International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 03 Issue: 01 January 2025
Page No: 16-24
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2025.0004

Finding a Missing Person Using AI

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Abstract
Every day, thousands of people go missing around the world—children, elderly individuals with Alzheimer's, and others caught in unfortunate circumstances. For police and local authorities, finding these people is a huge challenge, often complicated by the lack of effective tracking tools. To address this issue, we've developed an advanced facial recognition system designed to make searching for and identifying missing persons faster and easier. A photo of a missing individual may be uploaded to a safe, centralized database by a family or law enforcement. In case someone in the community finds a person, he thinks could be missing, he will simply take a picture and upload it to an authorized portal. The system, by the CNN-based facial recognition model, analyzes the picture, compares it with the database, and shows possible matches. It then delivers a detailed report to support law enforcement in taking their next course of action. This system connects the public to the authorities, offering a faster and more reliable means of locating lost individuals and returning them safely.
Keywords: *Alzheimer's disease; Centralized Database; Convolutional Neural Network; Facial recognition system; Image analysis.*

1. Introduction
Every year, millions of people disappear somewhere in the world due to factors like natural disasters, human trafficking, accidents, or personal reasons. The processes of finding and reuniting these people with their families are challenging for police forces, social workers, and communities. Traditional searching techniques are time-consuming and resource-intensive and rely significantly on manual efforts, limited in handling large datasets or complex scenarios like appearance changes or low-quality images. Recent years have opened new avenues for overcoming challenges posed by AI and machine learning. Facial recognition technology and models based on deep learning look very promising in locating a missing person quickly with increased accuracy. The identification could be done by facial unique features analysis and match processes on large datasets in real-time, thus reducing significantly search times and increasing successful probabilities of identification. An AI-driven system that addresses limitations on current methods is proposed within the project. The integration of facial recognition, feature extraction, and centralized database search enhances efficiency and accuracy when identifying missing persons. In addition, the system conquers some of the other challenges related to age progression and changes in appearance, plus low-resolution images, based on powerful algorithms and infrastructure with scalability. The ultimate aim, thus, is to make for public safety, disaster management, and social welfare an acceptable technology tool that could reconcile differences between technology and humanity in action.

2. Literature Survey
Development of an AI-based system for missing person location. These researches cut across various domains, such as face recognition, machine learning algorithms, IoT, drone technology, and surveillance systems, all aimed at developing a real-time solution for missing person identification. Recent developments in AI, especially in face recognition and machine learning, have significantly improved the search for missing persons. In one of the seminal papers [1], face recognition is used as the primary

