VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

A Project Phase-2 Report on

"AUTOMATED CRIMINAL IDENTIFICATION BY FACE RECOGNITION"

Submitted in partial fulfillment of the requirement for the degree of Computer Science and Engineering for the Academic Year 2022-23

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CERTIFICATE:

This is to certify that project entitled as **"AUTOMATED CRIMINAL IDENTIFICATION BY FACE RECOGNITION"** is a bonafide work carried out by **D SUPRITH (1SK19CS010), MADHU SUDHAN N (1SK19CS022), MITHUN KUMAR G T (1SK19CS023), SUDHAKAR (1SK20413)** as a partial fulfillment for the Award of Bachelor's Degree in Computer Science and Engineering for **Project Phase-2** as prescribed by **Visvesvaraya Technological University, Belgaum** for the academic year **2022-2023**

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ABSTRACT

We all know that our Face is a unique and crucial part of the human body structure that identifies a person. Therefore, it can be used it to trace the identity of a criminal person. With the advancement in technology, we are placed CCTV at many public places to capture the criminal's crime. Using the previously captured faces and criminal's images that are available in the police station, the criminal face recognition system of can be implemented. In this paper, we propose an automatic criminal identification system for police department to enhance and upgrade the criminal distinguishing into a more effective and efficient approach. Using technology, this idea will add plus point in the current system while bringing criminals spotting to a whole new level by automating tasks. Technology working behind it will be face recognition, from the footage captured by the CCTV cameras; our system is capable to detect face and recognize the criminal who is coming to that public place. The captured imagesof the person coming to the public place get compared with the criminal data existing in the database. The system displays details of the matched person including his/her photo. The matched accuracy of the proposed system in 80% when compared with stored imaged in the database. Web scrapping is a technique of extracting data and information from a website by accessing World Wide Web either directly through Hypertext Markup Language or by using a web browser. Most of the common facial recognition techniques include target matching method, geometric feature recognition method, and principal component analysis method and so on.

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CHAPTER 1

1. INTRODUCTION

1.1 OVERVIEW

Automated criminal identification by face recognition is a technology that uses artificial intelligence to analyze and match images of faces with a database of known criminal suspects. This technology has gained popularity in recent years as a tool for law enforcement agencies to quickly identify suspects and solve crimes. The process begins with capturing an image of a suspect's face, either from a live video feed or from a still image. The image is then analyzed by software that uses algorithms to identify unique features and characteristics of the face, such as the distance between the eyes, the shape of the nose, and the contours of the jawline.

Once the software has analyzed the image, it compares it to a database of known criminal suspects to find a potential match. If a match is found, law enforcement officials can use this information to identify and locate the suspect, or to confirm the suspect's identity if they are already in custody. While automated criminal identification by face recognition has been hailed as a powerful tool for law enforcement, it is not without controversy. Critics argue that the technology is prone to errors, particularly when analyzing images of individuals with darker skin tones. Additionally, there are concerns about privacy and civil liberties, as the use of facial recognition technology raises questions about who has access to our personal data.

Criminal identification can be done in two ways ,
A) Manual Identification System (MIS)
B) Automated Identification System (AIS)

In manual identification system identification is done by the Police officers searching them at public places. It takes a lot of time to give the proper attention and it also has the chances of skipping criminals as they will be alerted by seeing cops easily gets escape from there. Since the MIS is in the process of taking more time and we will not properly focus on everyone. But when it comes to an automated identification system there is no need for observation going in a public place. Here all the process involved in this system is automated.

1.2 PROBLEM STATEMENT

To develop an application which will serve a way to register and track criminals remotely with the help of criminal data.

EXISTING METHODS

As the crime rate and criminals are increasing day by day managing, finding and tracking these criminals is a major issue for police personnel. There are application which will help police department to store the records and data about a criminal but these applications won't help in finding those criminals. Criminal details were mainly managed using records books or stored as software records in the database. Previously when a criminal is found guilty the picture of the criminal is being taken and stored in records but these pictures serve no purpose. The existing methods will only help in managing criminal records and those methods will not be finding criminals from any location.

DISADVANTAGES OF EXISTING SYSTEM

- Existing system inefficient to process large volume of data.
- More training time.
- The process is implemented without removing the noise.
- Prediction is not accurate.

1.3 OBJECTIVES AND CONTRIBUTION

The objectives of automated criminal identification by face recognition are to aid law enforcement agencies in identifying suspects and criminals quickly and accurately. This technology can help to increase public safety by enabling authorities to track down criminals and prevent future crimes.

- To identify the person is crime or not from face image effectively. To enhance the overall performance for classification algorithms.
- The main objective of Real-time criminal identification based on face recognition is to help police personnel to identify criminals.
- The objective of this application is to provide information about a particular criminal which we are finding.

1.4 SCOPE OF THE PROJECT

The scope of automated criminal identification by face recognition is broad and can be applied in various contexts.

- Law enforcement: This is the primary area where automated criminal identification by face recognition is used. Law enforcement agencies can use the technology to identify suspects captured on surveillance cameras, social media, or other sources and match them with the faces of known criminals in police databases.
- Border security: Facial recognition technology can also be used to verify the identity of travelers at border crossings, airports, and other entry points. This can help to prevent individuals with criminal histories or fraudulent identities from entering a country.
- Access control: Facial recognition technology can be used to control access to secure areas, such as government buildings, corporate offices, or private homes. This can help to prevent unauthorized access by individuals with criminal histories or fraudulent identities.
- Marketing and advertising: Some companies use facial recognition technology to track customer demographics and behavior to target them with personalized marketing messages or to measure the effectiveness of their advertising campaigns.

The scope of automated criminal identification by face recognition is continuously expanding, and its potential applications are still being explored. However, the use of the technology also raises ethical, legal, and social implications that need to be addressed.

CHAPTER 2

2. LITERATURE SURVEY

Kewen Yanet al. [1] proposed "Face Recognition Based on Convolution Neural Network"

A face recognition method based on CNN is the network used here consists of nine layers. These nine layers contains three convolution layers, two pooling layers, two full-connected layers and one Softmax regression layer. The convolution layers and the pooling layers are used for feature extraction followed by two full-connected layers, and the last layer uses a Softmax classifier with strong non-linear classification capability. And activation function of the network is ReLU function . Caffe is used during the network training process and GPU is used to expedite calculation speed. As to the training algorithm, stochastic gradient descent algorithm is used to train the feature extractor and the classifier, which can extract the facial features and classify them automatically. And the Dropout method is used to solve the over-fitting problem.

Musab Coúkun, et al. [2] proposed "Face Recognition Based on Convolutional Neural Network"

Face recognition is the process of recognizing the face of a relevant person by a vision system. It has been a crucial human-computer interaction tool due to its usage in security systems, access-control, video surveillance, commercial areas and even it is used in social networks like Facebook as well. After rapid development of artificial intelligence, face recognition has once again attracted attention due to its nonintrusive nature and since it is main method of person identification for human when it is compared with other types of biometric techniques. Face recognition can be easily checked without the subject person’s knowledge in an uncontrolled environment.

Yongjing Lin, et al. [3] proposed "Face Gender Recognition based on Face Recognition Feature Vectors "

Face gender recognition has broad application prospects. Inspired by transfer learning, this paper proposes a face gender recognition method based on face recognition feature vectors. Our method achieves a high recognition rate in three different datasets. The visualization results also show that the feature vector can effectively distinguish the gender of the face. It is worth mentioning that because our method obtains features in the same way as to face recognition, this method can be directly applied to face recognition.

C. E. Lum et.al [4] proposed "Facial Recognition for Law Enforcement: Examining the Evidence"

Criminal identification is the most important task for the Police who are finding the criminals, but it is the difficult and most time-consuming task as they have to find it everywhere. It will be more difficult in cities or public places with high people density. In some cases, manual type of identification gives chance for getting more information related to criminals. Hence this paper proposes an automatic criminal identification system by detecting the face of criminals. This will help Police to identify and catch the criminals in public places. Criminal identification can be done in two ways In Manual Identification System (MIS), identification is done by the Police officers searching them at public places. It takes a lot of time to give the proper attention and it also has the chances of skipping criminals as they will be alerted by seeing cops easily gets escape from there. Since the MIS is in the process of taking more time and we will not properly focus on everyone. But when it comes to an automated identification system (AIS) there is no need for observation going in a public place.

Piyush Chhoriya, et al. [5] proposed "Facial Recognition for Law Enforcement: Best Practices"

It can detect and recognize faces of the criminals in a video stream obtained from a camera in real time. They have used Haar feature-based cascade classifiers in OpenCV approach for face detection. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. Also, they have used Local Binary Patterns Histograms (LBPH) for face recognition. Several advantages of this algorithm are: Efficient selection of features, Scale and location invariant detector, instead of scaling the image itself, they scale the features. LBPH recognizer can recognize faces in different lighting conditions with high accuracy. Also, LBPH can recognize efficiently even if single training image is used for each person. The real-time automated face detection and recognition system proposed would be ideal for crowd surveillance applications.

S. S. Naveen et al [6] proposed "Real-Time Face Recognition for Criminal Identification: A Systematic Literature Review"

In current days identifying criminals is becoming very complicated task for the cybercrime people because it is having a lot of factors need to be analyzed. Criminal record generally contains personal information about particular person along with photograph. To identify any criminal we need some identification regarding person, which are given by eyewitnesses. In most cases the quality and resolution of the recorded image-segments is poor and hard to identify a face. To overcome this sort of problem we are developing many software's by using recent trends to identify the criminals but no method is accurate in identifying the criminal information accurately.

A. T. Laufer et al [7] proposed "Facial Recognition Technology and Law Enforcement: Ensuring Accountability and Transparency"

It is able to detect and recognize faces of the criminals in an image and in a video stream obtained from a camera in real time. We have used Haar feature-based cascade classifiers in OpenCV approach for face detection. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. Also, we have used Local Binary Patterns Histograms(LBPH) for face recognition.

Ayappan et al [8] proposed "Criminal Identification System using Facial Recognition"

The identification of criminals and terrorists is a primary task for police, military and security forces.The terrorist activities and crime rate had increased abnormally. Combating them is a challenging task for all security departments. Presently, these departments are using latest technologies. But they have not enough efficient and accuracy as they expected This research study is based on the analysis of faces, emotions, Ages and genders to identify the suspects. Face recognition, emotion, age and gender identifications are implemented using deep learning based CNN approaches. Suits identification is based on LeNet architecture. In the implementation phase for the classification purpose, Keras deep learning library is used, which is implemented on top of Tensorflow. IMDB is the dataset used for the whole training purpose.

