

CRIMINAL IDENTIFICATION SYSTEM USING DEEP LEARNING

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Abstract: In this paper, we have developed a system for detecting criminal faces, for this, we have used deep learning algorithms. Since deep learning is now the most famous technology, it is used in different applications. One such application is crime detection and prevention. This system identifies the criminal face, retrieves the information stored in the database for the identified criminal and a notification is sent to the police personnel with all the details and the location at which the criminal was under the surveillance of the camera.

Index Terms - Crime, Detect, Deep Learning, mtcnn, faceNet.

I. INTRODUCTION

Crime is one of our societies most serious and pervasive issues, and preventing it is a critical duty. Different types of crimes and the full consideration of the protection and safety of citizens in any society are significant components that play a vital role directly in the quality of the lives of residents. Certain types of criminal incidents such as larceny, identity theft, or even pick-pocketing can cause disturbance and stress in an individual's life and affect his mental peace. The use of large numbers of closed-circuit television systems (CCTV) in both public and private settings has been considered a necessary in response to rising concerns about crime and its danger to security and safety. A deep learning-based approach is employed as it provides a better performance and faster results as compared to the existing techniques, thereby providing real-time data for police forces to function more efficiently.

II. RELATED WORK

Many facial applications, such as face recognition and facial expression analysis, involve face detection and alignment. However, in real-world applications, large visual fluctuations of faces, such as occlusions, substantial pose fluctuations, and severe lightings, offer significant hurdles for these tasks.

- Viola and Jones offer a cascade face detector that uses Haar-Like features and AdaBoost to train cascaded classifiers, resulting in good performance and real-time efficiency. However, several studies show that this type of detector, even with more advanced features and classifiers, may suffer dramatically in real-world applications with larger visual variances of human faces.
- In addition to the cascade structure, Mathias provided deformable component models for face detection, which performed admirably. They are, however, computationally demanding and may necessitate costly annotation during the training step.
- Convolutional neural networks (CNNs) have recently made significant advances in a range of computer vision applications, including image classification and face recognition.
- Deep CNNs are trained for facial attribute identification to get high response in face regions, which leads to candidate face windows. This technique, however, is very consuming in practise due to its sophisticated CNN structure.
- The use of cascaded CNNs for face detection necessitates extra processing cost for bounding box calibration from face detection and ignores the intrinsic relationship between facial landmarks localization and bounding box regression.

III. METHODOLOGY

3.1 Modules/Techniques

The below are the modules used in accomplishing the goal

3.1.1 MTCNN (Multi Task Cascade Neural Network):

MTCNN (Multi-task Cascaded Neural Network) detects faces and facial landmarks on images/videos. The MTCNN concept may be broken down into three stages, the third of which involves performing facial detection and facial landmarks at the same time. These stages consists of various CNN's with varying complexities.

- The MTCNN creates numerous frames in the first step, which scan the entire image starting from the top left corner and progressing to the bottom right corner. The information retrieval process is called P-Net (Proposal Net) which is a shallow, fully connected CNN.
- In the second stage all the information from P-Net is used as an input for the next layer of CNN called as R-Net (Refinement Network), a fully connected, complex CNN which rejects a majority of the frames which do not contain faces.
- In the third and final stage, a more powerful and complex CNN, known as O-Net (Output Network), which as the name suggests, outputs the facial landmark position detecting a face from the given image/video.

3.1.2 FaceNet:

Face-embedding were created using the FaceNet algorithm. The facial features of a person's face are represented by the embedding vectors. As a result, the embedding vectors of two separate photos of the same person will be closer together, whereas those of a different person will be more apart. The distance between face encodings created by the Encoder network (Inception-ResNet-v1) is used as a metric to compare two faces' similarity. The Triplet Loss is used to train the Encoder network, which necessitates effective Triplet Mining.

