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B.TECH. PROJECT REPORT
ON

"Criminal Face Detection"

Submitted in partial fulfilment of the requirements for the award of the degree of

Bachelor of Technology in
Information Technology by

1) Zaid Zakir Ansari (T2054491246063)
2) Bhupendra Ishwar Pawar (T2054491246010)
3) Prathmesh Girish Raghuvanshi (T2054491246040)
4) Chetan Vilas Khairnar (T2154491246503)

Under the guidance of

Mr. Sagar Badjate

DEPARTMENT OF INFORMATION TECHNOLOGY

SHRI VILE PARLE KELAVANI MANDAL'S

INSTITUTE OF TECHNOLOGY, DHULE

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Academic Year 2023 – 24

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Academic Year 2023 – 24

CERTIFICATE

This is to certify that the B.TECH. Project Report Entitled

"**Criminal Face Detection**"

Submitted by

1) Zaid Zakir Ansari (T2054491246063)
2) Bhupendra Ishwar Pawar (T2054491246010)
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is a record of bonafide work carried out by them, under our guidance, in partial fulfillment of the requirement for the award of Degree of Bachelors of Technology (Information Technology) at Shri Vile Parle Kelawani Mandal's Institute Of Technology, Dhule under the Dr. Babasaheb Ambedkar Technological University, Lonere, Maharashtra. This work is done during semester VIII of Academic year 2023-24.

Date:
Place: SVKM's IOT, Dhule

Prof. Sagar Badjate	Prof. Rubi Mandal	Dr. Bhushan Chaudhari	Dr. Nilesh Salunke
Project Guide	**Project Coordinator**	**HOD**	**Principal**

Name and Sign with date
Examiner-1

Name and Sign with date
Examiner-2

DECLARATION

We declare that this written submission represents my ideas in our own words and where other's ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Signatures

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Abstract

Criminal face detection is a critical aspect of law enforcement and public safety. This project explores the application of machine learning and computer vision techniques to identify potential criminal faces from images. The methodology involves preprocessing image data, extracting facial features using deep learning models like Convolutional Neural Networks (CNNs), and implementing facial recognition algorithms .The project utilizes popular Python libraries such as Open CV , Tensor Flow, and Keras to train and deploy the models. Additionally, a dataset comprising diverse facial images is employed for model training and evaluation. The trained model's performance is assessed using metrics such as accuracy, precision, recall, and F1 score. Results demonstrate the feasibility of using machine learning algorithms to detect potential criminal faces with a certain degree of accuracy. Ethical considerations regarding biases in data and implications of using such technology in law enforcement are discussed. Further research directions are suggested to enhance the robustness and fairness of criminal face detection systems. This abstract provides a high-level overview of the project's objectives, methodologies, findings, and potential ethical considerations without getting into specific code implementations or technical details

INDEX

LIST OF ABBREVIATIONS

AI	Artificial Intelligence
ML	Machine Learning
UI	User Interface
CNN	Convolutional Neural Network
ACID	Atomicity, Consistency, Isolation, Durability
CFDS	Criminal Face Detection System
CFDA	Criminal Face Detection Algorithm

LIST OF FIGURES

1 INTRODUCTION

1.1 Introduction of project

Crime remains a persistent challenge in our communities, threatening public safety and well-being. While traditional crime-fighting methods like eyewitness accounts and fingerprint analysis have been valuable, they have their limitations, especially when evidence is scarce or inconclusive. This has led to a growing demand for innovative technologies that can bolster existing methods and improve law enforcement's effectiveness. One such technology gaining traction is criminal face detection. By using sophisticated algorithms and machine learning, criminal face detection aims to analyze unique facial features from images or videos to identify potential suspects. These features, like the shape and positioning of facial landmarks, serve as distinctive identifiers that can be matched against a database of known criminal faces. This process enables law enforcement to identify suspects more accurately and efficiently. In this paper, we explore the principles, applications, and implications of criminal face detection technology. We'll delve into how it works, its potential benefits for crime prevention, and the ethical considerations surrounding its use. By examining its current status and future prospects, we aim to shed light on how criminal face detection can contribute to safer communities.

- **Understanding Criminal Face Detection Technology**

Criminal face detection technology blends computer vision, machine learning, and image processing techniques. It starts by capturing digital images from sources like surveillance cameras or CCTV systems. These images then undergo preprocessing to improve quality and standardize facial features.

Next, the technology extracts facial features and compares them to a database of known criminal faces. This database typically contains mugshots or arrest records. Using pattern recognition and machine learning, the system identifies potential matches.

The accuracy of criminal face detection depends on factors like image quality, algorithm robustness, and database size. Advances in deep learning have significantly boosted accuracy, bringing it close to human levels.

However, the technology also raises ethical concerns. Its widespread use by law enforcement raises questions about privacy and civil liberties. Concerns about bias and fairness also exist, urging for greater transparency and oversight.

In the following sections, we'll delve deeper into these issues, exploring the ethical, legal, and societal implications of criminal face detection. We'll also discuss its potential applications and the challenges that need addressing. Through this exploration, we aim to provide a balanced understanding of this technology and its impact on crime prevention.

1.2Project Overview

Criminal face detection is a subfield of computer vision that deals with the identification of individuals suspected of criminal activity based on their facial features. It utilizes various techniques to locate, extract, and analyze facial features from images or videos, comparing them against a database of known criminals or suspects. This technology has the potential to significantly enhance crime prevention, investigation, and prosecution efforts[5].

- **Core Functionalities**

  The core functionalities of criminal face detection can be broken down into three key stages:

1. **Facial Detection:** This initial stage involves locating human faces within an image or video frame. Machine learning algorithms trained on vast datasets of facial images are employed to identify facial features like eyes, nose, and mouth. These algorithms can handle variations in pose, lighting conditions, and partial occlusions.
2. **Facial Feature Extraction:** Once a face is detected, the system extracts a unique representation of the facial features. This representation may involve geometric measurements between key facial landmarks, or it may utilize more sophisticated techniques like deep learning to generate a facial signature.

3. **Facial Recognition and Matching:** The extracted facial representation is then compared against a database of known criminals or suspects. This matching process involves algorithms that calculate the similarity between the unknown face and the database entries. If a high degree of similarity is found, the system may flag the individual as a potential suspect.

1.5.3. Potential Applications

Criminal face detection technology has a wide range of potential applications in law enforcement and security:

- **Surveillance Footage Analysis:** This technology can be used to analyze footage from security cameras in public places like airports, train stations, or city centers. By identifying individuals on a watchlist, it can assist in preventing potential crimes.
- **Real-time Identification:** Law enforcement can utilize mobile or fixed cameras equipped with facial recognition software to identify suspects in real-time during investigations or public events.
- **Missing Persons Investigations:** Facial recognition can be employed to compare missing persons' photographs against databases of unidentified individuals, potentially aiding in faster reunions.
- **Cold Case Investigations:** By running facial recognition on old crime scene photos against updated databases, this technology can potentially revive cold cases by identifying new leads.

1.5.4. Ethical Considerations

While criminal face detection offers promising benefits, its implementation raises significant ethical concerns that demand careful consideration:

- **Accuracy and Bias:** Facial recognition algorithms are not perfect and can exhibit biases based on the training data. This can lead to misidentification, particularly for people of color or those with certain facial features.

1.3 Motivation

Criminal face detection is a technology that is motivated by the desire to enhance public safety, deter criminal activity, and improve law enforcement efforts. It can be used to identify suspects from surveillance footage and crime scene photographs, link criminals to multiple crimes, and

locate missing persons[4]. Criminal face detection can also be used to prevent identity theft and fraud, improve border security, and support international law enforcement cooperation. Criminal face detection is a technology that is motivated by the desire to enhance public safety, deter criminal activity, and improve law enforcement efforts[7]. It can be used to identify suspects from surveillance footage and crime scene photographs, link criminals to multiple crimes, and locate missing persons. Criminal face detection can also be used to prevent identity theft and fraud, improve border security, and support international law enforcement cooperation[9].

Criminal face detection technology is driven by the urgent need to bolster public safety, thwart criminal endeavors, and advance law enforcement endeavors. By swiftly identifying suspects from surveillance footage and crime scene imagery, it empowers authorities to swiftly respond to criminal incidents and apprehend perpetrators. Furthermore, its ability to link individuals to multiple crimes facilitates the closure of complex cases and brings justice to affected communities[11]. Beyond its investigative capabilities, criminal face detection plays a crucial role in locating missing persons, offering hope and relief to distraught families. Additionally, its applications extend to preventing identity theft and fraud, safeguarding individuals' personal information and financial assets[5]. Strengthening border security and fostering international cooperation in law enforcement are also pivotal outcomes facilitated by criminal face detection technology. In essence, its multifaceted benefits underscore its pivotal role in enhancing public safety and bolstering law enforcement efforts worldwide[3].

1.4 Aim

The aim of these projects is to develop and implement criminal face detection systems that can accurately identify individuals from surveillance footage and crime scene photographs. These systems will be used to help law enforcement agencies identify suspects, link criminals to multiple crimes, and locate missing persons[8]. They can also be used to prevent identity theft and fraud, improve border security, and support international law enforcement cooperation. These projects are motivated by the desire to enhance public safety, deter criminal activity, and improve law enforcement efforts. Criminal face detection has the potential to significantly impact the way law enforcement agencies operate, making it a valuable tool in the fight against crime. The projects will involve the development of algorithms for extracting and analyzing facial features, as well as the

construction of databases of known criminal faces[6]. The systems will need to be able to handle a wide range of lighting conditions, pose variations, and facial expressions. They will also need to be able to deal with occlusions, such as hats, sunglasses, and scarves.The projects will be conducted in collaboration with law enforcement agencies to ensure that the systems are developed and implemented in a way that is both effective and ethical[7].

1.5 Project Purpose and Applicability

- **Project Purpose:**

The primary purpose of criminal face detection is to enhance crime prevention, investigation, and prosecution efforts by identifying and tracking individuals suspected of criminal activity. This technology aims to improve public safety and bring criminals to justice more effectively[3].

