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A Survey of Integrating Deep Learning-Based Missing Person Detection Model Into CCTV Systems For Enhanced Identification

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Abstract: *This study looks at the possibility of increasing identification abilities in closed-circuit video (CCTV) systems using a deep learning-based missing person detection model. Missing individuals are becoming increasingly common, necessitating the development of novel search tactics. This study uses deep learning to augment traditional CCTV systems by using an improved model that can reliably identify and track persons who go missing. Taking a detailed look at current techniques to missing person identification, the literature review shows the shortcomings of existing systems and the potential for improving them through the use of deep learning. The paper examines past methodologies, including facial recognition accuracy, tracking robustness, and system scalability.The integration of computer vision with missing person identification, object tracking technologies, and facial recognition algorithms are among the main topics. The research also investigates privacy, moral, and legal implications of deploying such technology in public.*

Keywords: Missing person detection, Video surveillance, Deep learning

I. INTRODUCTION

India, the world's second most populated nation, has a sizable kid population. A significant number of children disappear each year for a variety of reasons, such as kidnapping, running away, child trafficking, and just going missing for no apparent reason at all. Over 174 children go missing on a daily average, and only half of them are ever located. The various methods, that children might be abducted and exploited. In essence, the term "missing person" refers to the ability to identify, monitor, and identify people in real-time using video footage or live feeds. With the use of image processing methods, specifically OpenCV, the system is able to recognize and follow people inside the specified video area or live stream[2].

Missing people instances in India, especially in public areas like bus stops, railway stations, and shopping centres. Locating a missing individual in a large, crowded area is exceedingly challenging and complex. By acting as a conduit between the public and the police, the program makes it easier to locate the missing people. It incorporates a thorough database of missing people that includes specific details like name, photo, contact information, and address. Users can use parameters like name, age, gender, and complexion to search for missing people, including the general public and law enforcement [3].

The aging-invariant feature discriminator must be derived. Missing kid identification poses a different problem than prior face-recognition systems. A youngster may not be aware that their photo is being taken, thus when it is taken by a stranger, the quality of the photograph may be compromised. When designing a deep learning architecture, these limitations must be consideration. In contrast, the suggested technology provides an easy, affordable, and trustworthy substitute for iris and fingerprint authentication.

With an alarming average of 200 youngsters reported missing every day in 2019, the exponential rise in the number of missing individuals highlights the necessity for such a system. The goal is to create a sophisticated strategy to effectively manage this circumstance. The system uses "Keras", "TensorFlow" and "OpenCV" for facial recognition,

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and it may be extended to carry out further functions as needed. The 'Mission Planner' program is used to plan missions[5].

India, the world's second most populated nation, has a sizable kid population. In India, 174 children go missing on a daily average, and only half of them are ever located. There are several strategies that children might be abducted and exploited.

The concept is intended to locate those who go missing, such as kids, the elderly and mentally ill with Alzheimer's disease, and criminals. Its main objective is to supply precise datasets for identification. For the purpose to identify a good match, the face recognition part of the model compares the face encodings of submitted photographs with those kept in the database. The National Missing and Unidentified Persons (NamUS) database indicates that 600,000 persons are reported missing on average each year, underscoring the serious problem of missing people in the nation. The suggested approach makes use of Face Detection and Recognition (FDR) techniques to improve the effectiveness of the search process by using surveillance technologies, namely CCTV cameras [6].

Research has been proposed to help locate missing people more effectively because of how often reports regarding missing people appear in newspapers, news channels, and social media. One suggested technology, called "Searchious," aims to shorten how long it takes to trace missing people. It includes a Python based desktop program for police stations and an Android app for the general public that uses the k-Nearest Neighbours (KNN) facial recognition algorithm [7].