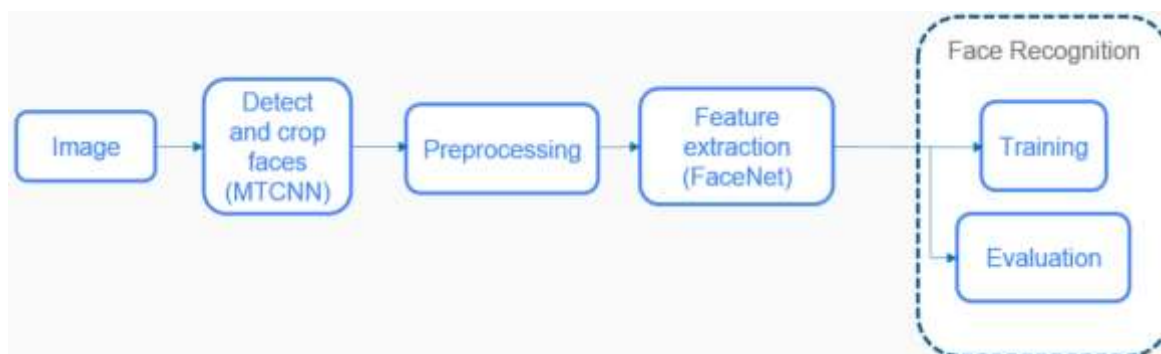


Fig 1: Flowchart for face detection and face recognition

3.1.3 OpenCV:

OpenCV is a video and image processing library that is used for image and video analysis such as facial detection, licence plate reading, photo editing, advanced robotic vision, and many more applications. OpenCV is used to do real-time face detection from a live stream via our webcam. The collection contains over 2500 optimised algorithms, which include a complete mix of both classic and cutting-edge computer vision and machine learning techniques. These algorithms can be used to detect and recognise faces, identify objects, classify human actions in videos, track camera movements, track moving objects, produce 3D point clouds from stereo cameras, extract 3D models of objects, stitch images together to create a high-resolution image of an entire scene, and find similar images from an image database.

3.2 Implementation

The criminal face identification is implemented by extracting the face from video or image, identify the face. The face is searched in the database to look for the details about the criminal.