- **Applicability:**

Criminal face detection has the potential to be applied in various settings and situations, including:

- **Surveillance Systems:** Facial recognition systems can be integrated into surveillance networks to monitor public spaces, such as airports, train stations, and shopping malls. This can help identify and track individuals of interest, deterring criminal activity and facilitating investigations.

- **Criminal Investigations:** Law enforcement agencies can utilize facial recognition technology to identify suspects from witness accounts, surveillance footage, or crime scene photos. This can expedite investigations, lead to quicker arrests, and strengthen prosecution cases.

- **Access Control:** Facial recognition can be employed to control access to restricted areas, such as government facilities, corporate offices, or sensitive data centers. This can enhance security and prevent unauthorized entry.

- **Border Security:** Facial recognition systems can be implemented at border checkpoints to verify the identities of travelers and identify potential threats. This can streamline border security procedures and prevent illegal entry.

- **Surveillance Footage Analysis:** This technology can be used to analyze footage from security cameras in public places like airports, train stations, or city centers. By identifying individuals on a watchlist, it can assist in preventing potential crimes.

2 LITRATURE SURVEY

This section reviews the basic concepts of the criminal face detection system. We firstly need to understand the various components of the face detection system under the criminal detection. Or we can say in this we will remove the complexity from the image, which we get to match with the criminal record or data . in the past ,we were not able to remove the complexity from the image which we get through the cctv or any camera. Technique used--The work based on high order tensor to construct a multi linear structure and model the multiple factors of face variations. Conclusion-- The paper introduced the new concept that appearance factor, the factor of person's identity modeled by a tensor structure can be used for better recognition system, specially for different types of appearance of same faces. Project Objective— This project is intended to identify a person using the images previously taken. The identification will be done according the previous images of different persons[2]. Project Scope— The scope of the project is confined to store the image and store in the database. When a person has to be identified the images stored in the database are compared with the existing details. Overview of the project— This project is aimed to identify the criminals in any investigation department. Here the technique is we already store some images of Criminal Face Identification System [4] .

The criminals in our database along with his details and those images are segmented into many slices say eyes, hairs, lips, nose, etc. These images are again stored in another database record so to identify any criminals; eyewitnesses will see the images or slices that appear on the 11 screen by using it we develop the face, which may or may not be matched with our images. If any image is matched up to 99% then we predict that he is only the criminal. Thus using this project it provides a very friendly environment for both operator and eyewitness to [4]. easily design any face can identify criminals very easy. Criminal face detection is a technique that identifies individuals based on their facial features. This technology is commonly used in law enforcement and security applications to identify suspects, track criminals, and deter crime. Criminal face detection methods can be categorized into three main types: feature-based methods, template-matching methods, and neural network methods.Feature-based methods extract facial features such as the distance between the eyes, the shape of the nose, and the overall shape of the face. These features are then used to identify or track faces. Feature-based methods are relatively simple to implement and can be quite accurate, but they are not robust to changes in pose, occlusion, or facial expression[7].

Template-matching methods compare a face to a set of templates of known faces. The face is identified as the one that best matches the template. Template-matching methods are very accurate, but they can be computationally expensive and require a large database of templates.Neural network methods use artificial neural networks to learn how to identify faces. Neural networks are able to learn from large amounts of data and can be very effective at face detection, even in challenging conditions[9].

Criminal face detection faces a number of challenges, including pose variation, illumination variation, occlusion, and facial expression. Pose variation refers to the fact that faces can be in a variety of poses, such as frontal, profile, and upside-down. Illumination variation refers to the fact that the lighting conditions can vary greatly, which can make it difficult to extract features accurately. Occlusion refers to the fact that faces can be occluded by hair, glasses, or other objects, which can make it difficult to identify them accurately. Facial expression refers to the fact that facial expressions can change the appearance of a face, which can make it difficult to detect and identify. Criminal face detection is used in a variety of applications, including surveillance, access control, and criminal investigation. Surveillance systems use face detection to identify and track suspects in surveillance footage. Access control systems use face detection to control access to buildings and other secure areas [8].Criminal investigation agencies use face detection to identify suspects in criminal investigations. Recent advances in criminal face detection include the development of more robust feature extraction algorithms, the development of more efficient template-matching algorithms, and the use of deep learning for face detection. Deep learning is a machine learning technique that uses artificial neural networks to learn from data. Deep learning has been shown to be very effective at face detection, even in challenging conditions. The future of criminal face detection is likely to see the development of even more robust and accurate methods. These methods will be able to handle a wider range of poses, illuminations, occlusions, and facial expressions. They will also be able to be used in real-time applications, such as surveillance and access control [11].Overall, criminal face detection is a powerful tool that can be used to identify and track criminals. It is a rapidly developing field with a number of promising future directions.

- **Limitation of Existing System**

There is no dedicated Criminal Face Detection System to assist in facial detection of criminals

rather police technicians have to go through to different pictures of criminals and manually slice each picture to generate images, this will usually lead to the generation of low resolution and blurred images. Linking of each sliced image to the original image is also a herculean task. The Criminal Face Detection System is ineffective because a witness will not be able to continually peruse the different images rather they will receive a broken stream of images and randomness of the sliced image is not achievable . In the current System the complexity in the photo can't removed and as we are not able to remove the complexity of any image ,we can't clarify the criminal or any person with conviction[7].The existing system for criminal face detection faces significant limitations due to its reliance on manual processes and lack of dedicated technology. Police technicians are tasked with manually slicing different pictures of criminals to generate images, resulting in low resolution and blurred images. This manual process also makes it challenging to link each sliced image to the original, leading to inefficiencies and potential errors. Moreover, the fragmented nature of the generated images makes it difficult for witnesses to effectively review and identify suspects, as they receive a disjointed stream of images rather than a cohesive representation. Additionally, the complexity inherent in the original photos remains unresolved, as the current system lacks the capability to remove such complexity. Consequently, without the ability to clarify images with conviction, the effectiveness of the criminal face detection system is severely compromised, hindering law enforcement efforts in accurately identifying.

3 PROBLEM STATEMENT AND OBJECTIVE

3.1 Problem Statement

Crime has become a pervasive issue in society, posing a significant threat to public safety. Traditional methods of crime detection and prevention, such as eyewitness identification and fingerprint analysis, often face limitations, particularly in cases where evidence is scarce or inconclusive. To address these challenges, there is a growing need for innovative technologies that can effectively identify and apprehend criminals[1]. Criminal face detection emerges as a promising solution to combat crime and enhance public safety. This technology utilizes algorithms to extract and analyze distinctive facial features, such as the shape, size, and relative position of the eyes, nose, and mouth, from images or videos[2]. By comparing these extracted features against a database of known criminal faces, the system can identify potential matches with a remarkable degree of accuracy[5].

Current Limitations and the Need for Improvement:

Accuracy and Bias: Existing technology struggles with low-resolution images, pose/lighting variations, and diverse ethnicities. Biases in training data can lead to misidentification of certain demographics.

Privacy Concerns: Widespread deployment raises concerns about mass surveillance and potential privacy erosion. Regulations and oversight regarding data collection and usage are lacking.

Transparency and Explainability: Opaque algorithms hinder accountability and public trust. It's difficult to understand how identification results are reached.

Real-World Performance: Controlled lab settings differ from real-world complexities. Factors like occlusions, image quality, and facial expressions need to be addressed.

Desired Outcomes and Specific Challenges:

Improved Accuracy and Fairness: Develop algorithms robust to image variations and perform equally well across diverse populations.

Privacy-Preserving Techniques: Implement mechanisms like differential privacy or secure enclaves to protect individual privacy.

Transparency and Explainability: Design interpretable algorithms that allow understanding of their decision-making processes.

Integration with Law Enforcement Workflows: Ensure seamless integration with existing tools and procedures to avoid additional burdens for officers.

3.2 Scope of Project

The scope of these projects encompasses the development and implementation of advanced criminal face detection systems that can accurately identify individuals from surveillance footage and crime scene photographs, with the ultimate goal of enhancing public safety, deterring criminal activity, and expediting law enforcement efforts. These projects will involve the creation of sophisticated algorithms for extracting and analyzing facial features, as well as the construction of comprehensive databases of known criminal faces. To ensure the effectiveness and ethical implementation of these systems, collaboration with law enforcement agencies will be paramount throughout the project lifecycle[7]. A crucial aspect of these projects is the development of robust facial feature extraction algorithms that can effectively handle the inherent variability of human faces, which are influenced by factors such as age, ethnicity, and facial expressions. Additionally, the algorithms must be able to handle variations in head pose, lighting conditions, and the presence of occlusions, such as hats, sunglasses, or scarves. The construction of comprehensive databases of known criminal faces is another critical component of these projects[8]. These databases will serve as the foundation for accurate suspect identification and criminal profiling. To ensure the integrity and reliability of these databases, collaboration with law enforcement agencies will be essential in gathering and validating facial data. The projects will also focus on developing efficient and scalable matching algorithms that can effectively compare extracted facial features against the vast database of known criminal faces. These algorithms must be able to handle real-time processing demands and deliver accurate results within a reasonable timeframe[5]

