Observation Framework for High Accuracy Realization of unauthorized individual intrusion from video recordings

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***Abstract* – Private sector environments often impose restrictions on individuals to protect sensitive information, assets, and operations from potential threats. National governments and institutions have installed surveillance cameras and personnel to manage and monitor them. However, traditional methods like naked-eye monitoring and manual image processing cannot accurately evaluate the captured video. The proposed system detects unauthorized persons in real-time from surveillance camera videos and notifies relevant institutions of intrusion. A scoring method based on face tracking is proposed to improve accuracy and confidence in recognition tasks. The system can process images from surveillance cameras in real-time using down sampling and effectively identify unauthorized persons using a face tracking ID unit. It minimizes prediction reversal by solving congested embedding problems in the feature space. The system also includes an identification score accumulation method and an**

I. INTRODUCTION

Institutions require security services to maintain safety protocols, deter potential threats, and maintain order within their premises. However, these services have limitations such as susceptibility to human error, limited coverage of areas, and predictability. To overcome these limitations, this paper proposes a face recognition system that makes searching and tracking of unauthorized persons easy and quick with less time. The proposed system detects the faces of unauthorized persons in real time from videos captured by a surveillance camera and notifies relevant institutions of the appearance of the individuals. Face identification is a technique used to identify faces based on features, such as name, age, gender, and photo. The primary task is to identify one or more segmented and extracted images from the scene, where upon it can be identified and matched. Digital images are images of f(x,y) that have been digitized both in spatial coordinates and brightness. The elements of such a digital array are called image elements, picture elements, or pixels.Biometric technologies have evolved as an alternative to traditional identification and authentication methods such as keys, ID cards, and passwords. Face recognition involves computer recognition of personal identity based on geometric or statistical features derived from face images. Building an automated system is challenging, but face recognition technology can be applied to a wide variety of application areas including access control for PCs, airport surveillance, private surveillance, criminal identification, and security in ATM transactions.

In recent years, considerable progress has been made in the area of face recognition with the development of many other useful techniques. Advances in computing technology have facilitated the development of real-time vision modules that interact with humans, particularly in biometrics and human computer interaction. For biometric systems that use faces as nonintrusive input modules, it is imperative to locate faces in a scene before any recognition algorithm can be applied. An intelligent vision-based user interface should be able to tell the focus of the user to respond accordingly.

Face detection plays an important and critical role for the success of any face processing systems. The face detection problem is challenging as it needs to account for all possible appearance variation caused by changes in illumination, facial features, occlusions, and scale, pose, and in plane rotations. Often, the size of the image is large, the processing time is small, and real-time constraints must be met.

This work focuses on unauthorized person identification and numberplate detection. It provides the accuracy percentage of the face detected and notifies the security sectors of the institution.

LITERATURE SURVEY

This research [1] offers a compact video surveillance device that uses detachable deep facial recognition to quickly identify the faces of criminals. The system handles real-time camera data rapidly, improves accuracy, and resolves blind spots by using down-sampled pictures and a face tracking-based grading algorithm.

Face recognition is a widely used biometric technique for person identification, particularly in home security, criminal identification, and phone unlocking applications. In this research [2], a deep learning-based face recognition system utilizing OpenCV in Python is designed and developed. Its high accuracy and efficacy are demonstrated through experimental findings. Cards and keys are no longer necessary thanks to this safe method.

Geospatial patterns are used in crime prediction to help with hotspot assessment, predictive policing, and geographic profiling. This study [3] suggests a 2-Dimensional Hotspot analysis and machine learning method for spatiotemporal crime prediction. When the model's performance is compared against cutting-edge classification methods both with and without hotspot analysis, it performs better.

While all studies contribute to security enhancement, the fourth study excels due to its real-time unauthorized person detection capabilities, advanced technologies, and comprehensive security features. It stands out for its holistic approach and effectiveness in addressing multiple security challenges simultaneously, making it the best choice for enhancing security measures.

PROPOSED SYSTEM

The initial step in the process outlined here involves capturing and processing an input image from a camera, which is then converted into a NumPy array for further analysis. Subsequently, the FaceNet algorithm is employed to identify and anticipate faces present within the image. Concurrently, the system utilizes Tesseract LSTM, an Optical Character Recognition (OCR) tool, to extract the car number from the image.

Once the faces are detected, the system compares them against a database of specific individuals. If a match is found, indicating that the detected faces correspond to those of restricted individuals, the linked vehicle number is retrieved using OCR. Subsequently, the system presents this information along with the accuracy percentage of the face detection.

Upon successful identification and matching, an alert is generated, notifying relevant stakeholders of the potential match with the restricted individual. This alert serves as a proactive measure to enhance security measures. The workflow seamlessly integrates facial recognition, OCR technology for vehicle number extraction, and alarm systems to bolster security protocols. By combining these components, the system aims to efficiently identify and mitigate potential security threats, thereby safeguarding the premises and its occupants effectively.