Mr.R.Prashanth Kumar et al. [9] proposed "Real-Time Criminal Identification System Based On Face Recognition"

After considering all the facts present in introduction section, we did research in different applications and came up with a solution. Real-time criminal identification system will help police to control crime rate. This application helps them in many different ways. With the advancement in security technology and installation of cameras throughout the public areas, it will become easier for police personnel to monitor, track and find criminals from police control room using this application.

Ganta Tejaswini, et al. [10] proposed "Online Criminal Identification Using Ml & Face Recognition Techniques"

The purpose of face identification system is to identify criminals. In past years this process is carried out by humans. This process gives the exact image of the criminal but it is very difficult to identify the criminal details and also it requires much amount of human burden. The main aim of our project is to overcome the drawbacks of human based system by using the machine based face identification process. In this process we store the details of criminal into the database along with his photo or image. Then we make the image into different clips containing hair, forehead, eyes, nose, lips and chin and store these clips into the database. When any crime occurs we compare the details given by the eyewitness with the clips already stored in the database and we will identify the criminal. This project can be extended to adjust the gaps between the clips after construction of the image to be a perfect photograph using image processing techniques.

George Johnson et al [11] proposed "Face Recognition Policy Template for State, Local, and Tribal Criminal Intelligence and Investigative Activities"

The implementation of proven policies and practices can mitigate the risk of negative impacts while improving mission effectiveness. As face recognition use expands, it is necessary for law enforcement, fusion centers, and other public safety agencies to ensure that comprehensive policies are developed, adopted, and implemented in order to guide the entity and its personnel in the day-to-day access and use of face recognition technology. Policies that are developed in a transparent manner and which are properly enforced foster trust not only within and between justice partners but also by the public.

Impana.H.C et al [12] proposed "Automated Criminal Identification By Face Recognition Using Open Computer Vision Classifiers"

The proposed face recognition system based on Haar cascade will be implemented. Even though the stored set of images of the person in the database differ from the input image, the system serves as a fruitful method of identifying the faces. In order to find the difference between input image and stored images the system takes out and calculates main features from the input image. Thus, some changes in the new face image to be recognized can be allowed. Recognition precision and better discriminatory power, computational cost because smaller images with only main features require least processing to train the Haar wavelets. The main advantage is that we use citizenship database which already exists.

Nurul Azma Abdullah, et al [13]Proposed "An implementation of principal component analysis for face recognition"

Face Recognition for Criminal Identification is a face recognition system in which the security expert will input an image of the person in question inside the system and the system will first preprocess the image which will cause unwanted elements such as noise to be removed from the image. After that, the system will then classify the image based on its landmarks for example, the distance between the eyes, the length of the jaw line, etc. Then, the system will run a search through the database to find its perfect match and display the output. This work is focusing on implementing the system for criminal identification. Current practice of thumbprint identification which is simple and easy to be implemented can be challenge by the use of latent thumbprint and sometimes cannot be acquired from the crime scene. The criminals have become cleverer and normally be very careful in leaving any thumbprint on the scene. This system encompassed face database and an image processing algorithm to match the face feed with faces stored in the database.

Alireza Chevelwalla et al [14] proposed "Criminal Face Recognition System"

This system uses our implementation of a face recognition system using features of a face including colors, features and distances. Using its two degree of freedom, our system allows two modes of operation, one that results in very few false positives and another which results in few false negatives. It demonstrates various concerns related to the face recognition process, such as the lighting and background conditions in which the facial images are taken. Our system could be improved in the future through the development of a face detection algorithm which is less prone to incorrectness, failure and performs well regardless of the skin color.

Nagnath B. Aherwadi et al [15] proposed "Criminal Identification System using Facial Recognition"

Face is a unique and crucial part of the human body structure that identifies a person. Therefore, we can use it to trace the identity of a criminal person. With the advancement in technology, we are placed CCTV at many public places to capture the criminal's crime. Using the previously captured faces and criminal's images that are available in the police station, the criminal face recognition system of can be implemented. In this paper, we propose an automatic criminal identification system for Police Department to enhance and upgrade the criminal distinguishing into a more effective and efficient approach. Using technology, this idea will add plus point in the current system while bringing criminals spotting to a whole new level by automating tasks. Technology working behind it will be face recognition, from the footage captured by the CCTV cameras; our system will detect the face and recognize the criminal who is coming to that public place. The captured images of the person coming to that public place get compared with the criminal data we have in our database. If any person's face from public place matches, the system will display their image on the system screen and will give the message with their name that the criminal is found and present in this public place. This system matching more than 80% of the captured images with database images.

CHAPTER 3
3. REQUIREMENTS ANALYSIS

3.1 SYSTEM REQUIREMENTS SPECIFICATIONS

3.1.1 Hardware Specifications:

- Processor : I3/Intel Processor
- RAM :4GB(min)
- Hard Disk :128 GB
- Key Board : Standard Windows

3.1.2 Software Specifications:

- Operating System :Windows 10
- Server-side Script :Python 3.6 +
- IDL : Jupiter Notebook.
- Libraries Used : Pandas, NumPy, Sci-Kit Learn, Matplotlib, Seaborn,OpenCV.

SOFTWARE USED :

- ❖ **PYTHON LANGUAGE**

FIG 1:PYTHON

Python is an interpreted high-level general-purpose programming language. Python's design philosophy emphasizes code readability with its notable use of significant indentation. Its language constructs as well as its object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects. Python is dynamically-typed and garbage-collected. It supports multiple programming paradigms, including structured (particularly, procedural), object-oriented and functional programming. Python is often described as a "batteries included" language due to its comprehensive standard library.

INTRODUCTION :

Python is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python's design philosophy emphasizes code readability with its notable use of significant whitespace. Its language constructs and object- oriented approach aim to help programmers write clear, logical code for small and large-scale projects Python is dynamically typed and garbage-collected. It supports multiple programming paradigms, including structured object-oriented, and functional programming. Python is often described as a "batteries included" language due to its comprehensive standard library.

HISTORY:

• Python was conceived in the late 1980s as a successor to the ABC language. Python 2.0, released in 2000, introduced features like list comprehensions and a garbage collection system capable of collecting reference cycles. Python 3.0, released in 2008, was a major revision of the language that is not completely backward-compatible, and much Python 2 code does not run unmodified on Python 3.

• The Python 2 language was officially discontinued in 2020 (first planned for 2015), and "Python 2.7.18 is the last Python 2.7 release and therefore the last Python 2 release."[30] No more security patches or other improvements will be released for it.[31][32] With Python 2's

end-of-life, only Python 3.5.x[33] and later are supported.

• Python interpreters are available for many operating systems. A global community of programmers develops and maintains C Python, an open source[34] reference implementation. A non-profit organization, the Python Software Foundation, manages and directs resources for Python and C Python development.

FEATURES AND PHILOSOPHY

- **Simple:** Python is a simple and minimalistic language. Reading a good Python program feels almost like reading English, although very strict English! This pseudo-code nature of Python is one of its greatest strengths. It allows you to concentrate on the solution to the problem rather than the language itself.
- **Easy to Learn:** As you will see, Python is extremely easy to get started with. Python has an extraordinarily simple syntax, as already mentioned.
- **Free and Open Source:** Python is an example of a FLOSS (Free/Libré and Open Source Software). In simple terms, you can freely distribute copies of this software, read its source code, make changes to it, and use pieces of it in new free programs. FLOSS is based on the concept of a community which shares knowledge. This is one of the reasons why Python is so good - it has been created and is constantly improved by a community who just want to see a better Python.
- **High-level Language:** When you write programs in Python, you never need to bother about the low-level details such as managing the memory used by your program, etc.
- **Portable:** Due to its open-source nature, Python has been ported to (i.e. changed to make it work on) many platforms. All your Python programs can work on any of these platforms without requiring any changes at all if you are careful enough to avoid any system-dependent features.You can use Python on GNU/Linux, Windows, FreeBSD, Macintosh, Solaris, OS/2, Amiga, AROS, AS/400, BeOS, OS/390, z/OS, Palm OS, QNX, VMS, Psion, Acorn RISC OS, VxWorks, PlayStation, Sharp Zaurus, Windows CE and PocketPC!. You can even use a platform like Kivy to create games for your computer and for iPhone, iPad, and Android.

- **Interpreted:** A program written in a compiled language like C or C++ is converted from the source language i.e. C or C++ into a language that is spoken by your computer (binary code i.e. 0s and 1s) using a compiler with various flags and options. When you run the program, the linker/loader software copies the program from hard disk to memory and starts running it.Python, on the other hand, does not need compilation to binary. You just run the program directly from the source code. Internally, Python converts the source code into an intermediate form called byte codes and then translates this into the native language of your computer and then runs it. All this, actually, makes using Python much easier since you don't have to worry about compiling the program, making sure that the proper libraries are linked and loaded, etc.
- **Object Oriented:** Python supports procedure-oriented programming as well as object-oriented programming. In procedure-oriented languages, the program is built around procedures or functions which are nothing but reusable pieces of programs. In object-oriented languages, the program is built around objects which combine data and functionality. Python has a very powerful but simplistic way of doing OOP, especially when compared to big languages like C++ or Java.
- **Extensible :** If you need a critical piece of code to run very fast or want to have some piece of algorithm not to be open, you can code that part of your program in C or C++ and then use it from your Python program.
- **Embeddable :**You can embed Python within your C/C++ programs to give scripting capabilities for your program's users.
- **Extensive Libraries :** The Python Standard Library is huge indeed. It can help you do various things involving regular expressions, documentation generation, unit testing, threading, databases, web browsers, CGI, FTP, email, XML, XML-RPC, HTML, WAV files, cryptography, GUI (graphical user interfaces), and other system-dependent stuff. Remember, all this is always available wherever Python is installed. This is called the Batteries Included philosophy of Python. Besides the standard library, there are various other high-quality libraries which you can find at the Python Package Index.

❖ ANACONDA

FIG 2: ANACONDA IDLE

Anaconda is a distribution of the Python and R programming languages for scientific computing (data science, machine learning applications, large-scale data processing, predictive analytics, etc.), that aims to simplify package management and deployment. The distribution includes data-science packages suitable for Windows, Linux, and macOS. It is developed and maintained by Anaconda, Inc., which was founded by Peter Wang and Travis Oliphant in 2012. As an Anaconda, Inc. product, it is also known as Anaconda Distribution or Anaconda Individual Edition, while other products from the company are Anaconda Team Edition and Anaconda Enterprise Edition, both of which are not free. Package versions in Anaconda are managed by the package management system conda. This package manager was spun out as a separate open-source package as it ended up being useful on its own and for other things than Python. There is also a small, bootstrap version of Anaconda called Miniconda, which includes only conda, Python, the packages they depend on, and a small number of other packages.