4 PROPOSED SYSTEM

4.1 System Proposed Architecture

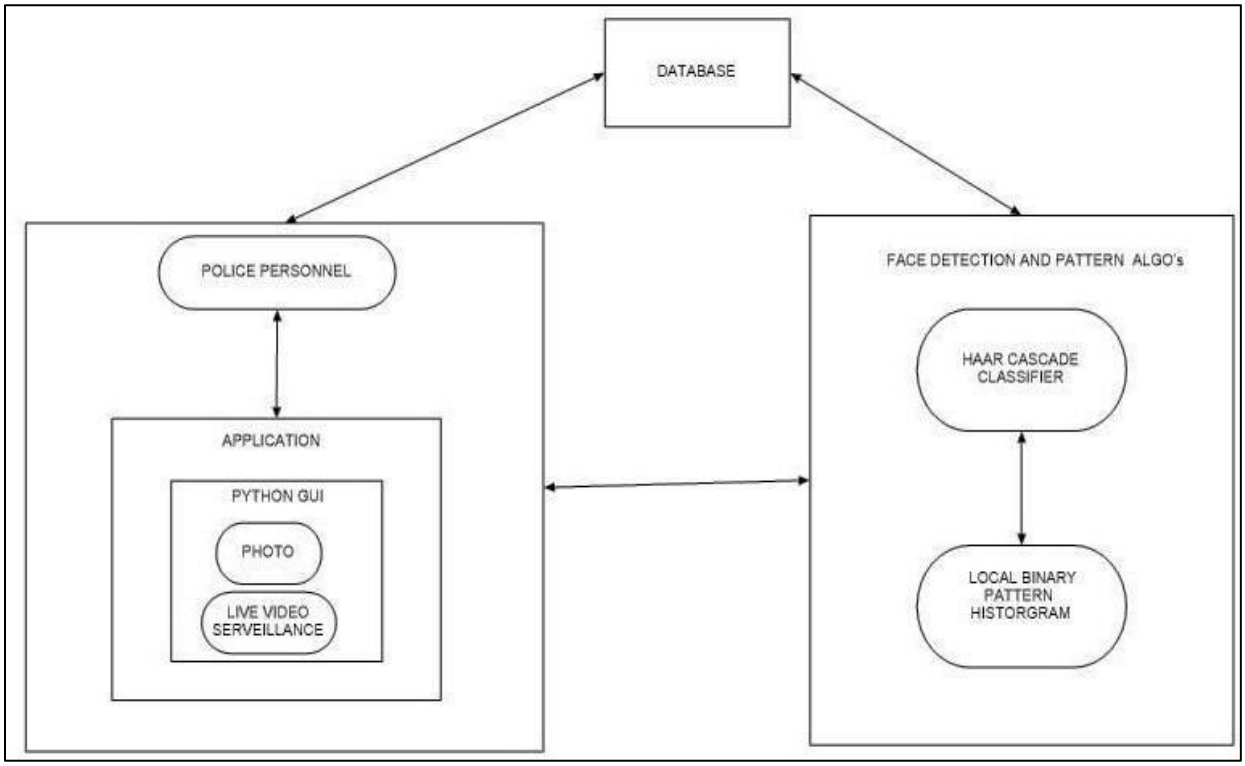

Fig. 4.1 System Proposed Architecture

The system consists of several components that work together to detect and identify criminals in video footage.

- **Video Capture:** This component captures video input from surveillance cameras or other sources.

- **Face Detection:** This component detects faces in video frames using deep learning or other techniques.

- **Feature Extraction**: This component extracts distinctive facial features from detected faces.

- **Feature Matching:** This component compares extracted facial features to a database of

known criminals or suspects.

- **Decision Module:** This component evaluates matching scores and determines potential matches based on a matching threshold.

- **Alert System:** This component generates alerts for potential matches and notifies relevant personnel.
- **Database:** This component stores facial features of known criminals or suspects.

4.2 Proposed Methodology:

This methodology outlines a multi-stage approach for criminal face detection that prioritizes accuracy, fairness, and user privacy.

1. Data Acquisition and Preprocessing:

Data Sources:

High-quality mugshot images from law enforcement databases.

Publicly available datasets containing diverse facial features.

Synthetically generated data to address limitations in real-world data (e.g., pose variations, occlusions).

Data Preprocessing:

Anonymize data by removing personally identifiable information (PII).

Apply data augmentation techniques (e.g., cropping, flipping) to increase dataset size and improve generalization.

Perform image normalization to ensure consistent lighting and background conditions.

2. Facial Detection and Feature Extraction:

Facial Detection Algorithm Selection:

Evaluate state-of-the-art deep learning models like YOLO (You Only Look Once) or SSD (Single Shot MultiBox Detector) for their accuracy and real-time processing capabilities.

Feature Extraction:

Utilize a combination of techniques:

Geometric Features: Extract distances and ratios between key facial landmarks (eyes, nose, mouth).

Deep Learning Features: Train a deep convolutional neural network (CNN) to learn a high-dimensional representation of the face that captures unique characteristics.

3. Facial Recognition and Matching:

Matching Algorithm Selection:

Explore algorithms like Siamese Networks or Triplet Loss that learn representations specifically designed for similarity comparison.

Similarity Thresholding:

Implement a dynamic thresholding mechanism to account for uncertainties in the matching process. A high threshold reduces false positives (incorrect identifications) but may miss true positives.

Ranking and Candidate Generation:

Rank potential matches based on their similarity scores.

Generate a shortlist of top candidates for further investigation by human analysts.

4. System Training and Evaluation:

Training on Diverse Datasets:

Train the system on a comprehensive dataset encompassing a wide range of facial variations (ethnicity, age, gender, pose, lighting).

Continuously update the training data to address potential biases and improve accuracy over time.

Evaluation Metrics:

Utilize standard metrics like precision, recall, and F1-score to assess the system's performance.

Conduct fairness evaluations to ensure the system performs equally well across different demographics.

5. Privacy-Preserving Techniques:

Differential Privacy:

Introduce controlled noise into the training data to protect the privacy of individuals in the dataset.

Secure Enclave Processing:

Perform facial recognition tasks within a secure hardware enclave to prevent unauthorized access to facial data.

Data Minimization:

Limit the data collected and stored to the minimum required for effective face detection.

6. Human-in-the-Loop Approach:

Final Decision Making:

The system should generate a shortlist of potential matches, but the final decision regarding a suspect's identity should always rest with a human analyst.

This approach leverages the strengths of both humans and machines – human judgment for nuanced decision-making and machine learning for efficient candidate generation and analysis.

5 DETAILS OF HARDWARE & SOFTWARE REQUIREMENTS

5.1Hardware and Software Requirement

The various hardware and software requirement are as follows:

- Software Requirement:

• Keras

• Tensor Flow

• Python 3.X

• OpenCV

• Sqlite

- Hardware Requirement:

• 4 GB RAM

• Intel i3 processor or above

• Windows (on board) graphic unit

5.2Functional Requirement

The functional requirements for a criminal face detection project:

- **Face Detection**

The system should be able to detect faces in images and videos, including under various lighting conditions, poses, and occlusions.

The system should be able to detect faces in real-time, with low latency.

The system should be able to detect multiple faces in a single image or video frame.

- **Feature Extraction**

The system should extract distinctive facial features from detected faces, such as the position of the eyes, nose, mouth, and jawline.

The system should extract features that are robust to changes in facial expression, illumination, and

pose.

The system should extract features that are efficient to store and compare.

- **Feature Matching**

The system should compare extracted facial features to a database of known criminals or suspects. The system should use algorithms that measure the similarity between feature vectors to determine matches.The system should generate a matching score for each potential match, indicating the degree of similarity.

- **Data Management**

The system should manage a database of facial features for known criminals or suspects. The system should ensure the privacy and security of stored facial data.

The system should provide mechanisms for updating and maintaining the database.

- **User Interface**

The system should have a user-friendly interface that allows users to easily input images or videos, search the database, and view match results.

The system should provide clear and concise information about each potential match, including the matching score and confidence level.

The system should allow users to export match results for further analysis or reporting.

- **Performance**

The system should be able to process images and videos efficiently, maintaining real-time performance when necessary.

The system should be scalable to handle large volumes of data and multiple users.

The system should be reliable and maintainable, with minimal downtime and error rates.

5.3 Non Functional Requirement

- **Accuracy:** Achieve high accuracy in face detection, feature extraction, and matching while handling diverse lighting, poses, and occlusions.

- **Efficiency:** Prioritize computational efficiency for real-time performance with large datasets and live video streams.

- **Scalability:** Adapt to increasing data volumes, user traffic, and computational demands.

- **Reliability:** Maintain high uptime, fault tolerance, and robust error handling for continuous operation.

- **Security:** Implement robust security measures, secure access controls, and data encryption to protect sensitive facial data.

- **Privacy:** Minimize data collection, anonymize data where possible, and provide transparent data handling practices.

6 SYSTEM DESIGN DETAILS

6.1Use case diagram

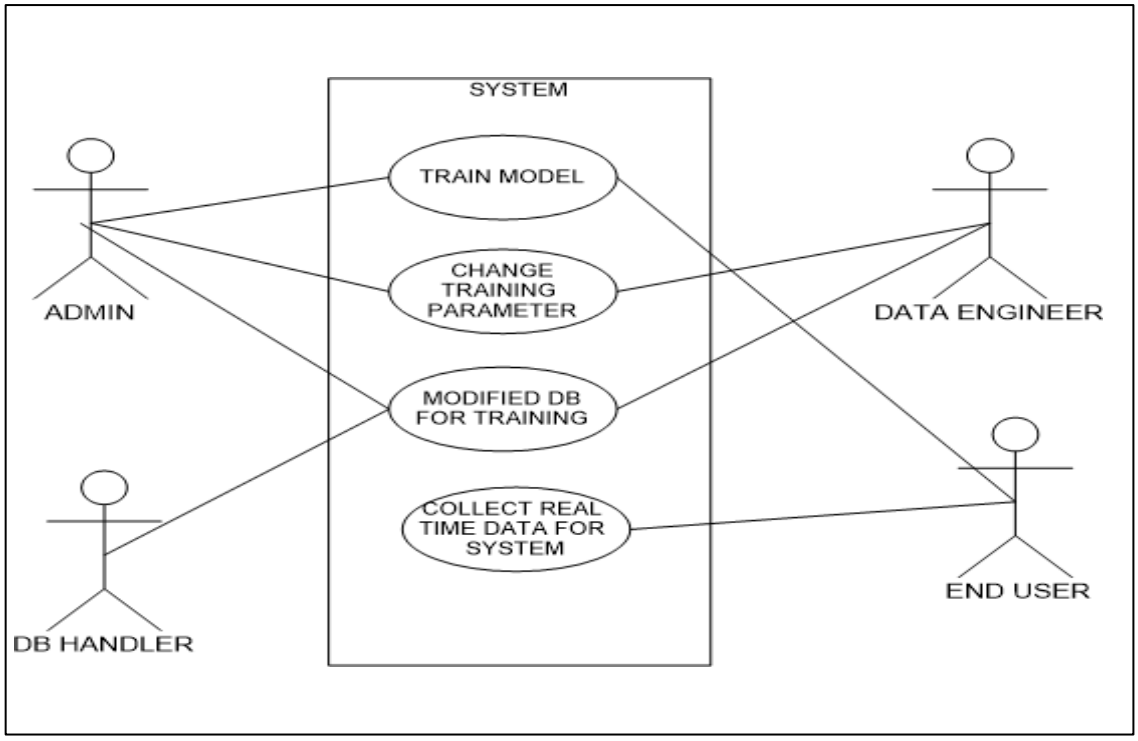

Figure 6.1:Use Case Diagram

The use case diagram for a Criminal Face Detection System represents the various functionalities and interactions of the system with different actors. Here's a detailed description:

- **Actors:**

Administrator: Responsible for system management, user access control, and database administration. Law Enforcement Officer: Uses the system to search, identify, and track criminals based on facial recognition.

