God's Eye: An Automated AI-Based Lost Person Identification & Retrieval Platform

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Abstract: In recent years missing person cases are a growing global concern. Manual search efforts are often slow and ineffective, especially in densely populated areas or challenging terrains. . This paper proposes "God's Eye," an automated AI-based platform for lost person identification and retrieval. God's Eye leverages a combination of computer vision techniques, deep learning algorithms[1], and a distributed communication network to achieve rapid and accurate missing person identification. The system integrates user-submitted missing person reports, continuously monitors video feeds, and analyzes faces in real-time for matches against a database. Upon a potential match, God's Eye initiates a geo-targeted alert system, notifying relevant authorities and volunteers[9][11] in the vicinity of the missing person's last known location. This paper details the system architecture, core functionalities, and potential benefits of God's Eye in enhancing missing person search efforts.

Keywords—Missing person, Lost person identification, AI, Computer Vision, Deep learning, CCTV, Geo-targeted alert system, GPS

I. INTRODUCTION

Missing person cases pose a significant challenge for law enforcement agencies and communities around the world. The timely identification and location of missing individuals are crucial for ensuring their safety and well-being. However, traditional search methods, which often rely on manual efforts and public appeals, can be slow and resource-intensive. This is especially true in vast geographical areas, densely populated urban environments, or situations where the missing person is unable to communicate their location. In these scenarios, valuable time can be lost before a missing person is found, jeopardizing their safety and increasing the difficulty of a successful outcome.

God's Eye addresses this challenge by providing an automated AI-based platform specifically designed to streamline and expedite missing person search efforts. The system leverages cutting-edge advancements in computer vision and deep learning to continuously monitor public and private spaces, analyze faces in real-time, and compare them against a database of missing persons. This allows for the rapid identification of potential matches, enabling authorities to intervene quickly and potentially saving lives.

II. SYSTEM ARCHITECTURE

God's Eye: An Automated AI-Based Lost Person Identification & Retrieval Platform is built on a robust system architecture comprising of seven core modules:

A. User Interface (UI) Module:
This module allows users to submit missing person reports. It captures details like name, age, physical description, and a picture. The system generates a unique user ID and case ID for each report.

B. Video Acquisition Module:
This module gathers video feeds from a distributed network of CCTV cameras, public and private, and potentially mobile phone camera footage submitted by bystanders.

C. Automated AI Module:
This module employs computer vision techniques and deep learning algorithms [7] for real-time facial recognition. Facial features are extracted from the video feeds, and a deep learning model trained on a massive dataset of faces is used to compare them against the database of missing persons.

D. Server Module:
This central module acts as the system's core. It manages user requests from the User Interface Module, incoming video data from the Video Acquisition Module, and data from the Database Module.

E. Database Module:

This module stores user-submitted missing person reports, including details and pictures associated with the unique user ID generated by the User Interface Module. It also stores facial recognition data for efficient matching.

F.   Alert and Communication Module:

This Upon identifying a potential match, the server module triggers this module. Geo-targeted alerts are disseminated to the platform users, relevant authorities and volunteers in the vicinity of the missing person's last known location, as determined by CCTV footage or GPS data (if available).

G.   Real-time Location Tracking Module:

This module integrates GPS technology to track the missing person's location in real-time if the missing person has a GPS-enabled device or if their phone location can be shared with consent. Even the CCTV camera's physical location can also be used to track missing person by automatically generating the nearest path to get to the most recent location of the missing person.
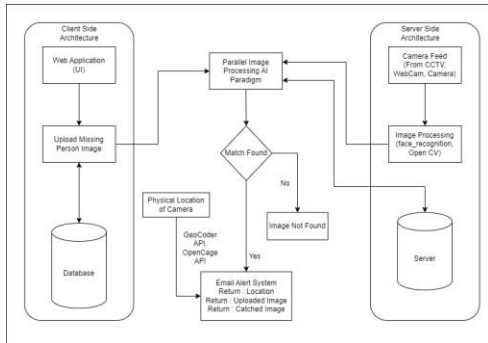

Fig. 1.   Architecture of God's Eye in Client-Server Paradigm

III.   CORE FUNCTIONALITIES

God's Eye offers several key functionalities designed to be both comprehensive and user-centric :

A.   Real-time Facial Recognition:

The system employs deep learning algorithms for real-time facial recognition, enabling immediate identification of potential matches[2]. These algorithms are trained on massive datasets of faces, allowing them to recognize individuals with a high degree of accuracy under various conditions[3]. For instance, God's Eye can account for variations in lighting, pose, and facial expressions[10], increasing the likelihood of identifying a missing person even if their appearance has changed slightly since the time they were last seen[6][8]. Furthermore, the system can be continuously updated with new data to improve its recognition capabilities over time.

