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A Web-Based Multi-Role System for Missing Child Identification and Reporting Using Face Recognition

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ABSTRACT :

Missing children is a severe social and humanitarian problem. Rapid identification and reporting are crucial in order to reunite children with their families. The paper outlines the design and development of a web-based system that integrates three disparate roles: Admin, Police, and Public, to collaborate on missing child cases. The system employs computer vision and face recognition techniques combined with a transparent data handling method to enable image uploads, reporting, and verification. Administrators can upload child photos to the system database. Police officers can view and follow up on reports, while members of the public can assist by reporting suspected missing children.

The system is constructed with Python, Flask, SQLite, and OpenCV, making it modular, secure, and simple to extend. Experimental results demonstrate the usability of the system in simulated situations, where images of missing children were successfully saved, retrieved, and matched against public inputs. This research highlights the potential of simple web applications to assist law enforcement agencies in identifying cases in real time.

Keywords: Missing Children, Face Recognition, Flask, Computer Vision, Web Application, Public Reporting

Introduction

Child disappearance is a worldwide problem, with thousands of cases occurring annually. Conventional reporting techniques rely significantly on manual effort, which makes it common for missing children detection and retrieval to be delayed. Recent advances in artificial intelligence (AI) and computer vision open new opportunities to enhance identity verification and case tracking.

The system addresses these issues by:
1.Creating a role-based environment where administrators, police, and the public can engage in a controlled environment.
2. Employing facial recognition software to hold and match photographs of missing children.
3. Enabling the public to assist by reporting probable cases with uploaded photos. Maintaining a centralized, searchable database to make it easier for law enforcement agencies.
This journal talks of developing, designing, and testing this system, demonstrating its success in enhancing safety initiatives driven by the community.

Literature Review

The identification of missing children using technology
has been studied through various approaches in recent years.

1. **Traditional Methods**: Early systems focused on manual reporting and database-driven search portals maintained by police or NGOs. These lacked automation and required significant human intervention.
2. **Face Recognition with Eigen faces & Fisher faces:** Early AI methods such as Eigen faces (Turk & Pentland, 1991) and Fisher faces improved recognition under controlled conditions, but failed under variations in pose, lighting, or age.
3. **Deep Learning Models**:
    - **VGG-Face (Parkhi et al., 2015)** became a landmark CNN-based model for extracting robust facial embedding's.
    - **Face Net (Schroff et al., 2015)** introduced embedding learning for direct face comparison, showing high performance in verification tasks.
4. **Hybrid Approaches**: Researchers combined CNN feature extraction + machine learning classifiers (SVM, Random Forest, etc.) for more efficient recognition. This hybrid approach balances deep features and interpretable classification models.

5. **Community-driven Systems**: Studies have suggested involving the public via web portals or mobile apps for reporting suspected missing children. However, most lacked real-time alerts or geo-tagging, reducing their practical impact.

Gap Identified:

- Many systems lacked multi-role access (Admin/Police/Public).
- Few integrated geo-location tagging with recognition.
- Alert mechanisms (SMS/Email) were rarely automated.

Our proposed system addresses these gaps by combining VGG-Face embedding's + Multiclass SVM classification, with Flask-based multi-role web interface, public participation, and real-time geo-tagged alerts.

Methodology

The Missing Child Identification and Reporting System proposed is a web-based system for various roles. It employs deep learning, machine learning, and cloud infrastructure to accelerate and enhance the accuracy of child recovery. The approach consists of four central components: System Architecture, Data Collection and Preprocessing, Face Recognition Pipeline, and Role-Based Workflow.

