Indonesian Journal of Electrical Engineering and Computer Science
Vol. 39, No. 2, August 2025, pp. 963~972
ISSN: 2502-4752, DOI: 10.11591/ijeecs.v39.i2.pp963-972

An implementation of GAN analysis for criminal face identification system

Ayesha Sarosh[1], Govindu Komali[2], Vishnu Vardhan Battu[3], Laxmaiah Kocharla[4], Eswaree Devi Kopparavuri[5], Ooruchintala Obulesu[6], Praveen Mande[7], Amanulla Mohammad[8]

[1]Department of Computer Science and Engineering, Senior SRE, John Deere, Moline, United State
[2]Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation (Deemed to be University), Green Fields, Guntur, India
[3]Department of Computer Science and Engineering, P.V.P. Siddhartha Institute of Technology, Vijayawada, India
[4]Department of Computer Science and Engineering, Vignana Bharathi Institute of Technology, Hyderabad, India
[5]Department of Computer Science and Engineering, Lakireddy Bali Reddy College of Engineering, Mylavaram, India
[6]Department of Computer Science and Engineering (AI and ML) and CSE (Data Science), G. Narayanamma Institute of Technology and Science for Women, Hyderabad, India
[7]Department of Electrical Electronics and Communication Engineering, GITAM School of Technology, GITAM Deemed to be University, Visakhapatnam, India
[8]Department of Computer Science and Engineering, Aditya College of Engineering and Technology, Surampalem, India

Article Info

Article history:

Received Mar 21, 2024
Revised Mar 11, 2025
Accepted Jul 2, 2025

Keywords:

Computer vision
Face recognition
GAN
Prevention

ABSTRACT

In recent times, the criminal activities are growing at an exponential rate. For the prevention of crime, one of the main issues that are before the police are accurate identification of criminals and on the other hand the availability of police officers are not adequate. The most tedious task is tracking the suspect once a crime was committed. Over the years, several technical solutions have been presented to detect the criminals however most of them were not effective. One of the most significant characteristics for the identification of a person is face. Even identical twins have their own unique faces. Face identification is a challenging topic in computer vision because the human face is a dynamic entity with a high degree of visual variation. In this area, identification accuracy and speed are significant challenges. Hence to solve these issues, an implementation of generative adversarial network (GAN) analysis for criminal face identification system is presented. GAN is used for the identification of criminals. Recall, precision, accuracy, and F1-score are used to assess the performance of the presented technique. Compared to previous models, this model will achieve better performance for criminal face detection.

Corresponding Author:

Ayesha Sarosh
Department of Computer Science and Engineering, Senior SRE, John Deere
Moline, Illinois, United State
Email: saroshsyed09@gmail.com

1. INTRODUCTION

Human identity is mostly determined by the face. The characteristic that most clearly identifies a person is this specific analysis. The difficulty of face recognition is both exciting and challenging, and it has significant implications for a number of industries, that includes personal identity, authentication for banking and security system access, and identification for law enforcement. However, for humans, the face recognition is simple but for a computer it is challenging [1]. The human face may reveal more information about us than what would they think, including the race, gender, age, health, emotions, psychology, and a profession. Looking at someone's face might reveal characteristics about them and reveal their sentiments [2]. Preventing crime is a important responsibility since it is one of the most serious and persistent problems in our society. Crime is the significant and essential considerable issue in the society where security and safety are important factors that directly affect the people [3]. Crime is one of the biggest and most prevalent problems facing our population, and it is not at all a difficult process. Numerous wrongdoings are constantly committed in large numbers every day. This calls for keeping track of all crimes and maintaining a database of may be used as a resource in the future. Large components that directly affect the characteristics of inhabitant's existences include different types of wrongdoings the general concept of the insurance and security of residents in any general public [4].

Preventing crime is an endorsing because it represents one of the most severe and pervasive issues that we face. In any culture, various crime patterns are the careful deliberation of citizens security and protection are significant factors that have a significant effect on how well people can live their lives. A person's life might become stressed out and disrupted as a result of crimes like stealing, identity theft, and even pickpocketing. This can have an influence on the person's psychological well-being [5]. A person's life might experience uncomfortable effect and stress from some types of criminal incidents, such as data fraud, burglary, or even pick-pocketing, which can affect they psychological well-being. It has been considered essential to use a significant number of closed-circuit television systems (CCTV) in both public and private places as a reaction to rising issues related to crime its threat to security and safety [6]. In response to increasing worries about crime, its threat to security and safety, the usage of many CCTV in both public and private settings has been considered necessary [7].