OpenCV

OpenCV is a library of programming functions mainly aimed at real-time computer vision. It has a modular structure, which means that the package includes several shared or static libraries. We are using image processing module that includes linear and non-linear image filtering, geometrical image transformations (resize, affine and perspective warping, and generic table-based remapping), color space conversion, histograms, and so on. Our project includes libraries such as Viola-Jones or Haar classifier, LBPH (Lower Binary Pattern histogram) face recognizer, Histogram of oriented gradients (HOG).

3.2 FUNCTIONAL REQUIREMENTS

Automated criminal identification by face recognition requires a set of functional requirements to ensure that it operates effectively and efficiently. Functional requirements are as follows:

- Face detection: The system should be able to detect human faces in images or videos accurately and reliably.
- Face recognition: The system should be able to compare the detected faces with a database of known criminal faces and identify matches.
- Performance and accuracy: The system should be able to perform quickly and accurately, even in challenging lighting conditions, such as low light or high contrast.
- Scalability: The system should be scalable to handle a large number of images and video footage and be able to handle a high volume of queries.
- Integration: The system should be able to integrate with existing law enforcement databases and systems.
- Security: The system should have robust security measures in place to protect the privacy and confidentiality of the data, such as encryption and secure storage.
- Auditability: The system should keep a detailed audit trail of all queries and results, allowing for transparency and accountability.
- Training and maintenance: The system should have a training program for users and regular maintenance to ensure its continued functionality.
- Legal compliance: The system should comply with all relevant legal and regulatory requirements, such as data protection laws and human rights.
- Error handling: The system should be able to handle errors and provide clear feedback to users when there is a problem, such as a failed match or technical issues.

3.3 NON FUNCTIONAL REQUIREMENTS

Automated criminal identification by face recognition involves the use of technology to identify individuals who may have committed a crime by analyzing their facial features. In addition to functional requirements, such as accuracy and speed of identification, there are also non-functional requirements that must be considered. Some examples include:

- Accuracy: The system must be highly accurate in identifying individuals to prevent false positives or false negatives.
- Speed: The system must be able to identify individuals quickly to allow for timely interventions and to avoid delays in law enforcement.
- Scalability: The system should be able to handle a large volume of facial images without any degradation in performance.
- Security: The system must be secure to prevent unauthorized access to the data and prevent hacking or tampering.
- Privacy: The system must comply with privacy laws and regulations, such as data protection laws, to protect the privacy of individuals.
- Reliability: The system must be reliable and able to function consistently and without errors over extended periods.
- Usability: The system should be user-friendly and easy to use, even for non-technical users.
- Interoperability: The system should be able to integrate with other systems and technologies used by law enforcement agencies.
- Accessibility: The system should be accessible to users with disabilities, such as those who are visually impaired.
- Maintenance: The system should be easy to maintain and update to ensure it stays current and effective over time

CHAPTER 4

4. SYSTEM DESIGN

4.1 SYSTEM ANALYSIS

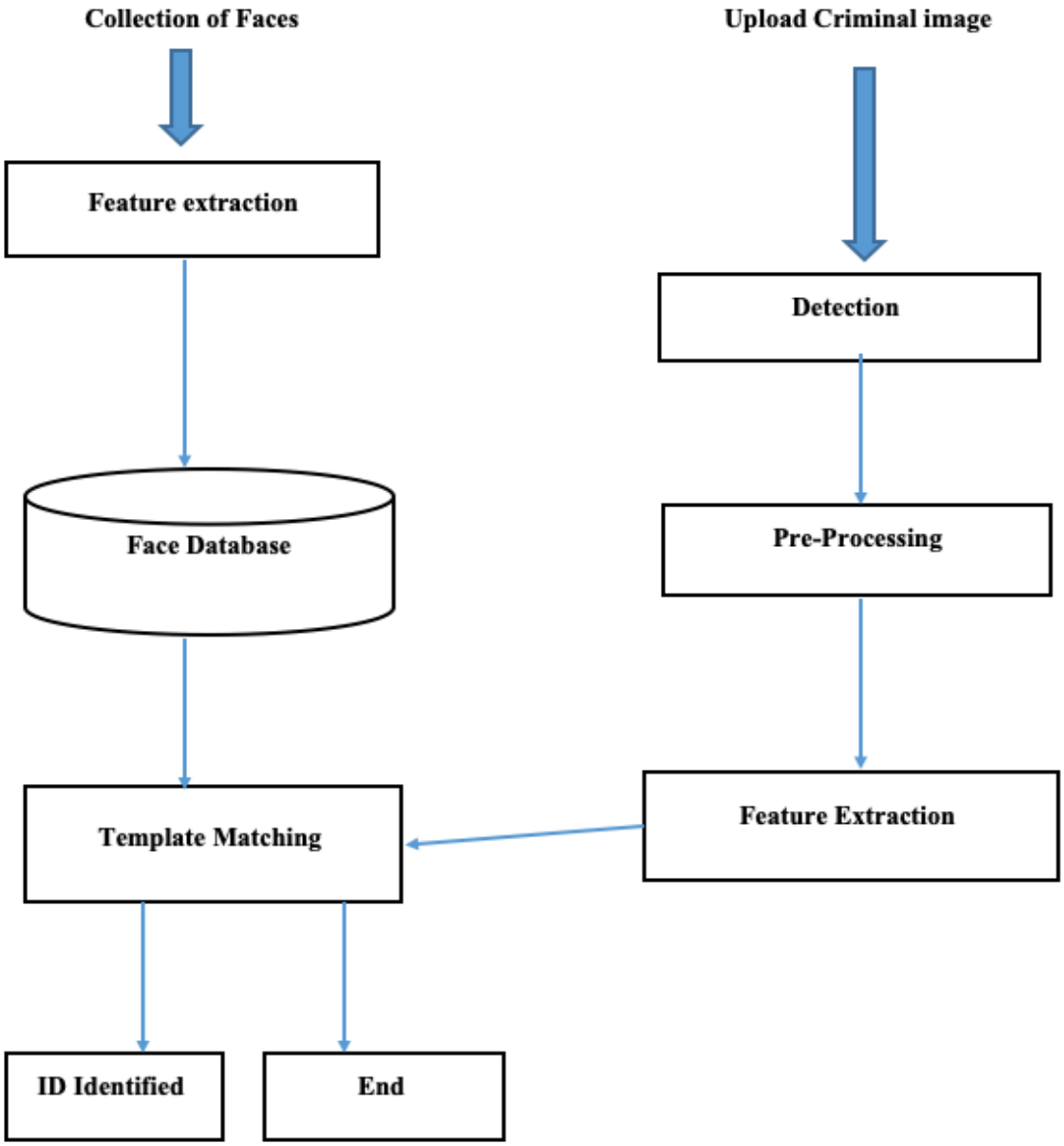

FIG 3: SYSTEM ARCHITECTURE

Automated criminal identification by face recognition involves the use of computer algorithms to analyze and match images of individuals' faces to a database of known criminals. The architecture of this system typically consists of the following components:

Image Acquisition: This component involves capturing facial images of individuals through various means such as CCTV cameras, smartphone cameras, or specialized cameras.

Preprocessing: The images acquired may require preprocessing to ensure they meet certain quality standards, such as removing noise or distortion, normalizing image lighting, and adjusting image contrast.

Face Detection: This component involves using computer vision algorithms to locate and isolate the facial region of the image, which includes the eyes, nose, mouth, and other facial features.

Feature Extraction: This component involves analyzing the facial region to extract unique features that are characteristic of an individual's face, such as the distance between the eyes, the shape of the jawline, and the size and shape of the nose.

Matching: This component involves comparing the extracted facial features of an individual against a database of known criminals to identify potential matches. If match is found it will display the criminal details of particular criminal ,if not it will display message box like no criminal is identified.

SEQUENCE DIAGRAME

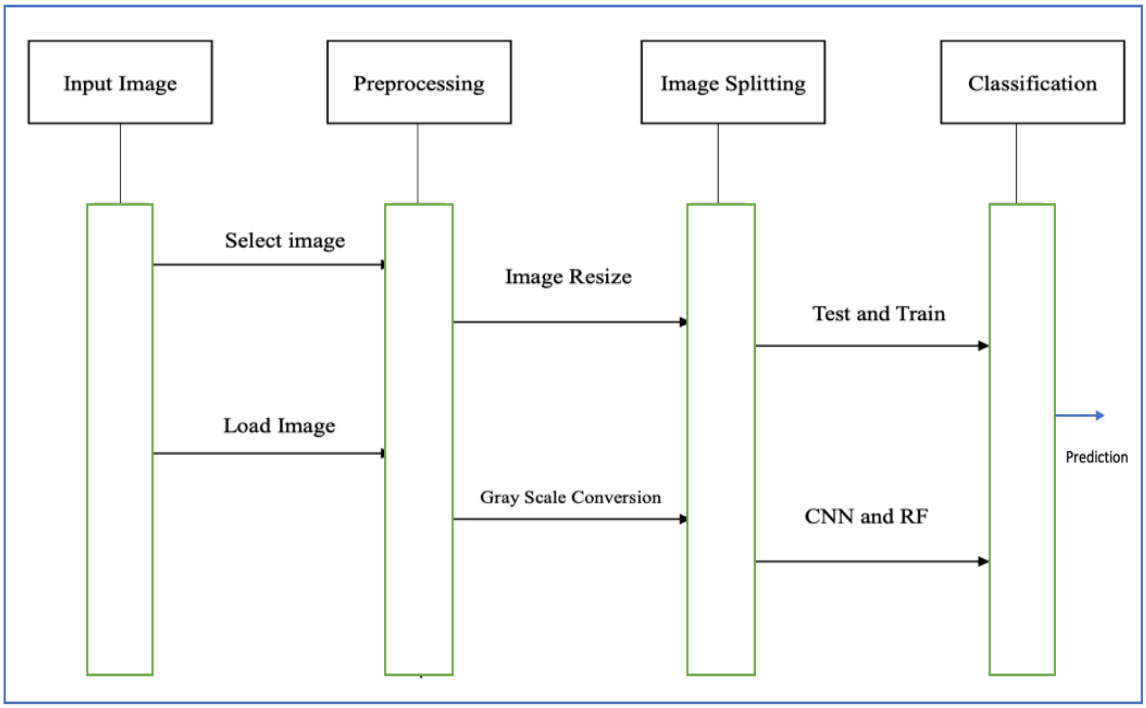

FIG 4: SEQUENCE DIAGRAME

A sequence diagram is a type of UML diagram that shows the interactions between objects or components in a system in a sequential manner. Here is an explanation of a possible sequence diagram for automated criminal identification by face recognition.

