

A Web Portal for Tracking and Finding Missing Person Using Aadhaar Enabled Biometrics

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Abstract

The Aadhaar-Enabled Biometric Web Portal for Finding Missing Persons research aims to address the critical issue of locating missing individuals by leveraging Aadhaar-enabled biometric data. With the widespread adoption of Aadhaar cards in India, this research uses the unique biometric information linked to Aadhaar cards to create a web portal. Through this portal, users can input relevant biometric data, such as fingerprints or iris scans, which are then compared with the Aadhaar database. The system utilizes advanced biometric matching algorithms to accurately identify potential matches, thereby aiding law enforcement agencies and concerned individuals in locating missing persons efficiently. By integrating Aadhaar-enabled biometrics into a user-friendly web interface, this research facilitates swift and accurate identification, offering a valuable tool in the effort to reunite missing individuals with their families and loved ones.

Keywords: Face Recognition, Aadhaar Biometrics, Deep Learning, Data Analysis, Database Management.

1. Introduction

The Aadhaar-Enabled Biometric Web Portal for Finding Missing Persons research proposes a ground-breaking solution to the persistent challenge of locating missing individuals. By leveraging the widespread adoption of Aadhaar cards in India, the proposed study capitalizes on the unique biometric data associated with each card to create an innovative web portal. This portal serves as a centralized platform where users can input crucial biometric information, such as fingerprints or iris scans. Utilizing advanced biometric matching algorithms, the portal then compares this data against the vast Aadhaar database, swiftly identifying potential matches [1-3].

This streamlined approach revolutionizes the traditional methods of searching for missing persons, offering a more efficient and accurate means of identification [4]. Families and communities grappling with the anguish of missing loved ones stand to benefit greatly from this initiative, as it provides a beacon of hope for resolution and closure [5]. Furthermore, the study empowers law enforcement agencies with a powerful tool to expedite their investigations and enhance their search efforts. By integrating cutting-edge technology with Aadhaar-enabled biometrics, this research represents a significant step forward in addressing the societal challenge of missing persons in India [6-8].

2. Existing System

1. **National Crime Information Centre (NCIC):** NCIC is a centralized database maintained by the Federal Bureau of Investigation (FBI) in the United States. It includes a section dedicated to missing persons, allowing law enforcement agencies to enter and search for information about individuals reported missing. While NCIC primarily relies on traditional identifiers such as physical descriptions and photographs, it plays a crucial role in coordinating nationwide efforts to locate missing persons.
2. **Facial Recognition Systems:** Various facial recognition systems, both commercial and governmental, are used worldwide for identifying individuals from images or videos. These systems analyse facial features and patterns to match faces against databases of known individuals. This method is increasingly utilized by law enforcement agencies for locating missing persons and identifying unidentified individuals [9,10].

- 3. Automated Fingerprint Identification Systems (AFIS):** AFIS is a biometric system used to automatically match fingerprints against a database of known prints. It is used by law enforcement agencies for both criminal identification purposes and missing persons cases. By comparing fingerprints found at crime scenes or on personal belongings to databases of known individuals, AFIS can help identify missing persons or link them to specific locations or events [11].
- 4. AMBER Alert System:** The AMBER (America's Missing: Broadcast Emergency Response) Alert system is an emergency alert system used in several countries, primarily in the United States, Canada, and Europe. It disseminates information about abducted children to the public via various media channels, including television, radio, and digital road signs. While not directly related to biometric identification, the AMBER Alert system plays a crucial role in rapidly notifying the public and law enforcement about missing children, increasing the chances of their safe recovery [12].
- 5. Interpol's Missing Persons Database:** Interpol, the international police organization, maintains a database dedicated to missing persons cases. This database allows law enforcement agencies worldwide to share information and collaborate on locating missing individuals across borders. While primarily focused on traditional identifiers such as physical descriptions and photographs, Interpol's database also facilitates the exchange of biometric data and other relevant information to aid in identifying and locating missing persons on a global scale.

3. Proposed Solution

i. Registration of Missing Persons

- Authorized officials would access the portal and register details of missing individuals.
- This would include Aadhaar number (if available) and any additional information like photos, last known location, and description.

ii. Searching for Missing Persons

Two primary methods would be available:

- By Aadhaar Number: If the missing person has an Aadhaar card, officials can search the database using their Aadhaar number. This would retrieve any existing biometric data associated with the individual.
- By Uploading Biometric Data: In cases where an unidentified person is found (e.g., a runaway child), law enforcement can upload fingerprints or iris scans captured from the individual.

iii. Biometric Matching

The core functionality of the portal involves robust biometric matching algorithms.