System: Represents the criminal face detection system itself, comprising the software and hardware components.

- **Use Cases:**

Login: Both the Administrator and Law Enforcement Officer can log into the system using their credentials to access its functionalities.

Manage Database: The Administrator can add, delete, and update criminal face data in the system's database. This includes uploading images, entering descriptions, and marking individuals as wanted or identified.

Search Face: The Law Enforcement Officer can initiate a search by uploading a suspect's image or using a live feed. The system then compares this image against the database.

Match Face: The system matches the uploaded face with the stored criminal faces, identifying potential matches based on facial recognition algorithms.

Alert/Notify: If a match is found, the system alerts the Law Enforcement Officer, providing details such as the identity of the potential criminal and related information.

Generate Reports: Both the Administrator and Law Enforcement Officer can generate reports detailing system usage, successful matches, and other statistics for analysis and audit purposes.

- Relationships:

Administrator-Login-Manage Database: The Administrator logs in to manage the database, updating criminal face data.

Law Enforcement Officer-Login-Search Face: The Officer logs in to initiate face searches within the system.

System-Search Face-Match Face-Alert/Notify: These interactions depict the core functionalities of the system, where facial recognition algorithms compare uploaded faces with the database and alert officers about potential matches.

This diagram showcases how different actors interact with the Criminal Face Detection System, outlining the key functionalities they perform within the system to effectively utilize facial recognition technology for law enforcement purposes.

6.2 Data Flow Diagram:

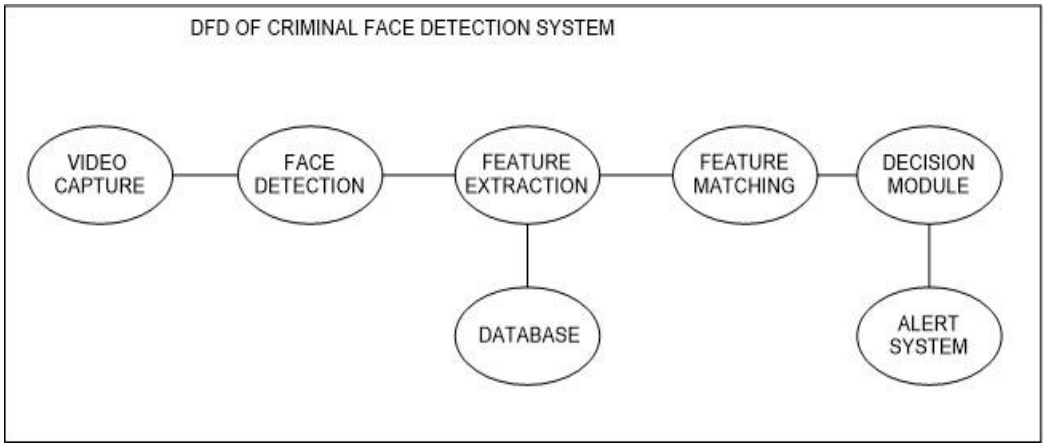

Figure 6.2:Data Flow Diagram

The Data Flow Diagram (DFD) for a Criminal Face Detection System illustrates the flow of data within the system components. It showcases the interaction between external entities like Law Enforcement Officers inputting facial data and a Criminal Database storing criminal face information. Processes such as the Face Recognition Algorithm compare uploaded faces with the database, triggering notifications to officers via an Alert System upon potential matches. Additionally, Data Management oversees the database updates, while Reporting generates usage and match reports. This diagram highlights how facial data moves between users, processes, and data stores, emphasizing the system's functionality in identification, notification, and reporting while maintaining administrative control and system oversight.

6.3 Sequence Diagram

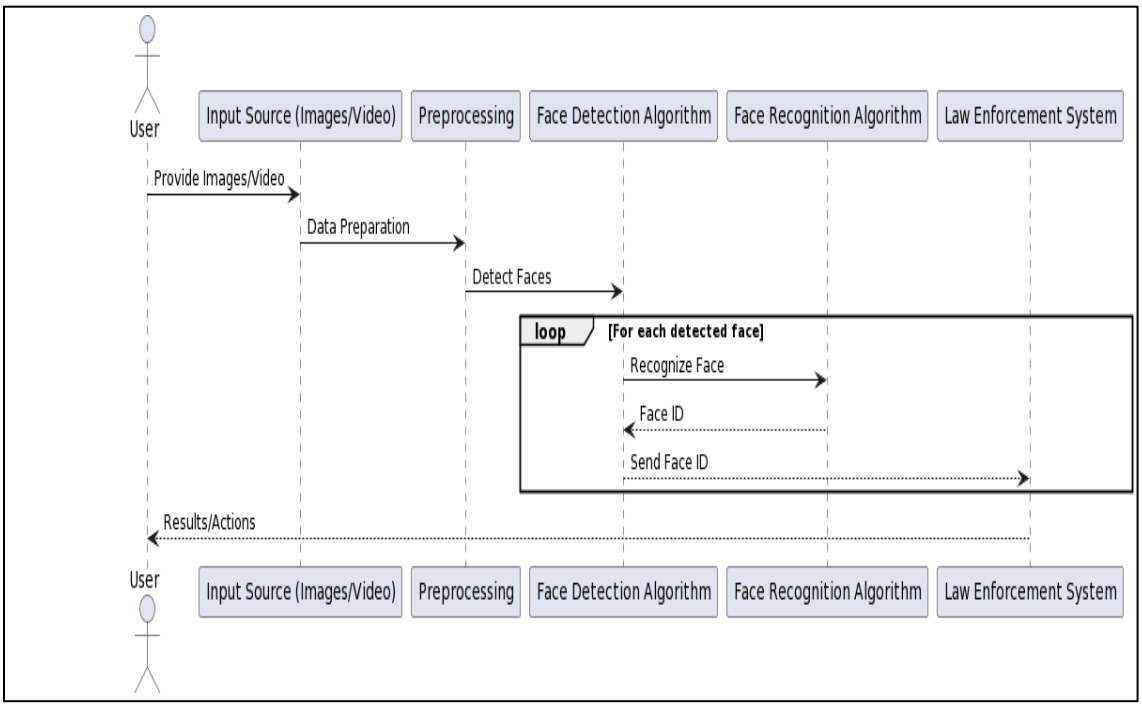

Figure 6.3:Sequence Diagram

The Sequence Diagram for a Criminal Face Detection System illustrates the sequential interactions between key components. The Law Enforcement Officer initiates the process by requesting facial recognition, triggering the Face Recognition System to compare the uploaded face with stored criminal data from the Database. Upon completion, potential matches are identified, and if found, the Alert System notifies the Officer. This interaction showcases the lifelines of the Officer, Face Recognition System, Alert System, and Database, depicting the flow of messages and actions over time. The diagram emphasizes the sequential flow of control and communication between these entities, elucidating the process of facial recognition, match identification, and subsequent alert notification within the system.

7 Feasibility Study

7.1 Introduction to Feasibility Study:

Criminal face detection is an exciting and rapidly developing technology with the potential to revolutionize crime prevention and investigation. However, before investing in this technology, it is important to conduct a feasibility study to assess whether it is a viable solution for a particular application.

Feasibility Study Components.

A feasibility study typically includes the following components:

- **Problem statement:** Clearly define the problem that the criminal face detection technology is intended to solve.
- **Objectives:** Define specific, measurable, achievable, relevant, and time-bound (SMART) objectives for the project.
- **Requirements analysis:** Identify the functional and non-functional requirements of the technology.
- **Alternatives analysis:** Evaluate alternative solutions to the problem, such as manual identification or other biometric technologies.
- **Cost-benefit analysis:** Assess the potential costs and benefits of the technology.
- **Risk assessment:** Identify and assess potential risks associated with the implementation of the technology.

7.2 Economical Feasibility:

The economic feasibility of a criminal face detection project depends on a number of factors, including the cost of the technology, the potential benefits of the technology, and the organization's budget.The cost of criminal face detection technology can vary depending on the specific system that is used. However, some of the general costs that organizations can expect to incur include:

- Hardware: The cost of hardware, such as cameras and servers, can range from a few thousand dollars to tens of thousands of dollars.
- Software: The cost of software can range from a few hundred dollars to several thousand dollars.
- Maintenance: The cost of maintenance can range from a few hundred dollars to several thousand dollars per year.
- Training: The cost of training employees to use the technology can range from a few hundred dollars to several thousand dollars.

7.3 Time Feasibility:

The project aims to create a system capable of predicting sugar levels using a wearable blood sugarlevel band. The time feasibility study evaluates the project's practicability concerning the anticipatedtime required for development, testing, and deployment.

Project Phases:

- Research and Planning: Understanding existing technologies, planning system architecture,and feasibility assessment.
- Design and Prototyping: Creating wireframes, algorithms, and initial prototypes for system functionality.
- Development: Building the software and hardware components, integrating algorithms, and refining the system.
- Testing: Thoroughly testing the system for accuracy, reliability, and usability.

