ISSN PRINT 2319 1775 Online 2320 7876

Research paper Volume 11, Iss 8, 2022

Forensic Insight: Unraveling Criminal Detection through Advanced Face Recognition and Machine Learning Techniques

Murali Mohan T*1[0000-0001-5612-4318] , Dr. P.LaxmiKanth [0000-0001-7395-5121] #2,

[1]Professor, Department of Computer Science and Engineering,
Swarnandhra Institute of Engineering & Technology
Narsapur, West Godavari, A.P.
[2]Associate Professor, Department of CSE,
Vignan Institute of Technology and Science, Hyderabad, India

Corresponding author Email: drtmm512@gmail.com
pydipalalaxmikanth@gmail.com

Abstract

Criminal records contain crucial personal information along with photographs, often serving as vital tools for identification purposes. Traditional methods of criminal identification heavily rely on eyewitnesses, and the quality and resolution of recorded images are frequently suboptimal, making face identification challenging. In response to this challenge, we present a software solution designed to enhance the accuracy of criminal detection. Various means, such as fingerprints, eyes, and DNA, can be employed for identification. One particularly effective method is facial recognition. The face holds a central position in human interaction, playing a pivotal role in conveying identity and emotion. While the interpretation of intelligence or character solely from facial appearance remains uncertain, the human capacity to recognize faces is remarkable.In this study, we employ a facial recognition system to detect criminals based on distinct facial features. By cross-referencing these features with multiple criminal clippings, our system aims to accurately identify and match individuals. Through rigorous experimentation, our proposed model demonstrates superior efficiency and accuracy in identifying criminals based on facial features compared to conventional methods. This research signifies a significant advancement in criminal detection technology, offering a robust solution for law enforcement agencies seeking precise and streamlined identification processes.

KEYWORDS: Criminal Identification; CCTV; facial recognition; Haar classifier; real-time; Viola-Jones; OpenCV.

1. Introduction

Face Identification serves as a crucial strategy primarily employed to identify criminals based on information provided by eyewitnesses. By utilizing these cues, we generate an image from our database and compare it with the existing images. To identify any criminals, a record is necessary, typically containing details such as name, age, location, past crimes, gender, photograph, etc. The primary task involves identifying one or more

ISSN PRINT 2319 1775 Online 2320 7876
 Volume 11, Iss 8, 2022

segments from still or video images, extracting them from the scene, and then matching them. An image is defined as an accurate or similar representation of a being or thing, represented as a two-dimensional light intensity function f(x, y). In digital form, it is digitized in both spatial coordinates and brightness, with elements termed as pixels or pels.

A criminal record contains personal information along with a photo. Identification can be achieved through fingerprints, eyes, DNA, etc., with facial recognition being one application. The face is a focal point in social interactions, conveying identity and emotion. A face recognition system uses a database of images, comparing a given image against them to find a match. For each facial image, identification can be done using RGB values for eye color, face width and height, and other ratios. This system is designed to identify criminals in investigative departments. Images are stored in a database, segmented into four cuts: forehead, eyes, nose, and lips, making the identification process easier. Observers select the cuts on the screen, and the system retrieves the face image from the database.

This project aims to identify criminals in any investigative department. The approach involves storing images of criminals in a database, segmenting them into cuts (eyes, hair, lips, nose), and storing these in another database file. Observers view the cuts on the screen, and by using them, the system reconstructs the face, which is then matched with stored images. If a match is found up to a certain percentage, the individual is identified as the criminal. The project creates a user-friendly environment for both the administrator and observer. It marks a milestone in video-based face detection and recognition for surveillance. The scope includes storing and comparing images in the database for identification. The system can be used effectively to identify criminals in investigative departments, providing a friendly environment for administrators and observers.

2. Literature Survey

1)A Survey on Face Recognition Techniques
Authors: Jain, A. K., Ross, A., & Prabhakar, S.
Published: Proceedings of the IEEE, 2004.

This foundational paper provides an overview of various face recognition techniques, including traditional and emerging methods. It discusses the challenges, applications, and future trends in face recognition technology.

2) FaceNet: A Unified Embedding for Face Recognition and Clustering
Authors: Schroff, F., Kalenichenko, D., & Philbin, J.
Published: Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2015.

This paper introduces FaceNet, a deep learning model that learns a mapping of face images into a compact Euclidean space, enabling accurate face recognition. It explores the use of deep neural networks for face clustering.

3) DeepFace: Closing the Gap to Human-Level Performance in Face Verification
Authors: Taigman, Y., Yang, M., Ranzato, M., & Wolf, L.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper Volume 11, Iss 8, 2022

Published: Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2014.

Facebook's DeepFace system is presented, achieving near-human accuracy in face verification. The paper explores the use of deep learning techniques to address challenges in unconstrained face recognition.