- For Aadhaar number searches, the system would compare the retrieved biometric data (fingerprints/iris scans) with the uploaded unknown individual's data.
- For uploaded scans, the system would compare them against the entire Aadhaar database containing biometric information of registered individuals.

iv. Alerting

- The matching algorithm would return results with a similarity score. A high score would indicate a potential match for the missing person.
- The system wouldn't directly generate emails. However, upon a high-scoring match, authorized officials would be notified within the portal interface or through a secure messaging system.

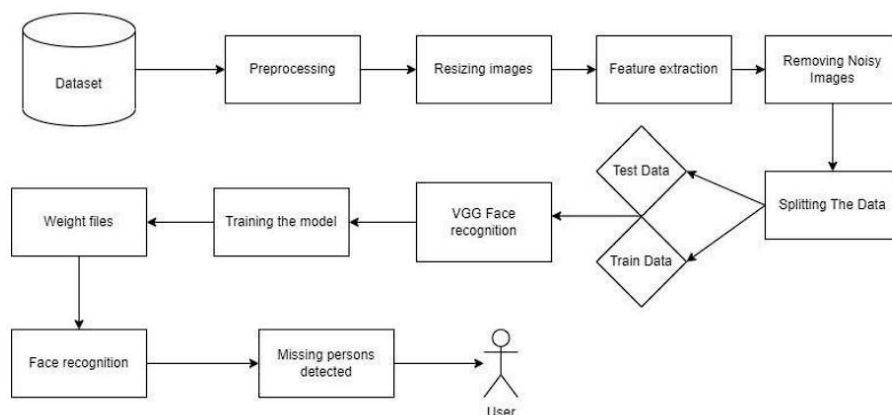


Figure 3.1. Architecture Diagram

A. Image Processing Module

The Image Processing Module is responsible for pre-processing and analyzing images submitted to the web portal. It consists of various sub-modules and functionalities aimed at enhancing the quality of images and extracting relevant information for biometric matching. Key components of this module include:

- **Image Pre-processing:** This sub-module involves tasks such as noise reduction employing the Gaussian Blur, image enhancement which was done applying histogram equalization, contrast stretching, and sharpening filters and Z-score normalization to ensure consistency and accuracy in image analysis.
- **Feature Extraction:** Feature extraction in the proposed work is carried out using the pre-trained VGG to identify and extract relevant information or patterns from raw images. This process involves Extraction of low-level features (e.g., edges, textures) in early layers and high-level features (e.g., facial structures, patterns) in deeper layers.
- **Quality Assessment:** This sub-module assesses the quality of images to determine their suitability for biometric analysis. It identifies factors such as blurriness, occlusions, or low resolution that may affect the accuracy of biometric matching.
- **Image Segmentation:** In cases where multiple individuals are present in an image or when specific regions of interest need to be isolated (e.g., faces in a crowd), this sub-module performs image segmentation to extract relevant areas for further analysis.

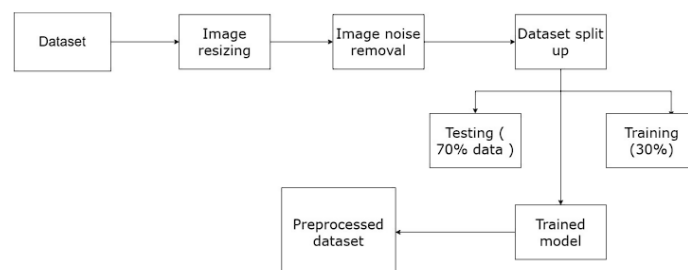


Figure 3.2. Image Processing Module

The pre-trained VGG Face model integrated in the web portal extracts facial features and compares them against a database containing photos of registered missing persons when an unidentified person's photo is uploaded.