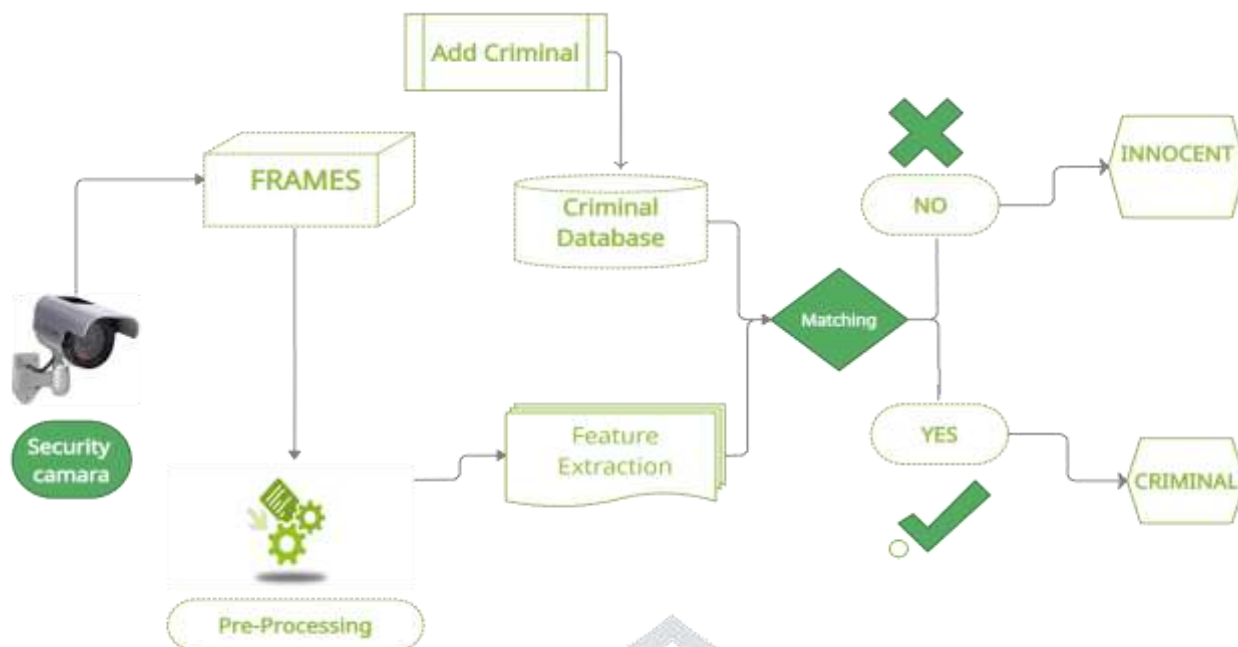


Fig 2: Flowchart for criminal identification system

- **Registering new criminal:** This is the first step of implementing face detection as the criminal face with id, name, age, state and crime committed is registered to the database.
- **Pre-processing Images:** Processing the features that are to be extracted, for improving the rate of recognizing the face. The facial image is cropped and is resized at lesser pixel value. Ascertain images contain disturbances it will be hard to train the model, results in the inaccurate histogram.
- **Feature extraction:** The performance of the entire system depends on this step. Different facial features are extracted using different mtcnn classifier. Grayscale images from this step used for identification of the criminal and train the model.
- **Matching:** Compare the resultant image with the existing images in database. If match is found then return the data related to that image from the database otherwise the recognized person is not criminal.
- **Send Notification (If person is criminal):** The system has been developed in an open source platform using python. Sending of SMS is done by creating an account in Twilio and installed the Twilio library in python. Twilio allows programmatically make and receive phone calls, send and receive text messages.

IV.RESULT ANALYSIS

The criminal database with 50 records is collected and trained. The accuracy achieved is 86%. The system considers threshold (which tells how accurate faces should be compared) parameter which can be adjusted according to our requirement.

The below shows the Home page of the criminal Identification System. On the side bar we have list of options to navigate like Add criminal details, video surveillance and crime statistics.



Fig 3: Landing page of the system

In the below figure we can see the “Add criminal details” option. This is used by police officers to add the details of newly identified criminals to the database. Before entering the details the officer needs to log in using his/her credentials. Only after the successful login, they can add the details.

