

AI-Powered Lost Child Detection System using Facial Recognition and Behavior Analysis

Bhagyashri Fulari¹, Sarika Gadhe², Pratima Devikar³, Aditi Khamkar⁴, Prof. Nikhil Deshpande⁵

^{1,2,3,4}Department Of Information Technology, Sinhgad College of Engineering, Pune – 41

⁵Assistant Professor, Department of Information Technology, Sinhgad College of Engineering, Pune - 41

Abstract—The growing number of incidents involving missing children emphasizes how urgently intelligent and automated solutions are needed to facilitate prompt recovery and identification. Finding missing children using manual methods takes a lot of effort and is frequently unreliable, especially in busy public places. The creation of an AI-powered lost child detection system that combines facial recognition and behavioral emotion analysis to improve detection accuracy and response time is suggested in this research as a solution to this problem. The suggested system automatically detects and recognizes children's faces in real time using surveillance camera feeds, then compares them with a centralized database of missing children. By identifying anguish or terror, emotion recognition helps authorities prioritize high-risk cases. After a successful identification, the system also seeks to instantly notify administrators, parents, and law enforcement. This study describes the architecture, data flow, and module interactions with an emphasis on the design and methodology phase. The AI model will be implemented, trained, and its performance assessed in real-world situations in subsequent work.

Index Terms—AI, Computer Vision, Facial Recognition, Lost Child Detection, Emotion Analysis, Deep Learning, CNN, YOLO

I. INTRODUCTION

The growing number of missing kid cases around the world has raised serious societal concerns and necessitated the development of quicker and more effective identification and recovery techniques. Due to human error, time delays, and the enormous volume of unprocessed monitoring data, traditional methods like manual searches, public announcements, and poster-based campaigns frequently prove insufficient. An opportunity to automate this procedure through intelligent picture identification systems is presented

by the development of computer vision and artificial intelligence (AI) technology.

In order to precisely identify and find missing children in real time, this study focusses on the construction of an AI-powered lost child detection system that integrates behavioral emotion analysis and facial recognition. Using CCTV or live video feeds, the technology can identify faces, interpret facial expressions, and compare them to a centralized database of children who have been reported missing. The system's ability to prioritize situations involving distress or terror is made possible by the addition of emotion analysis, which improves detection efficiency overall by offering a centralized and automated solution for child recovery, the suggested model seeks to support administrators, parents, and law enforcement. The study's focus at this point is on the architecture, design, and data flow of the system; subsequent research will focus on implementation, dataset integration, and performance assessment under real-world circumstances.

II. LITERATURE REVIEW

[1] Using artificial intelligence and picture recognition technology, a number of researchers have helped create intelligent systems for identifying missing people, especially youngsters. These studies show how AI can increase search operations' efficiency and accuracy, but they also point out several drawbacks that our suggested effort seeks to resolve. In order to identify children's faces from CCTV footage, Sai S. V. (2025) created an Intelligent Missing Child Identification System that used deep learning and neural networks. Although the method successfully increased detection accuracy, it just used facial recognition and did not incorporate behavioral or

emotional analysis to determine whether a child was in distress.

[2] Similar to this, Raghavendra et al. (2023) used face picture datasets to construct a Convolutional Neural Network (CNN) model for child identification. Despite achieving encouraging classification results, their model was only able to match static images and lacked real-time video processing, which is essential in dynamic surveillance settings.

[3] Misper-Bayes, a Bayesian network model for missing person investigations, was presented by Reilly et al. (2021). It used probabilistic reasoning to examine contextual data, including location, time, and reports. The system was inappropriate for real-time child identification, though, because it lacked facial and visual recognition features.

[4] Zambrano et al. (2020) presented SIGPRO, a real-time progressive notification system that used MQTT bridges and topic hierarchies for rapid communication in missing person cases. Although it enhanced alert delivery and coordination through IoT technology, the system's effectiveness depended heavily on stable IoT infrastructure and synchronized data availability

III. PROPOSED SYSTEM

By cleverly combining facial recognition and behavioral emotion analysis, the suggested approach presents an AI-based real-time framework intended to identify and find missing children. The system uses a Convolutional Neural Network (CNN) to identify both face identification and emotional state, and it uses YOLO (You Only Look Once) for effective facial detection from live video or CCTV feeds.