The process starts when a suspect is brought in for questioning or their face is captured by a surveillance camera.The face image is captured and sent to the face recognition system.The face recognition system uses a database of known criminal faces to compare the captured image with.The system generates a list of possible matches based on the comparison results.The system ranks the possible matches based on the level of similarity between the captured image and the known criminal faces.The system returns the ranked list of possible matches to the operator. The operator reviews the results and selects the most likely match from the list.The system displays additional information about the selected match, such as criminal records, photos, and other relevant data.The operator confirms whether the match is correct or not.If the match is confirmed, the system generates a report and alerts law enforcement officers or other authorities about the match.

If the match is not confirmed, the system continues to search the database for other possible matches, or the operator can choose to end the process. Overall, it shows how automated criminal identification by face recognition works by capturing a suspect's face, comparing it with a database of known criminal faces, and generating a ranked list of possible matches for human review and confirmation.

USE CASE DIAGRAME

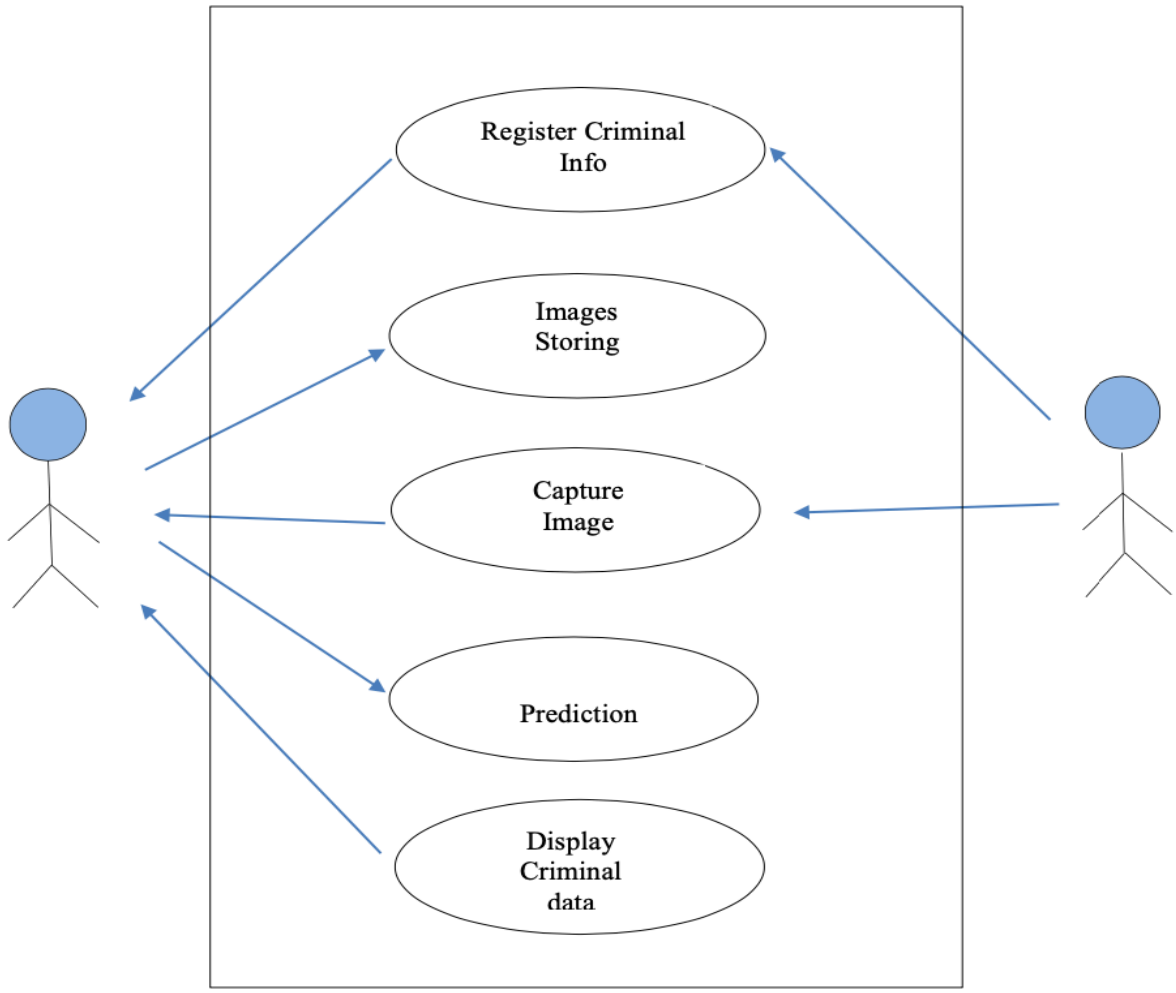

FIG 5: USE CASE DIAGRAM

ALGORITHMS

❖ CONVOLUTIONAL NEURAL NETWORK (CNN)

In neural networks, Convolutional neural network (ConvNets or CNNs) is one of the main categories to do images recognition, images classifications. Objects detections, recognition faces etc., are some of the areas where CNNs are widely used.CNN image classifications takes an input image, process it and classify it under certain categories (Eg., Dog, Cat, Tiger, Lion). Computers sees an input image as array of pixels and it depends on the image resolution. Based on the image resolution, it will see h x w x d(h = Height, w = Width, d = Dimension). Eg., An image of 6 x 6 x 3 array of matrix of RGB (3 refers to RGB values) and an image of 4 x 4 x 1 array of matrix of grayscale image.

Technically, deep learning CNN models to train and test, each input image will pass it through a series of convolution layers with filters (Kernals), Pooling, fully connected layers (FC) apply Softmax function to process an input image and classifies the objects based on values.

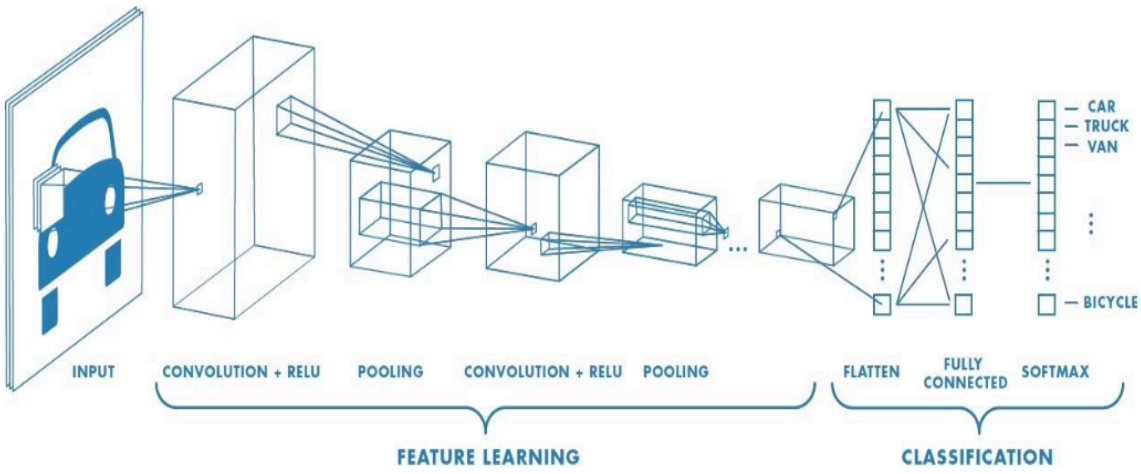

FIG 6 : Neural Network With Many Convolutional Layers

CONVOLUTION LAYER

Convolution is the first layer to extract features from an input image. Convolution preserves the relationship between pixels by learning image features using small squares of input data. It is a mathematical operation that takes two inputs such as image matrix and a filter or kernel.

- An image matrix (volume) of dimension **(h x w x d)**
- A filter **(f_h x f_w x d)**
- Outputs a volume dimension **(h - f_h + 1) x (w - f_w + 1) x 1**

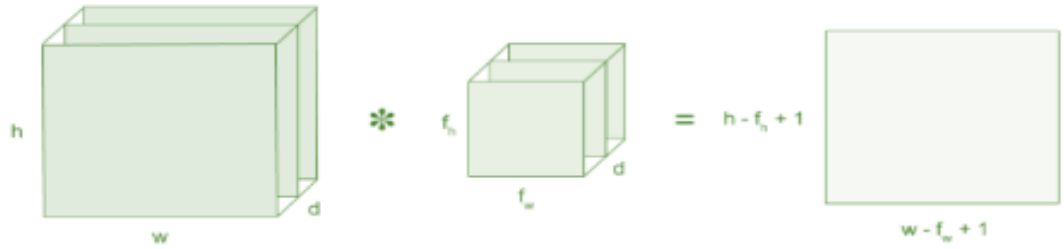

FIG 7: Image Matrix Multiplies Kernel Or Filter Matrix

Consider a 5 x 5 whose image pixel values are 0, 1 and filter matrix 3 x 3 as shown in below

FIG 8: Image Matrix Multiplies Kernel Or Filter Matrix

Then the convolution of 5 x 5 image matrix multiplies with 3 x 3 filter matrix which is called "Feature Map" as output shown in below

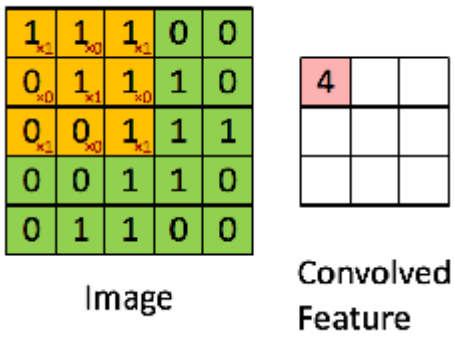

FIG 9: 3 x 3 Output matrix

Convolution of an image with different filters can perform operations such as edge detection, blur and sharpen by applying filters. The below example shows various convolution image after applying different types of filters (Kernels).

STRIDES

Stride is the number of pixels shifts over the input matrix. When the stride is 1 then we move the filters to 1 pixel at a time. When the stride is 2 then we move the filters to 2 pixels at a time and so on. The below figure shows convolution would work with a stride of 2.

PADDING

Sometimes filter does not fit perfectly fit the input image. We have two options:

- Pad the picture with zeros (zero-padding) so that it fits
- Drop the part of the image where the filter did not fit. This is called valid padding which keeps only valid part of the image.