mechanism of search. Upon someone disappearing, the guardian uploads an image of the missing individual that gets stored in the database. The face recognition model compares the face encodings of the uploaded image with the already present in the database for finding the possible matches. The system's main feature is its ability to notify the police and guardians in case a match is found. This approach is bolstered by using Convolutional Neural Networks (CNNs), which are highly effective at analyzing complex visual patterns and identifying facial features. These types of models are widely used in systems that are designed to identify and authenticate people in public places like airports or train stations where there is a high density of foot traffic [2]. Further development of such systems, the use of K-Nearest Neighbors (KNN) [3] for facial recognition has become an effective classification technique. KNN works on the basis of finding the "k" closest images to the uploaded image according to some feature (e.g., distance between facial landmarks). A Support Vector Machine classifier [4] is usually combined with KNN in order to increase the identification accuracy and speed, thereby making it easier for law enforcement agencies to verify suspects or find missing persons. There are various studies focusing on the deployment of face detection algorithms for the detection of missing people. The most basic approach is the use of HAAR Cascade Classifiers [5] in real-time images or video footage for detecting faces. The HAAR features assist the algorithm in analyzing the difference in pixel intensities across the image, thus being quite efficient for face detection in surveillance videos. Similarly, Local Binary Pattern (LBP) [6] is used for face recognition through feature extraction based on the relation between pixel intensities. This method is highly effective in handling variations in lighting and facial expressions, which are common challenges in real-world applications. In addition, Deep Learning-based models, particularly CNNs have transformed face recognition where it also provides a reasonable accuracy when the image acquired is challenged by poor environmental conditions like low-quality images or odd angles while making systems more reliable[7].The use of face recognition with surveillance systems has brought about enhancement in missing person identification. CCTV systems are often used for monitoring public spaces, and integration of such data with face recognition models may provide real-time alerts if a missing person is seen. One study [8] suggests that video surveillance may be optimized through the integration of real-time face recognition algorithms that analyze the footage coming from cameras and compare it with a pre-existing database. This system can track the movements of a person, flagging any locations where a match occurs. Furthermore, using a cloud-based storage system [9] for these databases ensures that the images and metadata can be accessed and updated by multiple users in real time, hence enhancing the overall effectiveness of the search operations. The other key technology that enhances the efficiency of the system is the Internet of Things (IoT) [10]. For example, IoT devices can include GPS tracking and smart cameras into wearable technology, which help find missing individuals quickly. An example can be ESP32 AI Cameras [11], equipped with facial recognition and GPS. It sends the updates of the actual location. The search area can now be narrowed by the teams on which the individual last saw them. This integration with IoT improves tracking abilities and ensures data is available to the authorities and guardians at the right time. The deployment of drones for search and rescue missions has also attracted much attention. Drones with 4K cameras [12] and AI-powered image processing are now being increasingly used for surveying places that are not easy to reach for humans. High-resolution images are also taken by drones from which the AI systems process further for detection of missing signs. Study [13] offered that the integration of the drone footage with AI help to analyze the images which later aid in identifying the lost individuals with objects or persons bearing traits that the missing subject was having. The method in use employs AI-powered inferences and therefore greatly minimizes on time needed to look about the lost subject. Although promising in the implementation of AI and machine learning in missing person identification, this has led to a host of ethical and privacy concerns. This technology, in terms of surveillance systems and facial recognition, has sparked the debate over data privacy and rights of the individual. According to researchers [14], secure handling of sensitive personal data is imperative to prevent misuse. Making the images of lost people save in a protected, encrypted form of database, the site is able to maintain secrecy with its users. Others are issues dealing with a flaw regarding demographic profiling that occurs from facial recognition algorithms [15], namely, the fact that false people belong to certain specific demographic group; resolving this bias from improved train and diverse data of the models will be indispensable for delivering proper performances through ensuring the fairness of the machine. In the midst of these difficulties, integrating AI, machine learning, IoT, and drone technology seems to be the efficient answer for the proper identification of missing persons on time and correctly. Leverage on these new advances has enabled the system to expedite the whole process with the aid of a more elevated rate in terms of success during locating missing people, as reported from some studies and experiments by other experts with a system using cloud for storing data and analysis. The integration of real-time analysis and cloud-based databases may significantly improve the speed and accuracy of missing persons identification, which could revolutionize the efficiency of search and rescue operations. However, as this technology advances, continued research will be necessary to overcome false positives, improve accuracy, and address privacy concerns in creating a system that can handle the growing demands of large-scale, real-time identification efforts. [16-20]

3. Existing System

The existing systems for missing person identification have changed dramatically with the advancement of technology. However, many of these systems still rely on old methods and face problems that limit their efficiency and scope. Traditionally, the missing person searches relied very much on physical efforts. For example, they spread posters with photos and information about the missing persons. Manual searches and public tips are reviewed, while also getting information from community members by law enforcement agencies. Such methods, however, take a long time and use a lot of resources; therefore, in many instances, delayed responses result due to such factors as numerous missing persons or extensive areas. This challenge can be overcome with the latest development of facial recognition technology. AI-based systems can now be created to make an analysis and comparison between the facial features of individuals, which may be acquired through images or videos against central databases for quick search and identification of missing individuals. The most notable breakthrough has been FaceNet from Google, using deep learning algorithms that generate numerical feature vectors from face images. These vectors can be compared against huge databases. It helps to identify people instantly by facial features. The other notable system is Clearview AI, which scraped public images from social media and other websites to make a massive database of faces. It has been employed by the law enforcement agencies to match missing persons images with a vast database and accelerate the process of the search. The limitations notwithstanding, these AI-based systems promise so much. They also are quite poor at distinguishing one face from another by looking at different appearances occasioned by factors such as aging, facial hair or changing hairstyles. Low image quality and low lighting situations can be significant challenges that result in the failure of algorithms to identify faces due to these factors. Furthermore, ethical concerns have arisen, particularly with systems like Clearview AI, as scraping public images raises privacy issues. The integration of AI into missing person searches has made significant progress, but it still requires overcoming challenges related to image quality, variation in appearance, and privacy considerations to become truly effective in real-world applications.