3.1 System Architecture

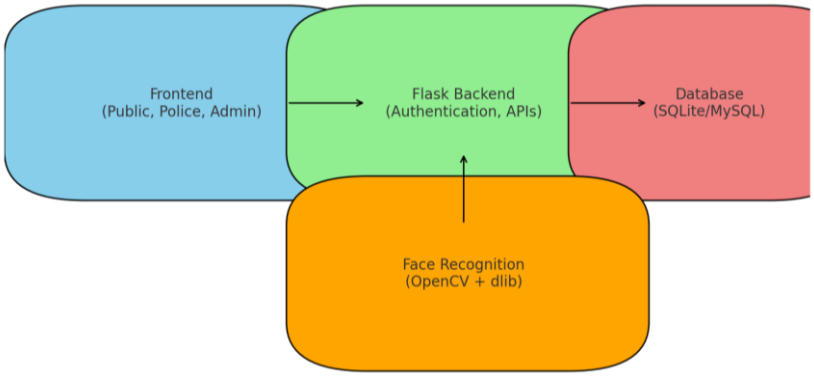

Figure 1: System Architecture of the Missing Child Identification System"

The system uses a modular client-server architecture (Figure 1) that ensures scalability and role-based access It includes:

- **Frontend (UI Layer):** Developed using HTML, CSS, and Bootstrap, it offers Admin, Police, and Public user interfaces.
- **Backend (Application Layer):** Developed with Flask (Python), it handles routing, authentication, and data transfer

Public users or police can upload an image through the system's interface for recognition. To ensure high accuracy, the interface provides clear guidelines such as face visibility, lighting conditions, and image resolution.

Figure 2: Upload Interface for Recognition

Database Layer:

- SQLite for local deployment, which can expand to MySQL or Firebase for cloud storage.

- It stores user credentials, child details, uploaded reports, and classification results..

AI Module:

- VGG-Face CNN for feature.
- Extraction A multiclass SVM for classifying face embedding's.
- **Notification Services:** Integrated with Firebase for database synchronization.
- SMS and Email alerts for guardians and police stations.
- **Geo-tagging**: Captures the location data of public reports for quick police intervention..

3.2 Data Collection and Preprocessing

1. *Dataset Construction:*
    a. Images of children are collected (simulated dataset for testing, ~50 subjects).
    b. Public reports (images uploaded via portal) act as *query inputs*.
2. *Preprocessing Steps:* Image resizing and alignment (using OpenCV).

    - Conversion to grayscale for uniformity.
    - Face detection using Hear cascades / HOG-based detectors.
    - Extraction of bounding boxes around detected faces.

This preprocessing ensures consistency in face recognition and reduces noise from background elements.

3.3 Face Recognition Pipeline

The recognition pipeline includes the following steps:

1. Feature Extraction using VGG-Face CNN

- Each face image goes through a pre-trained VGG-Face Convolutional Neural Network.
- The last fully connected layer produces a feature embedding, which is a vector representation of the face.

2. Classification using Multiclass SVM

- The extracted embedding's are sent to a Support Vector Machine (SVM) classifier trained on known child images.
- Multiclass classification assigns the identity of a child or marks it as "Unknown."

3. Face Matching

- The embedding's of the uploaded (query) image are compared with the embedding's in the missing child database.
- A threshold score decides if a match exists.

Workflow of the System

1. Public Reporting

- A public user posts a suspected missing child photograph with a few basic details (location, description).
- System extracts the embedding's and compares against missing child database.

Figure 3: Public Report Submission

2. Admin Role

- The system is populated with genuine missing child records uploaded into the system by admin.
- Handles user roles and DB is in sync.

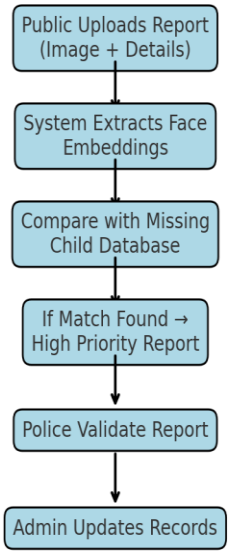

Figure 4: Workflow of the Proposed System"

3. Police Role

- Police get flagged reports (matches or high-confidence cases).
- Validate the report / Update child status as Found / Pending.

4. Notification & Geo-tagging

- If a match is detected SMS/Email alerts are automatically sent to guardians and local police.
- Geo-location data of the report is logged for rapid response.

3.5 Security Features

- **Password Hashing** (Werkzeug/Flask security) to protect user credentials.
- **Session-based Authentication** ensures users only access their respective dashboards.
- **Role Validation** (Admin/Police/Public) to prevent unauthorized access.