MATERIALS AND METHODOLOGY

A. FaceNet:

A deep neural network called FaceNet is used to extract information from a facial image. The most significant elements of a face are represented by a vector of 128 numbers that FaceNet generates from an image of a person's face. This vector is known as embedding in machine learning. This vector contains all of the essential information from an image. In essence, FaceNet compresses a person's face into a vector made out of 128 values. The goal is for similar faces to have similar embeddings.

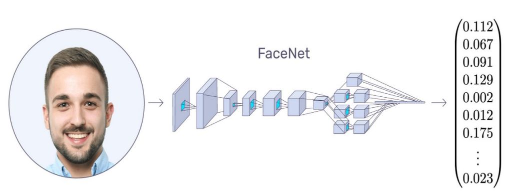


Fig 1: Understanding FaceNet

B. Number Plate Recognition:

LSTM is used in numberplate recognition. In that, the Recognition procedure involves two rounds of verification. During the initial pass, an effort is made to identify every word individually. An adaptive classifier receives each word that meets its requirements as training data. This gives the adaptive classifier an opportunity to identify text on the page lower down with greater accuracy.

C. HAAR Cascade Classifier:

Haar feature-based cascade classifiers are efficient for object detection in machine learning. They train a cascade function with a large number of positive and negative images, then identify objects in more pictures. Haar is a weak classifier used for facial identification, and is composed of rectangles divided into white or black rectangles.

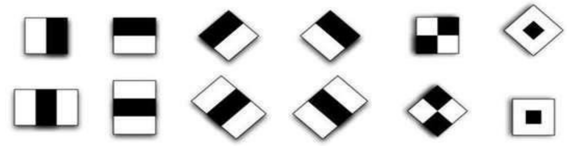


Fig 2: Types of Haar Features

Face detection in images or videos is achieved using retrieved feature combinations. The algorithm attempts to match features in scaled blocks of pixels, with a square size of 232 by 232 pixels. Each combination feature is attempted block by block, and if one is absent, the computer stops the investigation. If no face is found, the remaining traits are not examined. A new block is chosen, and the procedure is repeated.

Fig 3: Haar features applied on an image

D. OpenCV:

Real-time computer vision is the major focus of the OpenCV (Open source computer vision) collection of programming capabilities. The open-source BSD license allows for cross-platform use of the library at no cost. According to a stated list of supported layers, OpenCV supports certain models from deep learning frameworks like TensorFlow, Torch, PyTorch (after converting to an ONNX model), and Caffe.

E.(Anaconda (Python distribution):

For scientific computing (data science, machine learning applications, large-scale data processing, predictive analytics, etc.), Anaconda is a free and open-source distribution of the Python and R programming languages that attempts to streamline package management and deployment. The package management system conda oversees package versions. Data-science packages for Windows, Linux, and MacOS are included in the Anaconda distribution

F. Anaconda Navigator:

The Anaconda distribution comes with a desktop graphical user interface (GUI) called Anaconda Navigator, which enables users to manage conda packages, environments, and channels in addition to launching applications without requiring command-line instructions. Navigator is capable of finding packages in a local Anaconda repository or on Anaconda Cloud, installing them in an environment, running them, and updating them. Linux, macOS, and Windows can all use it.

G. Anaconda Cloud

The package management service Anaconda Cloud allows you to locate, access, save, and share environments, conda and PyPI packages, as well as private and public notebooks. Cloud computing environments, notebooks, and helpful Python packages are available for a wide range of applications. It's not necessary to sign in or have a Cloud account in order to look for, download, and install public packages. The Anaconda Client command line interface (CLI) can be used to create new packages, which can subsequently be uploaded to Cloud either automatically or manually.

H. Python Spyder IDE:
It is always necessary to have interactive environments to create software applications hence we have used a cross-platform, open-source IDE Spyder. The Python Spyder IDE is written completely in Python.

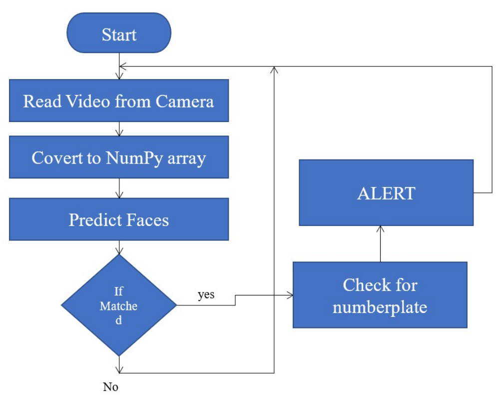
I. Variable Explorer:
The Variable Explorer displays every global object reference in the active IPython Console, including modules, variables, methods, and so on. Not only that, but you can use other GUI-based editors to interface with these as well.

J. File Explorer:
The File Explorer is a browser for the filesystem and directories that lets you view, access, and manage files and folders. The functionalities of the context menus can be used to interact with them.

