PROJECT PHASE-1

R E P O R T

On

“Criminal Face Detection”

Submitted in partial fulfillment of the requirements for the degree of

Bachelor of Technology in **Information Technology**

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CERTIFICATE

This is to certify that Mr. Zaid Zakir Ansari
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students of Information Technology, bearing has successfully completed project phase-1 report on "Criminal Face Detection" to my satisfaction and submitted the same during the academic year 2023-2024 towards the partial fulfillment of Bachelor of Technology under Dr. Babasaheb Ambedkar Technological University, Lonere , under the guidance of Mr. Sagar Badjate.

Date: / /2023
Place: SVKM's IOT, Dhule

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Name and Sign with date
Examiner-1

Name and Sign with date
Examiner-2

DECLARATION

We declare that this written submission represents 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.

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1.3 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].

1.4 Motivation behind project topic

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].

1.5 Aim and Objective(s) of the work

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 Overview of Project Domain

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].

- **Key Components of Criminal Face Detection Systems:**

- Face Detection: The initial step involves identifying and locating faces within an image or video frame. This task is typically accomplished using algorithms that analyze patterns and variations in pixel intensities, leveraging techniques like Viola-Jones and deep learning.

- Feature Extraction: Once faces are detected, their distinctive features are extracted and represented in a numerical format. This process involves identifying and extracting key facial landmarks, such as the position of the eyes, nose, mouth, and jawline.

- Feature Matching: The extracted facial features are then compared against a database of known criminals or suspects. This comparison involves matching the extracted features to the corresponding features in the database, using algorithms that measure the similarity between feature vectors.

- Matching Score: A matching score is generated, indicating the degree of similarity between the extracted facial features and those in the database. A higher score suggests a closer match, while a lower score indicates a less likely match.

1.6 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.

1.7 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].

Chapter 2: Literature Survey

3.1 Related Work Done

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, illumination, 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].

Chapter 3: Project Requirement Specification

3.1Hardware 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

3.2 Functional 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.

3.3 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.

