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CRIMINAL RECOGNITION USING IMAGE RECOGNITION AND AI

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Abstract - *Criminal identification plays a vital role in modern law enforcement, facilitating the detection, apprehension and prosecution of persons involved in criminal activity. Advances in criminal identification techniques have been fueled by rapid advances in technology. Traditional methods such as fingerprint analysis and DNA profiling have been augmented by sophisticated automated systems that enable faster and more accurate identification. Additionally, advances in facial recognition, voice analysis, and gait recognition have expanded the repertoire of tools available to law enforcement agencies, improving their ability to identify and apprehend criminals. This project explores how to develop a criminal identification system using ML and deep neural networks to identify criminals at an airport. The faces of criminals are stored in the database. Using Dlib68, people are identified from the live camera feed. Detected persons are compared with database images and identified as suspects. After that, the picture of the wanted person with the date and time will be sent to the authorized person by e-mail via the SMTP protocol. The following method can be inherited as an elegant way to ensure that enforcement is seamless.*

Key Words: **live camera feed, Dlib68, SMTP protocol**

1.INTRODUCTION

The criminal record contains personal data about a specific person together with a photo. In order to identify any criminal, we need an eyewitness identification of that person. Identification can be done using fingerprint, eyes, DNA etc. One application is facial identification. The face is the main focus of our attention in social interaction and plays a major role in conveying identity and emotions. The facial recognition system uses a database of stored images and compares the captured image to find a match, if any. For each face image, identification can be done using RGB values for eye color, face width, and height. This system is aimed at identifying offenders in any investigative department. In this system, we store the criminal's image in the database. Eyewitnesses select the slices that appear on the screen, and with this we get a face image from the database. Thus, this system provides a very friendly environment for the operator as well as the eyewitness to easily identify the criminal if the crime record exists in the database. The developed system is also the first milestone for image detection and recognition based on surveillance video.

1.1 Proposed System

This project is focused on the development of an application called Real-Time Criminal Identification System based on facial recognition. We are able to detect and recognize criminals from both image and video, a stream obtained from images in real time. An authorized person logs in through the welcome page to upload images for viewing. Images are stored in a database. A web camera installed at the airport records captured people and images. Image processing and segmentation is performed on the captured images. Using dlib's 68-point detection algorithm, only faces are identified and the identified images are compared with the images stored in the database. If a match is found, the captured image is sent to the authorized person along with the date and time via email via SMTP. This saves a lot of time and is a highly secure process and criminals can be easily detected. Our app is 80 percent accurate and is fast, robust, reliable and easy to use.

1.2 Objective

The main objective of real-time criminal identification based on facial recognition application is to help police personnel to identify criminals.

- The purpose of this application is to provide information about a specific criminal that we are finding.
- Police personnel can use this app anytime anywhere to find the criminal.
- Any police personnel can access this application using internet from anywhere anytime.
- We can also find criminals from live CCTV cameras.
- This application is fast, robust, reasonably simple and accurate with a relatively simple and easier to understand GUI

2. Architectural Diagram

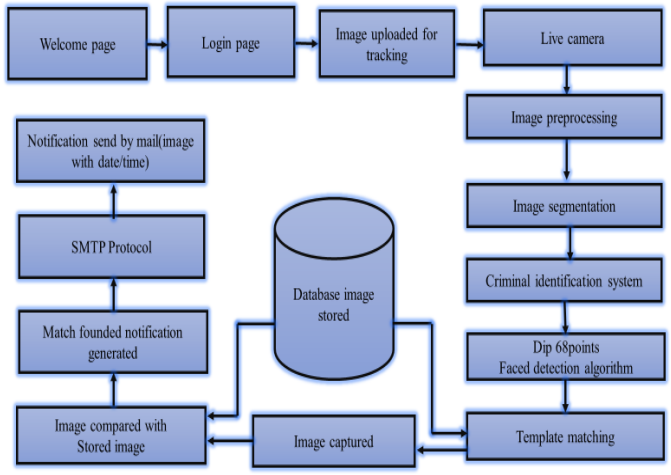


Fig-1 : Architecture Design

2.1 System Module

There are six models used in this system. The Image Preprocessing Module

- Image Segmentation Module
- Criminal Identification Module
- Database Module
- Image Matching Module
- Alert Module

1. Image preprocessing module

Processing features to be extracted to improve face recognition speed. The face image is cropped and resized to a smaller pixel value. If the images contain disturbances, it will be difficult to train the model, resulting in an inaccurate histogram

2. Image segmentation module

This is the main step. Various facial features are extracted. The grayscale images from this step are used to identify the criminal.

3. Criminal identification module

The extracted images are identified for faces using dlib library and deep learning algorithm. So the person's face alone is captured without any interruption of the background.

4. Database module

It is a tool for collecting and organizing information. Databases can store information about people, products, orders, or anything else. Many pictures of criminals along with their identities are stored in the database.

5. Image Matching Module

The resulting images are compared with existing images in the database. If a match is found, data related to that image is returned from the database, otherwise the recognized person is not a criminal.

