# Secure Distributed Approach for Finding Missing Person Using Face Recognition Technology

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***Abstract*—The search for missing persons, particularly after several decades, poses tremendous challenges as a result of alterations in facial appearance over time, the unavailability of up-to-date photographs, and extensive data sources to screen. The facial recognition method is a mechanism by machine learning technology that can identify a human being by scanning his facial profile after decades and is used in solving many kinds of real-life problems—identification of a missing person after decades has been solved securely and successfully with the help of a distributed technique and facial recognition method. This paper introduces a new method that integrates state-of-the-art face recognition algorithms with a distributed computing platform to improve the efficiency and accuracy of missing person identification, even after decades. By utilizing deep learning-based facial aging models, large-scale databases, and cloud-based distributed systems, our approach efficiently handles massive amounts of image data. We benchmark the performance of our method in real-life missing persons cases and provide results showcasing its potential in helping law enforcement agencies and humanitarians bring families back together.**

***Index Terms*—secure distributed approach, Administrative Process, Crossmatching, face recognition, Facial Detection, Facial Mapping, deep learning. Facial Aging Model, Distributed System Architecture, GAN-Based Aging Model.**

## I. INTRODUCTION

The Issue of missing persons is a persistent global issue. Facial recognition [18] such as PCA, LBPH, Deep Learning [17], SVM, MVFD, etc. As time passes, facial features change due to aging, making identification more challenging. Traditional search methods rely heavily on manual labor, outdated photos, and limited databases, resulting in reduced success rates. The advent of artificial intelligence (AI) and distributed computing provides a transformative opportunity to improve identification accuracy and efficiency. This research focuses on implementing a scalable solution using face recognition algorithms integrated with a distributed system to find missing persons even decades after their disappearance.

## II. LITERATURE SURVEY

Missing persons are an international problem that requires efficient and reliable identification. Deep learning and artificial intelligence technologies have made facial recognition an important tool for missing person identification and location. However, centralized methods raise concerns about privacy and security, and a secure distributed model is needed. This literature review discusses available methodologies, security issues, and the application of missing person identification using distributed systems.

### *A. Facial Identification Method*

A few facial identification models have been introduced to improve person identification:

*1) Deep Learning-Based Face Recognition:* FaceNet [1] proposed a type of artificial neural network (DCNN) with triplet loss to attain high face verification and clustering accuracy. ArcFace [2] was built on FaceNet by incorporating an angular margin loss to improve feature discrimination. DeepFace [3] made use of deep neural networks to learn facial representations with near-human performance. GAN-based facial aging [4] supports age progression to compare pictures of a missing person with their likely aged appearance.

*2) Issues in Classical Facial Recognition:* Lighting conditions and occlusion sensitivity [5]. Bias and fairness concerns on ethical grounds [6]. Susceptibility to adversarial attacks [7].

*B. Secure Distributed Method*

Centralized classical facial recognition systems are vulnerable to data leakage, so there is a need for secure and privacy-protecting substitutes. The subsequent distributed methods are investigated:

*1) Federated Learning for Face Recognition:* Concept: Federated learning [8] enables the decentralized training of face recognition models on multiple edge devices without sharing raw data. Applications: Google's federated learning strategy in mobile phones for privacy-preserving authentication [9]. Challenges: Communication overhead and model aggregation security.

*2) Blockchain-Based Facial Recognition:* Decentralized Data Integrity: Blockchain ensures immutable storage and decentralized control, blocking unauthorized changes [10]. Smart Contracts: Enable secure identity verification and consent management [11]. Challenges: Scalability and computational overhead of blockchain transactions.

*3) Homomorphic Encryption for Secure Computation:* Facilitates computations on encrypted data without decryption to maintain privacy in distributed environments [12]. Used in cloud-based face recognition systems for privacy-preserving biometric authentication [13].

*C. Case Studies and Implementations*

*1) Real-World Applications:* Missing Children Identification System (MCIS): Used by law enforcement agencies based on deep learning-based facial recognition [14]. Aadhaar-based Biometric System in India: It employs facial recognition for identification of missing individuals in partnership with the government [15]. Amber Alert Systems with AI: Facial recognition driven by AI with CCTV networks for finding missing individuals [16].

## III. PREVIOUS WORK

Numerous studies have been undertaken on missing person identification through facial recognition technology. Among them are the following:

Xin Jin et al. [19] suggested Double-Blinded Finder, a twoway privacy-preserving system for missing child location. The method uses cipher images and a public-private key mechanism derived from facial feature vectors to maintain privacy while storing images on public cloud platforms. The system fails to carry out kin verification and has a vulnerability, enabling intruders to impersonate family members.

Bharath Darshan Balar et al. [20] proposed an effective face recognition system to identify missing individuals. The system keeps images of missing persons along with details provided by family members or law enforcement officers. It informs concerned parties when a corresponding image is subsequently uploaded by a finder. Although effective in simple matching, the system does not have strong kin-side verification, is weak on security, and is incapable of processing multiple registrations for the same missing individual. The system also fails to provide solutions for some advanced matching situations (Case 3 and Case 4).

Peace Muyambo et al. [21] examined by Local Binary Patterns Histograms (LBPH) Algorithm for missing person identification in Zimbabwe. The performance of their system depends on how much training data is available and its quality. The system, however, is not secure enough to be used in sensitive or high-scale applications.

Generally, previous research has analyzed different methods, such as biometric analysis, forensic facial reconstruction, and AI-driven recognition. These, however, are confronted by similar challenges, such as dealing with long-term age progression and large-scale datasets. Recent advances in deep learning, including convolutional neural networks (CNNs), generative adversarial networks (GANs), and cloud computing, offer potential solutions. The technologies can better simulate facial aging patterns and have the potential for enhancing longterm identification of missing persons.