B. Detection Module

The Detection Module focuses on identifying potential matches between submitted biometric data and records in the Aadhaar database. It employs sophisticated algorithms and techniques to compare biometric features and determine the likelihood of a match. The module comprises the following components:

- **Biometric Matching Algorithms:** This component includes various algorithms tailored to different biometric modalities, such as facial recognition algorithms, fingerprint matching algorithms, or iris recognition algorithms. These algorithms compare the extracted features from submitted biometric data with those stored in the Aadhaar database to identify potential matches. Haar cascades can be employed as a preprocessing step to detect and extract facial features from an input image.
- **Threshold Setting:** To balance between false positives and false negatives, this component defines threshold values for biometric similarity scores. These thresholds determine the minimum level of similarity required to consider a match and are adjustable based on the desired level of accuracy and sensitivity. Haar cascades can assist in determining the quality and reliability of biometric data by detecting and analyzing specific facial landmarks or other features. This analysis can help in setting appropriate thresholds for biometric similarity scores using the Euclidean distance to ensure that only high-quality and reliable biometric data are considered for matching.
- **Matching Decision Logic:** Based on the results of biometric matching algorithms and threshold settings, this component makes a decision on whether a match is detected. It considers factors such as the confidence level of the match, the uniqueness of biometric features, and any additional validation criteria. The information extracted through Haar cascade-based feature detection can provide

valuable input to the matching decision logic. For example, the presence or absence of specific facial features detected by Haar cascades can be considered as part of the overall decision-making process to determine whether a match is detected.

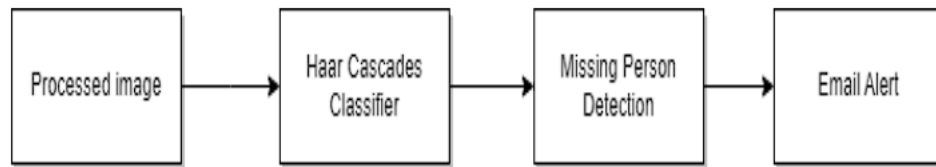


Figure 3.3. Detection Module

The Web portal integrates the Haar cascades for initial detection and subsequent biometric processing for identification or verification purposes.

C. Alert Module

The Alert Module is responsible for notifying relevant stakeholders about potential matches and coordinating follow-up actions. It ensures timely communication and collaboration among law enforcement agencies, NGOs, and individuals involved in missing persons cases. The module includes the following functionalities:

- **Notification Generation:** This component generates alerts or notifications when a potential match is detected between submitted biometric data and records in the Aadhaar database. Notifications may include details of the match, such as the identity of the individual and the confidence level of the match.
- **Alert Distribution:** Once generated, alerts are distributed to designated recipients, such as law enforcement agencies, social service organizations, or family members of missing persons. Distribution channels may include email, SMS, or push notifications through the web portal.
- **Case Management:** This component facilitates case management and coordination among stakeholders involved in missing persons cases. It tracks

the status of alerts, logs actions taken by stakeholders, and provides tools for collaboration, communication, and information sharing.

D. Email Configuration and Alert Mail Generation

Email Notification is integrated within the web portal to allow authorized officials to receive alerts about high-probability matches for missing persons.

i. Configuration Considerations

- **SMTP Server:** Details of the Simple Mail Transfer Protocol (SMTP) server is configured within the portal's backend. This specifies the server responsible for sending emails.
- **Authentication:** The system authenticates with the SMTP server using a designated username and password to ensure secure communication.
- **From Address:** A dedicated email address for the web portal is configured as the sender address for notifications.

ii. Content of Alert Emails

The email content is drafted with the subject "High Probability Match Found - Missing Person Portal."

The email body is designed to include essential details for the potential match:

- Name (if available from Aadhaar data)
- Aadhaar Number (masked for partial visibility)
- Matching biometric data type (fingerprint/iris)
- Similarity score from the matching algorithm
- A secure link within the portal for authorized officials to access detailed information about the potential match

The email content was designed using HTML along with CSS for styling. Regardless of the chosen notification method (internal messaging or email), robust security measures are

essential. The proposed approach utilizes the Flask framework and the PyCrypto library to implement encryption and decryption of sensitive data within the Python backend code

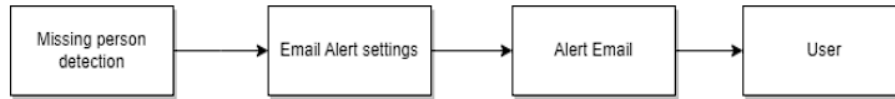


Figure 3.4. Alert Module

iii. Tools/Platforms

- IDE (Integrated Development Environment): Visual Studio Code
- Version Control: Git, GitHub

iv. Libraries/Frameworks

- Frontend Frameworks: HTML, CSS
- CSS Frameworks: Bootstrap, Materialize CSS.
- Backend Frameworks: Flask (Python)
- Biometric Authentication Libraries: Aadhaar authentication SDKs or APIs (for integrating Aadhaar-enabled biometrics).