Every year, countless numbers there are reports of missing peoplein India. A significant portion of the youngsters in situations of missing children are still unaccounted for. A application of deep learning technology that uses facial recognition to identify the stated missing kid from a large collection of accessible child photographs. The face identification is accomplished with the use of Convolutional neural network(CNN), a powerful deep learning method for image-based applications. Using a convolutional model that has previously trained, the VGG-Face deep architecture, face descriptors are retrieved from pictures. In contrast to typical deep learning applications, our system performs kid recognition using the learned SVM classifier and only employs convolution networks as high-level feature extractors [8].

II. MISSING PERSON DETECTION TECHNIQUES

Missing person detection by face recognition has many techniques face identification, feature vector, and detection, etc. It is furthermore the fundamental square in object detection, biometric security etc. Missing person detection normally states finding missing ones through CCTV footages using deep learning algorithms and traditionally through lodging a complaint in local police station and file a missing person report. This survey is all about applying techniques to them. Missing person detection techniques includes gathering of data and preprocessing, feature extraction using various algorithms like CNN, KNN, SVM etc. Finally, the model is trained and comparison algorithms which computes embedding for the face in question. There are few papers which discuss about missing person detection using CCTV cameras.

2.1 Implementation of Machine Learning and KNN Algorithm for Finding Missing Person [1]

Even with the widespread use of social media and other cutting-edge communication technology in the modern world, finding missing people is still a difficult undertaking. In order to solve this problem, the publication "Implementation of Machine Learning and KNN Algorithm for Finding Missing Person" suggests a creative approach that leverages both machine learning and the K-Nearest Neighbours (KNN) method.

The method is intended to simplify and hasten the process of locating individuals who have gone missing. It uses face recognition software as its main search engine. The guardian of a person who has vanished can use this system to submit the person's photo, which is subsequently stored in a database. The facial recognition model searches the database for possible matches using the KNN technique and machine learning.

The system immediately notifies the guardian and the police if a match is discovered. This greatly shortens the time needed to find the missing individual and improves the effectiveness and efficiency of the procedure. By lowering the quantity of documentation often required for these kinds of procedures, the system seeks to improve user-friendliness.

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Advantages:
The facial recognition method is made more accurate by utilizing machine learning and the KNN algorithm, which increases the likelihood of finding the missing person. This approach speeds up the search for the missing a considerable deal, perhaps saving lives and resources.
Disadvantages:
Misidentification may result from problems with false positives and false negatives in the system. A need for the system's effectiveness is the database's correctness and currentness, which can be challenging to maintain.

2.2 Image Processing-Based Real-Time Detection and Tracking of Human [2]
The paper demonstrates a system designed for the real-time monitoring and identification of people in video streams, with a special emphasis on security surveillance applications. The suggested method makes use of OpenCV, Histogram of Oriented Gradients (HoG), and facial recognition technologies to improve the usefulness of tracking and detecting humans in video footage. The goal of the system is to use image processing techniques to lessen the amount of manual labour involved in recognizing persons in video feeds.
Advantages:
The system's resistance to changes in appearance, lighting, and orientation is strengthened by the use of OpenCV and HoG methods, which enhance facial tracking and detection accuracy.The system is a useful tool for tasks like security monitoring and missing person identification since it uses facial recognition and image conversion from video frames to significantly lessen the amount of time and work involved in manual identification.
Disadvantages:
The accuracy of detection can be impacted by changes in illumination, occlusion, and other external factors while utilizing image processing techniques like HoG. Real-time processing can be computationally demanding and need a large amount of computational capacity, especially when utilizing sophisticated image processing algorithms.