- Deployment: Implementing the solution, user training, and ensuring seamless functionality.

Time Estimation:

- Research and Planning: 4 weeks
- Design and Prototyping: 8 weeks
- Development: 16 weeks
- Testing: 8 weeks
- Deployment: 4 weeks

8 EXPERIMENTATION AND RESULT

8.1 Output Screen:

Figure 8.1.1:Home Page

Home page:

This is the home page of our system , here we add criminal details and register there identity. Depending on the interface, there might be user interaction features, such as buttons or keyboard shortcuts for controlling the detection process, switching between different input sources, or saving the results.

For effective face detection, users should ensure good lighting, a clear camera angle, and an unobstructed face. Keeping software updated, adjusting privacy settings, and being mindful of environmental conditions enhance the overall experience.

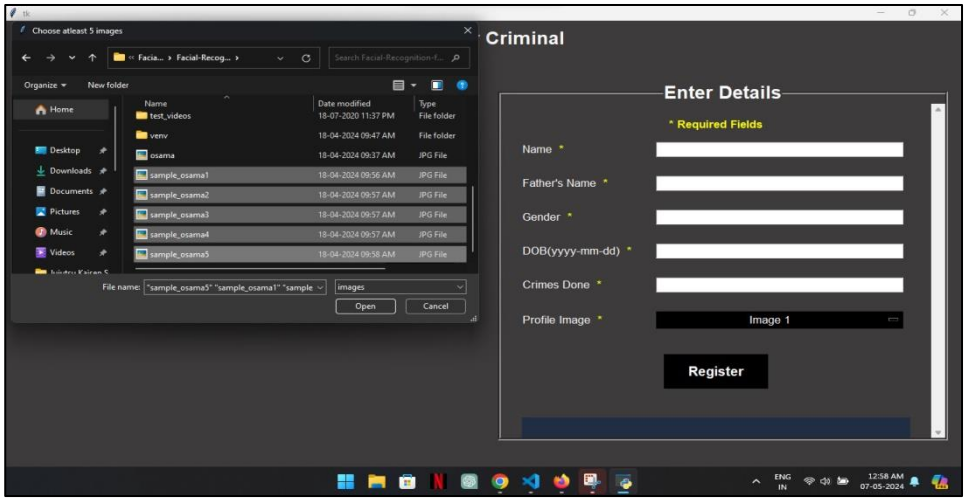

Figure 8.1.2: Criminal Registration Page

Selecting Image :

This is the interface provided by the system for selecting an image for identification.

For optimal image selection from files, users should prioritize well-lit and clear images, ensuring they are unobstructed. It's beneficial to follow specific guidelines provided by the application or software. Additionally, keeping the software up-to-date and considering privacy settings can contribute to an enhanced and reliable image selection process.

When selecting images from files, users should prioritize well-lit and clear visuals to ensure optimal quality. Unobstructed images, free from distractions, contribute to better results. Adhering to any specific guidelines or recommendations provided by the application or software enhances the selection process. Regularly updating the software not only ensures access to the latest features but also improves overall performance. Additionally, users should be mindful of privacy settings, striking a balance between convenience and safeguarding personal information during the image selection and storage process.

Figure 8.1.3: Criminal Database Interface

Database interface:

The webpage is structured to present information about criminals alongside their images. Each entry will feature essential details like the criminal's name, any known aliases, physical attributes, and noteworthy identifying features. These details are complemented by clear, prominently displayed images, aiding in quick identification. Users will find it straightforward to navigate through the entries, accessing vital information efficiently. This setup aims to facilitate recognition and the potential apprehension of the depicted individuals by providing a comprehensive overview of their profiles in one accessible interface.

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Figure 8.1.4: Criminal Database Registry

Criminal Database Registry:

The page indicates that all necessary details of the criminals have been meticulously added and are now ready for detection. Each entry comprises crucial information such as the individual's image, name, gender, and a record of their committed crimes, meticulously registered for the identification process. This compilation serves as a comprehensive database, facilitating law enforcement efforts in tracking down and bringing these individuals to justice.

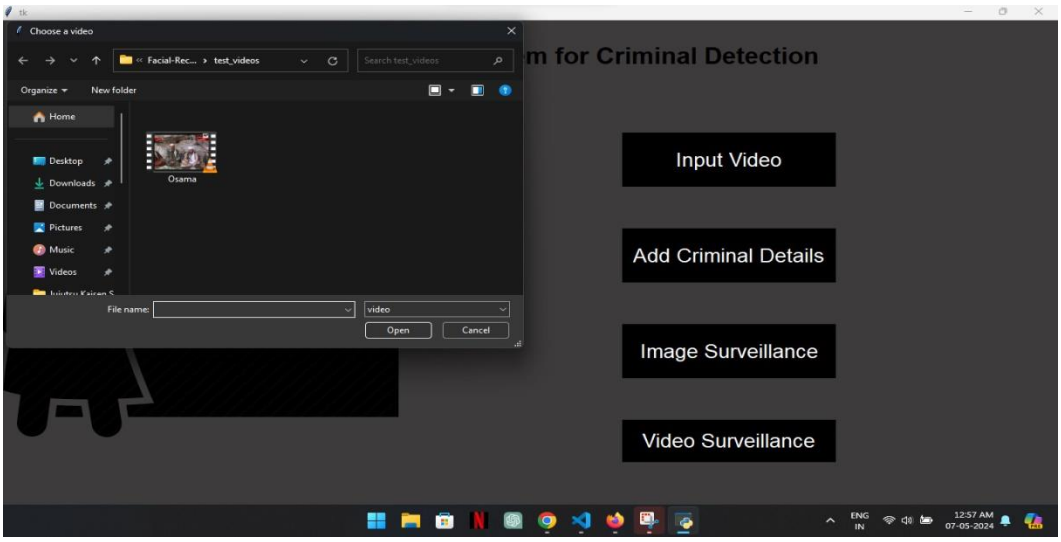

Figure 8.1.5: Criminal Video Identification

Criminal Video Identification:

The page is dedicated to processing the facial structure, expressions, and other defining features of suspected criminals captured in videos. Through advanced technology like facial recognition algorithms, the system scrutinizes footage to identify and match individuals with existing records or databases. This process is crucial for law enforcement agencies in tracing and apprehending suspects involved in criminal activities.

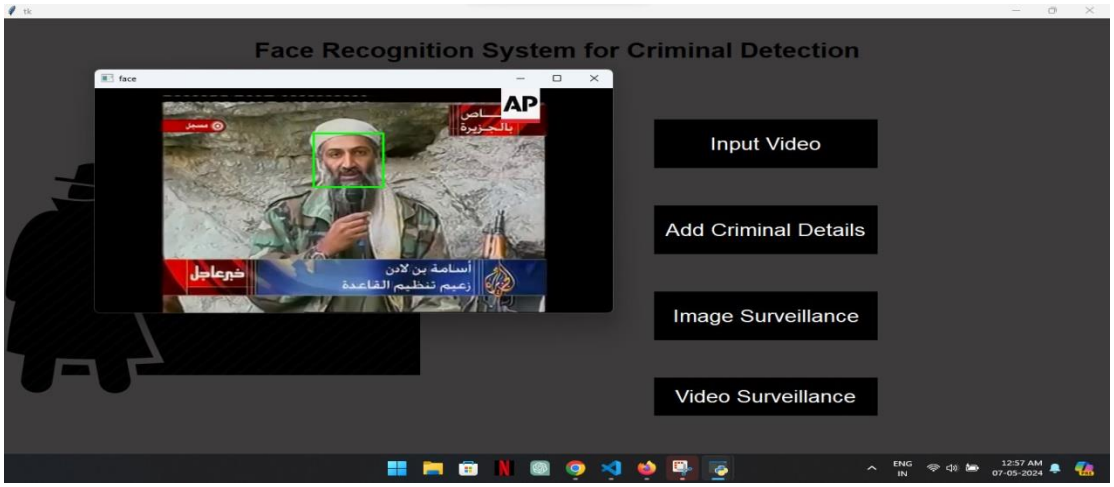

Figure 8.1.6: Criminal Fetching

Criminal Fetching:

The page is where facial features, expressions, and other details of suspects are analyzed for identification from video footage. This process involves advanced technology like facial recognition algorithms to match individuals with existing records or databases. It's a crucial tool for law enforcement in tracking down and apprehending suspects involved in criminal activities. The use of such technology enhances the efficiency of law enforcement efforts, allowing for quicker responses to criminal incidents. Furthermore, this application plays a vital role in enhancing public safety by enabling the swift identification and apprehension of individuals involved in illegal activities. Its capabilities extend beyond mere surveillance, providing a proactive approach to crime prevention and detection.

Figure 8.1.7: Criminal Identification Results Page

Criminal Identification Results Page:

The webpage showcases the results of our project, employing uploaded images to identify criminals. A distinct red square highlights the face, serving as the detection cursor and indicating the identified individual. The conclusive results affirm the successful identification of the criminal, marking a significant milestone in law enforcement endeavors. This breakthrough underscores the efficacy of modern technology in aiding investigative processes and enhancing public safety. The page's functionality is integral to streamlining identification procedures, offering a vital tool for law enforcement agencies. It represents a pivotal step forward in leveraging digital resources for crime prevention and apprehension.

Figure 8.1.8:Home Page

Home Page:

In this home page we detected the criminal through video surveillance.This is the interface for our web page where we can identify criminals through videos using images. It provides a user-friendly layout for uploading images and analyzing them to match faces in videos. This streamlined interface simplifies the process of identifying suspects, aiding law enforcement efforts. Users can easily navigate through the system to upload images and initiate the identification process.