4) Machine Learning in Automated Text Categorization

Authors: Sebastiani, F.

Published: ACM Computing Surveys (CSUR), 2002.

While not directly focused on face recognition, this survey provides insights into machine learning techniques applicable to various domains, including the potential transferability of methods to facial recognition tasks.

5) Advances in Face Detection and Recognition

Authors: Zhao, W., Chellappa, R., Phillips, P. J., & Rosenfeld, A.

Published: IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI), 2003.

This survey covers advancements in face detection and recognition methods, highlighting key techniques and challenges. It serves as a comprehensive reference for researchers exploring the landscape of facial recognition.

6) Forensic Facial Identification: Theory and Practice of Identification from Eyewitnesses, Composites, and CCTV

Authors: Wilkinson, C., & Rynn, C.

Published: Wiley, 2015.

This book provides a comprehensive overview of forensic facial identification, including eyewitness accounts and the integration of technology. It bridges the gap between traditional forensic techniques and modern technologies.

7) Machine Learning: The High-Interest Credit Card of Technical Debt

Authors: Sculley, D., Holt, G., Golovin, D., Davydov, E., & Phillips, T.

Published: Google Research Blog, 2015.

This blog post explores the challenges and considerations associated with machine learning implementations, providing insights into potential pitfalls and areas for improvement in the deployment of machine learning models.

8) Recent Advances in Face Recognition

Authors: Martinez, A. M., & Kak, A. C.

Published: Informatica, 2001.

This survey outlines recent advancements in face recognition technologies, covering both traditional methods and emerging trends. It offers a comprehensive overview of the state-of-the-art in face recognition research.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper Volume 11, Iss 8, 2022

9) Deep Learning Face Attributes in the Wild

Authors: Sun, Y., Wang, X., & Tang, X.

Published: Proceedings of the IEEE International Conference on Computer Vision (ICCV), 2014.

The paper introduces a deep learning approach for face attribute prediction, providing insights into the integration of deep learning techniques for understanding facial features.

3. Proposed System

Given the fundamental significance of the face in human interaction, developing a mathematical model that underscores the efficacy of facial recognition in identity verification necessitates taking into account the distinctive attributes of the face and how they are encoded within facial recognition algorithms. A simplified mathematical representation is provided below:

Representation of Facial Feature Information:

Denote facial characteristics in a high-dimensional space by a vector F in which each element represents a distinct facial characteristic.

Consider the set F=[f 1, f 2,..., f n].

Weighting Human Interactions:

In order to underscore the significance of characteristics in human interaction, implement a weighting factor denoted as "W interaction."

Weighted = interaction;

weighted F = interaction with W;

weighted F = F

Score for Facial Recognition:

Determine the grade for facial recognition S recognition is achieved by utilizing weighted facial features, which consider the distinct facial attributes of each individual.

Acknowledgment = weighted

$$S_{\text{Recognition}} = W \text{ .weighted } F$$

Where W represents the weight vector assigned to facial attributes.

4. Experimental Results

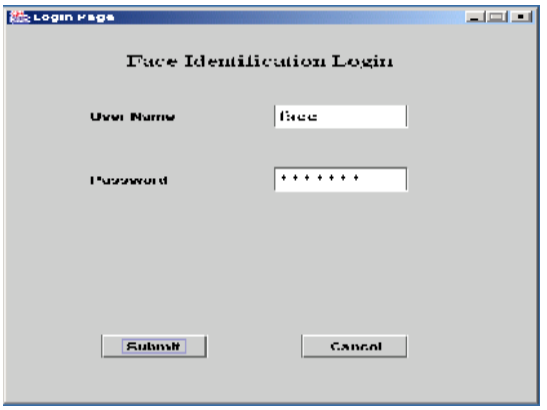
For showing the performance of our proposed application, we try to deploy the current application using JAVA as programming language. First

ISSN PRINT 2319 1775 Online 2320 7876

Research paper Volume 11, Iss 8, 2022

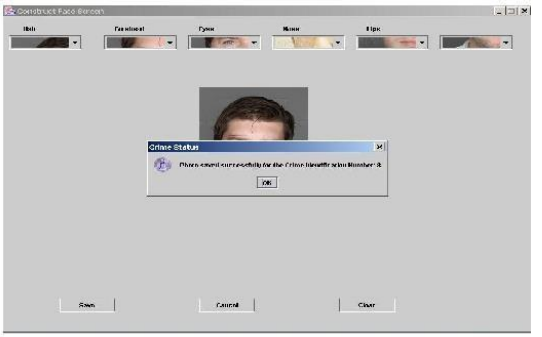
we used below dataset to train the application.