2.3 Detection of Missing Persons Using Mobile App [3]
The paper discusses the growing issue of missing persons in India and proposes a mobile application as a solution. Real-time communication and updates are made possible by the program, which acts as an interface between the public and the police. A database is populated with a person's details, including name, photo, contacts, and address, when they are reported missing. Using these specifics, the tool then enables users to look up missing people. The program notifies the police and the person who reported the missing person if a match is discovered. The application's ability to speed up the search for missing people and enhance public-police cooperation is emphasized in the report.
Advantages:
By using a consolidated missing person database, the program simplifies information administration and improves search efficiency. The app's user-friendly layout makes it simple for law enforcement and the general public to look up and obtain information about missing people. Using technology to expedite and enhance the search process, the application is made to facilitate the prompt and accurate identification of those who go missing.
Disadvantages:
In terms of algorithm complexity, processing resources, and potential false positives or negatives, implementing sophisticated features like face recognition may provide technological obstacles.The application's effectiveness is largely dependent on user engagement, and it may be difficult to guarantee that the public and police would use it widely and consistently provide data.

2.4 AI for Detection of Missing Person [4]
This paper uses algorithms like Convolutional Neural Networks (CNN) and Support Vector Machines (SVM) which has shown to recognise various patterns. In this system, CNN functions as a trainable feature extractor and SVM as a recognizer. This hybrid algorithm automatically generates predictions based on data extracted from raw pictures.This study tackles the urgent problem of missing people' location, highlighting its importance in cutting down on the time and manpower needed for these kinds of investigations. This work's main goal is to help identify missing people quickly and securely, which will support victim identification and investigative efforts.In order to do this, the authors

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suggest a complete system uses facial recognition technology and combines artificial intelligence, deep learning, and machine learning. In order to do this, the authors suggest a complete system that makes use of facial recognition technology and combines artificial intelligence, deep learning, and machine learning.

Advantages:

The paper's advantages highlight the higher performance of the suggested mechanism, especially when compared to other approaches like KNN and SVM with PCA, especially in terms of precision.Recognizing the worldwide problem of missing individuals, the suggested system is made to be applicable on a global level. This suggests that it might be applied in a variety of social and cultural situations.

Disadvantages:

Unexpected consequences, such the inadvertent surveillance of innocent individuals, might arise from incorrect identification. The data security and protection of the system may have problems.

2.5A CCTV Camera-Based Target Detection and Positioning UAV System [5]

The method that the study suggests combines drone technology with CCTV monitoring to follow and locate targets in real-time who may be a suspect or a person who has vanished. The system makes use of the benefits of both technologies: the mobility and adaptability of drones and the wide coverage of CCTV cameras1. The basic concept is to monitor and identify the target using CCTV cameras, then follow the target with the drone to give real-time video surveillance1. The system employs software called "Mission Planner" to plan the drone's missions and face recognition technologies including "Keras," "TensorFlow," and "OpenCV" for target identification.

Advantages:

It offers broad coverage and versatility by fusing the benefits of drones with CCTV cameras.

Disadvantages:

The quality of the CCTV footage and the drone's video feed determine how successful the system is.

2.6 FDR: An Automated System for Finding Missing People [6]

The approach seeks to use CCTV cameras to speed and simplify the search process. The authors suggest a system that makes use of a cloud system for data storage, Local Binary Pattern Histograms (LBPH) for face recognition, and Haar for face detection. The face recognition model identifies missing children, people with Alzheimer's disease, and offenders by comparing face encodings from submitted photographs with those already in the database. The system generates a unique guide for every new face and compares it with photos from the current collection to optimize processing time efficiency.

Advantages:

Centralizing and making data publicly accessible through cloud storage enhances the system's overall performance. Using methods for machine learning like Haar and LBPH increases the precision of face detection and identification.

Disadvantages:

Accuracy limitations in difficult scenarios such as non-frontal faces, complicated backdrops, and occlusions may affect standard techniques.

2.7 Searchious: Locating missing people using an optimised face recognition algorithm [7]

This study presents "Searchious," a program that uses an optimized algorithm for face recognition to speed up the means of locating missing persons.The tool is a reaction to the expanding worldwide problem of missing people, a large number of whom are victims of human trafficking, abduction, and other illicit activities. The authors want to expedite the process of missing person searches by combining this technology with a desktop program for police stations and an Android application for the general public.