These video recordings are essential in incident investigations. However, these systems are increasing so as the need for human operators to perform monitoring duties. Time is a crucial element that may be used to identify the cause of a crime as well as the culprit or thieves. Because live video streams from cameras are readily available, live monitoring is done for security reasons. However, real-time monitoring of these video feeds is not always practicable thus a system that automates the procedure is required [8]. Personal information on a specific person is included in criminal records, along with a photograph. Any criminal must have identification, which the witnesses must provide in order to identify them. Fingerprints, DNA (deoxyribonucleic acid) eyes, and other characteristics can be utilized for identification [9]. Face recognition is one of the applications. In social interactions, the face serves as the main point of emphasis and is essential for communicating identity and emotions. The capacity of humans to recall and recognize faces is appearance the fact that it is challenging to infer intellect or character from facial appearance [10].

One of the most effective uses of image analysis, which has lately become important in surveillance and security applications are face recognition. It is the process of confirming a person's identification by looking at their face. It records, examines, and contrasts patterns based on a person's face features, including their chin, eyes, nose, and mouth. To grant authenticated and permitted access to a system or service, it is utilized. It is a biometric identification system that uses a human face's biometric patterns [11]. Face recognition technology is used by many businesses in their access controls, security cameras, and other applications. Face recognition has been included into Facebook's website with the goal of generating digital profiles for visitors. To compare any suspect with the database, law enforcement in advanced countries creates face databases to be utilized with their facial recognition systems [12].

An image is compared to a database of images in a facial recognition system to see whether there is a match. Segmentation, separation, and validation of facial features from the uncertain surroundings and likely genuine faces are all steps are in the face recognition process [13]. The first attempt is to identify the face with different facial characteristics including nose size, brow width, and forehead area. The newest technology includes face recognition as an authentication technique. Apple and Samsung, two manufacturers of smartphones, have released their latest models that have face authentication [14]. The world has gained many miracles due to artificial intelligence (AI) technologies, including face recognition. In order to determine each input object's category, a dataset, or group of images, is compared by face recognition systems. For researchers in human-computer interaction applications, facial recognition analysis is growing as one of the more interesting fields of analysis [15]. In actuality, face features have been used to identify persons from the beginning of time. Across worldwide, face images are used to identify people using identity cards, citizenship identification, intrusion detection, and social security cards [16].

The analysis of all public camera video footage following a large or minor incident is challenging for the criminal department. Finding the criminal's prior behavior and movements becomes crucial, but doing it manually takes time [17].Over the years, several technical solutions have been presented to detect the criminals however most of them were not effective deep learning holds the potential to discover complex, AI systems utilize hierarchical models to express probability distributions over the several types of data they utilize, including speech-containing audio waveforms, real-world pictures, and natural language corpora [18]. A popular framework for managing generative AI belongs to the deep learning framework class known as generative adversarial networks (GANs). In order to create graphics, animations, or virtual environments, GANs may produce images from text descriptions. GANs may translate images from one domain to another, which can be utilized for colorization, style transfer, or data augmentation.

In [19], androgenic hair patterns matching performance in low-resolution images is described for identifying criminals and victims. Gabor filter based model is employed for computing androgenic hair patterns orientation, histograms on dynamic grid model for describing the local orientation environments and chi-square distance is measured block wisely for measuring dissimilarity between the patterns. Experiments indicated that, these hair patterns were effective biometric traits even in low-resolution images and proposed model was compared with popular methods.

A real time high precision surveillance system was designed to recognize the criminal faces from wild videos. This system detects the criminal's faces from the videos which are captured by the surveillance camera in real time and notifies the appropriate persons/institutions about the criminal's appearance. Down-sampled image was extracted from the original image for the localization of unknown and unspecified faces. Scoring techniques based on face tracking was employed to improve the confidence and accuracy of presented system. The score of accuracy and confidence were combined for determining the embedding distance from the criminal face embedding data. This system identified the criminals by a face tracking ID unit and it minimized the prediction reversal. This system was achieved 90% accuracy [20].

Authors explains the use of a deep learning technique for face identification and recognition. With the help of Python's OpenCV, this system illustrates the idea to create a facial recognition system. Because of its great accuracy, deep learning describes to be a promising strategy for performing facial recognition. To prove the effectiveness of the suggested facial recognition system, experimental data are shown. There are only a few things that can change the accuracy of the system. Comparatively to an enhancement in light intensity, when the light intensity is too low, the accuracy is quite low. The classifier is the main element of the recognition process [21].

A case study of Beni-town's intelligent crime detection system is described. A sophisticated criminal detection system is presented in this research study. They utilize a facial recognition system to find criminals who get out of prison and other wanted individuals. The following analysis aims to fight criminals or individuals' fleeing authorities in order to lower crime rates in Beni and its surroundings. They support the installation of the system in airports, entrance points, and other public locations [22].

