Employing Machine Learning for Criminal Face Detection System

Ashish Tiwari
Email: ashish.20scse1010517@galgotiasuniversity.edu.in
Mukul Gupta
Email: mukul.20scse1010634@galgotiasuniversity.edu.in
Priyanshu Singh
Email: priyanshu.20scse1010641@galgotiasuniversity.edu.in
Dr Abdul Aleem
Email: er.aleem@gmail.com
Galgotias University Greater Noida, India

Abstract: The crime rate is increasing daily, and finding criminals in such a large population will be challenging. It is known that the face is a unique and determining part of the human body that identifies a person; hence, it can be used to track down the identity of a criminal. A solution to this problem would be to create a system that controls CCTV cameras and monitors them 24/7 to identify criminals and notify the nearest police station. In times like now, security cameras can be found almost everywhere, and criminal face recognition systems can be implemented using the previously captured faces from police stations and criminal images. This article proposes a system that can enhance criminal distinction and provide a more effective and efficient outlook for the police department. This proposed system consists of a database where the appearance of the criminal will be uploaded along with the criminal description he has made, and then the database will provide the information to the system. Once the image is in the database, the system will detect the criminal by comparing the captured appearance, which can be done with facial recognition software. The crime data in our database along with the people who come to this public place, if the face of a person from the public place matches the present data in our database, will be the most recent to notify the police department. This leads to improved social security.

Keywords – Face detection, OpenCV, Machine Learning, Face recognition, Anaconda and Jupyter

I. INTRODUCTION

Criminal identification is the most critical part of any criminal investigation, but it is also the most crucial and requires much more time to match the face with the existing database. As the crime rate is increasing rapidly, it is very necessary to adopt an advanced system to detect criminals for the security and safety of society. In face recognition, there are several challenges, like a covered face, beard, spectacles, masks, etc. [1] These things make face recognition more challenging. There are several system requirements to detect the face in the face recognition system. External variables like picture quality, contrast, and glare on the face also have an impact on the extraction of characteristics from the image. Over the years, face recognition has advanced [2]. A computer program that uses a person's complexion to automatically recognize and validate the person from a digital picture or a video frame is one of the few biometric techniques that has the advantages of both high accuracy and low intrusiveness [3]. It uses hardware to identify people, or it analyzes specific facial characteristics from the image and a face database. The system design is a software that is made using a Python GUI that contains all the functionality of the criminal face detection system, in which the photograph of the

criminal with details of his actions is stored in the database. CCTV is monitored to detect an increase in the number of criminals by comparing each person's facial features with images in a database to ensure that if a suspect walks past the camera, they will alert the police to their presence in that particular area. The criminal face detection system not only helps the police department but also terrorizes the public into not committing any crime, which will in a similar way help society. This paper proposes a facial recognition system for criminal databases to analyze faces that are assumed to be identical.

II. BACKGROUND DETAILS

Facial recognition was once thought of as a science fiction concept. According to some sources, Woodrow Wilson Bledsoe is credited with developing facial recognition technology. The main idea is the use of neural networks, which are used in a variety of applications like pattern recognition, object or character recognition, and automatic robot driving, which is what we usually refer to as driverless cars, like those used in contemporary bullet train systems around the world and even in our country. Bledsoe created a technique in the 1960s that allowed users to manually organize images of people using a RAND pad. In essence, a tablet is a device that allows users to enter vertical and horizontal coordinates on a framework. The coordinate regions of facial features like the eyes, nose, and mouth can be manually recorded using this approach. The 1950s and 1960s can be used as a reference point for the preceding work discussed on facial recognition. Face recognition technology is not a matter of advancement; rather, it has always been a crucial requirement in a variety of industries, particularly in the criminal cell, where offenders are regularly apprehended and the need to know their pasts is crucial for future inquiry [4].

The primary goal of research over the past 20 years has been to fully automate the face identification system in order to solve the issues of locating many facial components in an image or video and uprooting individual facial characteristics like the mouth, nose, and eyes. The development of feature classifiers for accurate recognition of facial features has advanced significantly. Comparing the performance of existing systems and the new systems we build is extremely important as we develop new systems with improved algorithms because it allows us to assess how much progress we have made from the past to the present and what still needs to be done in the future to implement an improved algorithm that will result in a successful design and implementation. Face detection has two steps that make up its objective. The first phase is based on the idea of whether the image being used contains a face or not. If a face is present, we will proceed to the next step, which instructs us to locate the face and its facial features as precisely as possible; if there is no face present, we will halt and not progress on. In recent years, technological advancements and attention have both been paid to facial recognition. There are many commercial facial recognition systems available on the market, but their accuracy is unreliable, and they shouldn't be relied upon. In the area of video-based systems with aspects of recognition, tracking, and integration, there have been important efforts. Additionally, fresh datasets are being created for the analysis and assessment of the recognition methods. It is not an overstatement to say that the majority of the applications currently in use support face recognition and its features, and we are working to expand this capability so that these applications can be utilized in every area of science and study with satisfactory outcomes.