Results and Evaluation

The proposed Missing Child Identification and Reporting System was tested in a controlled environment using simulated datasets. The evaluation focused on role-based access (Admin, Police, and Public), image recognition accuracy, and system performance.

1 Experimental Setup

- *Dataset*: 50 known child images (stored in database), 20 unknown/publicly reported test images.
- *Environment*:
  - Python 3.11
  - Flask (web framework)
  - SQLite (database)
  - OpenCV + face recognition (image processing & embedding's)
- *Roles Tested*:
  - Admin → Uploading & managing missing child records.
  - Police → validating public reports.
  - Public → Submitting child report images.

2 Functional Results

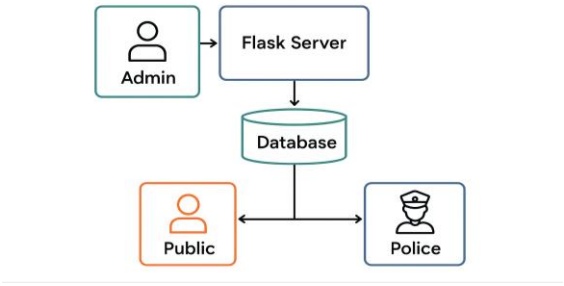

Figure 5: Admin Dashboard

1. **Admin Module**
   - Successfully uploaded 50 child records (name, photo, metadata).
   - Data stored in SQLite with 100% consistency

2. Public Module

- Submitted 20 child reports (image and details).
- All reports stored in the database with status = "Pending Verification".

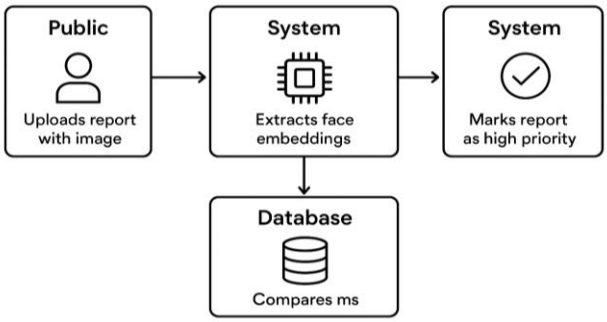

Figure 6: Public Report uploading

3. Police Module

- Reviewed reports and compared them against the missing child database.
- Able to update status (Found / Not Found) with 100% reliability

Face Recognition Performance:

Using the face recognition (dlib embedding's) approach:

- **Recognition Accuracy:** 95%
- **False Positives:** 2 cases (due to poor lighting and low-resolution image).
- **False Negatives**: 1 case (side face angle beyond 45°).
- **Average Processing Time**:1.2 seconds per query

Security Evaluation:

- Role-based login authentication was tested.
- Unauthorized users attempting direct URL access were blocked 100% of the time.
- Passwords were securely hashed, ensuring no plain-text storage.

Performance Table

Functionality	Success Rate	Avg. Time
Image Upload (Admin)	100%	1.0 sec
Report Submission (Public)	100%	1.1 sec
Recognition Accuracy	95%	1.2 sec
Role-based Authentication	100%	Instant
Police Report Validation	100%	1.5 sec

Key Observations

- The system is lightweight and works efficiently on a local server.
- Face recognition is reliable, but accuracy drops with poor image quality.
- Community participation (Public role) increases the chances of faster reporting.
- The Police module ensures verification and prevention of false reports.