K. Configuring Spyder:
The settings menu contains simple configuration choices for the Python Spyder IDE. Anything may be altered, including font size, syntax colors, and themes. Go to the Tools menu and choose the Preferences option to accomplish this.

L. Jupyter Notebook:
The Jupyter Notebook App is a server-client program that lets you edit and use your notebooks using a web browser. The application may be placed on a distant server and accessed via the Internet, or it can be used on a PC without Internet connection.

FUNCTIONAL DIAGRAM



WORKING AND OUTPUT

The system operates in two distinct phases: Training and Prediction. In the Training phase, users have the capability to assign an ID for the individual and train the system by providing a sample video containing relevant footage. During this process, users can select any five clear frames from the video, which will be used to educate and fine-tune the system.

Fig 4: Five frames selected by the user to train the system

It is crucial that these selected frames are of high clarity to ensure optimal efficiency and accuracy in subsequent predictions. The system utilizes these clear frames to learn and extract key features, patterns, and characteristics and gives prompt that the given ID has been successfully registered.

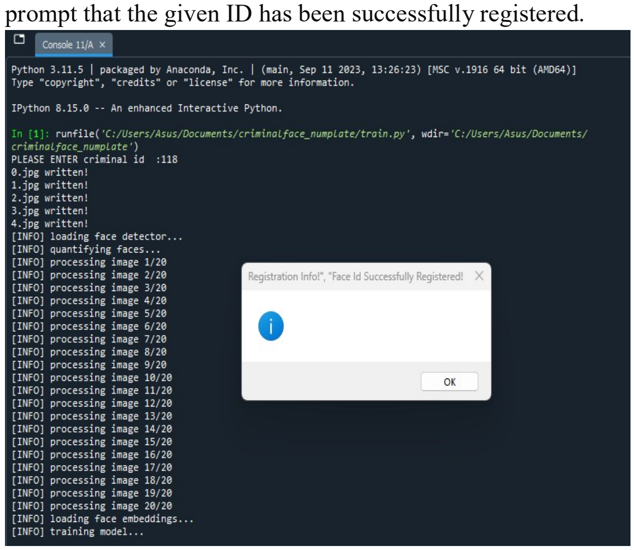


Fig 5: Training and registration of face ID

Moving on to the Prediction phase, the system leverages the trained model to compare a given video stream against a criminal dataset, aiming to detect any potential matches. If a match is identified, the system promptly notifies the user by displaying the corresponding face ID within the application interface.

Fig 6: Prediction and Identification of matching faceID

Moreover, the system goes a step further by employing Optical Character Recognition (OCR) technology to read and analyze the vehicle number depicted in the image. Upon user input, the system extracts the vehicle number from the image and cross-references it with known criminal records, thereby providing valuable information on the vehicle associated with the identified individual.

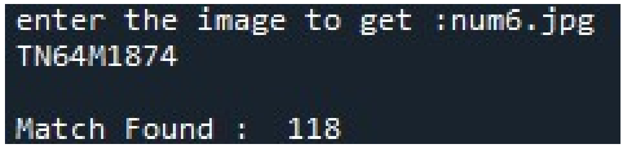


Fig 7: Analyzing vehicle number using given image

For real time reporting, the output is also displayed in the application called BLYNK app. The face ID of the individual and the vehicle number which is identified are updated simultaneously on the app for the reference of the security services.

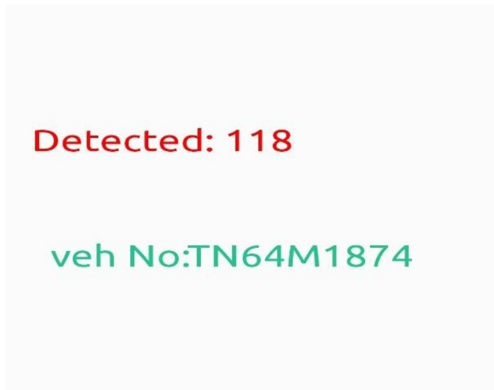


Fig 8: Face ID and Vehicle number of the individual on BLYNK app

CONCLUSION

In conclusion, the Observation Framework presented offers a comprehensive solution for enhancing security measures against unauthorized intrusions from video recordings and vehicle-related incidents. By leveraging cutting-edge technologies such as the FaceNet algorithm and LSTM for facial recognition and vehicle number detection using OCR, the framework demonstrates remarkable accuracy and reliability in identifying potential security threats. The integration of real-time alert messaging capabilities ensures prompt notification to security services, enabling swift responses to mitigate risks and safeguard the particular sector's security. With its high accuracy and proactive approach to intrusion detection and vehicle tracking, the Observation Framework stands as a vital tool in bolstering security infrastructure and protecting critical assets and personnel. By combining these cutting-edge technologies, the proposed framework offers a comprehensive solution for real-time monitoring and detection of unauthorized intrusions, providing heightened security and surveillance capabilities in various settings, including private sectors, border control checkpoints, and high-security zones.

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