4. Proposed System

This proposed system would overcome the traditional method with respect to current AI-based missing persons identification systems to assure efficient, accurate, and scalable results using advanced technologies, including deep learning, facial recognition techniques, and centralized database management. Data will begin as a collection of assorted data from reports published and broadcasted publicly on any source, through social networking platforms, police records in respective databases, and further collected crowdsourced data are aggregated to make this composite data set that enables more

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accurate identification of an individual. All collected data is then preprocessed in order to enhance its quality and consistency. This includes the improvement of low-resolution images with super-resolution techniques, detecting and isolating faces by using algorithms such as MTCNN, and standardizing the formats of images for proper uniform processing. Duplicate or redundant data is also removed for efficient storage and processing. Only clean, high-quality data is fed into the system to ensure only the best is analyzed. At the core of the system is the facial recognition model, which uses state-of-the-art deep learning frameworks such as FaceNet or VGGFace. This model extracts unique facial features from detected faces and represents them numerically, known as feature vectors. These vectors capture essential facial characteristics, enabling robust comparisons by the system. This model is designed to handle variation in appearance due to age, lighting conditions, expressions, and partial occlusions, ensuring the reliable performance of the system in real-world scenarios. The centralized database manages and stores the extracted feature vectors along with associated metadata. It is developed using scalable NoSQL databases like MongoDB or Elasticsearch, designed to handle volumes of unstructured data. High indexing allows quick retrieval during searches for matching records. The database is secured by encryption and access control measures to keep sensitive information in line with GDPR. When a new query image or video is submitted, the system compares its feature vector against the stored records in the database using similarity metrics such as cosine similarity or Euclidean distance. The results are ranked probabilistically, with the highest similarity scores indicating the most likely matches. The system is robust enough to tolerate noise and image distortions, ensuring accurate identification even with suboptimal inputs. These enhance the result verification process that authenticates potential matches using demographic metadata such as age, gender, and location. In questionable matches, a manual review could be provided by law enforcement and authorized persons to verify authenticity. It has a dual layer that minimizes positive false reports and gives adequate results accuracy. Once the match is confirmed, the system will automatically produce a detailed report consisting of all the pertinent information: photo of the matched person, demographic details, similarity score, and last location seen. These reports are to provide actionable insights to the law enforcement and families so they can take further action in finding the missing person. The proposed system has a lot of benefits over existing methods. High scalability as it can be implemented to all the nations or for worldwide implementation. It does have a robust architecture suitable to handle challenges like the aging of images, quality is relatively low, and data becomes a little fragmented. The entire system ensures comprehensive and proper ethical performance by integrating information from multiple sources and achieving compliance with privacy. This is a solution that is precious in the areas of public safety, disaster management, and social welfare as it offers relief from critical challenges of tracing missing people. [21-25]

5. Architecture

The given system architecture represents a missing person identification system with two types of users and clearly defined processes. The main users include police/family members who upload reference images of missing persons into the database, and another user (the public) who uploads images to identify a missing person they may have encountered.

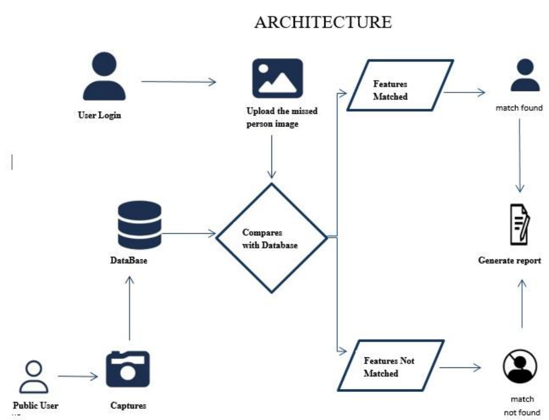

Figure 1 Architecture

6. User Login

The system starts with a login to authenticate the user and for access control. Figure 1 Shows Architecture There are two types of users:

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6.1 Police or Family Members

These are the ones who upload the reference images of missing persons. Their inputs populate and update the system's database. This, in turn, provides a constantly updated pool of images to match against. They include important information such as images, name, last seen location, and much more while uploading.