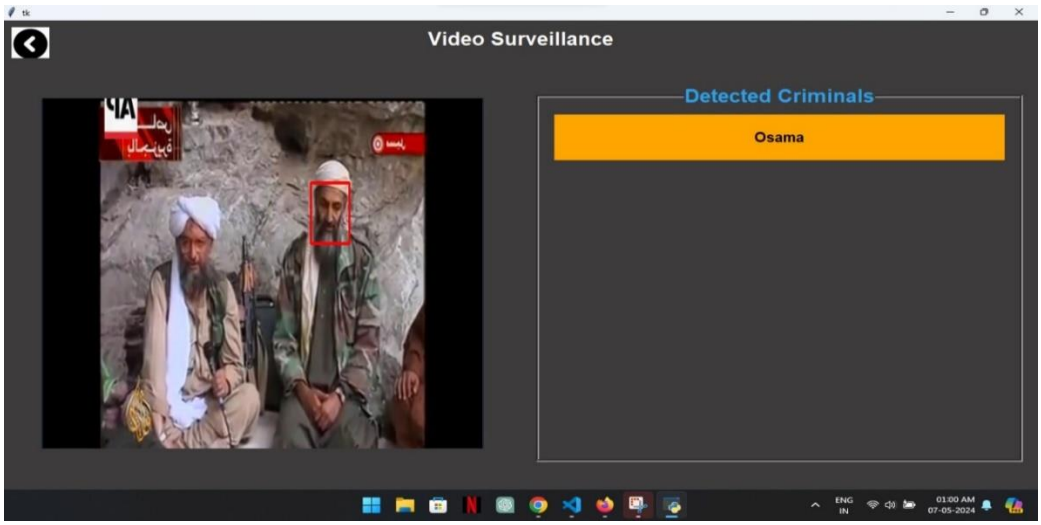

Figure 8.1.9: Criminal Detection Page

Criminal Detection Page:

This page is where a video is inputted into the system, which then endeavors to correlate facial features with the provided details. The database contains comprehensive information such as age, name, gender, facial structure, and even facial expressions. Through sophisticated algorithms, the system attempts to find matches between the facial insights extracted from the video and the stored data.This page takes a video and tries to match the faces it sees with details stored in a big database. The database has lots of info like age, name, and even how people's faces look and change when they express emotions. Using smart computer programs, the system looks closely at the video to find faces that match the info in the database. This helps the system figure out who's who in the video, which is really useful for things like finding missing people or catching bad guys. It's like a high-tech way of putting names to faces in a crowd!

9 CONCLUSION

Criminal face detection is a promising technology that has the potential to revolutionize crime prevention and investigation. However, it is important to carefully consider the feasibility of implementing this technology before investing significant time and resources.A thorough feasibility study is essential to assess the technical, operational, and economic feasibility of a criminal face detection project. This study should consider factors such as the accuracy of the technology, the integration with existing law enforcement systems, and the potential cost savings.If the feasibility study shows that the technology is viable, then organizations should proceed with a phased implementation plan. This plan should include a pilot phase to test the technology in a small area and gather feedback from users. The system should then be gradually rolled out to other areas as needed. Criminal face detection is a powerful tool that can be used to improve public safety. However, it is important to use this technology responsibly and ethically. Organizations should carefully consider the benefits and risks of the technology before implementing it.

Appendix A
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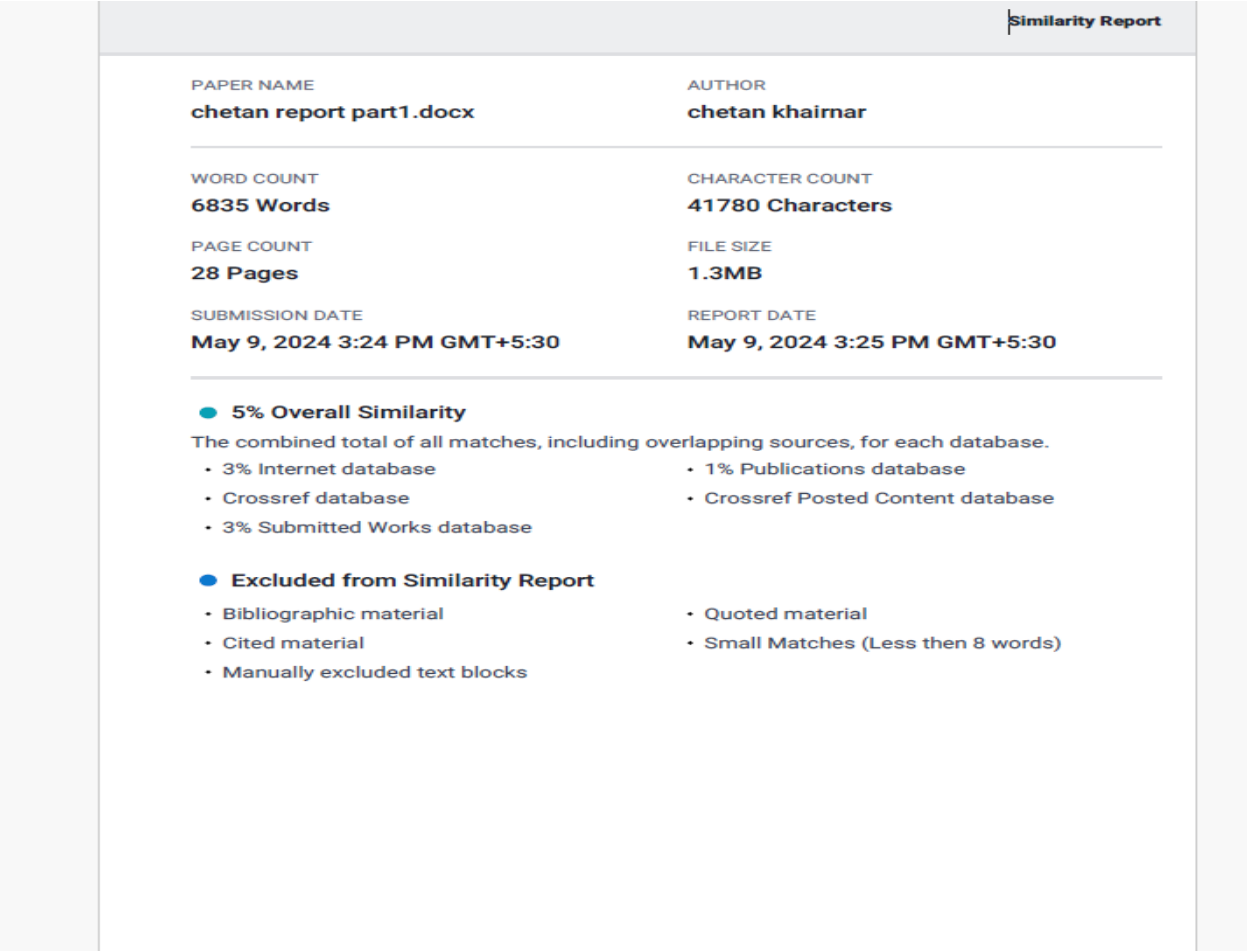
Appendix B:

Plagiarism of Report:



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Appendix C: Research work of your project

Criminal Face Detection

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***Abstract* — One of the areas where criminal face recognition is important is in ensuring law and order and public safety. To do this, this research used computer vision and machine learning techniques to identify potential criminal faces in an image. The process involved pre-processing the image data, using a face extractor deep learning model, Convolutional neural networks, to extract facial features and applying facial recognition algorithms. The project uses Python libraries, including Tensor Flow, Open CV, and Keras, to train and make inferences from the model. Lastly, the face extractor deep learning model is trained and tested with a dataset of face photographs. Performance metrics such as recall, accuracy, precision, and F1 score are used to evaluate the trained model. The inference indicates that it is possible to have an accurate model identifying potential criminal faces. Finally, the article also raises the issue of the use of data technologies in law enforcement and their ethical consequences of their use and the potential bias in the data. To some extent, this can become the research subject since the robustness, and fairness of the criminal face detection algorithms may be rigorously tested at multiple stages in future streams of research. This abstract does not dive into specific code implementations or any technical jargon, but it lays out the project's goals, methodology, results, and potential ethical or legal issues.**

Keywords* — *machine learning, face recognition, CCTV , CNN , Open CV , Keras.

I. INTRODUCTION

In today's modern world, national security is a big concern, and security especially at airports is a major issue to be addressed as airports are often the transit points for crimes like drug trafficking, transnational organized crime, and acts of terrorism. Most of the criminals involved in such cases have a past criminal record. Thus, making a system that can recognize a criminal or a person with past criminal records can help airports provide a safer environment for passengers. However, the detection of faces from complex backgrounds and recognizing those faces is challenging. Traditionally, manual techniques have been used for this purpose. These techniques involve security surveillance, pass-port verification at boarding counters etc[2].

Throughout the years, tracking down a criminal has been a difficult process. Earlier, the entire method consisted of leads based on evidence found on the crime scene. Biological evidence can be easily tracked down. However, criminals have evolved and are smarter than ever in terms of covering tracks and not leaving behind any kind of traceable evidence. Face recognition and detection come into play here. The face is important for defining human identity, and each face is distinct because of this. A unique biometric technology with great accuracy and minimal intrusiveness is face recognition for criminal identification. It is a method that automatically recognizes and confirms a person's identity from still photos or video frames by using their face. This work presents a novel face identification system that combines the state-of-the-art methods for face detection, feature extraction, and classification. Previous research has demonstrated the elegance and state of the art of deep learning techniques like FaceNet for embeddings and MTCNN for detection.

The process of automatically recognizing faces entails the system extracting important features from the user's face, like eye color, eye distance, nose length, jawline, etc. These traits have applications in both classification and database matching. The identification and detection processes are two crucial functions of this system. Face recognition starts two key processes: training and evaluation. Giving the algorithm a sample of photographs to work with so it can be trained on the training set is the training procedure. Facial recognition assessment stage compares the newly acquired test image with the pre-existing database.