III. PROPOSED METHODOLOGY

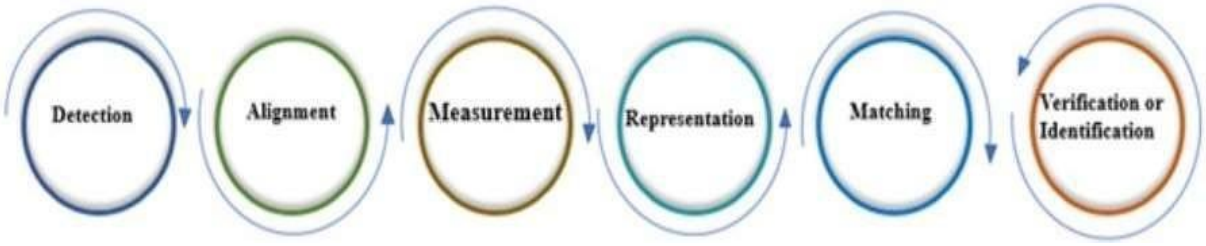

Fig. 1 Proposed methodology for Criminal Face Detection System

The methodology for the criminal face detection system consists of several processes like detection, alignment, measurement, representation, matching, and verification or identification. The system first detects whether the image taken from the camera is a facial image or not. If it is a facial image, then the system starts its alignment, converts it into a matrix of color codes, and represents it in grids. The system starts the process of matching the image from the stored database images using a Python haar-cascade frontal face and classifier to verify that the image detected by the camera belongs to a criminal image.

A. Open CV

A group of computer tools mainly for image analysis makes up the OpenCV library. Under the Berkeley Software Distribution open-source agreement, it is openly accessible. It began as a study for Intel. There are many instruments in OpenCV that can be used to address computer vision-related issues [5]. For facial recognition, feature matching, and tracking, it combines high-level algorithms with low-level image processing techniques. For identifying people, matching their characteristics, and tracking them, it combines high-level algorithms with low-level picture processing techniques [6].

In the system we used two XML files: Haarcascade frontal face default and Classifier provided by OpenCV.

1. **Haar-cascade frontal face default.xml: -** The Haar-Cascade face recognition algorithm identifies things based on their component parts using a cascading aperture algorithm. A pre-trained model that was developed after intensive training and submitted by Rainer Lienhart on behalf of Intel in 2000 can be found in this "XML" file [7]. The Adaptive Boosting Algorithm (AdaBoost) was approved by Rainer's model to contribute superior outcomes and increased accuracy.

2. **Classifier.xml: -** Paul Viola and Michael Jones have suggested an effective object recognition technique that uses cascade classifiers built on Haar features [7]. With the help of both positive and negative pictures, a cataract function can be refined using a machine learning proven method used later to identify items in additional pictures.

B. Face Detection

The face plays a critical role in social cooperation and also conveys a person's identity and affections. Face detection consists of various processes and steps to first recognize a face, as before putting the face in the detection algorithm it is required to check whether it is a human face or not. It is only possible when we train our model with human eyes, ears, noise, mouth, and the combined structure of a human. After confirmation, we will allow our database to interact with the sample data and try to match the faces and produce the output. Therefore, face identification, facial expression recognition, head location estimation, and human-computer contact all depend on automated face

detection connections. Face recognition uses a computer method to locate and quantify human features in digital imagery [8]. In the literature on computer vision, face recognition has received a lot of attention. The primary purpose of it is to record the images that are in front of the camera. The output of this phase includes every complexion in the original picture, which is a bit exhaustive. Create a facial detection system that is perfect and improved. To simplify the size and direction of these points, faces are aligned. After the face recognition stage, there is another process called face spot extraction [9]. Fig 2 shows the detection of the face and extracted face spot in another window.