Non Linearity (ReLU)

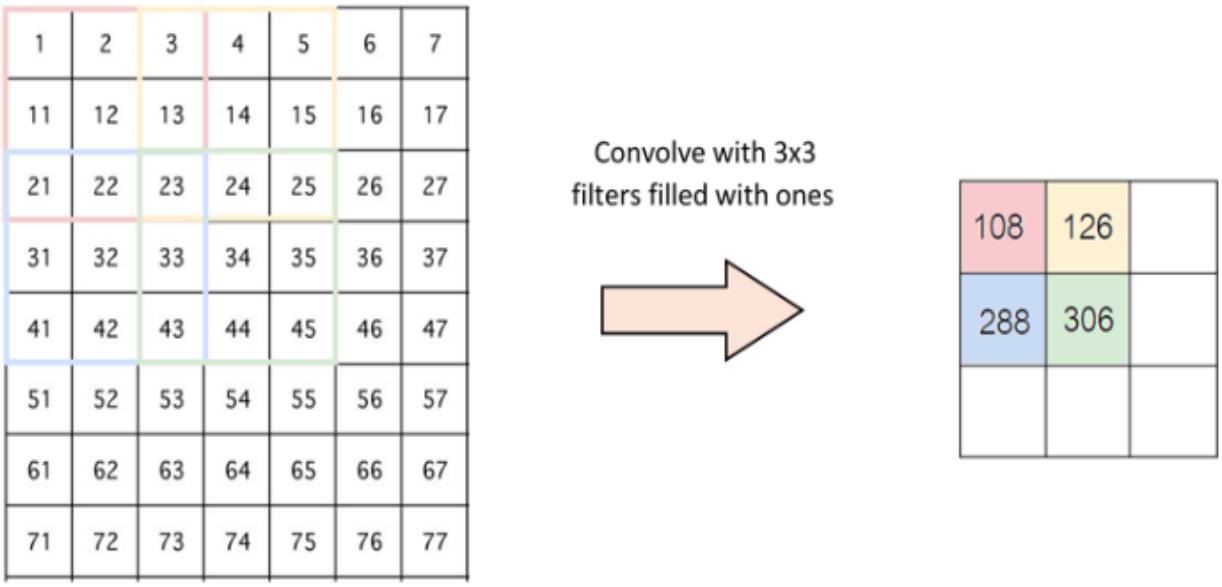

FIG 10 : Stride of 2 pixels

ReLU stands for Rectified Linear Unit for a non-linear operation. The output is $f(x) = \max(0,x)$. Why ReLU is important : ReLU's purpose is to introduce non-linearity in our ConvNet. Since, the real world data would want our ConvNet to learn would be non-negative linear values.

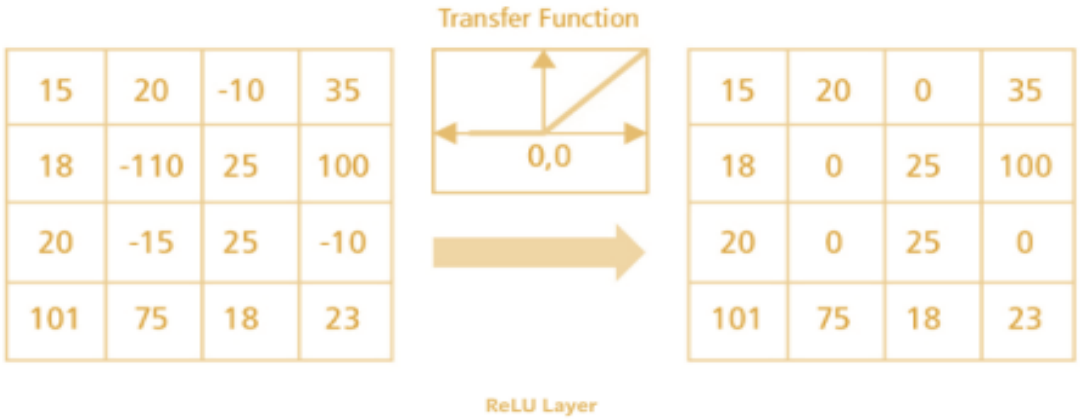

FIG 11: ReLU operation

There are other non linear functions such as tanh or sigmoid that can also be used instead of ReLU. Most of the data scientists use ReLU since performance wise ReLU is better than the other two.

POOLING LAYER

Pooling layers section would reduce the number of parameters when the images are too large. Spatial pooling also called subsampling or down sampling which reduces the dimensionality of each map but retains important information. Spatial pooling can be of different types:

- Max Pooling
- Average Pooling
- Sum Pooling

Max pooling takes the largest element from the rectified feature map. Taking the largest element could also take the average pooling. Sum of all elements in the feature map call as sum pooling.

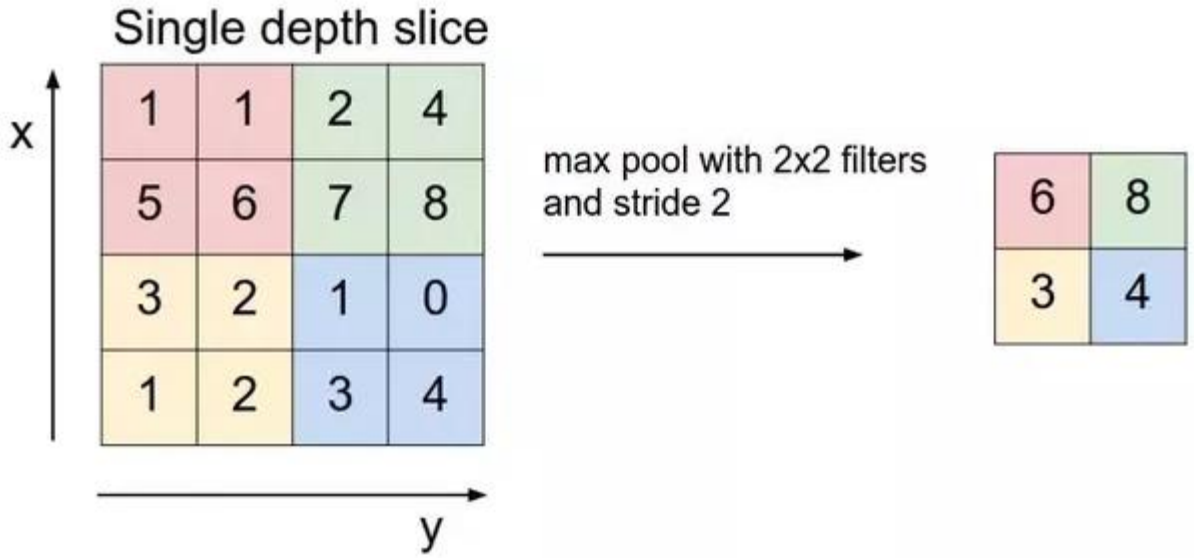

Figure 12 : Max Pooling

FULLY CONNECTED LAYER

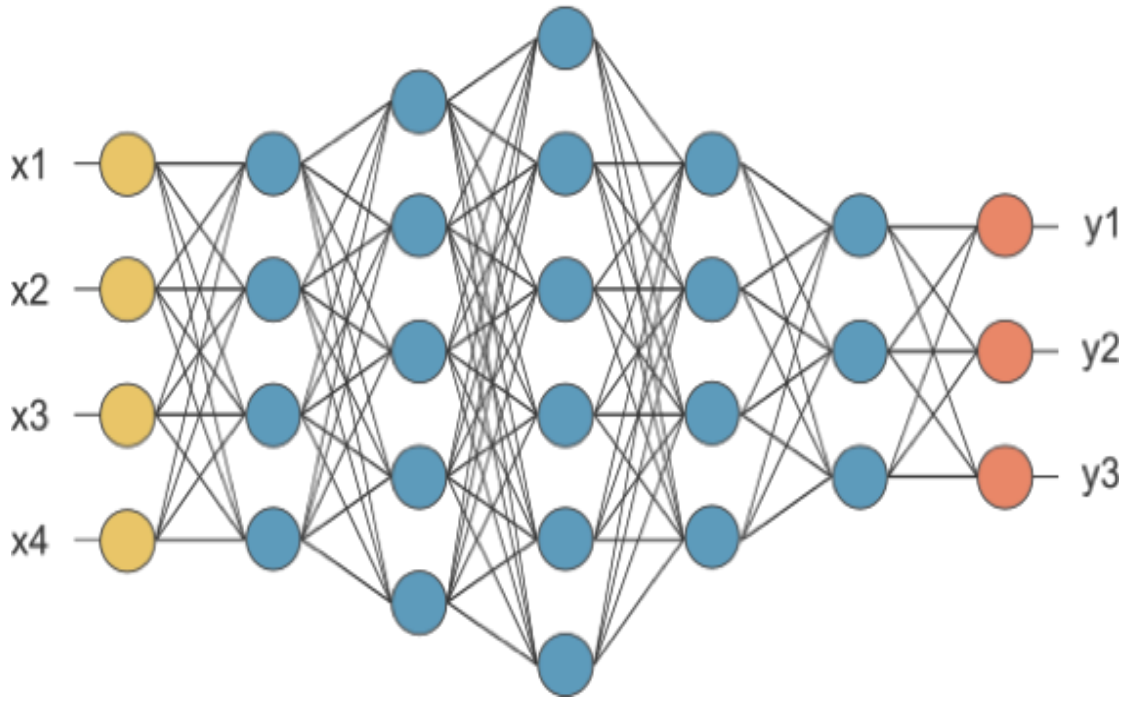

FIG 13: After Pooling Layer, Flatted As FC Layer

In the above diagram, the feature map matrix will be converted as vector (x1, x2, x3, ...). With the fully connected layers, we combined these features together to create a model. Finally, we have an activation function such as softmax or sigmoid to classify the outputs as cat, dog, car, truck etc.,

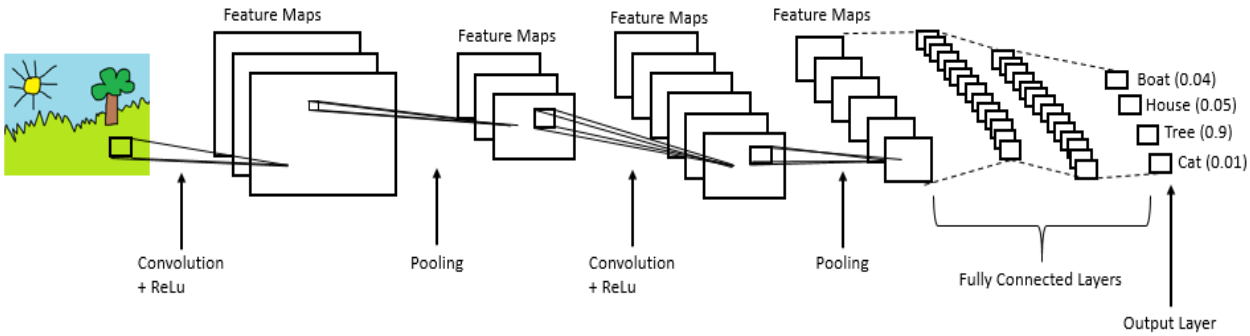

FIG 14: Complete CNN architecture

❖ HAAR CLASSIFIER ALGORITHM

The face detection algorithm proposed by Viola and Jones .The face detection algorithm looks for specific Haar features and not pixels of a human face . When one of these features is found, the algorithm allows the face candidate to pass to the next stage of detection. A face candidate is a rectangular section of the original image which is called as a sub-window. Generally, these sub windows have a fixed size (typically 24×24 pixels). This sub-window is often scaled in order to obtain a variety of different size faces. The algorithm scans the entire image with this window and denotes each respective section a face candidate.