Criminal identification system using facial recognition is presented. Face recognition technology will be at work behind the scenes; using CCTV video, this system will be able to identify the criminals who are entering that public space by recognizing their faces. The video footage of the person entering that public space is matched to the criminal information stored in the database. The system will display that person's image on the screen notify they with their name that the criminal has been located is present in this public area if any other person's face from a public location matches. More than 80% of the collected images are matched with database images [23].

Criminal detection using convolutional neural networks (CNN) is discussed. This analysis compares the effectiveness of several models in effectively extracting criminal characteristics from a human face. On a public database, National institute of standards and technology (NIST), the performance of the mentioned deep learning models was evaluated. Only male images have been utilized by the authors in this work to avoid any inconsistencies. It was discovered that visual geometry group (VGG) CNN models perform the best, particularly in a scenario with little data, resulting in greater classification accuracy for recognizing criminal faces [24].

Face recognition system is described. This application only works when the subject of the camera recognizes him, it automatically recognizes the human face using face detection, feature extraction, and identification algorithms. They utilized the Kanade-Lucas-Tomasi (KLT) method, the Viola-Jones face detection technique (although the camera continually detects the face with each frame), and the principal component analysis (PCA)approach for feature selection. To match the geometrical features of the human face, they combine a model [25].

A face detection and recognition system for criminal identification is described. Criminal database offered with automated facial recognition system. This technology has the ability to recognize faces in real time and automatically. The task of identifying the face accurately remains difficult. Researchers frequently employ the Viola-Jones framework to identify faces and other items in an image. Classifiers for face detection are provided through open communities like OpenCV [26].

The criminal face recognition system is presented. In order to provide a comprehensive solution for image-based face identification face detection with increased accuracy and reaction rates as well as a first step in video surveillance this project will investigate face recognition and face detection methodologies. The proposed method is based on analyses of several face-rich datasets in terms of subjects, pose, emotions, and light. This system provides two modes of operation using its two degrees of freedom: one that produces very few false positives and another that produces extremely few false negatives. A face detection algorithm that is less prone to error might be created in the future to enhance this system [27].

Various research works were described for face recognition and identification. But still, there is a need for accurate and effective face recognition and identification system. Hence, to fulfill this, an implementation of GAN analysis for criminal face identification system is presented. The remainder of the writing is structured as follows: the section 2 demonstrates an implementation of GAN analysis for criminal face identification system. The section 3 provides an examination of the results of the presented strategy. The section 4 ends with conclusion.

2. IMPLEMENTATION OF GAN ANALYSIS FOR CRIMINAL FACE IDENTIFICATION SYSTEM

In this section, an implementation of GAN analysis for criminal face identification system is presented. The Figure 1 shows the block diagram of presented approach. Detection of face is the first step to design a facial recognition system. At this step, the system detects the face and identifies whether it is human face or others. Additionally, it can also distinguish between the subject and a background, enabling quick and simple face detection, recognition.

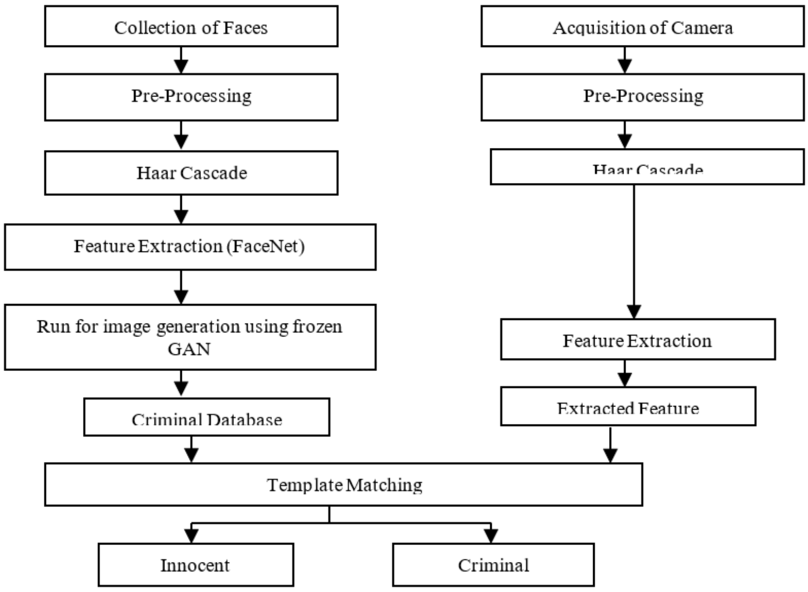


Figure 1. Block diagram of implementation of GAN analysis for criminal face identification system

Firstly, a criminal database is collected with the criminal records. The history of a person's criminal convictions is documented by their criminal history. The data that is recorded in criminal records and whether they even exist vary among jurisdictions within a country. Adding the criminal's face to the database together with their identification, name, age, state, and they committed is the first stage in implementing face detection.