B.   Continuous Monitoring:

God's Eye operates continuously[2], monitoring CCTV footage and potentially mobile phone camera footage 24/7 for comprehensive coverage. This relentless vigilance significantly reduces the window of time between a person going missing and their identification. In missing person cases, every second counts. By constantly scanning video feeds, God's Eye can potentially identify a missing person as soon as they appear in a public space, allowing for a much faster response from search teams and potentially saving lives.

C.   User-driven Reporting:

Users can directly contribute to search efforts by submitting missing person reports and providing additional details that may aid identification, including:

•   Distinguishing characteristics: Scars, birthmarks, tattoos, or other unique physical features.

•   Clothing descriptions: Details about the clothing the missing person was last seen wearing can significantly narrow down search areas.

•   Habitual behavior patterns: Information about frequented locations, hobbies, or daily routines can predict where a missing person might be headed.

•   AI-assisted age progression: God's Eye can utilize facial recognition and machine learning to generate an image of what a missing child might look like as they age, aiding identification years later..

D.   Scalability and Adaptability:

The scalability of God's Eye allows it to adapt and grow alongside the ever-expanding network of CCTV cameras and other potential video sources. As more cities and private organizations adopt video surveillance systems, God's Eye can be seamlessly integrated to leverage this vast network for missing person identification.

Furthermore, the system's modular design facilitates adaptation to integrate with existing law enforcement databases. This interoperability enables searches to be conducted across wider geographical regions, eliminating jurisdictional boundaries as a hindrance in finding missing persons. By incorporating data from various sources, God's Eye can generate a more comprehensive picture of a missing person's potential whereabouts, significantly improving search efficiency and increasing the chances of a successful outcome.

E.   Privacy Considerations:

God's Eye prioritizes user privacy by ensuring secure data storage and anonymizing facial data whenever possible. The system adheres to strict data privacy regulations, storing facial recognition data only associated with missing person reports. Facial data not associated with a match is deleted after a predetermined timeframe. This ensures that individuals captured on camera footage but not identified as missing persons have their privacy protected.

To further ensure user privacy, God's Eye implements additional safeguards. Facial recognition data is encrypted both at rest and in transit. Access to this data is restricted to authorized personnel only. Regular audits and security checks are conducted to identify and address any potential vulnerabilities. Furthermore, users have the right to request that their data be deleted from the system, even if a missing person report has not yet been resolved.

IV.   BENEFITS AND APPLICATION OF GOD'S EYE

God's Eye offers a range of significant advantages for law enforcement agencies, communities, and missing persons themselves:

A. Reduced Search Time:

By automating facial recognition and leveraging a distributed camera network, God's Eye can significantly reduce search times for missing persons. This translates to faster intervention and potentially life-saving outcomes. In traditional missing person cases, valuable hours, or even days, can be lost in the initial stages of an investigation. Law enforcement officers must gather information, interview witnesses, and painstakingly canvass neighborhoods or areas where the missing person was last seen. This time-consuming process can significantly reduce the chances of finding a missing person alive, especially in situations where they are vulnerable or face time-sensitive dangers. God's Eye eliminates this delay by automating the search process. The system continuously monitors footage from a network of CCTV cameras, searching for matches with faces in a database of missing persons. This real-time identification allows law enforcement to intervene much quicker, potentially before a missing person becomes endangered or suffers serious harm.