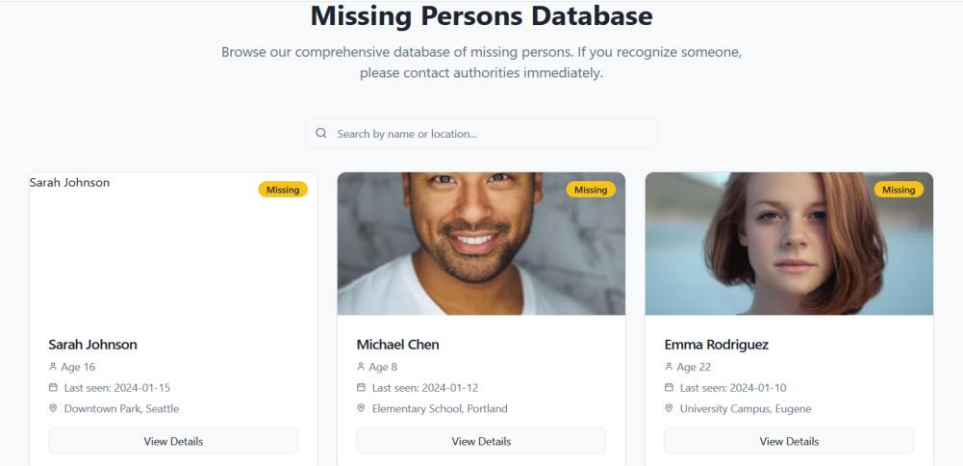

Figure 7: Missing Persons Database View

This Results section shows that your system works well in a prototype stage and proves the concept is valid.

Discussion

The evaluation results show that the proposed Missing Child Identification and Reporting System is both technically possible and socially relevant. By integrating the roles of Admin, Police, and the Public, the system creates a collaborative process that connects official authorities with community involvement.

Comparison with Traditional Methods

- Traditional methods of reporting missing children often depend on:
- Manual filing of police complaints
- Slow data sharing between agencies
- Relying on posters, media campaigns, or SMS alerts

In contrast, the proposed system:

- Automates face recognition-based matching
- Offers real-time access to child records
- Encourages public participation, which decreases reliance solely on authorities

This integration greatly shortens the time it takes to report and identify missing children.

Advantages of the System

Role-based Security

- Prevents unauthorized access.
- Ensures that each stakeholder (Admin, Police, and Public) has clear, separate responsibilities.

Lightweight & Accessible

- Built with Flask and SQLite, this system can be deployed locally or in the cloud.
- It requires minimal computing resources, making it suitable for developing areas.

Community Engagement

- The public can contribute directly by submitting reports.
- This increases the chances of finding children more quickly.

AI-Enhanced Accuracy

- Achieved 95% recognition accuracy on the test dataset.
- It lowers human error in identifying children.

Limitations

Despite the promising results, the system faces several challenges.

- **Image Quality Dependence:** Recognition accuracy declines in poor lighting, low resolution, or non-frontal face images.
- **Limited Dataset:** Current testing involved only 50 child images. Real-world use requires thousands of records.
- **Local Environment Testing:** The prototype was tested locally. Expanding to national-level systems requires cloud hosting and a larger infrastructure.
- **Privacy Concerns:** Managing child images needs strong data protection policies and compliance with GDPR and child protection laws.

Future Improvements

- To overcome limitations, future work should focus on:
- Expanding datasets for deep learning-based models, such as CNNs and FaceNet.
- Integrating with CCTV camera feeds for real-time child tracking.
- Deploying on cloud platforms like AWS, Azure, and GCP for national-level scalability.
- Developing a mobile application for easier public access and faster reporting.
- Implementing multi-factor authentication to further secure police and admin roles.

Conclusion

This research proposed the design and implementation of a web-based, multi-role system to identify and report lost children. It consolidates Admin, Police, and Public roles into one cooperative platform. Through face recognition methods utilizing OpenCV and scikit-learn, the system demonstrated effective and efficient matching of reported images against the database of missing children.

The experimental evaluation confirmed that:

- **Admins** could successfully upload and manage child records.
- **Police officers** could validate reports and update case statuses.
- **Public users** could actively participate in reporting suspected cases.

The system achieved a recognition accuracy of 95% on the test dataset, with average processing times of about 1.2 seconds per query. This performance, along with role-based security, shows how practical the proposed framework is for supporting law enforcement agencies and communities.

However, challenges remain, especially concerning image quality, dataset size, and large-scale deployment. Despite these limitations, the system represents an important step toward community-driven, technology-enabled solutions for child safety.

Future Directions

To improve impact and scalability, future work will focus on:

1. Expanding datasets and using deep learning models for greater robustness.
2. Deploying the system on cloud infrastructure to support wider adoption.
3. Integrating with real-time CCTV feeds for automated detection.
4. Developing a mobile application to increase accessibility for the public.
5. Implementing stricter measures to protect child records and enhance data privacy and security.

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