The system's match template is created in the next stage, which is the creation of face databases. By collecting a number of people images, a face database is produced. The photo must be half body image where the face is facing its front. The digital camera-taken image is analyzed as part of the identification and verification procedure for an image.

Detection and extraction of the image is completed before moving on to the next step. To increase the accuracy of face recognition, the extracted features need to be processed. The facial image is reduced in pixel value and cropped. It is challenging to train the model if the images contain disruptions, which will lead to an inaccurate histogram. In pre-processing phase, the unnecessary features are removed. This is done to eliminate excessive processing effort. In contrast of their size and position in the image, objects can be found in images using the Haar cascade technique. This algorithm is simple and real-time.

A Haar-cascade detector is programmed to recognize a number of items, including cars, bikes, structures, and fruits. A technique for identifying things from photos called Haar cascade uses features. On a large number of both positive and negative images, a cascade function is trained for detection. The method is quick to compute and can operate in real-time. Database images are gathered and represented as vectors throughout the feature extraction process. The Haar cascade then determines the average face vector, or the mean, and subtracts the mean face from each sample face.

The cascading window and cascade function are used in the Haar cascade. It makes an effort to compute the features for each window and categorize positive and negative data. It determines as positive if the window might be considered a component of an item otherwise negative. Positive images: these images include the pictures that they want classifier 1 to be able to recognize. Negative images are images that don't include the things for face recognition.

Calculation of Haar features: collecting the Haar features is the initial step. Simply, a Haar feature is a computation performed on nearby areas at a certain position inside a different detecting window. In order to calculate the sum differences, it is primarily necessary to add the pixel intensities in each region. Calculation is simplified by using integral images. Instead of doing calculations at each individual pixel, it generates the sub-rectangles, which are then referenced by the array to perform the Haar features calculation. Future extraction steps determine the system functions overall.

FaceNet generates the embedding vector from the face image as its input. When given a face image as input, FaceNet generates a vector of 128 integers that represent the most important facial features. The term "embedding" refers to this vector in machine learning. A state-of-the-art neural network for face identification, verification, and grouping is called FaceNet. It is a deep neural network with 22 layers that directly trains a 128-dimensional embedding as its output. When trying to match a image with the proper one in the database during the recognition phase, these characteristics will be considered. Using the FaceNet algorithm, face-embedding is produced. The embedding vectors reflect the facial characteristics of a person's face. In consequently, this causes the embedding vectors of two different images of the same person to be more closely spaced apart than those of different persons.

To compare the similarity of two faces, the encoder network's (Inception-ResNet-v1) distance between face encodings is used as a measure. The basic objective is to identify the target using visual signals captured by the camera. This is the GAN is fed the input image. Since the target's facial characteristics don't change, GAN are strong enough even in the most plausible disguise, to spot them.

The GAN network's generator module creates a set of labels for each face detected using the characteristics of an image as input. The discriminator module of the same network receives this output image as input. The discriminator's task is to take the generator's output and determine whether any of the features of the provided target match any of the features in the database. The image will be invalidated and the identity of the target will be returned if there is a match. In order to construct the superset of features f(x), the network will extract as many observable features as it can the pictures with x=1 to n.

Encoder and decoder are two more sub-modules of the generator. The encoder receives an image as input and pulls out as many details as possible from the target's location. GAN network is then given all of the combined features from the n input photos as f(x). The target image is restored using this feature set by the GAN generation network's decoder using various positions indicated by various and distinctive pose-codes. The discriminator receives this image result, and if the target is a real individual, a value is created.

Generally, one may recognize the criminal when seeing their images captured by the camera. The images are preprocessed and applied to Haar cascade algorithm. The output of the Haar cascade is applied as a input to feature extraction step. Feature extraction: reducing the size and complexity of the original images to create a completely new illustration. PCA is applied in this case. A different set of factors is considered by PCA, all of which are orthogonal and are all assessed by the data's deviation within them. Extracted features are the output of the feature extracted. The image's identity will be confirmed if the matches are there; else, it will end. The GAN classifier is used to process the retrieved features. The generated image is compared with the criminal database's images. If a person face is matched with database image, then that person is identified as criminal otherwise identified as innocent.

3. RESULT ANALYSIS

In this section, an implementation of GAN analysis for criminal face identification system is implemented. In terms of precision, accuracy, recall, and F1-score, the performance of the presented technique is assessed.