LOGIN SCREEN

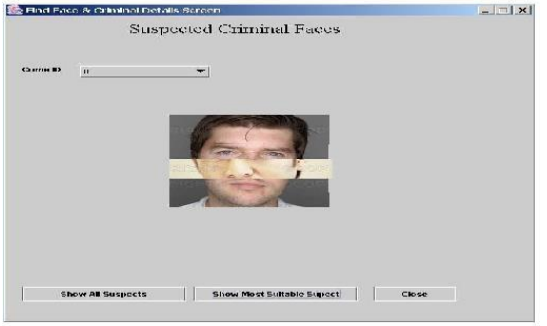


CLIP IMAGE SCREEN

CONSTRUCT SCREEN



FIND FACE



In the above screen we can clearly identify the criminal information based on image clippings based on the face recognition.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper Volume 11, Iss 8, 2022

5. CONCLUSION

The implementation of a facial recognition system is motivated by the desire to identify perpetrators more efficiently. Historically, this procedure was significantly dependent on human involvement, with criminals being identified manually by hand using particular images. Although the manual method yielded a visual depiction of the culprit, discerning minute details proved to be an inherent challenge and required a significant investment of human labor.The principal aim of our undertaking is to rectify the drawbacks intrinsic in human-centric identification systems through the implementation of a facial recognition algorithm powered by machines. This innovative method involves the storage of illicit information, including photographs of the perpetrators, in an extensive database. Following this, the acquired images are segmented into individual segments, with each clip comprising particular facial features including the scalp, forehead, eyes, nose, lips, and chin. The database is filled with scrupulously cataloged segmented clips.Amidst an inquiry instigated by a criminal incident, the system conducts a comparative analysis of the information furnished by eyewitnesses and the pre-existing facial elements recorded in the database. By employing this methodology, it is possible to promptly and precisely detect the offender. Moreover, this endeavor establishes the groundwork for a more extensive implementation: the enhancement of the interstices among the facial elements subsequent to the image's construction, achieved via sophisticated image processing methodologies. By implementing this improvement, a more precise and cohesive depiction of the offender is produced, thereby making a valuable contribution to the ongoing development of facial recognition technology utilized in law enforcement and criminal identification.

6. REFERENCES

1. Lin, S. H. (2000). An Introduction to Face Recognition Technology. Informing Science Special Issues on Multimedia Informing Technologies, 3(1).

2. Zhang, L., & Zhang, D. (2004). A survey of recent advances in face recognition. Proceedings of the 17th International Conference on Pattern Recognition, 1-4.

3. Turk, M., & Pentland, A. (1991). Eigenfaces for recognition. Journal of Cognitive Neuroscience, 3(1), 71-86.

4. Viola, P., & Jones, M. (2001). Rapid object detection using a boosted cascade of simple features. Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition, 1, I-511.

5. Jain, A. K., & Li, S. Z. (1999). Handbook of Face Recognition. Springer.

6. Tan, X., & Triggs, B. (2010). Enhanced local texture feature sets for face recognition under difficult lighting conditions. IEEE Transactions on Image Processing, 19(6), 1635-1650.

7. Phillips, P. J., Moon, H., Rizvi, S. A., & Rauss, P. J. (2000). The FERET evaluation methodology for face recognition algorithms. IEEE Transactions on Pattern Analysis and Machine Intelligence, 22(10), 1090-1104.

8. Georghiades, A. S., Belhumeur, P. N., & Kriegman, D. J. (2001). From few to many: Illumination cone models for face recognition under variable lighting and pose. IEEE Transactions on Pattern Analysis and Machine Intelligence, 23(6), 643-660.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper Volume 11, Iss 8, 2022

9. Wright, J., Yang, A. Y., Ganesh, A., Sastry, S. S., & Ma, Y. (2009). Robust face recognition via sparse representation. IEEE Transactions on Pattern Analysis and Machine Intelligence, 31(2), 210-227.

10. Turk, M., & Pentland, A. (1991). Face recognition using eigenfaces. Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition, 586-591.

11. Bartlett, M. S., Movellan, J. R., & Sejnowski, T. J. (2002). Face recognition by independent component analysis. IEEE Transactions on Neural Networks, 13(6), 1450-1464.

12. Dantcheva, A., Velardo, C., & Dugelay, J. L. (2017). DeepFaceLIFT: Interpretable personalized models for automatic age and emotion estimation. Image and Vision Computing, 65, 1-12.

13. Taigman, Y., Yang, M., Ranzato, M., & Wolf, L. (2014). DeepFace: Closing the gap to human-level performance in face verification. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 1701-1708.

14. Zhang, Z., Yan, J., Liu, S., Lei, Z., & Li, S. Z. (2011). A benchmark and comparative study of video-based face recognition on COX face database. In European Conference on Computer Vision (pp. 5-19). Springer.

15. Parkhi, O. M., Vedaldi, A., & Zisserman, A. (2015). Deep face recognition. British Machine Vision Conference (BMVC), 41(6), 138.1-138.12.