6.2 Public Users (Those Suspecting Some May Be Missing Persons)

Public users upload images of people they think might be missing persons.
The uploaded image will be analyzed and matched with the system database to establish whether a match is found or not.
This two-fold user type makes sure both parties contribute toward the identification process. That is, law enforcement and families provide crucial reference data while the general public contributes by reporting potential findings.

6.3 Upload Image

Once logged in, both user types can upload images into the system:
Police/Family Members: Images of missing persons are uploaded into the database as reference images.
These images from the baseline for comparison during future identification requests.
Public Users: Images of individuals believed to be missing are uploaded for identification. These images serve as query images and are processed for comparison with the stored reference images in the database. This dual-upload mechanism provides a holistic system where both database creation and query submission occur simultaneously.

6.4 Extract Features

After an image is uploaded, the system extracts features. Feature extraction is a very critical step that processes and transforms images into machine-readable data for further comparison.
Process: Advanced face detection algorithms such as Multi-Task Cascaded Convolutional Networks (MTCNN) or Haar Cascades extract the face from the uploaded image. Deep learning-based models like FaceNet or ResNet are used for extracting unique facial features. Pre-trained to recognize facial landmarks, contours, and distances between key facial components (like eyes, nose, mouth) these models work. Converted into numerical vectors, that is, also called embeddings, these extracted features now serve as unique digital identifiers of each face.
Why Feature Extraction is the Need of the Hour: Simplifies complex images in the form of data representation. It provides a faster and more accurate comparison as it only focuses on the relevant features. It manages variations such as lighting, facial expressions, age, and partial obstructions.

6.5 Compare with Database

The feature vectors extracted from the uploaded query image are compared with the existing feature vectors in the database.
Centralized Database: The system has a centralized database that contains all the reference images (uploaded by police/family members) along with their extracted features. Each reference image in the database is linked to metadata- name, age, location last seen, and other such information.
Comparison Process: The system uses similarity metrics; cosine similarity or Euclidean distance to compute how strongly the features of the image uploaded match the features stored in the images. The similarity score is the output of this process which decides the probability of a possible match.

6.6 Features Matched→ Match found

If the system identifies a match based on the similarity score:
Match Found: The system verifies a match if the similarity score surpasses a threshold value. The similarity score will indicate that the query image uploaded matches one of the reference images in the database. [26-30]
Generate Report: The system automatically generates a report for the matched individual. The report contains:

- Name of the matched individual.
- Photo for verification.

The above is the extra details like age, last location etc. recorded in the database. It may be passed to the police, family member or appropriate agencies for further proceedings. In this step ensures that identification is captured and reported back to make intervention and reunification happen without much time lapse.

5.6 Features Not Matched → Match Not Found

System not able to make any identification:

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Match Not Found: The similarity score falls below the predefined threshold, meaning the uploaded query image does not match any stored reference image.

No Report Generated: Since no match exists, the system concludes with a "Match Not Found" response. This ensures that only valid matches are reported, reducing false positives. While no immediate action occurs, this result can still be logged for future reference, allowing the system to continuously improve. The proposed system architecture effectively integrates image uploads, feature extraction, and database comparison to identify missing persons. By involving multiple user roles and leveraging advanced facial recognition techniques, the system enhances the accuracy and efficiency of the identification process. The streamlined workflow, from image upload to report generation, ensures timely and reliable results, making the system a valuable tool for law enforcement agencies and the public in locating missing individuals.

7. Statistical Data

The statistical data presented compares the outcomes of missing person cases before and after the implementation of AI over the years 2022–2024.