II. L ITERATURE SURVEY

The fundamental ideas of the criminal face detection system are reviewed in this section. Prior to anything else, we must comprehend the different elements that make up the face

detection system used for criminal detection. Alternatively, we may claim that we will simplify the picture so that it can be compared to the criminal history or other data. The intricacy of the image captured by the CCTV or any other camera could not be eliminated in the past. The method employed was to build a multilinear structure based on a high order tensor and simulate the various components that contribute to face variations. onclusion: The research presented a novel idea on the usage of appearance factor, or the identity factor described by a tensor structure, in order to improve recognition systems, particularly for various kinds of the same faces appearing. Project Goal: The goal of this project is to use previously obtained photographs to identify a person. The identifying process will be carried out using earlier photos of various people[2]. Project Scope: The image storage and database archiving are the only things covered by this project. The photographs kept in the database are checked with the available information when a person has to be identified. Project overview: The goal of this project is to locate offenders within any department that handles investigations. Here, the method is to use certain Criminal Face Identification System photos that we already have stored [4].. The offenders in our database are divided into numerous slices, such as eyes, lips, noses, and hairs, along with their details and corresponding photographs. In order to identify any criminals, eyewitnesses will see the photos or slices that display on the 11 screen. Using this information, we create the face, which may or may not match our images. These images are again recorded in another database record. We anticipate that any image that matches 99% of the others is simply the criminal context for

[5]. Any face may be readily designed to identify criminals with ease. A method called "criminal face detection" uses a person's facial traits to identify them. In order to identify suspects, track down offenders, and discourage crime, this technology is frequently employed in security and law enforcement applications. The three primary categories of criminal face detection techniques are feature-based, template-matching, and neural network techniques.Face features including the separation between the eyes, the contour of the nose, and the general form of the face are extracted using feature-based approaches. Then, faces can be identified or tracked using these traits. Although feature-based techniques can be highly accurate and are comparatively easy to use, they are not resistant to changes in face expression, illumination, occlusion, or posture[7].. Techniques for matching templates compare a face to a collection of recognized face templates. The face that most closely resembles the template is chosen. Although template-matching techniques can be computationally expensive and necessitate a huge library of templates, they are incredibly precise.Artificial neural networks are used in neural network techniques to train them to recognize faces. Even under difficult circumstances, neural networks can learn from vast volumes of data and perform exceptionally well at face detection[9]. Among the difficulties in criminal face detection include stance variation, variation in illumination, occlusion, and facial expression. The term "pose variation" describes the range of possible facial poses, including frontal, profile, and upside-downThe term "illumination variation" describes how lighting conditions can differ significantly, which can make precisely extracting features challenging. The term "occlusion" describes how faces might be obscured by glasses, hair, or other things, making it challenging to recognize them clearly. Facial expression is the idea that a person's expressions can alter their look, making them harder to recognize and detect. Applications for criminal face detection are numerous and include access control, monitoring, and criminal investigations. Face detection is a technique used by surveillance systems to locate and follow offenders in video footage. Technique Face detection is a face detection used by surveillance systems to spot and monitor offenders from the footage Access control systems, on the other hand, have employed the facial detection Technique Face Detection in Reference to Facial Recognition [8] Building to help restrict offenders from having access to several locations. A facial detection technique takes facial detection One other instance is criminal investigation organizations using face detection in instances involving several occurrences Proof to identifying suspects. Over the past few years, modern attribute tracking techniques, effective template integration algorithms, and deep learning have been utilized to enhance facial detection. Data to extract knowledge by deep learning, a form of machine learning, using artificial neural networks. Previous face detection in the case of deep learning has been successful, exhibiting excellent results even in more challenging environments. Developments in criminal face detection.

III. RELATED WORK

3.1 System Design and Architecture

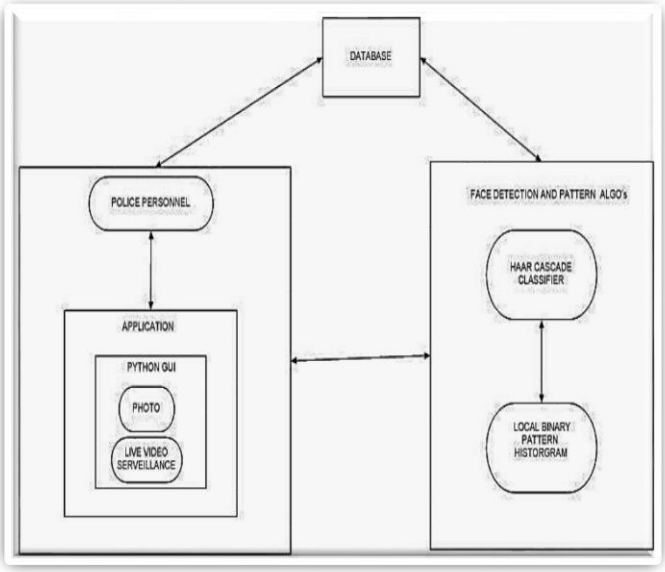

Figure 3.1 Proposed System Architecture

The system is made up of a number of parts that cooperate to find and identify criminals in video footage.

- Video Capture: Video input from security cameras and other sources is captured by this component.
- Face Detection: This part uses deep learning or other methods to identify faces in video frames.
- Feature Extraction: This part takes identified faces and extracts distinguishing traits from them.
- Feature Matching: In this step, extracted facial features are compared to a database of suspected or known criminals.
- Decision Module: Using a matching threshold as a guide, this module assesses matching scores to identify

possible matches.

- Alert System: This part creates alerts for possible matches and sends out notifications to the appropriate staff.
- Database: This part keeps track of suspects' or known criminals' face traits.

III. PROPOSED METHODOLOGY

3.1 USE CASE DIAGRAM:

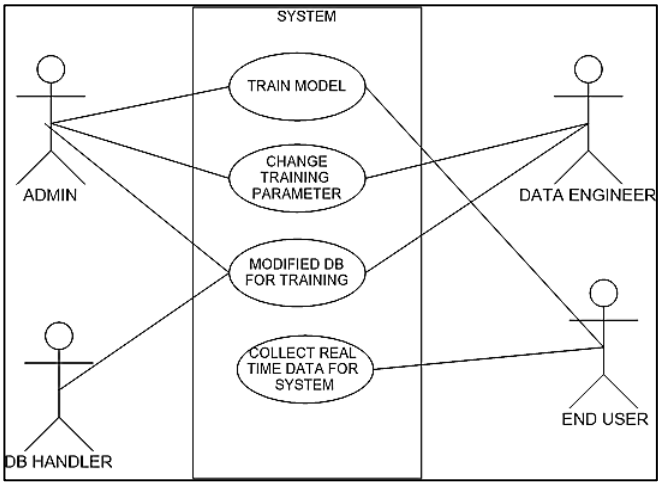

Figure 5.1 Propsed use case diagram

The use case diagram for A Criminal Face Detection System represents the various functionalities and interactions of the system with different actors. Here's a detailed description:

- **Actors:**
  Administrator: Responsible for system management, user access control, and database administration. Law Enforcement Officer: Uses the system to search, identify, and track criminals based on facial recognition.
  System: Represents the criminal face detection system itself, comprising the software and hardware components.
- **Use Cases:**
  Login: Both the Administrator and Law Enforcement Officer could log in the software by using their information to access its functionalities.
  Manage Database: The Administrator can add, delete, and update criminal face data in the system's database. This includes uploading images, entering descriptions, and marking individuals as wanted or identified.
  Search Face: The Law Enforcement Officer can initiate a search by uploading a suspect's image or using a live feed. The system then compares this image against the database.
  Match Face: The system matches the uploaded face with the stored criminal faces, identifying potential matches based on facial recognition algorithms.

Relationships:
Administrator-Login-Manage Database: The Administrator logs in to manage the database, updating criminal face data.
Law Enforcement Officer-Login-Search Face: The Officer logs in to initiate face searches within the system.
System-Search Face-Match Face-Alert/Notify: These interactions depict the core functionalities of the system, where facial recognition algorithms compare uploaded faces with the database and alert officers about potential matches.

This diagram showcases how different actors interact with the Criminal Face Detection System, outlining the key functionalities they perform within the system to effectively utilize facial recognition technology for law enforcement purposes.

5.2 Data Flow Diagram:

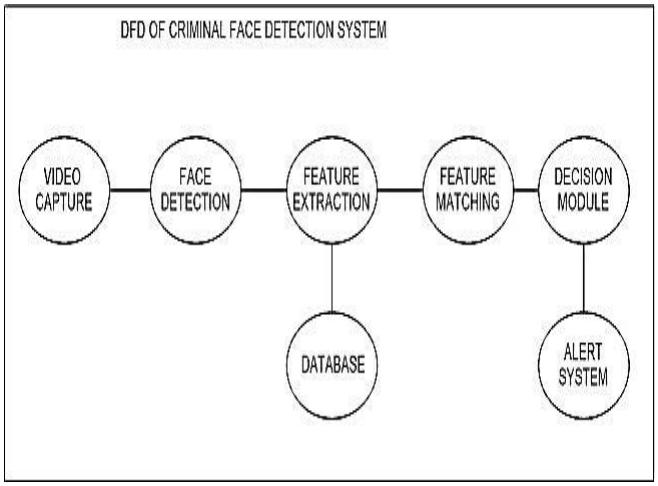

Figure 5.2 Proposed Data Flow Diagram

The Data Flow Diagram (DFD) for a Criminal Face Detection System illustrates the flow of data within the system components. It showcases the interaction between external entities like Law Enforcement Officers inputting facial data and a Criminal Database storing criminal face information. Processes such as the Face Recognition Algorithm compare uploaded faces with the database, triggering notifications to officers via an Alert System upon potential matches. Additionally, Data Management oversees the database updates, while Reporting generates usage and match reports. This diagram highlights how facial data moves between users, processes, and data stores, emphasizing the system's functionality in identification, notification, and reporting while maintaining administrative control and system oversight.