INTEGRAL IMAGE

The integral image is defined as the summation of the pixel values of the original image. The value at any location (X, Y) of the integral image is the sum of the image's pixels above and to the left of location (X, Y).

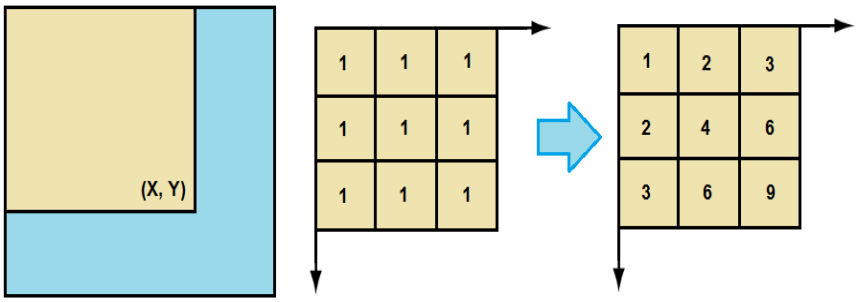

FIG 15: Integral Image Generation

The dark region represents the sum of the pixels up to position (X, Y) of the original image. It shows a 3×3 image and its corresponding integral image representation.

HAAR FEATURES

A simple rectangular Haar-like feature can be defined as the difference of the sum of pixels of areas inside the rectangle, which can be at any position and scale within the original image. This modified feature set is called 2- rectangle feature.Faces are scanned and searched for Haar features of the current stage. The weight and size of each feature and the features themselves are generated using a machine learning algorithm. The weights are constants generated by the learning algorithm. There are a variety of forms of features as seen below.

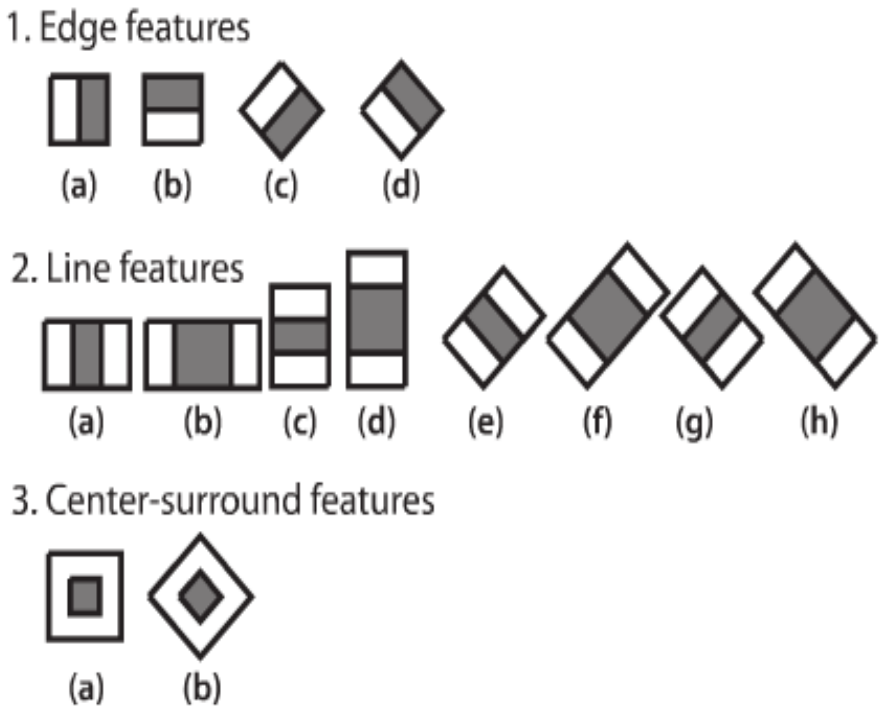

FIG 16: Common Haar Features

Each Haar feature has a value that is calculated by taking the area of each rectangle, multiplying each by their respective weights, and then summing the results . The area of each rectangle is easily found using the integral image. The coordinate of the any corner of a rectangle can be used to get the sum of all the pixels above and to the left of that location using the integral image. By using each corner of a rectangle, the area can be computed quickly. Since A is subtracted off twice it must be added back on to get the correct area of the rectangle. The area of the rectangle R, denoted as the rectangle integral, can be computed as follows using the locations of the integral image: C + A - B - D.

FIG 17: Examples of Haar features.

Areas of white and black regions are multiplied by their respective weights and then summed up to get the Haar feature value.

HAAR FEATURE CLASSIFIER

The cascade classifier contains a list of stages, where each stage consists of a list of weak learners. The system detects the required object by moving a window over the image. Each stage of the classifier labels the specific region defined by the current location of the window as either positive or negative where positive means that an object was found and negative means that the specified object was not found in the image . If the labelling yields a negative result, then the classification of that particular region is over and the location of the window is moved to the next location. If the labelling gives a positive result, then the region moves to the next stage of classification. The classifier yields a final result as positive, when all the stages, including the last one, yield a positive result, which implies that the required object is found in the image..

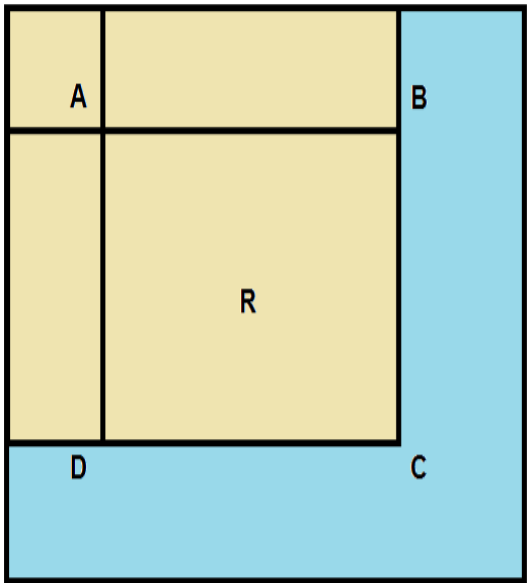

FIG 18: Calculating the area of a R is done using the corner of the rectangle: C + A - B - D.

CASCADE

The Viola and Jones face detection algorithm eliminates face candidates quickly using a cascade of stages. The cascade eliminates candidates by making stricter requirements in each stage with later stages being much more difficult for a candidate to pass. Candidates exit the cascade if they pass all stages or fail any stage. A face is detected if a candidate passes all stages.

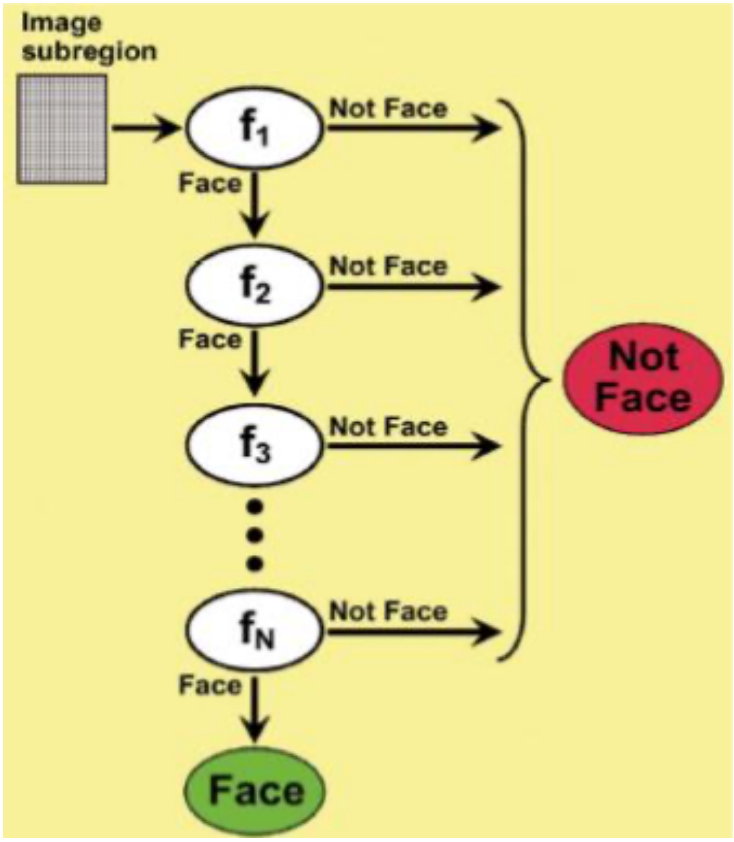

FIG 19: Cascade of stages.

CHAPTER 5

5. SYSTEM IMPLEMENTATION

5.1 MODULES

A. Import the required modules

The Modules required to perform the facial recognition are cv2, os, image module and numpy. cv2 is the OpenCV module and contains the functions for face detection and recognition. OS will be used to maneuver with image and directory names. First, we use this module to extract the image names in the database directory and then from these names individual number is extracted, which is used as a label for the face in that image. Since, the dataset images are in gif format and as of now, OpenCV does not support gif format, Image module from PIL is used to read the image in grayscale format. Numpy arrays are used to store the images.

B. Load the face detection Cascade

To Load the face detection cascade the first step is to detect the face in each image. Once we get the region of interest containing the face in the image, we use it for training the recognizer. For the purpose of face detection, we will use the Haar Cascade provided by OpenCV. The haar cascades that come with OpenCV are located in the directory of OpenCV installation. haarcascade frontalface default.xml is used for detecting the face. Cascade is loaded using the cv2 CascadeClassifier function which takes the path to the cascade xml file. if the xml file is in the current working directory, then relative path is used.

C. Create the Face Recognizer Object

The next step involves creating the face recognizer object. The face recognizer object has functions like FaceRecognizer.train() to train the recognizer and FaceRecognizer.predict() to recognize a face . OpenCV currently provides Eigenface Recognizer, Fisherface Recognizer and Local Binary Patterns Histograms(LBPH) Face Recognizer. We have used LBPH recognizer because extracting local features from images. The idea is to not look at the whole image as a high-dimensional vector but describe only local features of an object. The basic idea of Local Binary Patterns is to summarize the local structure in an image by comparing each pixel with its neighbourhood. LBP operator is robust against monotonic gray scale transformations.