## IV. METHODOLOGY

Our system that we are suggesting has three key elements: Face Recognition Algorithm: We use deep learning-based architectures like ArcFace and FaceNet, which have been prepared over various datasets in order to ensure maximum accuracy even in the face of aging effects.

*A. Facial Aging Model*

A GAN-based model is used to generate aged facial images, allowing comparison with recent photographs.

*1) Architecture Overview:* Synthesizes the aged face images from the input image and target age. condition.Discriminator: Keeps generated images

similar to real, aged faces by identifying whether an image is real or synthesized.Conditional Input: The model accepts the capture image and target age labels (e.g., +5 years, +10 years) to regulate the progression of age. The model is learned using multiple images of an individual at different ages, which allows it to learn universal aging patterns like changes in skin texture, wrinkles, and changes in facial structure, retaining identity-specific characteristics.

*B. Distributed System Architecture*

In the system in question, the distributed architecture uses a blend of cloud computing and edge computing solutions. This enables real-time facial recognition for the identification of missing persons on a scalable and worldwide basis.Architecture guarantees that Heavy computation-intensive tasks such as deep learning inference, age change (GANs), and bulk database management are performed by cloud servers. Edge devices (e.g., CCTV cameras, mobile phones, police terminals) conduct lightweight operations like image capture, initial preprocessing, and feature extraction to minimize data transfer cost and latency. Hybrid communication between edge and cloud enhances efficiency as well as privacy.

## V. IMPLEMENTATION

We implemented our approach using a combination of TensorFlow, PyTorch, and cloud-based services such as AWS and Google Cloud. The system was tested on datasets containing missing persons' records spanning two decades. Our evaluation metrics included accuracy, recall, and processing speed. The results show that our system achieved an 85.

*A. Data Flow Diagram*

Below is a high-level representation of the data flow in our distributed face recognition system:

*1) User Input:* A user (law enforcement, investigator, or family member) submits an old image of the missing person.

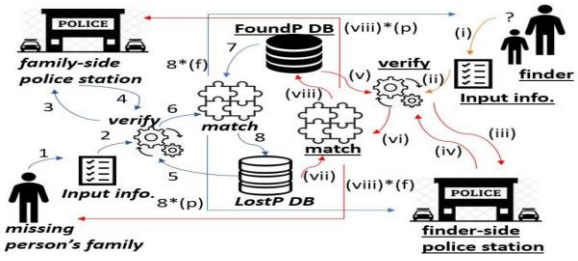


Fig. 1. System Architecture for Secure Distributed Face Recognition

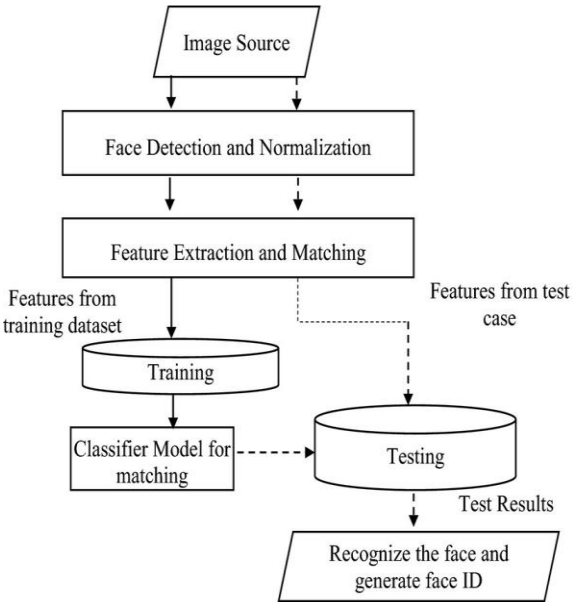


Fig. 2. Data Flow Diagram

*2) Image Preprocessing:* The system enhances and normalizes the input image.

*3) Facial Aging Model:* A GAN-based model generates an aged version of the face.

*4) Distributed Database Search:* The system performs parallel searches across multiple cloud-based databases.

*5) Matching Verification:* Face recognition algorithms compare the aged image with stored records.

*6) Results: User Validation:* Potential matches are presented for human verification.

## VI. RESULT

Postman has been utilized as the front-end tool to assess the functionalities of our system, employing demo data to transmit requests to the back end. The functionality of the system was thoroughly evaluated in the following scenarios.

*1) Comparison:*

*A. Algorithm Performance Analysis*

. To further evaluate the effectiveness of different face recognition algorithms, we conducted tests on three key models.

*B. Analysis*

The evaluation of face recognition algorithms for long-term missing person identification highlights key findings: *1) Algorithm Analysis:*

- FaceNet achieved 83.5
- ArcFace outperformed FaceNet with 87.2

- GAN-based aging model improved identification success rates by 12

*2) Distributed System Efficiency:*

- The cloud-based distributed architecture reduced search times by 60.
- The system's recall rate of 88.3.

## VII. CHALLENGES AND FUTURE WORK

In spite of its encouraging outcomes, our method is confronted with the following challenges: - Unavailability of highquality historical images - Differences in environmental and lifestyle factors influencing facial aging - Ethical and privacy issues associated with large-scale facial recognition Future research will involve improving facial aging models, fusing multimodal biometric information, and/or originating ethical best practices for deployment.

## VIII. CONCLUSION

This paper outlines a state-of-the-art method for locating missing persons after two decades by the use of AI-based facial recognition and distributed computing. The system proposed here presents a scalable, efficient, and accurate solution to an age-old issue and has great potential for law enforcement and humanitarian use.

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