Advantages:

If a face that isn't in the database is found, the tool may handle new cases.

Disadvantages:

The tool's accuracy falls short of expectations. The tool's performance under different lighting and environmental conditions is not discussed.

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2.8 Missing Child Identification System Using Deep Learning and Multiclass SVM [8]

The research presents a deep learning framework that makes advantage of multiclass support vector machines (SVM) and convolutional neural networks (CNN) with VGG-Face to locate missing children. The purpose is to raise the efficiency and accuracy of using facial recognition technology to detect missing children.The system's accuracy in identifying missing children is probably the main criterion used to assess its success. Metrics like recall, accuracy, and precision may be used to gauge how well the suggested strategy works.

Advantages:

For precise identification, the system makes use of multiclass SVM and sophisticated deep learning techniques.

Disadvantages:

The system's reliance on user submission of photographs may provide a drawback.Deep learning models, like as CNN, may be difficult to implement and need a lot of processing power to train and fine-tune.

2.9 Deep Learning Based Missing Object Detection and Person Identification and Application for Smart CCTV [9]

The method presented in this study enhances security and protection by utilizing computer vision and deep learning. The system is intended for smart CCTV applications and focuses on object detection, a computer vision subtask that allows us to identify objects. Through the use of a deep convolutional neural network, the system processes CCTV data in real time. The primary objective is to focus the material on objects. The system found the missing object with 10% more sparsity than the state-of-the-art approach when it used the YOLO technique.

Advantages:

It outperformed the most recent state-of-the-art algorithm by 10% in sparsity.

Disadvantages:

In order to train networks more quickly, relying only on smaller picture sizes may cause information loss at the expense of speed. It is possible that important features will occasionally be overlooked in favour of speed.A comparison with current object detection models or approaches is absent from the study. More thorough evaluation would come from knowing how the suggested two-layer deep network stacks up against alternative designs.

2.10 Criminals And Missing Children Identification Using Face Recognition And Web Scrapping [10]

The technique shown in the research employs online scraping and facial recognition to detect missing children and offenders. The method uses machine learning to take a picture and turn it into a feature vector that is used to build a digital profile. Repeat offenders and missing children are both intended to be recognized by the system. The ability of the technology to detect many faces at once is useful for swiftly identifying suspects.

Advantages:

It obtains information from several sources by using web scraping.The system has the capacity to manage more than one face at once, which is helpful for quick recognition.Each face is assigned a distinct template that is contrasted with other images in the set.

Disadvantages:

Pictures on the system are often fuzzy and hard to see.Reliance on the quality and availability of internet scraped data might be a potential weakness in the system.

2.11 Missing Person Identification Using Machine Learning With Python [11]

The method for locating missing people using Python and machine learning approaches is presented in the article. The writers make use the capabilities of digital photos and video, which are progressively significant in the information age. The system recognizes and detects faces quickly and easily using a Python algorithm. The authors want to possess the capability to identify people using an already-existing face database. Subsequently, the system employs a facial recognition software to assess if the identified individual is missing or unknown by comparing their face to the database.

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Advantages:
The study makes use of machine learning, suggesting a modern and innovative method for resolving the missing person identification issue.
Disadvantages:
The measures that are used to assess how well the machine learning system are doing are not well documented. The work might be improved by include a thorough assessment part with measures like accuracy, recall, and F1-score.One crucial issue that isn't covered in detail is the machine learning solution's scalability. Large datasets may be used in real-world application, hence the model's scalability is essential for actual use.