D. Prepare the training set and Perform the training

To create the function to prepare the training set, we will define a function that takes the absolute path to the image database as input argument and returns tuple of 2 list, one containing the detected faces and the other containing the corresponding label for that face. For example, if the i^{th} index in the list of faces represents the 4th individual in the database, then the corresponding i^{th} location in the list of labels has value equal to 4. Now to perform the training using the Face Recognizer. Train function. It requires 2 arguments, the features which in this case are the images of faces and the corresponding labels assigned to these faces which in this case are the individual number that we extracted from the image names.

E. Testing

For testing the Face Recognizer, we check if the recognition was correct by seeing the predicted label when we bring the trained face in front of camera. The label is extracted using the os module and the string operations from the name of the sample images folder. Lower is the

5.1.1 CODE SNIPSET

```
####### IMPORTED LIBRARIES  #####
import tkinter as tk
from tkinter import filedialog
from tkinter import messagebox
from PIL import Image
from PIL import ImageTk
import threading
import shutil
from facerec import *
from register import *
from face_detection import *
from handler import *
import time
import csv
import pandas as pd
import numpy as np
import ntpath
import os
## ### Register Page #####
def getPage1():
    global active_page, left_frame, right_frame, heading, img_label
    active_page = 1
    img_label = None
    opt_menu = None
    menu_var = tk.StringVar(root)
    pages[1].lift()
```

```
    basicPageSetup(1)
    heading.configure(text="Register Criminal", bg="#3E3B3C")
    right_frame.configure(text="Enter Details", fg="white", bg="#3E3B3C")

    btn_grid = tk.Frame(left_frame, bg="#3E3B3C")
    btn_grid.pack()

    tk.Button(btn_grid, text="Select Images", command=lambda: selectMultiImage(opt_menu, menu_var), font="Arial 15 bold", bg="#000000",
          fg="green", pady=10, bd=0, highlightthickness=0, activebackground="#3E3B3C",
          activeforeground="white").grid(row=0, column=0, padx=25, pady=25)


    # Creating Scrollable Frame
    canvas = tk.Canvas(right_frame, bg="#202d42", highlightthickness=0)
    canvas.pack(side="left", fill="both", expand="true", padx=30)
    scrollbar = tk.Scrollbar(right_frame, command=canvas.yview, width=20, troughcolor="#3E3B3C", bd=0,
                             activebackground="#3E3B3C", bg="#000000", relief="raised")
    scrollbar.pack(side="left", fill="y")

    scroll_frame = tk.Frame(canvas, bg="#3E3B3C", pady=20)
    scroll_win = canvas.create_window((0, 0), window=scroll_frame, anchor='nw')

    canvas.configure(yscrollcommand=scrollbar.set)
    canvas.bind('<Configure>', lambda event, canvas=canvas, win=scroll_win: on_configure(event, canvas, win))
```

```
    tk.Label(scroll_frame, text="* Required Fields", bg="#3E3B3C", fg="yellow", font="Arial 13 bold").pack()
    ####### IMAGE surveillance Page #########
    def selectImage():
        global left_frame, img_label, img_read
        for wid in right_frame.winfo_children():
            wid.destroy()

        filetype = [("images", "*.jpg *.jpeg *.png")]
        path = filedialog.askopenfilename(title="Choose a image", filetypes=filetype)

        if(len(path) > 0):
            img_read = cv2.imread(path)

            img_size =  left_frame.winfo_height() - 40
            showImage(img_read, img_size)
    def getPage2():
        global active_page, left_frame, right_frame, img_label, heading
        img_label = None
        active_page = 2
        pages[2].lift()

        basicPageSetup(2)
        heading.configure(text="Detect Criminal")
        right_frame.configure(text="Detected Criminals", fg="white")

        btn_grid = tk.Frame(left_frame, bg="#3E3B3C")
        btn_grid.pack()
```

```
    tk.Button(btn_grid, text="Select Image", command=selectImage, font="Arial 15 bold", padx=20, bg="#000000",
              fg="red", pady=10, bd=0, highlightthickness=0, activebackground="#3E3B3C",
              activeforeground="white").grid(row=0, column=0, padx=25, pady=25)
    tk.Button(btn_grid, text="Recognize", command=startRecognition, font="Arial 15 bold", padx=20, bg="#000000",
              fg="red", pady=10, bd=0, highlightthickness=0, activebackground="#3E3B3C",
              activeforeground="white").grid(row=0, column=1, padx=25, pady=25)
def videoLoop(path,model, names):
    p=path
    q=ntpath.basename(p)
    filenam, file_extension = os.path.splitext(q)
    # print(filename)
    global thread_event, left_frame, webcam, img_label
    start=time.time()
    webcam = cv2.VideoCapture(p)
    old_recognized = []
    crims_found_labels = []
    times = []
    img_label = None
    field=['S.No.', 'Name', 'Time']
    g=filenam+'.csv'
    # filename = "g.csv"
    filename = g
    num=0


###### video surveillance Page #####
```

```
def getPage4(path):
    p=path
    global active_page, video_loop, left_frame, right_frame, thread_event, heading
    active_page = 4
    pages[4].lift()
    basicPageSetup(4)
    heading.configure(text="Video Surveillance")
    right_frame.configure(text="Detected Criminals")
    left_frame.configure(pady=40)
    btn_grid = tk.Frame(right_frame, bg="#3E3B3C")
    btn_grid.pack()
    (model, names) = train_model()
    print('Training Successful. Detecting Faces')
    thread_event = threading.Event()
    thread = threading.Thread(target=videoLoop, args=(p,model, names))
    thread.start()
def getPage3():
    global active_page, video_loop, left_frame, right_frame, thread_event, heading
    active_page = 3
    pages[3].lift()
    basicPageSetup(3)
    heading.configure(text="Video Surveillance")
    btn_grid = tk.Frame(left_frame,bg="#3E3B3C")
    btn_grid.pack()
    tk.Button(btn_grid, text="Select Video", command=selectvideo, font="Arial 15 bold",
padx=20, bg="#000000",
            fg="green", pady=10, bd=0, highlightthickness=0,
activebackground="#3E3B3C",
```

```
            activeforeground="white").grid(row=0, column=0, padx=25, pady=25)
    def selectvideo():
        global left_frame, img_label, img_read
        for wid in right_frame.winfo_children():
            wid.destroy()


        filetype = [("video", "*.mp4 *.mkv")]
        path = filedialog.askopenfilename(title="Choose a video", filetypes=filetype)
        p=''
        p=path
        if(len(path) > 0):
            getPage4(p)
    def selectvideo1():
        filetype = [("video", "*.mp4 *.mkv")]
        path = filedialog.askopenfilename(title="Choose a video", filetypes=filetype)
        p=' '
        p=path
        if(len(path) > 0):
            detect(p)
```

5.2 SYSTEM TESTING

System testing is the stage of implementation, which aimed at ensuring that system works accurately and efficiently before the live operation commence. Testing is the process of executing a program with the intent of finding an error. A good test case is one that has a high probability of finding an error. A successful test is one that answers a yet undiscovered error. Testing is vital to the success of the system. System testing makes a logical assumption that if all parts of the system are correct, the goal will be successfully achieved. . A series of tests are performed before the system is ready for the user acceptance testing. Any engineered product can be tested in one of the following ways. Knowing the specified function that a product has been designed to from, test can be conducted to demonstrate each function is fully operational. Knowing the internal working of a product, tests can be conducted to ensure that is the internal operation of the product performs according to the specification and all internal components have been adequately exercised.

❖ UNIT TESTING

Unit testing is the testing of each module and the integration of the overall system is done. Unit testing becomes verification efforts on the smallest unit of software design in the module. This is also known as ‘module testing’. The modules of the system are tested separately. This testing is carried out during the programming itself. In this testing step, each model is found to be working satisfactorily as regard to the expected output from the module. There are some validation checks for the fields. For example, the validation check is done for verifying the data given by the user where both format and validity of the data entered is included. It is very easy to find error and debug the system.

❖ INTEGRATION TESTING

Data can be lost across an interface, one module can have an adverse effect on the other sub function, when combined, may not produce the desired major function. Integrated testing is systematic testing that can be done with sample data. The need for the integrated test is to find the overall system performance. There are two types of integration testing. They are:

- Top-down integration testing.
- Bottom-up integration testing.

5.2.1 TESTING TECHNIQUES/STRATEGIES

- **WHITE BOX TESTING**

White Box testing is a test case design method that uses the control structure of the procedural design to drive cases. Using the white box testing methods, we Derived test cases that guarantee that all independent paths within a module have been exercised at least once.

- **BLACK BOX TESTING**

1. Black box testing is done to find incorrect or missing function
2. Interface error
3. Errors in external database access
4. Performance errors.
5. Initialization and termination errors

In 'functional testing', is performed to validate an application conforms to its specifications of correctly performs all its required functions. So this testing is also called 'black box testing'. It tests the external behaviour of the system. Here the engineered product can be tested knowing the specified function that a product has been designed to perform, tests can be conducted to demonstrate that each function is fully operational.

5.2.2 SOFTWARE TESTING STRATEGIES VALIDATION TESTING

- **VALIDATION TESTING**

After the culmination of black box testing, software is completed assembly as a package, interfacing errors have been uncovered and corrected and final series of software validation tests begin validation testing can be defined as many But a single definition is that validation succeeds when the software functions in a manner that can be reasonably expected by the customer

❖ USER ACCEPTANCE TESTING

User acceptance of the system is the key factor for the success of the system. The system under consideration is tested for user acceptance by constantly keeping in touch with prospective system at the time of developing changes whenever required.

❖ OUTPUT TESTING

After performing the validation testing, the next step is output asking the user about the format required testing of the proposed system, since no system could be useful if it does not produce the required output in the specific format. The output displayed or generated by the system under consideration. Here the output format is considered in two ways. One is screen and the other is printed format. The output format on the screen is found to be correct as the format was designed in the system phase according to the user needs. For the hard copy also output comes out as the specified requirements by the user. Hence the output testing does not result in any connection in the system.

CHAPTER 6

6. RESULTS

A. Homepage

Homepage is the main page of Criminal Identification System application. It contains three buttons for: Register Criminal, Detect Criminal and Video Surveillance.