Continuous video streams, human face detection in dynamic situations, and feature extraction to produce distinct embeddings for every face are all made possible by the architecture's structure. To find possible matches, these embeddings are compared to a centralized database that contains information about missing children. Authorities can prioritize urgent situations by using the system's ability to analyze the detected child's psychological condition, such as fear or anguish, thanks to the addition of emotion recognition.

In order to guarantee timely alert production upon detection of a match, the system additionally integrates automated decision-making and real-time data management. The appropriate authorities,

administrators, and guardians receive notifications with important information, including the image, location, and emotional state. Through the integration of facial and emotional clues, the suggested design offers a thorough method for monitoring kid safety.

IV. MODULES

A. Module for Image and Data Acquisition Capturing live video feeds or photos from CCTV cameras, surveillance systems, or uploaded sources is the responsibility of this module. The main input for further processing is the collected data. In order to preserve compatibility with the detection and identification models, it guarantees appropriate frame extraction, resizing, and normalization.

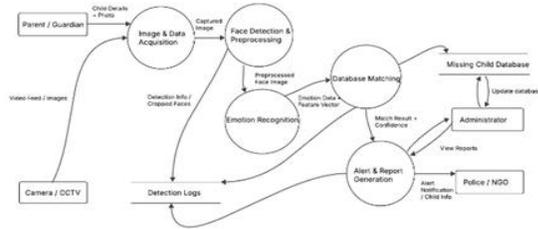
B. Module for Face Detection The face identification module locates and recognizes human faces in every video frame in real time by using the YOLO (You Only Look Once) algorithm. Even in crowded or dimly lit areas, YOLO's one-stage recognition method allows for quick and precise face localization. Cropped face regions that are sent on for additional examination make up this module's output.

C. Module for Feature Extraction and Recognition This module uses a Convolutional Neural Network (CNN) to extract distinguishing features after a face has been recognized. A feature embedding, a distinct numerical representation that captures facial traits, is created from the image by the CNN. To find possible matches, these embeddings are compared with the records kept in the centralized missing kid database using similarity metrics like cosine or Euclidean distance.

D. Module for Emotion Recognition To ascertain the child's emotional state; this module examines the detected face. The CNN-based emotion classifier recognizes expressions like neutrality, fear, sadness, and enjoyment. The system can determine whether the identified child may be in distress thanks to this extra layer of analysis, which aids authorities in setting priorities for their response.

E. Notification and Alert Module This module automatically creates alerts with pertinent details, such as the identified image, location, time, and emotional state, when the algorithm detects a high-confidence

match. Parents, administrators, and police officers are among the registered users who receive these notifications promptly via the communication interface. The module also records every detection event for case monitoring and future verification.



V. ALGORITHMS USED

In order to accurately and instantly identify lost children, the suggested system combines a Convolutional Neural Network (CNN) with the YOLO (You Only Look Once) object detection technique. Because it effectively processes whole photos in a single evaluation and provides both high detection speed and precision, YOLO is used to recognize human faces in live CCTV or video feeds. Faces are extracted after localization and sent to the CNN model for in-depth examination. CNN is in charge of two main tasks: classifying emotions and recognizing facial features. CNN transforms each identified face into numerical feature embeddings during the facial recognition process. These embeddings are then compared with previously stored embeddings in a centralized missing kid database using similarity metrics such as Euclidean distance or cosine similarity.

Simultaneously, emotion analysis is carried out using the same CNN model or a different classifier to identify emotional states like fear, sadness, or neutrality. Prioritizing alarms for kids who seem upset or in danger is made easier with this extra layer of interpretation. Thus, a hybrid detection framework that can function well in dynamic contexts while retaining high accuracy is ensured by the merging of YOLO and CNN. When a match is made, the system automatically creates an alert with the image, emotion detected, time, and location. This alert is then sent right away to the guardians and authorities who need to know. The algorithm's continuous operation makes it appropriate for use in extensive public surveillance systems where accuracy and real-time performance are crucial.

VI. CONCLUSION

By employing CNN for emotion recognition and YOLO for facial detection, the suggested method seeks to create an AI-based real-time framework for missing child identification. Automating child detection, analyzing emotional states, and sending timely alerts to relevant authorities are all made possible by the infrastructure that has been built. This strategy supports the project's goals of improving the effectiveness, precision, and responsiveness of efforts to recover missing children.

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