

Lecture Notes in Networks and Systems 974

Dipak Kumar Kole ·
Shubhajit Roy Chowdhury ·
Subhadip Basu · Dariusz Plewczynski ·
Debotosh Bhattacharjee *Editors*

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Preface

COMSYS-2023, the fourth International Conference on Frontiers in Computing and Systems, was organized by the Indian Institute of Technology-Mandi, Himachal Pradesh, India, and COMSYS Educational Trust, Kolkata, from 16th December to 17th December 2023. Like its previous three editions, COMSYS-2020, COMSYS-2021, and COMSYS-2022, COMSYS-2023 offered a unique platform for scientists and researchers in computing and systems to interact and exchange scientific ideas and present their novel contributions in front of a distinguished audience, fostering business and research collaborations. The conference accepted papers on several important and cutting-edge topics that have been grouped into five tracks: (1) AI, ML, and Data Science, (2) Devices, Circuits, and Systems, (3) Computational Biology and Bioinformatics, (4) Communication Networks, Security, Cloud computing and IoT, (5) Image, Video, and Signal Processing.

We received 255 submissions from different educational institutes and research organizations in India as well as abroad. After thorough reviews and plagiarism checking, 97 papers were accepted for oral presentations, with an acceptance rate of around 38%. Accepted papers were spread over 16 technical sessions and presented at IIT Mandi. In addition, the COMSYS-2023 technical program included four keynote lectures by eminent scientists and academicians from Sweden, Poland, and India. A large number of students and research scholars from India and abroad had also registered for the conference.

The overall technical program of COMSYS-2023 effectively blended a wide area of interest in computing and systems and brought together experts from both industry and academia. We are especially thankful to the submitting authors for their strong and diverse submissions that could help the review committee members to choose a strong set of technically sound research papers. A good number of students and research scholars from India and abroad had also registered for the conference.

COMSYS-2023 received considerable global and national attention, with technical program committee members and reviewers from 20+ different countries voluntarily participating in the technical process. Participants from seven countries outside India and 21 different states in India attended the conference.

We would like to express our sincere gratitude to all the technical program committee members and reviewers for their wholehearted cooperation and support in completing the review process smoothly. This conference was basically an output of great teamwork. The success of this conference represented the cumulative efforts of all our colleagues that are too numerous to name individually. We would like to thank all for making this a lively community dedicated to the advancement of technology.

COMSYS-2023 was inaugurated by the Chief Guest, Prof. Santanu Chaudhury, Director IIT Jodhpur, and the guest of honor, Prof. Laxmidhar Behera, Director IIT Mandi, in the presence of distinguished dignitaries from renowned institutions of India and abroad. In a word, it is always a team effort that defines a successful conference. We look forward to seeing all of you at the next edition of COMSYS.

Jalpaiguri, India
Mandi, India
Kolkata, India
Warsaw, Poland
Kolkata, India

Dipak Kumar Kole
Shubhajit Roy Chowdhury
Subhadip Basu
Dariusz Plewczynski
Debotosh Bhattacharjee

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Debotosh Bhattacharjee is working as a full professor at the Department of Computer Science and Engineering, Jadavpur University with nineteen years of

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Artificial Intelligence, Machine Learning and Data Science

AI Based Criminal Detection and Recognition System for Public Safety and Security using novel CriminalNet-228



Jamuna S. Murthy and G. M. Siddesh

Abstract The recent surge in public space criminal activities underscores the need for an efficient system to promptly detect, recognize, and track criminals. Existing AI-based criminal detection literature, while insightful, has limitations such as the complexity to analyze video data, time, and speed of accuracy when it comes to training the algorithms that call for further advancements. Hence proposed AI-driven system addresses this demand, aiming to automate criminal identification, equipping law enforcement with a potent tool for proactive crime prevention and resolution. The system utilizes the innovative “CriminalNet-228” Convolutional Neural Network (CNN) architecture, meticulously trained on a vast criminal image dataset for enhanced detection accuracy. To bolster face detection, additional computational resources like parallel processing and distributed computing are employed, enabling real-time analysis of extensive CCTV footage. Notably, the system tracks identified criminals, providing law enforcement with real-time situational awareness. CriminalNet-228 achieves an impressive overall Mean Average Precision (mAP) of 0.65 and excels in detecting facial features as small as 4×4 pixels, demonstrating its detail-oriented recognition capabilities. When evaluating Proposed CriminalNet-228 in comparison to established state-of-the-art techniques like Fast-RCNN, Yolov7, and AlexNet, it surpassed them in terms of precision, recall, f-measure, and accuracy, achieving an impressive accuracy rate of 99.2%.