- Accuracy: the number of successfully identified instances to the accuracy ratio is defined as the total number of occurrences.
- Precision: the high standard of a good example the model provides. The ratio of genuine positives to all other positive cases is known as precision.
- Recall: it goes by the titles sensitivity and true positive rate (TPR), among others. The ratio of accurately detected positive instances to all positive instances is used to determine.

– F1-score: an assessment metric that evaluates a model's accuracy is the F1-score. It combines a model's accuracy and recall ratings. The accuracy statistic calculates the proportion of a model correctly predicted the complete set of data. The Table 1 shows the performance validation.

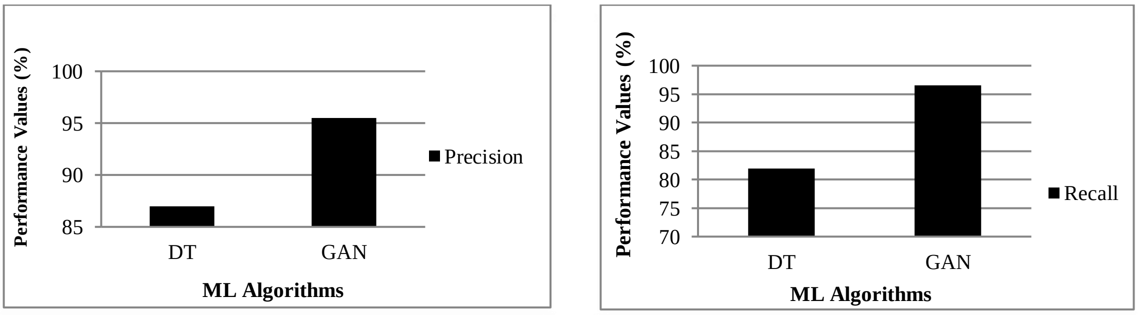
The performance presented approach is compared with DT algorithm in terms of precision, accuracy, F1-score, and recall. The GAN algorithm has obtained better results than DT. The Figure 2 shows the performance metrics comparative graphs. The Figure 2(a) demonstrates the precision performance and Figure 2(b) shows recall performance comparative analysis.

In Figure 2(a), the x-axis indicates ML algorithms for criminal face identification and y-axis indicates the performance values. From the results, it is observed that GAN has high precision than DT. From Figure 2(b), it is clear that GAN has achieved high recall compared to DT. The Figure 3 demonstrates the performance comparison graphs. The Figure 3(a) demonstrates accuracy performance comparison and Figure 3(b) demonstrated F1-score comparison.

Compared to DT algorithm, GAN has high and better accuracy for identifying the criminal faces. The GAN has obtained better F1-score than DT. Hence, presented GAN has better performance than previous algorithms. In addition, it identified various criminal faces very accurately.

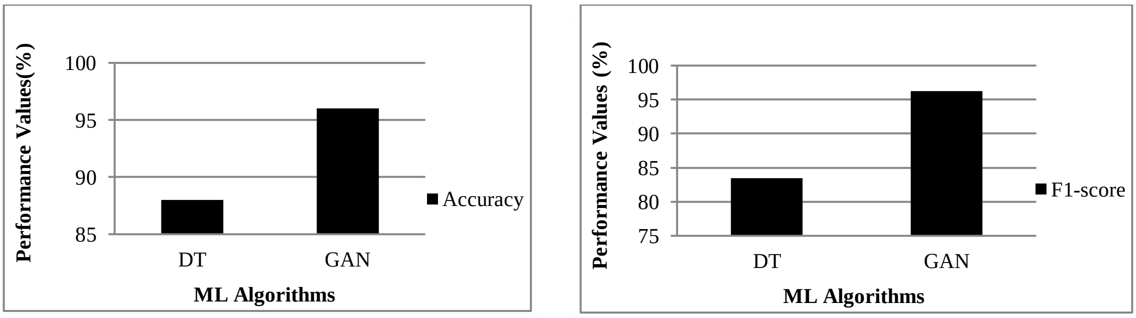
Table 1. Performance validation

Metrics/methods	DT algorithm	GAN algorithm
Accuracy (%)	88	96
Precision (%)	87	95.5
Recall	82	96.5
F1-score	83.45	96.23



(a) (b)

Figure 2. Performance comparative graph in terms of (a) precision and (b) recall



(a) (b)

Figure 3. Performance comparison in terms of (a) accuracy and (b) F1-score

4. CONCLUSION

In this work, an implementation of GAN analysis for criminal face identification system is presented. This system's primary goal is to locate and capture criminals before they commit any further crimes. This technology has the ability to instantly identify criminals faces in an image is captured by a camera. For face detection, a cascade classifier depending on the Haar features is utilized. A cascade function is learned using a large number of both positive and negative images in this machine learning-based technique. GAN is used to identify the criminal faces event with differential facial features like eye color, hair color, structure of the hair, etc. With GAN, the discriminator may extract characteristics from the more realistic fake images produced by the generator and use them to build the target's associated identification code from the database. The advantage of this model is that it can distinguish between the blurred picture and side face that other conventional models cannot recognize. If the person face is matched with criminal database image, then the person is identified as criminal otherwise innocent. Precision, recall, accuracy, and F1-score are used to validate the performance of the presented technique. Compared to previous algorithms, GAN algorithm has better results. Hence this system will be used in real time to catch the criminal before doing another crime. Further, the future work will be focused on how quickly the criminal face is recognized using hybrid deep learning techniques.