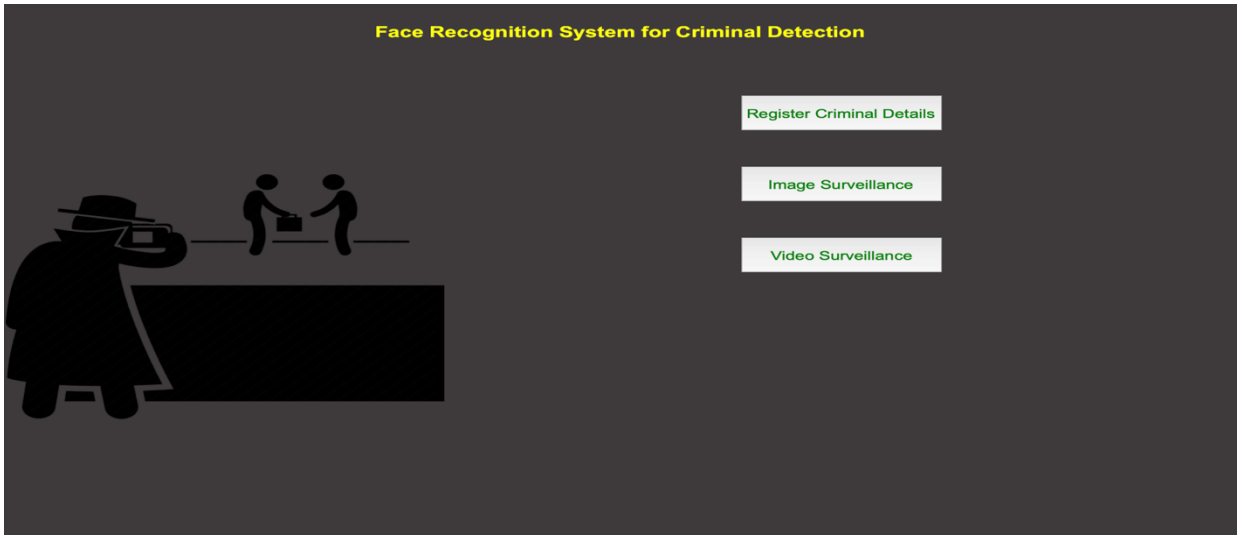

FIG 20: HOMEPAGE

B. Criminal Registration

Criminal Registration page will ask the user to select atleast 5 images of the criminal that needs to be registered and also provides input form for providing various details of the criminal like his Name, DOB, Identification mark,image etc. After selecting images and filling details, user will click register. The criminal will be successfully registered if any error doesn't occur.

FIG 21: Criminal Registration Page

C. Detect Criminal Page

This page. allows the user to browse an image from the system and helps in detecting one or more criminals in it. User can also see the profile of the criminal by clicking on detected criminal names.

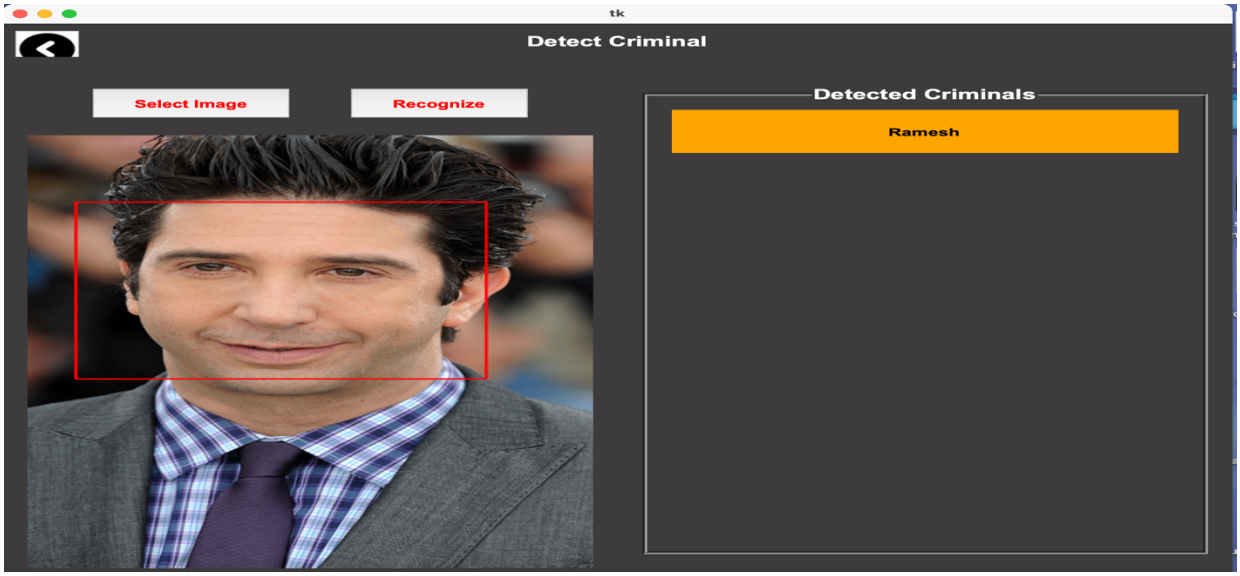

FIG 22: Detect Criminal Page

D. Detecting Unknown Criminal

Our system is able to identify a non-criminal face.

FIG 23: Non-Criminal Face

E. Video Surveillance

This page will use the pc webcam to capture the video frames in real time. After this it will use face detection module on each frame to detect and recognize criminals in the video in real time.

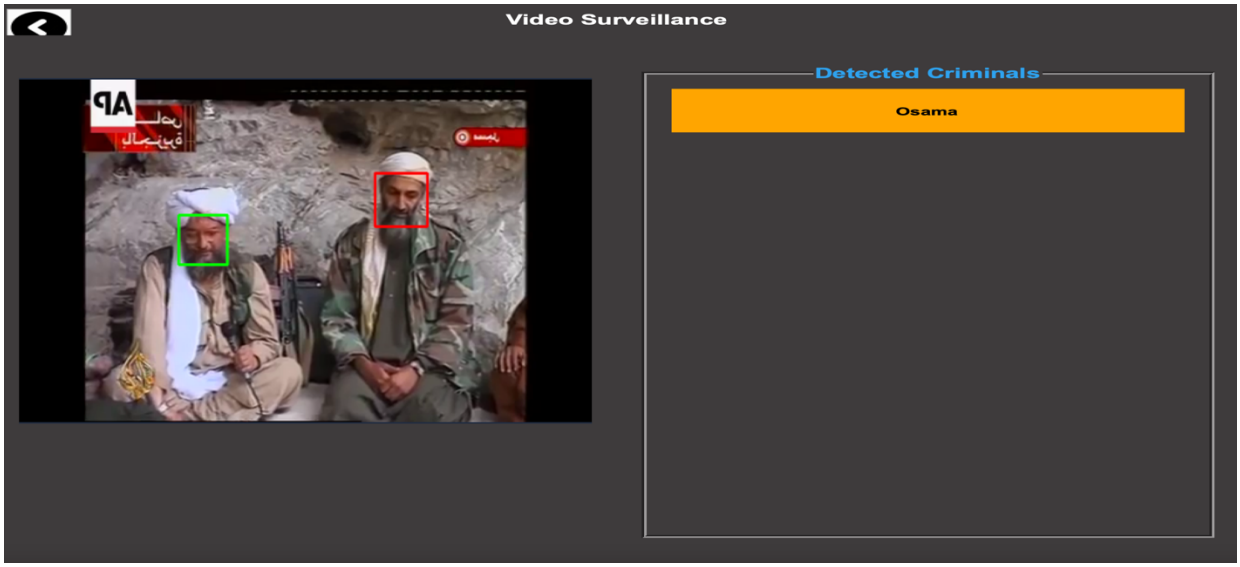

FIG 24: Output: Video Surveillance

6.1 EVALUATION

Automated criminal identification by face recognition is a technology that uses algorithms to match faces captured in images or videos with a database of known criminal faces. This technology has been increasingly adopted by law enforcement agencies around the world as a tool to identify and apprehend criminals.

The evaluation of automated criminal identification by face recognition involves several key factors, including:

- Accuracy: The accuracy of the face recognition system is the most critical factor in evaluating its effectiveness. The system's accuracy is measured by comparing its results against a known set of data and determining the number of correct and incorrect matches. The accuracy rate should be high enough to ensure that false positives (incorrect matches) and false negatives (missed matches) are minimized.
- Bias: The system's accuracy should not be affected by any biases, such as race, gender, or age. The system should be trained on a diverse dataset that includes faces from different ethnicities, genders, and age groups to avoid bias in the system's output.
- Privacy: The use of facial recognition technology raises concerns about privacy. The evaluation of such a system should include an assessment of the system's compliance with privacy regulations and its potential impact on individuals' privacy rights.
- Transparency: The system's decision-making process should be transparent to ensure accountability and fairness. The evaluation should include an assessment of the system's ability to explain its decisions and provide users with a clear understanding of how the system works.
- Cost-effectiveness: The cost of implementing and maintaining a face recognition system should be evaluated to ensure that the benefits outweigh the costs.

6.2 DISCUSSION

Automated criminal identification by face recognition is a technology that uses artificial intelligence and machine learning algorithms to analyze images or videos of a person's face and match them with a database of known criminals or suspects. The technology is becoming increasingly prevalent in law enforcement and other security settings, and it has generated a lot of controversy and debate. Proponents of automated criminal identification argue that the technology can be an effective tool for catching criminals and making communities safer. They point to examples of successful prosecutions and convictions that have been aided by facial recognition technology. They also argue that the technology can help law enforcement quickly identify dangerous individuals in situations where time is of the essence, such as during a terrorist attack or mass shooting.

The Opponents of automated criminal identification, however, have raised concerns about privacy, accuracy, and bias. They argue that the technology can be used to unfairly target marginalized communities, as studies have shown that facial recognition algorithms are often less accurate when used on people with darker skin tones. Critics also point out that facial recognition technology can be easily abused, particularly in countries with authoritarian regimes or weak legal protections for citizens' rights.Overall, the discussion of automated criminal identification by face recognition is complex and multifaceted. While the technology has the potential to be a powerful tool for law enforcement, it also raises important questions about privacy, accuracy, and bias that must be carefully considered and addressed.

CHAPTER 7

7. CONCLUSIONS

Our project successfully detects and recognizes criminal faces in both images and real-time video streams. For face detection, we employed the Haar feature-based cascade classifiers in the OpenCV approach. This method employs a machine learning-based approach where a cascade function is trained using positive and negative images, which is then used to detect objects in other images. Additionally, we used Local Binary Patterns Histograms (LBPH) for face recognition. The algorithm we used has several advantages, such as efficient feature selection, a scale and location-invariant detector that scales the features rather than the image itself, and the potential for a generic detection scheme that can be trained for the detection of other objects, such as cars, signboards, and number plates. LBPH can efficiently recognize faces in varying lighting conditions and even with a single training image per person, with high accuracy. There are some limitations to our application. The detector is most effective only on frontal images of faces and struggles to cope with 45° face rotations around both the vertical and horizontal axes.

FUTURE SCOPE

In future advanced face recognition techniques can be used to improve the results and login page must be created so that any police personnel can access this application remotely. Moreover if a criminal is found in a particular zone then alert messages should be send to nearby police stations. The application that is developed is a simple and user friendly. By using advanced CSS styles and different front-end technologies, interface of the application can be developed more according to user requirements.

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