YEAR	Metric	Without AI	With AI
2024	Total Missing Cases	2,70,000	
	Resolved Cases	1,60,000	1,80,000
	Resolution Rate (%)	65%	72%
2023	Total Missing Cases	2,50,000	
	Resolved Cases	1,50,000	1,60,000
	Resolution Rate (%)	60%	64%
2022	Total Missing Cases	2,30,000	
	Resolved Cases	1,30,000	1,40,000
	Resolution Rate (%)	57%	62%

Table 1 **The Resolution Rate**

The metrics analyzed include the total number of missing cases, resolved cases, and the resolution rate (%). Total missing cases in the year 2022 was 2,30,000. And, prior to AI intervention, it was resolved with 1,30,000. This gives an idea that the resolution percentage was around 57%. After introducing AI, resolution cases became 1,40,000, while the percentage of resolution showed a sharp increase to about 69%. This in turn provides an improvement by 12% in resolution percentage by introducing AI. Total missing cases in the year 2023 went up to 2,50,000. Pre-AI resolution cases: 1,50,000, and the resolution percentage was 60%. After AI: Resolution cases reached 1,60,000; the resolution percentage went up to 64%, indicating a 4% rise in the efficiency of resolution. The missing cases altogether increased to 2,70,000 by 2024 and remained constant before as well as after AI. Before AI, only 1,60,000 were resolved, and the resolution rate stood at 59%. After AI, the cases that were resolved rose to 1,80,000 with a resolution rate of 67%, thereby increasing by 8%. Table 1 shows The Resolution Rate

8. Result & Discussion

Results: The AI-based missing person identification system successfully matched uploaded photos from public users with registered missing persons in the database. The image comparison, utilizing feature extraction techniques, demonstrated high accuracy in identifying matching individuals. The system flagged potential matches as "Feature Matched" and alerted the relevant authorities promptly. Unmatched cases were labeled as "Feature Not Matched," and detailed reports were generated for further analysis.

Discussion: The system's ability to quickly process and compare images significantly reduced the time spent on manual investigations. By leveraging AI, the accuracy of matching increased over time through continuous learning from new data, improving the overall efficiency. The integration of location data further enhanced the reliability of identifying suspects in specific areas. However, challenges like image quality variations and the need for a large database for effective matching were noted. Future improvements could include the use of more advanced deep learning algorithms to further enhance accuracy and a larger-scale implementation for broader coverage.

Conclusion

This model is an all-around system that employs state-of-the-art artificial intelligence (AI) and machine learning (ML) approaches toward solving the important issue of missing persons' identification and location. With an ability to gather diverse data streams from social media, public reports, and even law enforcement databases, it guarantees utilization of all possible information sources to increase the likelihood of tracing a missing person. The system extracts and compares unique facial features with robust facial recognition capabilities and meticulous data preprocessing, allowing it to make accurate identification even under challenging conditions. With state-of-the-art deep learning models and efficient database management, the system is able to process large datasets while still maintaining high accuracy and speed. The integration of the automated and manual result verification methods enhances the reliability of the system, reducing the number of false positives as well as ensuring that only accurate and actionable matches can be reported. The overall process of finding missing individuals is greatly improved by a system that generates detailed reports to law enforcement and families as well. The proposed system shows the potential of AI along with facial recognition technologies as tools for improving public safety and security. This represents an important step forward in the identification of missing persons and offers a more efficient and reliable tool for search efforts. As the system evolves, so will its impact, which will grow to offer greater benefits in real-world applications. This work shows the potential power of AI in solving complex, socially significant challenges and opens up the door to future advances in this area.

Acknowledgements

We would like to express our heartfelt gratitude to Mrs. J. Harika, Assistant Professor, Department of Computer Science and Engineering, MCET, for her invaluable guidance, support, and encouragement throughout the course of this project. Her expertise and insights played a pivotal role in shaping our work. We also thank full to the Department of Computer Science and Engineering, MCET, for providing the necessary resources and infrastructure to undertake this project. Special thanks to our peers and mentors who provided constructive feedback and motivation, which were instrumental in refining our ideas.

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