Chapter 4: Proposed System

4.1 System Design and Architecture

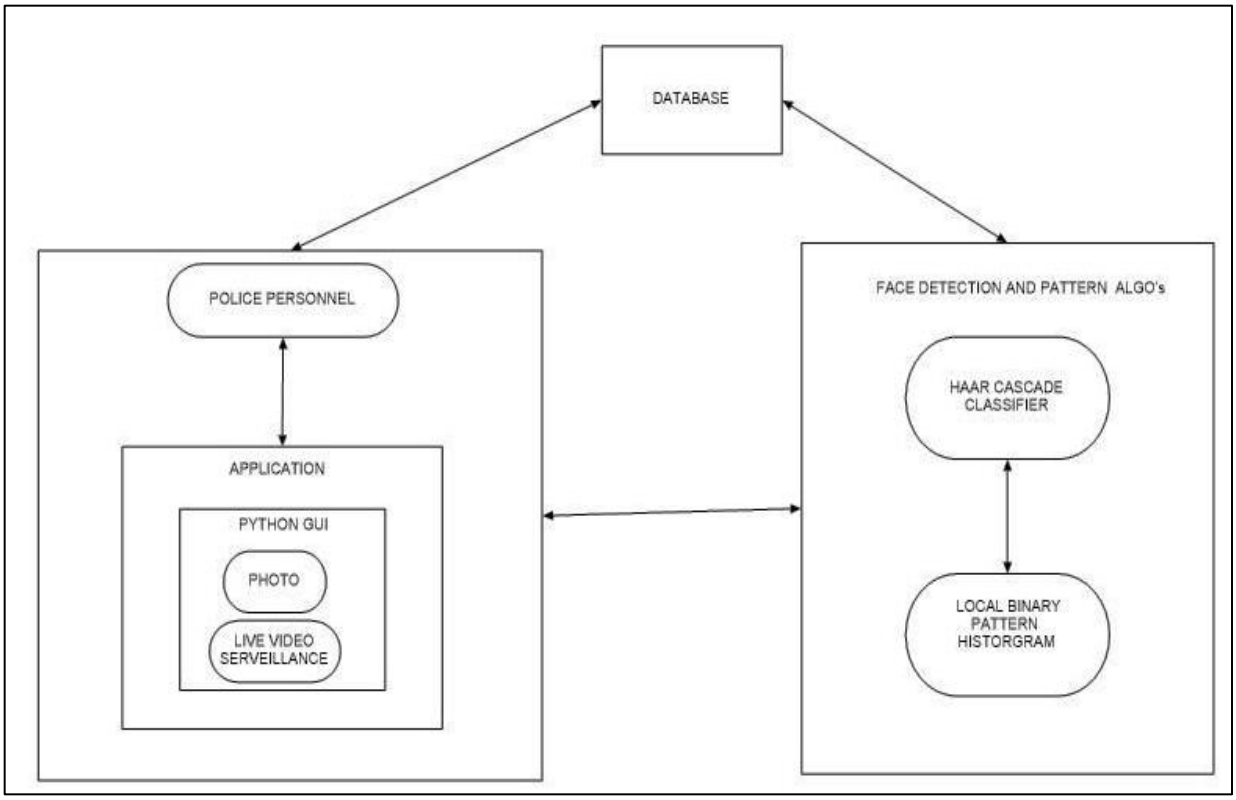


Figure 4.1: System Architecture

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.

Chapter 5: High Level Design of the Project

5.1 Use-case Diagram:

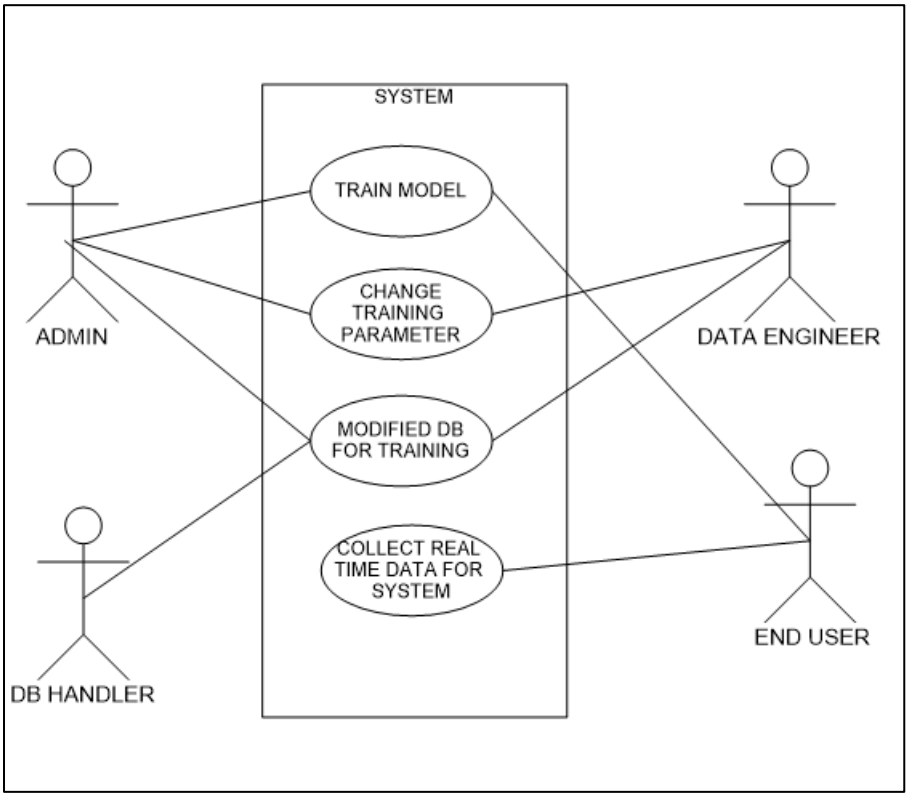


Figure 5.1:Use Case Diagram

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.