FUNDING INFORMATION

Authors state no funding involved.

AUTHOR CONTRIBUTIONS STATEMENT

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Ayesha Sarosh	✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	
GovinduKomali		✓	✓			✓	✓		✓		✓	✓		
Vishnu Vardhan Battu	✓			✓		✓		✓	✓		✓			
LaxmaiahKocharla		✓		✓	✓		✓	✓		✓		✓		
Eswaree Devi Kopparavuri	✓		✓			✓					✓	✓		
OoruchintalaObulesu		✓		✓	✓		✓	✓		✓			✓	
Praveen Mande	✓		✓			✓		✓	✓			✓		
Amanulla Mohammad		✓		✓	✓		✓		✓	✓			✓	

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing -**O**riginal Draft
E : Writing - Review &**E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

- The data that support the findings of this study are openly available in [Ananthi*et. al.*,] at http://10.17577/IJERTV13IS100122.org/[10.17577/IJERTV13IS100122], [5].
- The data that support the findings of this study are openly available in [Akhand*et. al.*,] at http://10.3390/electronics10091036.org/[10.3390/electronics10091036], [2].
- The data that support the findings of this study are openly available in [Kakkarand Sharma] at http:// 10.17148/IJARCCE.2018.7346.org/[10.3390/cancers13071524], [26].
- The data that support the findings of this study will be available in [IEEE][DOI: 10.1109/ACCESS.2023.3282451] allow for the commercialization of research findings.

REFERENCES

[1] I. Brănescu, R. -I. Ciobanu, C. Dobre and C. Mavromoustakis, "Decentralized machine learning for face recognition," *2023 22nd International Symposium on Parallel and Distributed Computing (ISPDC)*, Bucharest, Romania, 2023, pp. 1-8, doi: 10.1109/ISPDC59212.2023.00010.

[2] M. Akhand, S. Roy, N. Siddique, M. Kamal, T. Shimamura, "Facial emotion recognition using transfer learning in the deep CNN,"*Electronics*, vol.10, no. 9, pp.1-19, 2021, doi:10.3390/electronics10091036.

[3] P. R. A. Nikam, “Automatic face recognition and detection for criminal identification using machine learning,”*International Journal for Research in Applied Science and Engineering Technology*, vol. 11, no. 5, pp. 5599–5603, 2023, doi: 10.22214/ijraset.2023.52959.

[4] S. Sandhya, A. Balasundaram, and A. Shaik, “Deep learning based face detection and identification of criminal suspects,”*Computers, Materials and Continua*, vol. 74, no. 2, pp. 2331–2343, 2023, doi: 10.32604/cmc.2023.032715.

[5] B.Ananthi, K. Priyanga, S. Sasmitha, S. Sowmiya, and V. Dhanya, “Detecting of criminals using facial recognition,” *International Journal of Engineering Research & Technology (IJERT)*, vol. 13, no. 10, pp.1-6, 2024,doi:10.17577/IJERTV13IS100122.

[6] K. K. Kumar, Y. Kasiviswanadham, D. V. S. N. V. Indira, P. P.Palesetti, and C. V. Bhargavi, “Criminal face identification system using deep learning algorithm multi-task cascade neural network (MTCNN),”*Materials Today: Proceedings*, vol. 80, pp. 2406–2410, 2023, doi: 10.1016/j.matpr.2021.06.373.

[7] H. R. V. Kumar and M. Mathivanan, “A novel hybrid face recognition framework based on a low-resolution camera for biometric applications,”*Indonesian Journal of Electrical Engineering and Computer Science (IJEECS)*, vol. 24, no. 2, pp. 853–863, 2021, doi: 10.11591/ijeecs.v24.i2.pp853-863.

[8] J. Gao, J. Shi, P. Balla, A. Sheshgiri, B. Zhang, H. Yu, Y. Yang, “Camera-based crime behavior detection and classification,” *Smart Cities*, vol. 7, no.3, pp.1169-1198, 2023, doi:10.3390/smartcities7030050.