Keywords Real-time · Criminal · Apache Kafka · Distributed · CriminalNet-228

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1 Introduction

The escalating prevalence of criminal activities in public spaces has emerged as a critical global concern, prompting numerous nations to seek innovative strategies for enhancing public safety and security [1–5]. Conventional law enforcement methods often prove inadequate in addressing the complexities of contemporary crime prevention and resolution, necessitating the integration of advanced technological solutions [6–10]. In response to this imperative, we propose an AI-driven system tailored for criminal detection, recognition, and tracking, poised to empower law enforcement agencies with a dependable and efficient tool for crime prevention and resolution.

The present manual procedure of scouring CCTV footage following criminal incidents represents a laborious and time-consuming endeavor, largely reliant on human intervention within cyber cell units [11–15]. This reliance on manual review processes underscores the exigency for a more streamlined and effective solution [21–25]. To meet this demand, our AI-based criminal detection, recognition, and tracking system has been introduced, offering a tangible enhancement in public safety and security. This system undertakes the automation of labor-intensive tasks associated with criminal identification, thereby furnishing law enforcement entities with a robust and efficient resource for the proactive prevention and resolution of criminal activities.

The primary contribution of our proposed system encompasses several key facets:

1. **Enhanced Law Enforcement Efficiency:** By significantly reducing response times and enhancing accuracy using novel CriminalNet-228, our system empowers law enforcement to mount more effective responses to criminal incidents.
2. **Diminished False Alarms:** The integration of proposed AI algorithms within the system substantially mitigates false alarms, thereby bolstering its operational efficiency and overall credibility.
3. **Augmented Public Confidence in Law Enforcement:** The system’s transparent and dependable nature is poised to bolster public trust in law enforcement agencies.
4. **Ethical Considerations:** A paramount consideration in our system’s design is the incorporation of ethical principles, including privacy safeguards, bias mitigation, and accountability measures.
5. **Technological Advancement:** Beyond its immediate benefits, our system serves as a foundational platform for the ongoing development and refinement of AI algorithms and technologies, fostering the continued advancement of AI within the realm of criminal detection and recognition.

2 Literature Review

Katkar et al. [16] and presents a framework plan that is made out of preservation RestNet 50 and LSTM organizations. The photographs with significant level component maps were obtained utilizing the principal unit work which is convolutional subsequently the intricacy of the second brain network info will be lower by utilizing RestNet50 which is a pre-prepared model. It extricates the edges from CCTV accounts that have been obtained after a short time frame stretch. The cycle separates the edge and the record outline is then scaled to 224×224 pixels under 50 information aspects. The motivation behind this study is to deduct strange human actions in swarms to further develop swarm security. The uncommon edge and strange way of behaving is recognized separately and alarmed by means of mail to the control room. The task's principal benefits incorporate effectiveness, openness, and peculiarity.

Ayyappan [17] proposes a framework for distinguishing hoodlums and missing youngsters utilizing face acknowledgment and web scratching. The framework uses different face acknowledgment strategies, for example, Eigenfaces, Fisher faces, LBP, and LBPH for precise recognizable proof of suspects. Furthermore, the utilization of Haar overflows for face recognition and web scratching for information gathering permits the framework to give quicker and more productive outcomes contrasted with customary techniques. The framework's precision can likewise be improved by enhancing the boundaries utilized in face acknowledgment calculations, for example, limit values and distance measurements. Moreover, the framework can be prepared on countless pictures, permitting it to actually perceive faces with various varieties more. The proposed framework gives a promising answer for the distinguishing proof of crooks and missing kids and could be a significant instrument for policing. Be that as it may, the framework's adequacy might be impacted by different factors, for example, the nature of the pictures utilized for preparing and the presentation of the face acknowledgment calculations. Consequently, future exploration might zero in on working on the framework's exactness by tending to these variables. By and large, the proposed framework presents a special and functional methodology for the recognizable proof of lawbreakers and missing kids that could have critical ramifications for public wellbeing.