6. Warning module

If a criminal is detected, an alert message is sent to the person along with the captured images and details of the criminals using SMTP.

3. Working

The working theory for identifying criminals using CCTV surveillance and image recognition revolves around using the power of CCTV cameras and advanced image recognition algorithms to identify and recognize criminals based on captured images or video footage. The theory includes several key components and steps, which are listed below:

1. CCTV surveillance system: The basis of the working theory is a network of strategically placed CCTV cameras that monitor public spaces such as streets, shopping centers or transport hubs. These cameras capture continuous video and provide a huge amount of visual data for analysis.

2. Image capture: A CCTV system captures images or video footage from recorded footage whenever there are suspicious activities or events such as crimes or incidents requiring investigation. These specific images serve as input for the subsequent recognition process.

3. Feature extraction: The next step involves extracting characteristic visual features from the pre-processed images. These features capture unique facial features, physical attributes, or other identifying features that can help distinguish individuals.

4. Recognition algorithm: The extracted features are then used as inputs to the image recognition algorithm. The algorithm compares the captured image with a database of known criminals or a list of suspected persons. Various recognition techniques such as similarity matching or classification algorithms are used to identify potential matches

5. Matching and Decision Making: The recognition algorithm generates a similarity or probability score indicating the likelihood of a match between the captured image and database entries. A threshold is set to determine when a match is considered significant enough to warrant further investigation or intervention. Based on the similarity score, the algorithm decides the presence of a potential criminal.

6. Alert and notification generation: If a significant match is found, the system generates an alert or notification that is sent to the relevant authorities or security personnel in real time. An alert provides information about a potential criminal, including their appearance, location and relevant details, enabling quick action.

3.1 Facial Landmark Algorithm

The facial landmark algorithm is a computer vision technique that aims to locate and identify specific landmarks or facial points on the human face. These landmarks represent key features such as the eyes, nose, mouth and other facial structures. By accurately identifying and tracking these landmarks, facial landmark algorithms enable a variety of applications, including facial analysis, facial recognition, emotion detection, virtual reality avatars, and facial animation. Facial landmark detection has 2 steps:

1. Detection of key facial structures on a person's face.

2. Includes face localization in the image.

We can perform face detection in many ways. We can use OpenVMS built-in Hear Cascade XML files or even Tensor Flow or using Keas. In particular, here we need to use HOG (Histogram of Gradients) object detector and Linear SVM (Support Vector Machines) specifically for the face detection task. We can also do this using Deep Learning based algorithms that are built for facial localization. The algorithm will also be used to detect faces in the image.

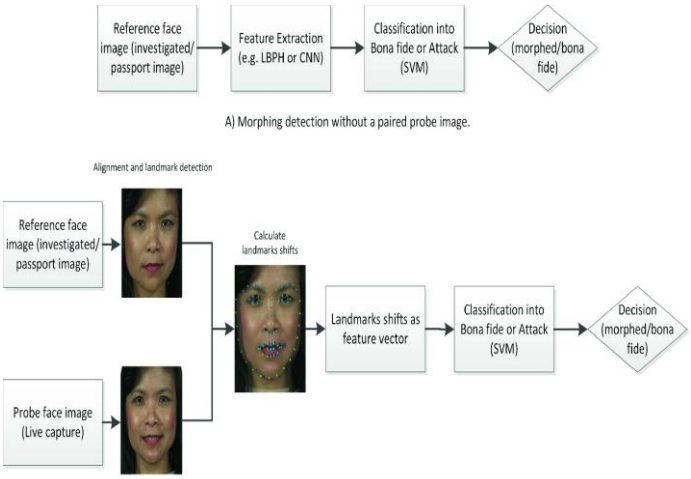


Fig-2: Face detection using facial landmark

3.2 D-Face Recognition Using LBP

Local Binary Pattern (LBP) It is a simple but very powerful texture user that marks the pixels of an image with each pixel of proximity and displays the result as binary numbers.

D-Face recognition involves extracting distinctive features from face images using LBP. LBP captures local textural patterns in facial regions and provides robust and expressive representations. In the context of criminal recognition, D-Face recognition using LBP offers advantages such as computational simplicity, robustness to illumination changes, and insensitivity to facial expressions. By using LBP in combination with a histogram, face images can be described with a simple data vector.

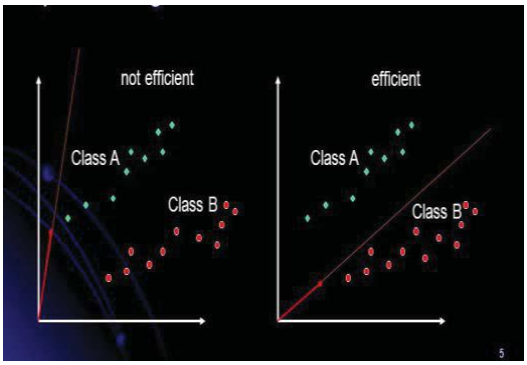


Fig-3: PCA seeks directions that are efficient for representing the data.