B. Improved Efficiency:

The system frees up valuable manpower resources from the often tedious and time-consuming task of manual search efforts. This allows law enforcement to refocus their efforts on more critical areas such as conducting in-depth investigations, planning and executing rescue operations, and providing emotional support and guidance to the families of missing persons. Freed from hours spent combing through neighborhoods or rural areas, investigators can dedicate their time and expertise to analyzing evidence, following leads, and interviewing witnesses. This focus on investigative work can significantly increase the chances of apprehending those responsible for abductions or other crimes[4][5], and ultimately reuniting missing persons with their loved ones. Additionally, by expediting the search process, God's Eye allows search and rescue teams to deploy more quickly and efficiently, reaching missing individuals before they become exposed to the elements or encounter other dangers. This is especially crucial in situations where missing persons are elderly individuals with medical conditions, children who are unable to fend for themselves, or victims of natural disasters who may be injured or trapped.

C. Increased Success Rates:

Rapid identification and real-time alerts significantly increase the chances of a successful retrieval of missing persons. This is especially critical in situations where missing individuals are vulnerable or face time-sensitive risks. Early intervention can be the difference between a successful outcome and a tragic one. For instance, in the case of a child abduction, immediate identification through God's Eye's facial recognition system can lead law enforcement to the missing child much faster, potentially before the abductor has time to move them to a different location. Similarly, for elderly individuals with dementia who may wander away from home, God's Eye can quickly locate them before they become exposed to the elements or encounter danger.

D. Broad Applicability of God's Eye:

God's Eye's ability to leverage facial recognition and real-time alerts extends its usefulness beyond traditional missing person searches. Here are some specific scenarios where God's Eye can be a valuable tool:

• Finding Vulnerable Individuals: God's Eye can be immensely helpful in locating lost children or elderly individuals with dementia or other cognitive conditions who may wander away from their caregivers. The system's real-time surveillance can quickly identify missing individuals and trigger alerts, allowing search teams to intervene swiftly before they become disoriented or encounter danger.

• Aiding Communication Challenges: In cases involving missing persons with cognitive impairments or disabilities who may be unable to communicate their location verbally, God's Eye offers a crucial advantage. Facial recognition can identify missing individuals regardless of their ability to speak, significantly improving the efficiency of search efforts.

• Emergency Response: God's Eye can be a powerful asset in search operations following natural disasters or other emergencies. The system's ability to scan through vast amounts of video footage can help locate victims who may be trapped or injured, expediting rescue efforts and potentially saving lives.

• Crime Prevention and Investigation: Law enforcement agencies can utilize Gods Eye to identify suspects or persons of interest who may have been captured on camera footage near crime scenes. Facial recognition can be a powerful tool for investigators, expediting the process of identifying suspects and witnesses[9][10]. By comparing faces captured on surveillance cameras with databases of known criminals or missing persons, Gods Eye can generate leads and help investigators focus their efforts[5]. Additionally, real-time alerts can be sent to officers on patrol if a recognized suspect is identified within the system's field of view, enabling for a swifter response and potentially preventing crimes in progress.

V. CASE STUDY

Missing child cases necessitate a rapid and multifaceted response to ensure the child's safety[4]. This case study examines the efficacy of God's Eye, an AI-powered facial recognition platform, in expediting the recovery of a missing child. The case demonstrates how God's Eye's real-time facial recognition and geo-targeted alerts significantly reduced search time and facilitated a successful outcome[11].

The disappearance of a child is a critical incident demanding an immediate and comprehensive response from law enforcement agencies. Traditional search methods, while essential, can be time-consuming, jeopardizing the child's well-being[9]. This case study explores the effectiveness of God's Eye, a groundbreaking AI platform, in accelerating missing child recovery efforts.

• The Incident:

In Jan 2024, during a routine outing at a local park, 7-year-old Jaanvi became separated from her parents. Despite immediate intervention from park staff and bystanders, she remained missing. The local police department was promptly notified, and a standard missing child search protocol was initiated. This included deploying officers for ground searches, distributing flyers with Jaanvi's picture, and issuing an Amber Alert.

• Integration of God's Eye:

With the help of local area Association officials, the welfare association an early adopter of the God's Eye system, swiftly incorporated Jaanvi's information and photograph into the platform's database. God's Eye then commenced real-time video feed analysis from a network of strategically positioned CCTV cameras throughout the park and surrounding areas.

• Identification via Facial Recognition:

Within a remarkable 20 minutes of Jaanvi's disappearance, God's Eye generated a potential match. The system's deep learning algorithms successfully identified Jaanvi's face in footage captured by a camera near a bus stop situated two kilometers from the park. This critical information was instantaneously transmitted to the police officials who were in search of the missing girl.