v. Software

- Development Environments: Python (for backend), JavaScript, HTML/CSS (for frontend).
- Database Management Systems: MongoDB (for storing and managing data).
- Deployment Platforms: Heroku

E. Dataset Description

The dataset used for the face recognition module consists of facial images of friends, collected specifically for the purpose of this project. The images were sourced from personal photographs provided by friends who consented to participate in the project. The dataset comprises a collection of images captured under various lighting conditions, facial expressions, and angles to ensure diversity and robustness in facial recognition.

i. Characteristics of the Dataset

- **Number of Samples:** The dataset consists of a total of 45 facial images collected from 45 friends with a proper consent from them.
- **Image Resolution:** The images are captured at a resolution of 128*128 pixels, ensuring sufficient detail for facial feature extraction and recognition.
- **Variability:** The dataset includes images depicting individuals in different poses, facial expressions, and lighting conditions to mimic real-world scenarios and improve the robustness of the face recognition system.
- **Annotations:** Each image is labeled with the corresponding friend's identity to facilitate supervised learning and evaluation of the face recognition algorithm.
- **Data Augmentation:** To enhance the diversity and size of the dataset, data augmentation techniques such as rotation, scaling, and cropping may have been applied to the original images.
- **Privacy Considerations:** Prior to using the images, explicit consent was obtained from each friend to ensure compliance with privacy regulations and ethical standards. Additionally, measures were taken to anonymize and protect the identity of individuals in the dataset.

4. Current progress and Future work

The proposed module is currently in progress, developing a web portal for detecting missing persons. The development of the web portal is currently underway. The complete implementation of the module, as outlined in the proposed work, along with the implementation process, will be carried out in the future

4.1 Implementation

- The web portal for finding missing persons using Aadhaar-enabled biometrics will be implemented using a combination of frontend and backend technologies.

- The frontend is developed using HTML, CSS and Javascript for building user interfaces. Bootstrap will be utilized for styling and layout, ensuring a responsive and visually appealing design.
- For the backend, Flask, a high-level Python web framework, is chosen for its robustness and scalability. The biometric matching algorithm is implemented using OpenCV, a computer vision library, for facial recognition.
- The system will be deployed on a cloud platform (Heroku) to ensure scalability and availability.

4.2 Hardware Requirements

The hardware requirements for deploying the web portal include:

- Minimum of 2 CPU cores and 4 GB of RAM for hosting the backend server.
- High-speed internet connection for real-time data processing and communication with the Aadhaar database.
- Storage capacity for storing biometric data and system logs, with a recommended minimum of 100 GB.
- Webcam or fingerprint scanner for capturing biometric data from users, if required.

i. Advantages

- Efficient detection of missing persons.
- Enhanced accuracy through biometric matching.
- User-friendly interface for ease of use.
- Facilitates collaboration among stakeholders.
- Maintains privacy and confidentiality.

ii. Limitations

- Dependency on Aadhaar database completeness.
- Risk of false positives and false negatives.
- Technical challenges in implementation.
- Concerns about data security.

5. Conclusion

The research utilizes advanced technologies such as facial recognition and machine learning algorithms to increase the accuracy and speed of the search process. By creating a database of known individuals and continuously updating it, the system is able to compare images of missing persons with potential matches, thus increasing the chances of locating the missing person. The user-friendly interface and admin dashboard make it easy for users to submit images of missing persons and for administrators to manage the system. The success of the research will be measured by its ability to locate missing persons and reunite them with their families. The research has the potential to revolutionize the way missing persons are located, and it represents a significant step forward in the use of technology for public safety. Overall, the research is a valuable contribution to society, and it has the potential to save lives and bring peace of mind to families affected by missing persons. The future work will focus on implementing the project and making the web portal available for public use.

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Author's biography

Prema A- Assistant Professor of Artificial Intelligence and Data Science at Velammal Engineering College, Chennai. She has a year of experience in teaching and has produced above 95% results. She has played a vital role in the department duties such as Exam cell in charge, counseling, and mentoring of students' academic progress, as well as organizing workshops and FDP. Her area of interest is Data mining, Web technologies and she has conducted research in this field.

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