2.12 A Real-Time Framework for Human Face Detection and Recognition in CCTV Images [12]
The study suggests a methodology for identifying and classifying human faces in CCTV footage that is built using deep learning and machine learning. The stages that make up the framework are as follows: acquiring the images, preprocessing them, detecting, localizing, extracting, and recognizing faces. Using a dataset of 40K photos with varying environmental circumstances, clutter backgrounds, and occlusion, the study compares the performance of four classification techniques (KNN, CNN, CNN, and decision tree) and two feature extraction approaches (PCA and CNN). According to the article, the suggested framework can identify faces with more accuracy and a minimum amount of computation time.
Advantages:
Using a sizable dataset of 40K photos with various environmental conditions, clutter backgrounds, and occlusion, the study employs and contrasts. Many feature extraction strategies are efficient and categorization, including PCA, CNN, KNN and CNN. The suggested framework, based on the report, can identify faces with more than 90% accuracy and a minimum computation time.
Disadvantages:
The methods used for face identification, face localization, face extraction, and picture preprocessing are not well explained in the study. The suggested framework is not contrasted in the research with other facial recognition techniques currently in use for CCTV footage. The use of face recognition in CCTV photos raises privacy and ethical concerns that are not discussed in this work.

2.13 ArcFace: Additive Angular Margin Loss for Deep Face Recognition [13]
The ArcFace technique greatly improves facial recognition algorithms' ability to discriminate.Given that ArcFace precisely matches the geodesic distance on a hypersphere1, it has an obvious geometric explanation. The goal of the authorsapproach is to optimize class separability, a well-liked area of face recognition research1. Additionally, the study addresses ArcFace's vulnerability to enormous label noise and suggests sub-center ArcFace as a remedy. This variation promotes non-dominant sub-classes that include hard or noisy faces, as well as one dominant sub-class that comprises the bulk of clean faces.
Advantages:
The ArcFace approach precisely matches the geodesic distance on a hypersphere, it offers a clear geometric explanation.It greatly improves facial recognition algorithms' ability to discriminate.It is possible to produce identity-preserved face pictures for persons both inside and outside the training data using the suggested ArcFace approach.Massive label noise does not deter the ArcFace technique from working.The numerous studies presented in the research show that ArcFace can improve generative face creation and discriminative feature embedding.
Disadvantages:
The quality and accessibility of data sources determine the ArcFace method's efficacy.For the system to process and analyse data, a large amount of computational power is needed.

2.14 GhostFaceNets: Lightweight Face Recognition Model From Cheap Operations [14]
An innovative method for facial recognition that works well and quickly. Using GhostNetV1 and GhostNetV2, the authors provide GhostFaceNets, a collection of low-complexity facial recognition models. These models make use of Ghost modules, which extract new feature maps from a collection of fundamental characteristics using low-cost linear

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transformations. This makes it possible to portray the underlying data in a more thorough manner. In comparison to previous state-of-the-art models, the models exhibit greater performance while needing much less computing complexity.

Advantages:

With the addition of an attention method to capture long-range dependencies, GhostNetV2 builds upon the foundation of GhostNetV1.When trained with the ArcFace loss on the improved MS-Celeb-1M dataset, GhostFaceNets exhibit cutting-edge performance on all benchmarks.

Disadvantages:

On unfamiliar or unseen face recognition tasks, the models might not perform as well.There might be some information lost if feature map redundancy is reduced.The computational cost of GhostNetV2 can rise because of its attention strategy.

2.15 An Efficient Method for the Detection of Missing Person from Crowd [15]

A unique method for finding people who have gone missing in congested areas. The authors track a person or item in a crowd using OpenCV and techniques for processing images. The person's picture is analysed and fed into the tracking system. An alarm system is activated when the person or object is identified from a crowd video, enabling authorities to respond quickly and appropriately.

Advantages:

The technique makes advantage of one-shot learning, which, after training with a single image, can identify a human from any viewpoint. The technology may be used in a variety of surveillance tools.

Disadvantages:

The caliber and variety of the training data may have an effect on the system's effectiveness, the one-shot learning strategy might not work with every kind of item.Extremely congested situations may impair the usefulness of the device.