5.3 Sequence Diagram

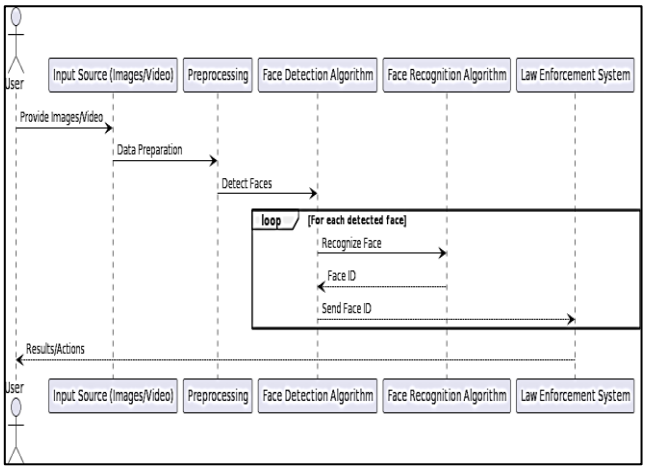

Figure 5.3 Proposed Sequence diagram

The Sequence Diagram for a Criminal Face Detection System illustrates the sequential interactions between key components. The Law Enforcement Officer initiates the process by requesting facial recognition, triggering the Face Recognition System to compare the uploaded face with stored

criminal data from the Database. Upon completion, potential matches are identified, and if found, the Alert System notifies the Officer. This interaction showcases the lifelines of the Officer, Face Recognition System, Alert System, and Database, depicting the flow of messages and actions over time. The diagram emphasizes the sequential flow of control and communication between these entities, elucidating the process of facial recognition, match identification, and subsequent alert notification within the system.

V.RESULTS AND DISCUSSION

6.1 Output Screen:

Figure 6.1 Home Page

Home page:

This is the home page of our system , here we add criminal details and register there identity. Depending on the interface, there might be user interaction features, such as buttons or keyboard shortcuts for controlling the detection process, switching between different input sources, or saving .

For effective face detection, users should ensure good lighting, a clear camera angle, and an unobstructed face. Keeping software updated, adjusting privacy settings, and being mindful of environmental conditions enhance the overall experience.

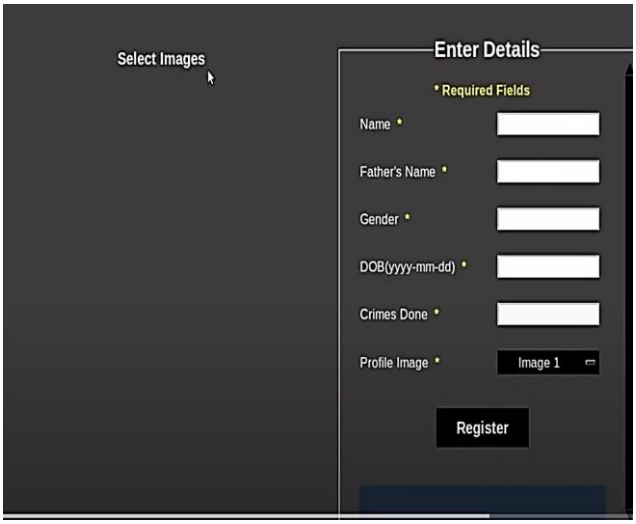

Figure 6.2 Enter Details

SELECTING IMAGES:

Figure 6.3 Detected Criminals

DETECTED CRIMINALS

This portion allows us to control the data files and choose the photographs from our file to upload to our system. For the best result, quality and well-illuminated photos will be considered to use in detecting files. Eliminate distractors and choose those files with a clear subject to increase your performance while making detections. The best thing when you receive good results is by following each given instruction by the detection program or software. By updating the software, one gets to match the latest techniques of detection and improvements made. Keep in mind the sensitiveness of any private data with the chosen files' privacy settings.

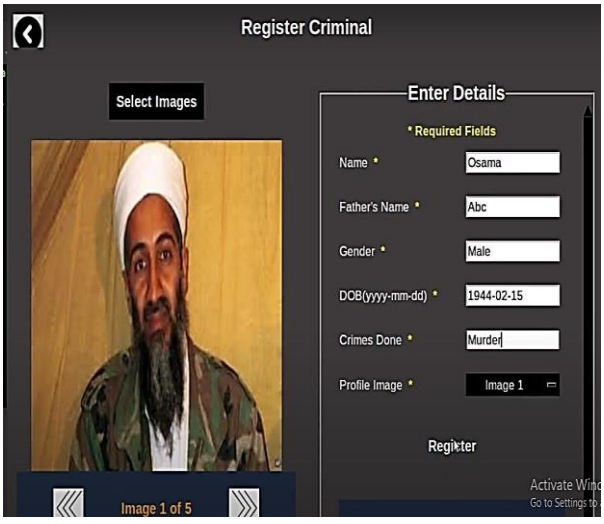

Figure 6.4 Register Criminal

In this section, we are able to do matching for the stored previous data with the face, so it would identify that the system detects the face from the video. Systems using green rectangle for face detection should always be used where a clear vision and clear, good lighting on the chosen image are in place. Use clear-faced files for better recognition by the green rectangle, and take instructions from the system on how to bring out images to have the best results after identification. Update the system regularly and acquire the new technology on identifying faces. Therefore, due consideration needs to be taken regarding privacy settings that establish the fine balance between better face detection and responsible personal information handling linked with identified names in the system.

VI. CONCLUSION

Criminal face detection is such a great technological innovation that it is surely going to change the very scenario of fighting and investigating crime. Therefore, one would surely like to take up the task of exploring technology implementation feasibility prior to investing any time or treasury into it. A comprehensive feasibility study helps one check whether or not a project for criminal face detection is technically sustainable, operationally workable, and financially feasible. The key factors in this study are the accuracy of the technology, how it will integrate with the current police systems, and potential cost savings. Feasibility study states that "technology is feasible and business should proceed to development plans in a gradual adoption," this may include pilot program to test technology in a small area with the availability of suggestion of user about technology. Then it could progressively be expanded to other localities should the need arise for the same, one of the useful technologies in increasing public safety is the criminal face detection software. Even then it is also greatly needed that this technology is used in a responsible and just manner. Under such a scenario, the companies involved have to balance the implications of using a sort of particular kind of technology limited locality to gather user feedback.

VII.ACKNOWLEDGMENT

We would like to convey our gratitude to Mr. Sagar Badjate for sharing their pearls of wisdom with us during this work.

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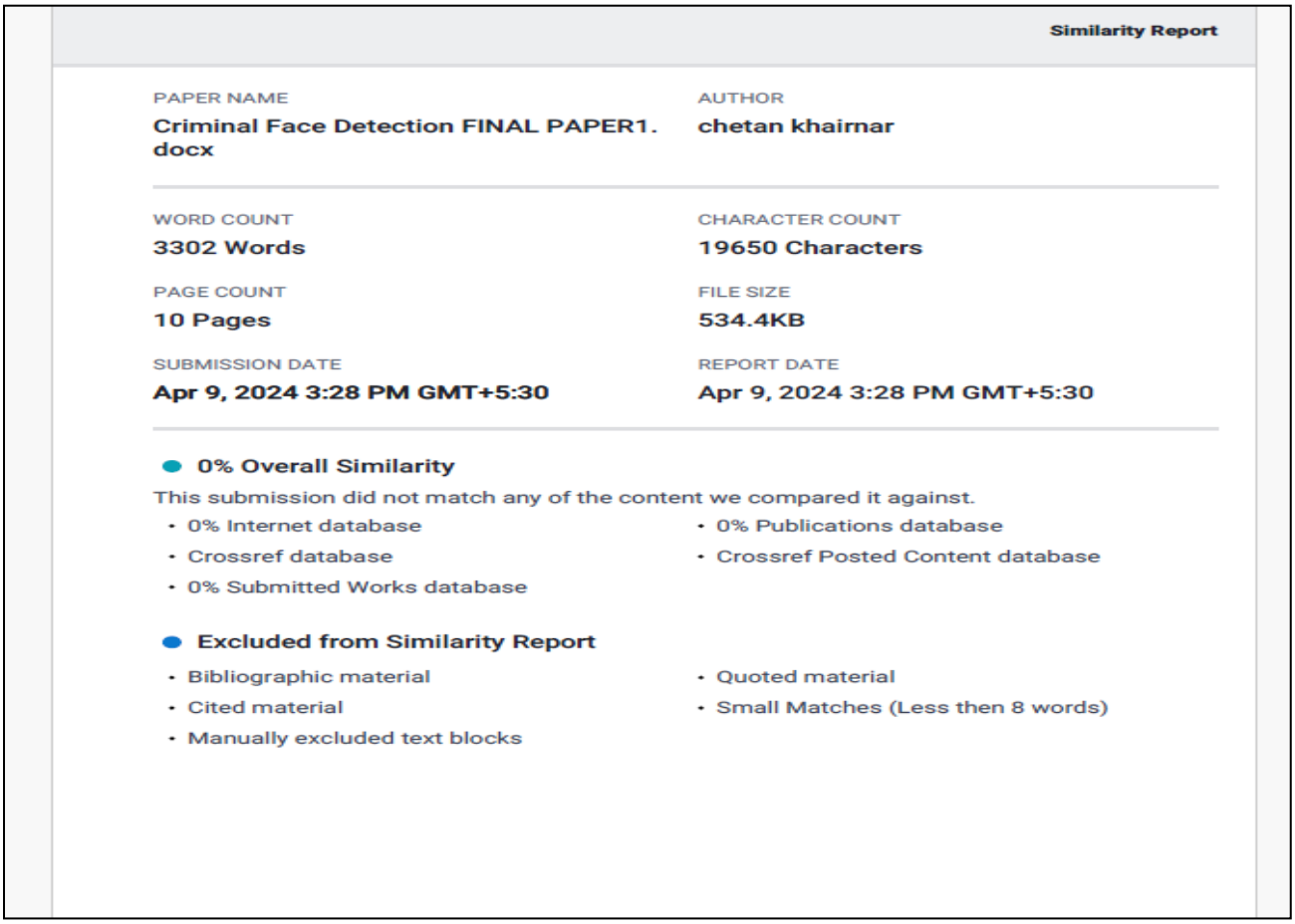

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