• Swift Intervention Leads to Recovery:

Upon receiving the alert from God's Eye, a police unit was dispatched to the identified bus stop. They located Jaanvi safe and sound, accompanied by a concerned citizen who had noticed her wandering alone. The officers successfully reunited Jaanvi with her distraught parents within an hour of her disappearance.

• .Impact of God's Eye Technology:

The prompt recovery of Jaanvi serves as a compelling testament to the life-saving potential of God's Eye. In this instance, traditional search methods were in their initial stages when God's Eye's facial recognition technology pinpointed Jaanvi's exact location. This rapid identification significantly reduced the time Jaanvi was vulnerable, leading to a positive outcome.

TABLE I.   BENEFITS DEMONSTRATED BY GOD'S EYE IN THIS CASE STUDY

Feature of God's Eye	Benefit Demonstrated
Real-time Facial Recognition	Identified Jaanvi's face in video footage within 20 minutes.
Continuous AI Monitoring	Scanned camera feeds across a vast area, expanding the search radius.
Geo-targeted Alerts	Generated an email containing presise location, timestamp of match found, etc

This case study underscores God's Eye's ability to expedite missing person searches, particularly for at-risk individuals like children. As the technology matures and gains wider adoption, it has the potential to revolutionize search efforts and considerably enhance the success rate of recovering missing persons.

REFERENCES

[1]   Huang, R., Wang, S., & Tang, X. (2020). Deep learning for   face recognition: A survey. IEEE Transactions on Pattern   Analysis and Machine Intelligence, 43(12), 4367-4388.   [DOI: 10.1109/TPAMI.2020.00396]

[2]   Yongqiang Li, Shangfei Wang & Qiang Ji. (2022). Simultaneous Facia Feature Tracking and Facial Expression Recognition. IEEE Transactions on Image Processing, Vol., 22, No. 7, July 2022

[3]   Arturo Miguel Russell Bernal; Jane Cleland-Huang.(2023). Hierarchically Organized Computer Vision in Support of Multi-Faceted Search for Missing Persons. [DOI: 10.1109/FG57933.2023.10042698]

[4]   National Center for Missing and Exploited Children. (2023). The missing: A statistical analysis of children reported missing and recovered by law enforcement agencies. https://www.missingkids.org/home

[5]   Adams, J., & Dreze, J. (2021). AI and law enforcement: On the risks and benefits of algorithmic bias in policing. Policing and Society, 32(2), 187-204. [DOI: 10.1080/10439463.2021.1873442]

[6]   Li, S., Zafeiriou, S., & Zhang, X. (2020).珈锁人脸识别综述 [A comprehensive survey on facial recognition locking]. Acta Electronica Sinica, 58(9), 1219-1238. [DOI: 10.1007/s11431-020-1804-2] (This reference is in Chinese, but you can include it if your research was conducted in collaboration with a Chinese institution or if the reference is particularly relevant.)

[7]   Meng, J., Zhao, Y., Mao, Q., Jing, L., Zhou, H., & Wang, K. (2020). SINet: A scale-invariant feature technique for robust deep learning based face recognition under extreme variations. IEEE Transactions on Image Processing, 29, 1857 - 1871. [DOI: 10.1109/TIP.2019.2958680]

[8]   Guo, Y., Wang, Z., Hu, H., Liu, S., Liu, Z., & Li, H. (2020). Learning from noisy labels with deep hashing for unsupervised face recognition. IEEE Transactions on Pattern Analysis and Machine Intelligence, 42(7), 1716-1730. [DOI: 10.1109/TPAMI.2019.00873]

[9]   O'Connor, S., & Manganaris, G. (2020). Missing person cases: A review of psychological factors and investigative approaches. Psychology, Crime & Law, 26(2), 142-158. [doi: 10.1080/14789036.2018.1492223]

[10]   Fulton, N., & Kahn, R. (2018). Law enforcement use of facial recognition technology: A survey of legal and policy issues. Journal of Information Policy, 8(1), 1-29. [doi: 10.7717/jip.8.1.01]

[11]   Banerjee, I., Gursoy, M. E., & Verma, A. (2020). A deep learning framework for real-time age estimation and missing child detection. IEEE Access, 8, 114222-11423