Fig. 2. Face detection GUI

C. Face recognition

Facial recognition is used to biometrically identify a community based on the appearance of their aspect. A person is identified by biometrics [10]. The individual eye can easily recognize people with just a glimpse, but the utilizing range of the human eye is defined. Therefore, a computerized method has been invented to perform facial recognition. The first stage in describing a face is becoming conscious of it. We have appearance based on face turned into code in our table for the comparison of identified facial appearance with pictures. In order to identify a common face in the database, the facial recognition processor employs biometrics to create facial expressions from look or preset emotions [11]. Fig 3 shows the flow chart of working face recognition of how the data is first inserted into database and then the person gets recognized. Analysis of people can be aided by facial recognition. but it can also give rise to private issues. Face recognition technology is used in business for a variety of purposes, including protection and marketing.

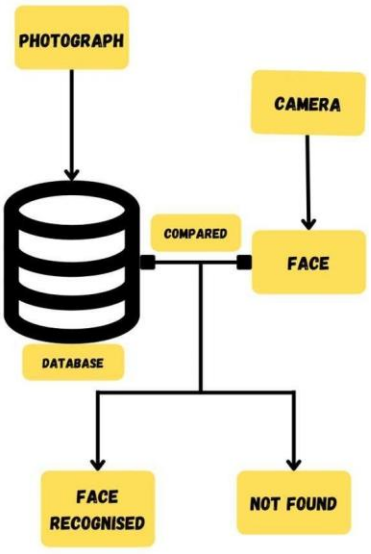

Fig. 3. Face Recognition FlowChart

IV. EXPERIMENTAL DETAILS

TKINTER

Python has included Tkinter for a very long time. It offers Python coders using the Tkinter package a robust, platform-neutral windowing tool. Fig 4 show the ways to import tkinter into python file, the first line show how to import whole tkinter module and second line projects the import a particular module in tkinter.

```
from tkinter import *
from tkinter import ttk
```

Fig. 4. Importing Tkinter

The three primary ideas commonly referred to as controls, or window elements, are widgets, shape management, and event handling. Widgets are all observable items on a graphical display [12]. An example of a frame is a label or button, a text entry is a checkbox or a checkbox is a checkbox, a tree view is a scrollbar and a text entry is a text box. Some images of our project GUI (GRAPHICAL USER INTERFACE):

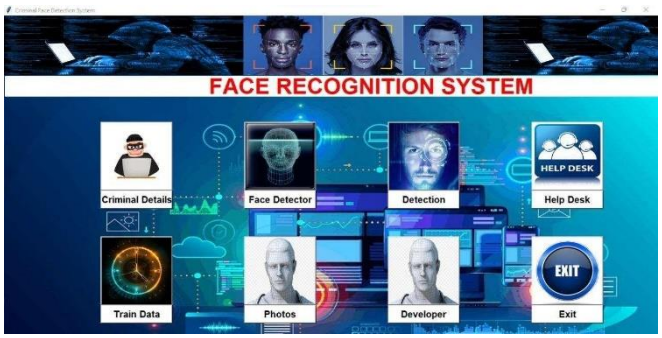

Fig. 5. Different modules of criminal face detection system

Fig 5 is the main module of the criminal face recognition system which is interconnected with several other modules like criminal details form, face detector, training module, testing module exit and help module.

Fig. 6. Criminal Detail Form system

This criminal face detection module is connected with the database. It takes the data from the user and inserts it into the database in the form of a tuple. Fig 6 shows the form to be filled with criminal information.

Fig. 7. Working of detection module

This module detects the face of the criminal and shows his name and details. Fig 7 shows the working of face recognition alongside shows information about the criminal

V. RESULT ANALYSIS

For pictures that are already in the database, OpenCV provides 80–90% accuracy, but it always yields the best-matching face from the database for anonymous images that are not in the database. The Haar cascade achieved a certainty of 97.24%, and the LBP classifier achieved a certainty of 95.74%. The implementation works on Haar-cascade and LBP classifiers using frame count.

Dataset (no.of images)	Train	Test	Accuracy
100	70	30	93.87%
1000	700	300	98.81%

Fig 8. Rate of Accuracy with data

Fig. 8 shows variation, more the number of variations more the accuracy. Since dividing the dataset into a 7:3 ratio, the accuracy has increased.

