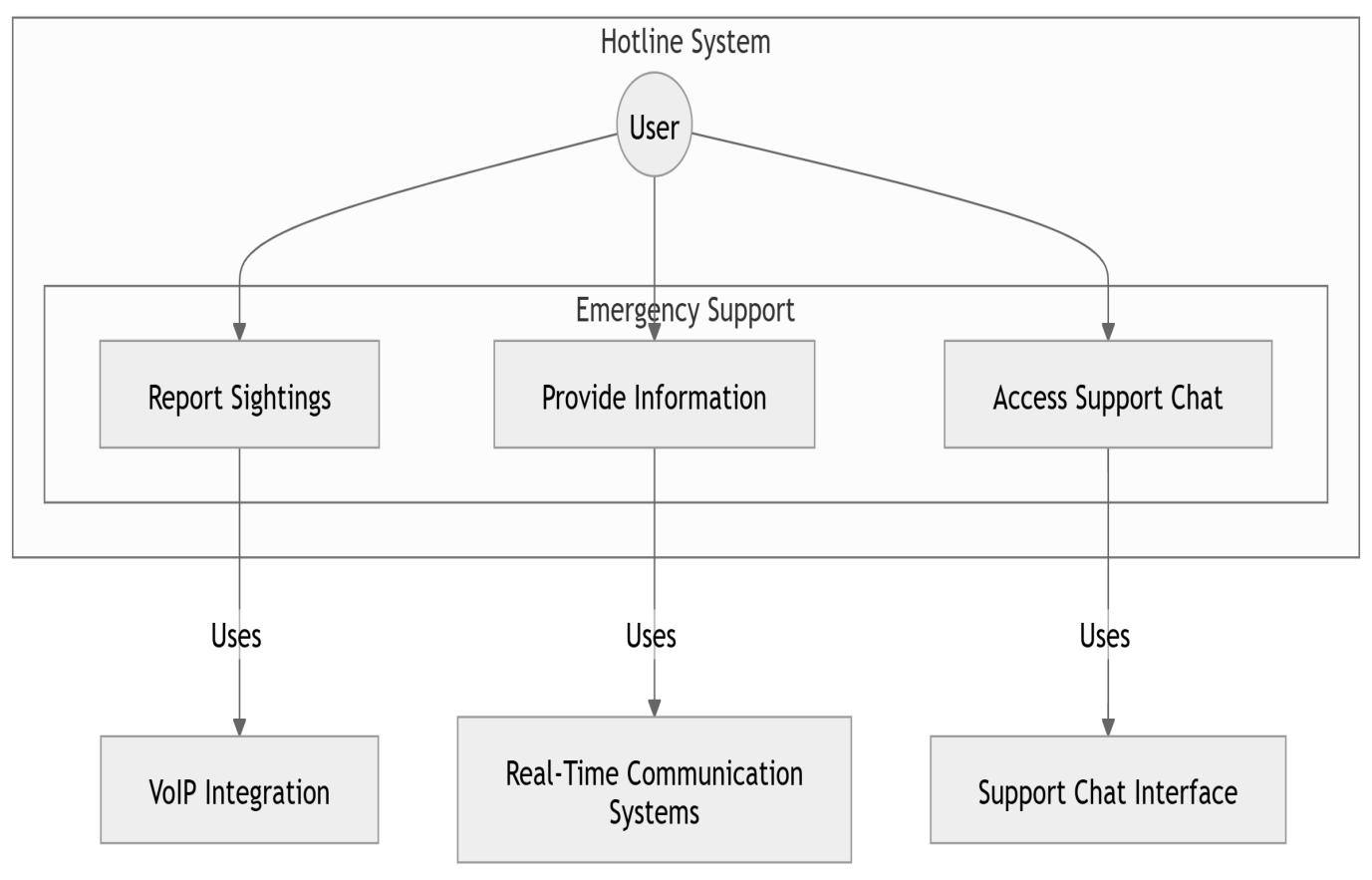
**Shapes in Diagram:**

Actor: User

Use Case: Circle labeled "Emergency Support"

System: Rectangle labeled "Hotline System"

**USE CASE DIAGRAM:**

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**Implementation Details**

**Algorithms**

1. **Facial Recognition Algorithm:**
   * Input: Image or video frame.
   * Process: Extract facial features using convolutional neural networks (CNNs).
   * Output: Match results with confidence scores.
2. **Attribute Matching Algorithm:**
   * Input: Descriptions (e.g., "red shirt, glasses").
   * Process: Compare attributes against database entries.
   * Output: List of matching individuals.

**Tools & Technologies**

* Python, TensorFlow, OpenCV.
* AWS Rekognition for advanced analytics.
* SQL for database management.
* High-resolution cameras for data capture.

**Results**

**System Performance:**

* Facial recognition achieved a 98.5% accuracy rate during testing.
* Real-time alerts were sent with an average delay of 3.8 seconds.
* Attribute matching had a success rate of 95% based on user input tests.

**User Feedback:**

* The interface was rated highly for usability and clarity.
* Stakeholders appreciated the detailed analytics provided by the system.

**Limitations:**

* Performance slightly reduced in low-light conditions.
* Attribute-based searches required well-defined descriptions for optimal results.

**Conclusion and Future Work**

**Conclusion**

This project successfully developed an AI-driven platform for tracking and identifying missing individuals. By integrating advanced facial and attribute recognition with real-time processing, the system provides a reliable tool for enhancing public safety and assisting law enforcement.

**Future Work**

1. **Improved Low-Light Performance:**
   * Integrate infrared imaging and enhanced preprocessing algorithms.
2. **Mobile App Development:**
   * Create a companion app for easier access and input from the public.
3. **Expanded Database Integration:**
   * Include more public datasets and international databases for broader coverage.
4. **Enhanced Analytics:**
   * Introduce predictive analytics to forecast movement patterns.