[9] Y. Sun, Y. Tang, X. Chen, “A neural network-based partial fingerprint image identification method for crime scenes,” *Applied Sciences*, vol. 13, no.2, pp.1-14, 2023, doi:10.3390/app13021188.

[10] D. Patel, H. Sanghvi, N. K. Jadav, R. Gupta, S. Tanwar, B. C. Florea, D. D. Taralunga, A. Altameem, T. Altameem, R. Sharma,” BlockCrime: blockchain and deep learning-based collaborative intelligence framework to detect malicious activities for public safety,” Mathematics, vol. 10, no. 17, pp.1-22, 2022, doi:10.3390/math10173195.

[11] Z. Zhu *et al.*, “WebFace260M: a benchmark for million-scale deep face recognition,”*IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 45, no. 2, pp. 2627–2644, 2023, doi: 10.1109/TPAMI.2022.3169734.

[12] J. C. L. Lopera, F. B. Martinez, L. A. F.Bocanegra, “Building a custom crime detection dataset and implementing a 3D convolutional neural network for video analysis,” *Algorithms,* vol. 18, no. 2,pp. 1-22,2025, doi:10.3390/a18020103.

[13] Q. Abbas, T. S. Albalawi, G. Perumal, M. E. Celebi, “Automatic Face recognition system using deep convolutional mixer architecture and AdaBoost classifier,”*Applied Science*s, vol. 13, no. 17, pp. 1-36, 2023, doi:10.3390/app13179880.

[14] Z. Wang *et al.*, “Masked face recognition dataset and application,”*IEEE Transactions on Biometrics, Behavior, and Identity Science*, vol. 5, no. 2, pp. 298–304, 2020.

[15] D. V. Thosar, A. Kapse, R. Narahare, M. Sananse, and H.Khan, “Face recognition with machine learning,”*International Journal of Advanced Research in Science, Communication and Technology*, vol. 2, no. 2, pp. 435–439, 2022, doi: 10.48175/ijarsct-3681.

[16] N. Li *et al.*, “Chinese face dataset for face recognition in an uncontrolled classroom environment,”*IEEE Access*, vol. 11, pp. 86963–86976, 2023, doi: 10.1109/ACCESS.2023.3302919.

[17] D. B. Acharya, B. Divya, and K. Kuppan, “Explainable and fair AI: balancing performance in financial and real estate machine learning models,” *IEEE Access*, vol. 12, pp. 154022–154034, 2024, doi: 10.1109/ACCESS.2024.3484409.

[18] T. Sanjay and W. Deva Priya, “Criminal identification system to improve accuracy of face recognition using innovative CNN in comparison with Haar cascade,”*Journal of Pharmaceutical Negative Results*, vol. 13, no. SO3, pp. 218–223, 2022, [Online]. Available: https://www.pnrjournal.com/index.php/home/article/view/901.

[19] H. Su and A. W. K. Kong, “A study on low resolution androgenic hair patterns for criminal and victim identification,” *IEEE Transactions on Information Forensics and Security*, vol. 9, no. 4, pp. 666–680, Apr. 2014, doi: 10.1109/TIFS.2014.2306591.

[20] H. Bin Kim, N. Choi, H. J. Kwon, and H. Kim, “Surveillance system for real-time high-precision recognition of criminal faces from wild videos,”*IEEE Access*, vol. 11, pp. 56066–56082, 2023, doi: 10.1109/ACCESS.2023.3282451.

[21] K. H. Teoh, R. C. Ismail, S. Z. M. Naziri, R. Hussin, M. N. M. Isa, and M. S. S. M. Basir, “Face recognition and identification using deep learning approach,”*Journal of Physics: Conference Series*, vol. 1755, no. 1, 2021, doi: 10.1088/1742-6596/1755/1/012006.

[22] A. Baraka, S. Kataliko, and A. Digne, “An intelligent criminal detection system: a case study of Beni-town,”*International Journal of Scientific and Research Publications (IJSRP)*, vol. 11, no. 11, pp. 474–479, 2021, doi: 10.29322/ijsrp.11.11.2021.p11961.

[23] N. B. Aherwadi, D. Chokshi, S. Pande, and A. Khamparia, “Criminal identification system using facial recognition,” in *Proceedings of the International Conference on Innovative Computing & Communication (ICICC)*, 2021, pp. 1–6, doi: 10.2139/ssrn.3884827.

[24] H. Verma, S. Lotia, and A. Singh, “Convolutional neural network based criminal detection,”*IEEE Region 10 Annual International Conference, Proceedings/TENCON*, vol. 2020-November, pp. 1124–1129, 2020, doi: 10.1109/TENCON50793.2020.9293926.