Tofighi et al. [18] proposes a technique to improve the presentation of face location and acknowledgment frameworks. This technique fundamentally comprises two primary parts: first is to distinguish faces and afterward perceive the recognized

appearances. In the discovery step we utilized the skin variety division with Gaussian skin variety model joined with AdaBoost calculation, which is quick and furthermore more precise contrasted with the other known strategies. Likewise, utilizes a progression of morphological administrators to further develop the face location execution. Acknowledgment part comprises four stages: Gabor highlights extraction, aspect decrease utilizing PCA, include choice utilizing LDA, and SVM based grouping. Mix of PCA and LDA is utilized for working on the capacity of LDA when a couple of tests of pictures are accessible.

Rasanayagam et al. [19]. presents a system that combines the examination of faces, feelings, ages, and sexual orientations to recognize the suspects. Face acknowledgment, feeling, age, and orientation IDs are carried out utilizing profound learning based CNN approaches. Suits distinguishing proof depends on LeNet engineering. IMDb is the dataset utilized for the entire preparation reason. Preparing is performed utilizing AWS cloud which is an all the more remarkable and fit approach to preparing as opposed to utilizing neighborhood machines. Continuous Video and pictures are taken for the analysis. In results, this has been prepared for over one month and 80% normal precision is accomplished.

Rajapakshe et al. [20] presents AI and profound learning based E-police frameworks to upgrade public security and backing policing. Principal objective of the framework is counteraction of violations. E-Police is an application that helps cops to become educated about the occurrences occurring around continuously. What's more, the framework gives expectations about potential violations liable to happen in the future with the goal that precautionary measures can be taken to forestall those. The ResNet50 based model accomplished the best execution among the pre-prepared models utilized in the component extraction process with approval exactness of 100% and heaps of 0.0031. Second best execution among the choice CNNs accomplished by the InceptionV3 based model with an approval precision of 74.71% and deficiency of 0.4820.

3 Proposed Work

Public safety and security are vital concerns in today's world, and the need for efficient and reliable tools to ensure public safety is becoming increasingly important. With the rise of criminal activities in public spaces, law enforcement agencies around the world are exploring various ways to prevent and solve crimes effectively. In this context, we propose an AI-based criminal face detection, recognition, and tracking system that can enhance public safety and security by automating the manual task of detecting and recognizing criminal faces.

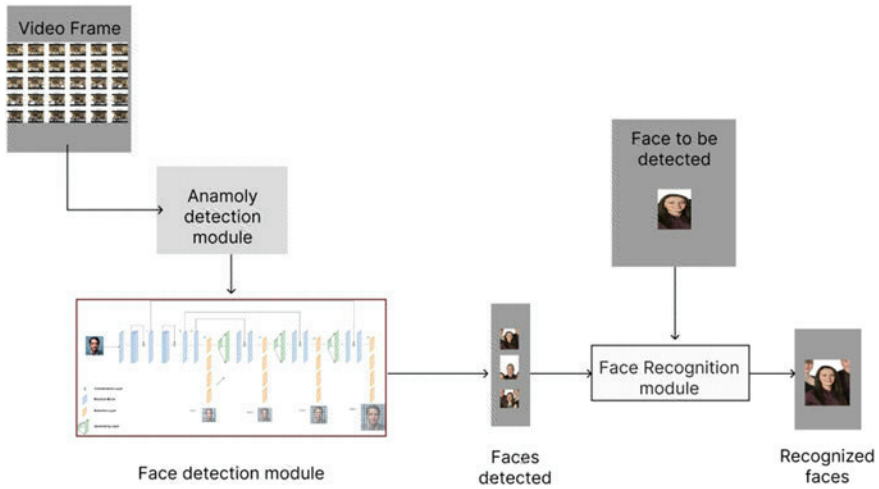


Fig. 1 Proposed AI based criminal detection and tracking system

The proposed system leverages a novel Convolutional Neural Network (CNN) architecture called “CriminalNet-228” to distinguish and perceive criminal appearances in CCTV camera film. The framework is prepared on a huge dataset of criminal pictures to expand the precision of the framework. By implementing parallel processing and distributed server concepts, the system can analyze vast amounts of CCTV footage simultaneously, which is not possible for humans to do in real-time. The system also tracks the movements of recognized criminals using a map, providing law enforcement officials with real-time information to take appropriate action. While the system is a tool and cannot replace the expertise and judgment of law enforcement officials, it has the potential to significantly improve public safety and security. The architectural design of the Criminal Detection Recognition and Tracking System is depicted in Fig. 1 which consists of three main subcomponents, namely the Anomaly Detection Module, Face Detection Module, and Face Recognition Module.