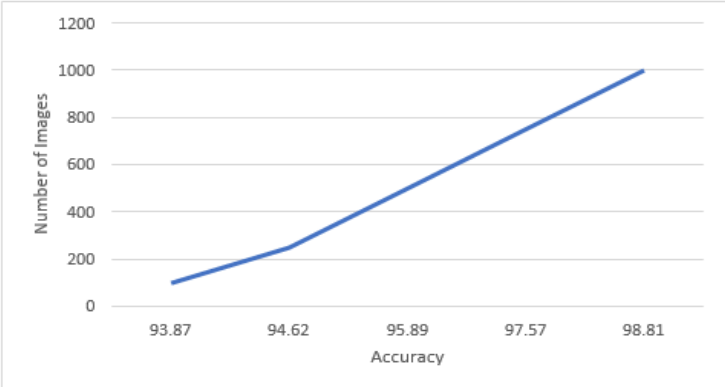

Fig 9. Graph of no. of images vs accuracy

Fig 9 above shows the variation on a more graphical level however Fig 8 shows more on the analytical level. Fig 10. Shows the Properties comparison of proposed system with other system. As

the proposed methodology stated in this paper elaborates about these features.

Properties/System	Proposed System	Other System
Overall Accuracy	96.43%	94.32%
Training and testing time	45 sec	38 sec
GUI Response time	1 – 2 sec	3-5 sec
Data Appending	Can append data to training and testing for more accuracy	Cannot append
Algorithm	Custom Face recognition (Haarcascade and classification are used to extract features and those features are used to recognize)	Standard Face recognition

Fig 10. Properties Comparison of proposed system with Others

VI. CONCLUSION AND FUTURE SCOPE

In this study, an advanced model was built using machine learning algorithms. The facial detection and recognition system will certainly speed up the process of verifying criminal face detection as compared to other biometric verification methods and will be able to match its accuracy in the correct cases. Various pieces of software, such as Microsoft's facial API or a library like OpenCV, are available today that make facial identification and recognition simple, dependable, and ever-improving. The maximum number of calls to a given software's Face API, for example, differs. However, using multiple pieces of software can lessen these restrictions and produce better outcomes for facial recognition technology, which can be used to secure institutions, train stops, airports, and many other locations. Facial recognition programs can collect and process information without humans even being able to recognize it. This knowledge spreads unknowingly. Government entities or traders could also use this data to monitor people.

VII. REFERENCES

[1] Patel UA, Swaminarayan Priya R. Development of a student attendance management system using RFID and face recognition: a review. Int J Adv Res Computer Sci Manag Stud. [2014]

[2] Pnevmatikakis and Lazaros Polymenakos on a Testing Methodology for Face Recognition Algorithms Aristodemos [2005]

[3] Adriana Kovashka Margaret Martonosi- Feature-Based Face Recognition for Identification of Criminals vs. Identification for Cashless Purchase. [2011]

[4] R Patel, SB Yagnik. A Literature Survey on FaceRecognition Techniques, International Journal of Computer Trends and Technology (IJCTT), 5(4), [2013]

[5] Face Recognition- NSTC Committee on Technology Committee on Homeland and National Security Subcommittee on Biometrics. Face recognition for criminal identification. [2015]

[6] Dr. Asif Ali, Radhika Mandhanya, Shraddha Birla, UjjwalMandloi and Vipul Jain's "Automatic Face Recognition Attendance System using Python and OpenCV", Journals- Global Research and Development Journal for Engineering | Volume 6 | Issue 4 [2021]

[7] M. Naveenkumar, A. Vadivel, OpenCV for Computer Vision Applications Proceedings of National Conference on Big Data and Cloud Computing (NCBDC'15), [2015]

[8] Lahiru Dinalankara Face Detection & Face Recognition using OPENCV Classifiers. [2017]

[9] P. Kowsalya, J. Pavithra, G. Sowmiya and C.K. Shankar's "ATTENDANCE MONITORING SYSTEM USING FACE DETECTION & FACE RECOGNITION", International Research Journal of Engineering and Technology (IRJET), Volume: 06 Issue: 03 [2019]

[10] Mikhaylov, D., Samoylov, A., Minin, P., & Egorov, A. (2014, November). Face Detection and Tracking from Image and Statistics Gathering. In Signal-Image Technology and Internet Based Systems (SITIS), [2014]

[11] X. Wang, T. X. Han, and S. Yan. An hog-lbp human detector with partial occlusion handling. In2009 IEEE 12th International Conference on Computer Vision, pages 32–39, [2009].

[12] S. K. Jain, U. Joshi, and B. K. Sharma, "Attendance management system," Masters Project Report, Rajasthan Technical University, Kota, [2011]