III. ANALYSIS TABLE

Sr no.	Paper Title	Techniques	Addressed Issue
1.	Implementation of Machine Learning and KNN Algorithm for Finding Missing Person [1]	The K-Nearest Neighbors (KNN) algorithm and machine learning are the main methodologies used in this study to power the facial recognition system.	It suggests a cutting-edge solution that uses the KNN algorithm and machine learning to speed up the procedure and raise the likelihood of finding the missing individual.
2.	Image Processing-Based Real-Time Detection and Tracking of Human [2]	The study uses HoG for extracting facial features, OpenCV for processing images and videos, and a Deep Convolutional Neural Network (CNN) for reliable human identification in face recognition.	With the use of image processing techniques, the system seeks to automate, making it suitable for scenarios including security, surveillance, and missing person identification.
3.	Detection of Missing Persons Using Mobile App [3]	The primary method employed in this study is the creation of a mobile application that stores and retrieves data from a database.	The study tackles the problem of missing individuals in India by suggesting a mobile application that expedites the search procedure and enhances communication between law enforcement and the general public.
4.	AI for Detection of Missing Person [4]	Techniques used are CNN and SVM to recognize various patterns.	The goal was to increase system efficiency and decrease calculation time while achieving 90.00 percent

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			accuracy.
5.	A CCTV Camera-Based Target Detection and Positioning UAV System [5]	For target identification and tracking, the system combines drone technology, CCTV surveillance, and face recognition software (Keras, TensorFlow, and OpenCV). Drone missions are planned using the "Mission Planner" program.	With the rising number of missing people and suspects, the system tackles the critical problem of monitoring and identifying a suspect or missing person.
6.	FDR: An Automated System for Finding Missing People [6]	The system uses LBPH for face recognition, Haar for face detection, and a cloud infrastructure for effective data storage and retrieval.	The study tackles the important social issue of missing people by putting forth an automated system that makes use of FDR approaches, offering a possible way to expedite and enhance the search procedure.
7.	Searchious:Locating missing people using an optimisedface recognition algorithm [7]	A face in a picture is classified into 68 facial points using the KNN method, which maps 128-dimension vectors.	An Android software called Searchious facilitates communication between the public and law enforcement, enabling them to locate missing persons more quickly.
8.	Missing Child Identification System using Deep Learning and Multiclass SVM [8]	For identification, the system combines SVM with deep learning. It extracts face descriptors from the pictures using the VGG-Face deep architecture and utilizes CNN for face recognition.	In India, where many children disappear each year, the system deals with the problem of identifying missing children. It offers a coordinated, methodical methodology for monitoring and identifying these kids.
9.	Deep Learning Based Missing Object Detection and Person Identification and Application for Smart CCTV [9]	The system employs a deep convolutional neural network and the YOLO technique for object detection	The system tackles the important problem of safety and security in the everevolving world of today. Utilizing cutting-edge deep learning methods, the system seeks to increase the perfomance of intelligent closed-circuittelevision applications.
10.	Criminals And Missing Children Identification Using Face Recognition And Web Scrapping [10]	The system makes use of web scraping, facial recognition, and machine learning.	The important problem of identifying offenders and missing children is handled by the system. Through the use of web scraping and sophisticated machine learning algorithms, the system seeks to increase accuracy and speed up identification.

IV. CONCLUSION

This paper presents a study on different sorts of missing person detection techniques. An overview of all related missing person detection methods such as CNN, KNN, SVM and facial recognition and classification techniques have been presented in this paper. Missing person detection using a combination of SVM and deep learning algorithm

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giveswell referenced detection approach, even in noise content images. The method using Convolutional Neural Network(CNN) for face recognition on VGG-Face Deep architecture gives the high accuracy.

Missing person detection is a technique to find person using video surveillance from the database created. The paper studies KNN,SVM, HoG, CNN and OpenCV algorithms for detection ofmissing individual. It also shows edge detection techniques. Overall the papers give knowledge of best methods used for locating a missing individual through video surveillance.

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