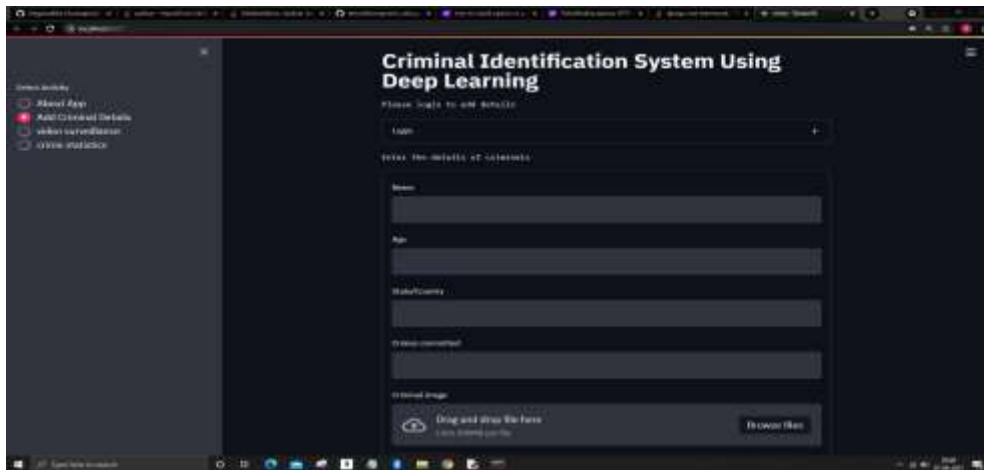


Fig 4: Add criminal details page view

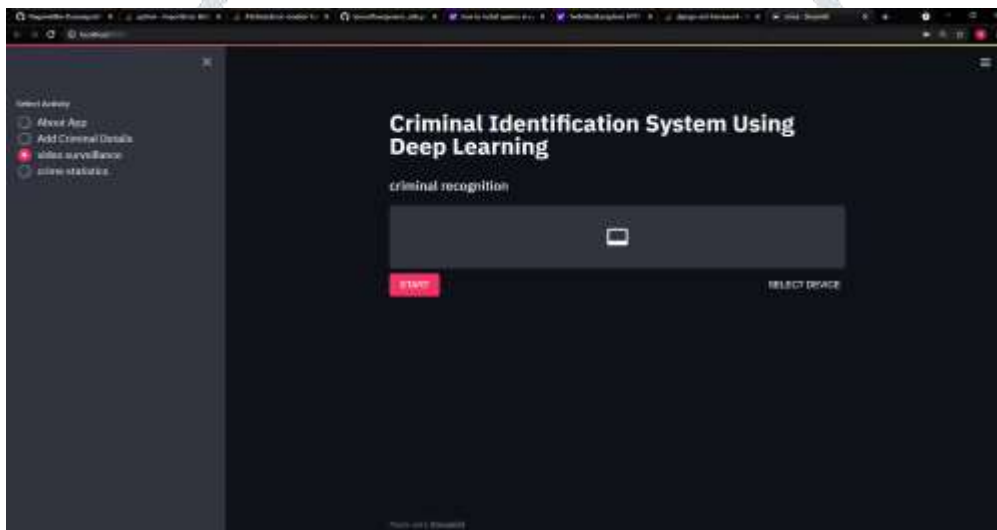


Fig 5 : Video Surveillance for real-time criminal identification



Fig 6 : Instance when person is identified

Below figure depicts the notification sent to police when a criminal is found. When a criminal is identified in video surveillance, the database is queried for all of the suspect's information. The place where the criminal is identified is also forwarded to the appropriate authority along with the details.

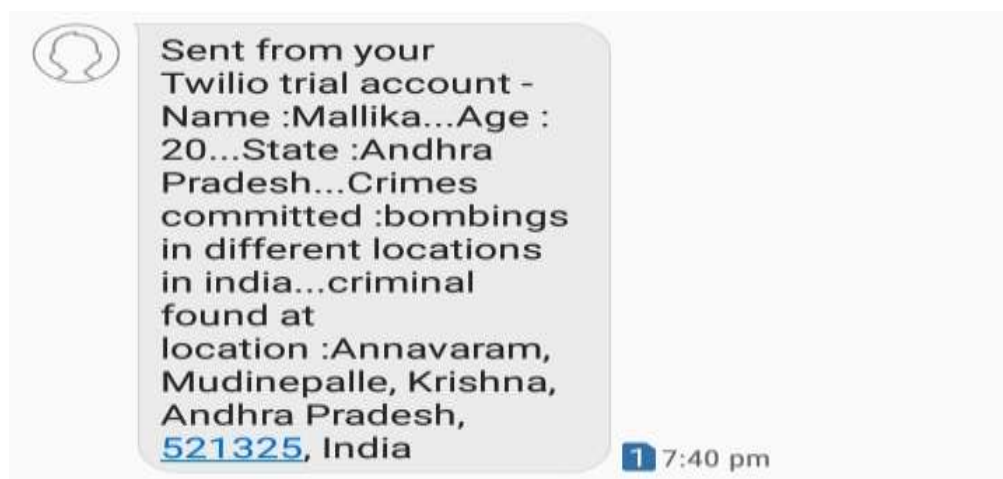


Fig 6: Notification send to police when criminal is identified

V. CONCLUSIONS

In the present world, almost all people are aware of the importance of CCTV footage, but in most cases, this footage is being used for investigation purposes after a crime/incident has happened. The proposed model has the benefit of identifying and catching criminals before they commit another crime. The real-time CCTV footage is being tracked and analysed. The result of the analysis is a command to the respective authority to take any action if in case the system identifies the criminal. Hence this can be stopped.

VI. FUTURE ENHANCEMENTS

Even though the proposed system is limited to the academic area, this can also be used to identify criminals in public or private places. The model can be used in any scenario where crimes are more likely to happen. Instead of searching the entire database to compare the faces, model performance can be improved by considering other traits like the age and gender of a person.

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