Local Binary Patterns, or LBPs for short, the work of popular et al. such as texture descriptor, multi resolution grayscale and rotation invariants

Texture classification with local binary patterns (LBP definition was implemented in early 1993). Unlike Haralick, it computes a global texture representation based on the gray level concurrency matrix. LBPs compute the regional representation of textures. A binary image is created by comparing each pixel to its surrounding pixel. For example, look at the original 3 x 3 pixel LBP neighborhood descriptor, which works the same way:

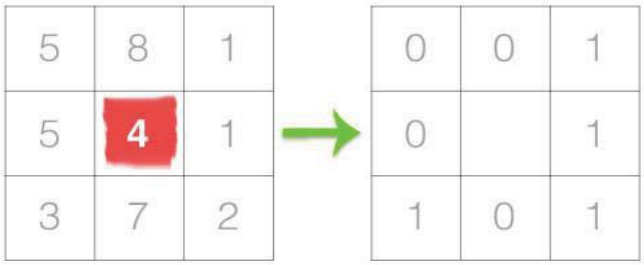


Fig-4: Binary Pattern

The middle pixel and 8-bin numeric closure is the first step to create a LBP for the neighborhood of 8 pixels. In the image above, we select the center pixel and set it against its 8 pixel surroundings. If the center of the pixel is larger than the next line, set the value to l; set the value to 0, otherwise. A total combination of 2 ^8= 256 possible LBP codes with eight pixels will be achieved. With a 3x3 neighborhood, we have 8 neighbors that we need to check binary on. These binary search results were stored in an 8-bit array and converted to decimal.

3.3 SMTP Protocol

SMTP protocol method

Store-and-Forward Method The store-and-forward method is used within an organization.

End-to-End method The end-to-end method is mainly used for communication between different organizations. The SMTP client is the one that wants to send the mail and will certainly contact the destination SMTP host directly in the order to send the email to the destination. The session is also initiated by the SMPT client. The SMTP server mainly responds to the session request. So the session is started by the SMTP-client and the SMTP-server responds to the sender's request.

3.4 IMAGE PREPROCESSING

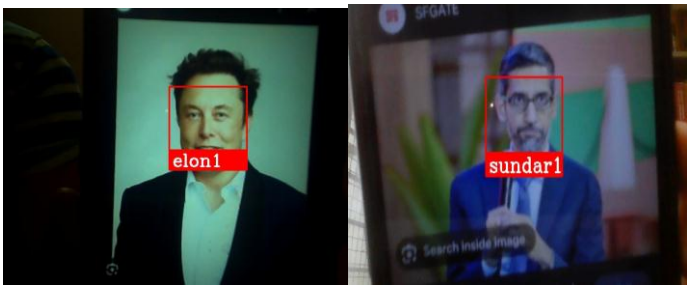
Image preprocessing is the steps taken to format images before they are used in model training and inference. This includes, but is not limited to, resizing, orientation, and color corrections. Image preprocessing can also reduce model training time and increase model inference speed. If the input images are particularly large, reducing the size of these images dramatically reduces model training time without significantly reducing model performance. For example, the default image size on the iPhone 11 is 3024×4032. The machine learning model Apple uses to create masks and use portrait mode runs on images half that size before scaling its output back to full size.

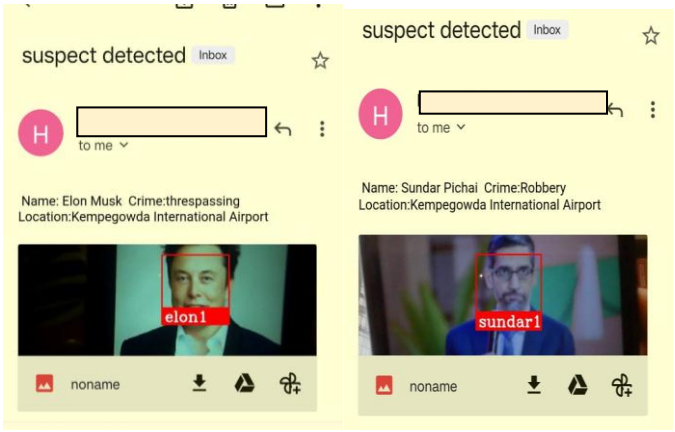
4. Applications

We can use this system anywhere for security purposes e.g. In Law enforcement investigation, Public safety

5. Experimental Results

We have proposed a promising crime detection system for live videos with faces. CCTV cameras are used for continuous video and image capture; on the main screen we will see information about which image from the database corresponds. When the image in the database matches the image captured by the camera system, an email is sent to the control room containing the details of the criminal and his current location.





6. CONCLUSIONS

The real-time criminal identification system will help the police to control the crime rate. This app helps them in many different ways. With the advancement in security technology and the installation of cameras in public areas, it will become easier for police personnel to track, trace and locate criminals from the police control room using this app. In the future, advanced facial recognition techniques can be used to improve the results and a login page must be created so that any police personnel can remotely access this application. Additionally, if a criminal is found in a certain zone, alert messages should be sent to nearby police stations. The developed application is simple and user-friendly. By using advanced CSS styles and various front-end technologies, the application interface can be developed more according to the user's requirements.

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