[25] N. V. S. L. Swarupa and D. Supriya, “Face recognition system,”*International Journal of Computer Applications*, vol. 1, no. 29, pp. 36–42, 2010, doi: 10.5120/577-314.

[26] P. Kakkar and V. Sharma, “Criminal identification system using face detection and recognition,”*International Journal of Advanced Research in Computer and Communication Engineering*, vol. 7, no. 3, pp. 238–243, 2018.doi: 10.17148/IJARCCE.2018.7346

[27] A. Gurav, A. Chevelwalla, S. Desai, and S. Sadhukhan, “Criminal face recognition system,”*International Journal of Engineering Research and*, vol. 4, no. 3, pp. 47–50, 2015, doi: 10.17577/ijertv4is030165.

BIOGRAPHIES OF AUTHORS

Ayesha Sarosh working as senior SRE, John Deere, Moline, Illinois, United State. Completed MBA from Ottawa University, MS in computers from Kent State University and bachelor’s in electrical engineering from GITAM. She can be contacted at email: saroshsyed09@gmail.com.

Govindu Komali highly motivated assistant professor with a passion for teaching and research. Experienced in the development and implementation of innovative instructional methods. Creative assistant professor with 1 year of experience in providing an engaging and stimulating learning environment. She can be contacted at email: komaligovindu1996@gmail.com.

Vishnu Vardhan Battu is currently an assistant professor in the Faculty of Computer Science and Engineering at the P V P Siddhartha Institute of Technology, Kanuru. He is pursuing his Ph.D. in CSE at Annamalai University. He has published one patent and several papers nationally and international journals, book chapters and participated in workshops. He delivered hands-on workshops in the field of IoT for B.Tech. students. Under his guidance, students participated and won prizes in Tech Expos/Hackathons. He is interested in the IoT with ML. He can be contacted at email: bvishnuvardhan84@gmail.com.

Dr. Laxmaiah Kocharla associate professor has more than 18 years of experience in teaching. Presently working in Department of Computer Science and Engineering. He can be contacted at email: hello.laxman12358@gmail.com.

Eswaree Devi Kopparavuri received the B.Tech. degree in computer science and engineering in 2015 form Chirala Engineering College, Chirala and M.Tech. degree in computer science and engineering in 2017 from Bapatla Engineering College, Bapatala. Currently, she is an assistant professor at department of computer science and engineering in LBRCE Engineering College. Her research area interest includes network and sensors. She can be contacted at email: eswari.nani196@gmail.com.

Dr. Ooruchintala Obulesu was awarded Ph.D. from JNTUA Anantapur, A.P in 2017. He has 16 years of teaching experience in reputed institutions. He is currently working as associate professor and head for the Departments of CSE (AI and ML) and CSE (Data Science). He is a reviewer for DST SERB-POWER scheme and IEEE Transactions on Neural Networks and Learning Systems and Springer SN-Computer Science Journals. He received Best Professor Award by Indian Servers at VRSEC, Vijayawada, A.P. He received Best Paper Award at SRM University, Chennai in 2014. He has published 48 research papers in national/international journals and conferences. He has conducted an AICTE-GOC Sponsored International Conference at GNITS, Hyderabad during November 18-19, 2022 as a Program Co-Coordinator. He delivered sessions as a resource person in various FDPs/Workshops in the areas of data analytics, machine learning, and data visualization using R. He is a recognized supervisor and co-supervisor for various universities such as JNTUH, KLU, and MBU, Tirupati. 02 Research scholars are pursuing Ph.D. under his guidance. He is an expert member of BoS at NBKRIST, Nellore, A.P. He is a Module Coordinator for various courses relevant to CSE-Data Science specialization. He serves as Reviewer, Program committee member of various national/international journals and conferences. He is a life member of CSI and member of ACM and IAENG professional societies. He received two grants of 22 lakhs from AICTE and DST SERB respectively. He can be contacted at email: obulesh194@gmail.com.

Praveen Mande is currently working as an assistant professor in Department of Electrical Electronics and Communication Engineering, GITAM School of Technology at Gandhi Institute of Technology and Management, Visakhapatnam. His research interests include power system operation and control, smart grids and micro grids, electrical vehicles, power electronics and power quality improvement using FACTS devices and its applications. He can be contacted at email: pmande@gitam.edu.

Amanulla Mohammad received the B.Tech. in computer science and engineering from the JNTU, AP, the M.Tech. in computer science and engineering from the Andhra University, AP., and pursuing Ph.D. from JNTUK University, AP. He is currently an Senior Assistant Professor with the Department of Computer Science and Engineering. He has supervised more than 22 under graduate and masters' students. His research interests include artificial intelligence, machine learning, and image processing. He can be contacted at email: amanmdphd@gmail.com.