5.2 Data Flow Diagram:

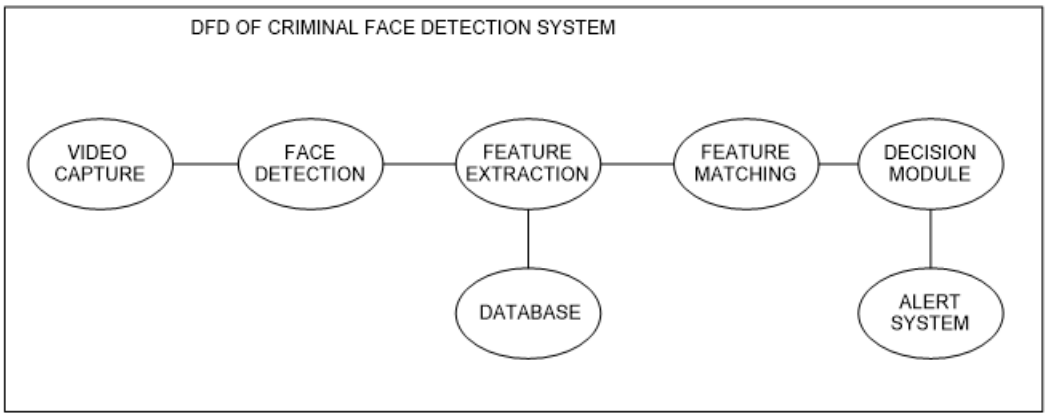


Figure 5.2:Data Flow Diagram

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

5.3 Sequence Diagram

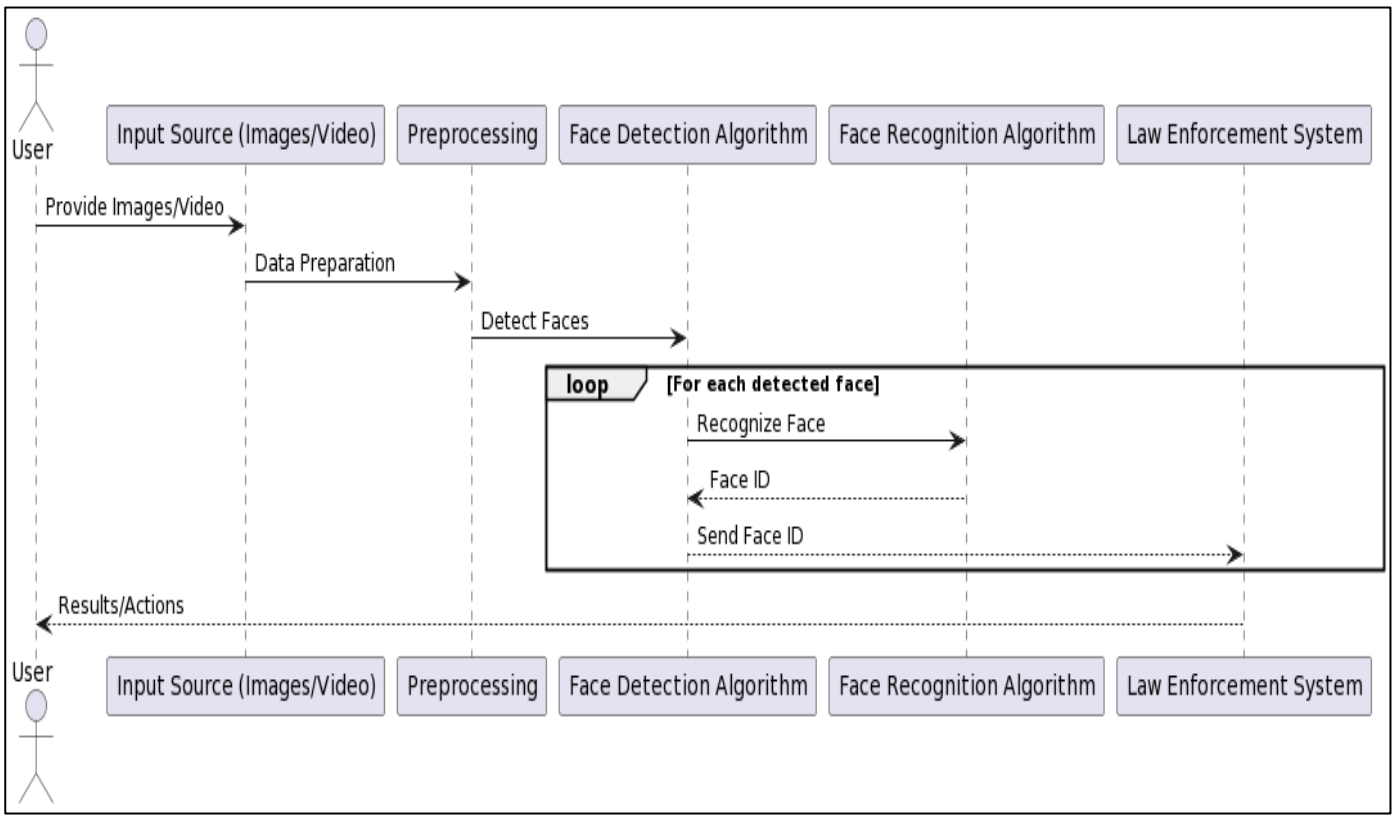


Figure 5.3:Sequence Diagram

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.

Chapter 6: System Implementation

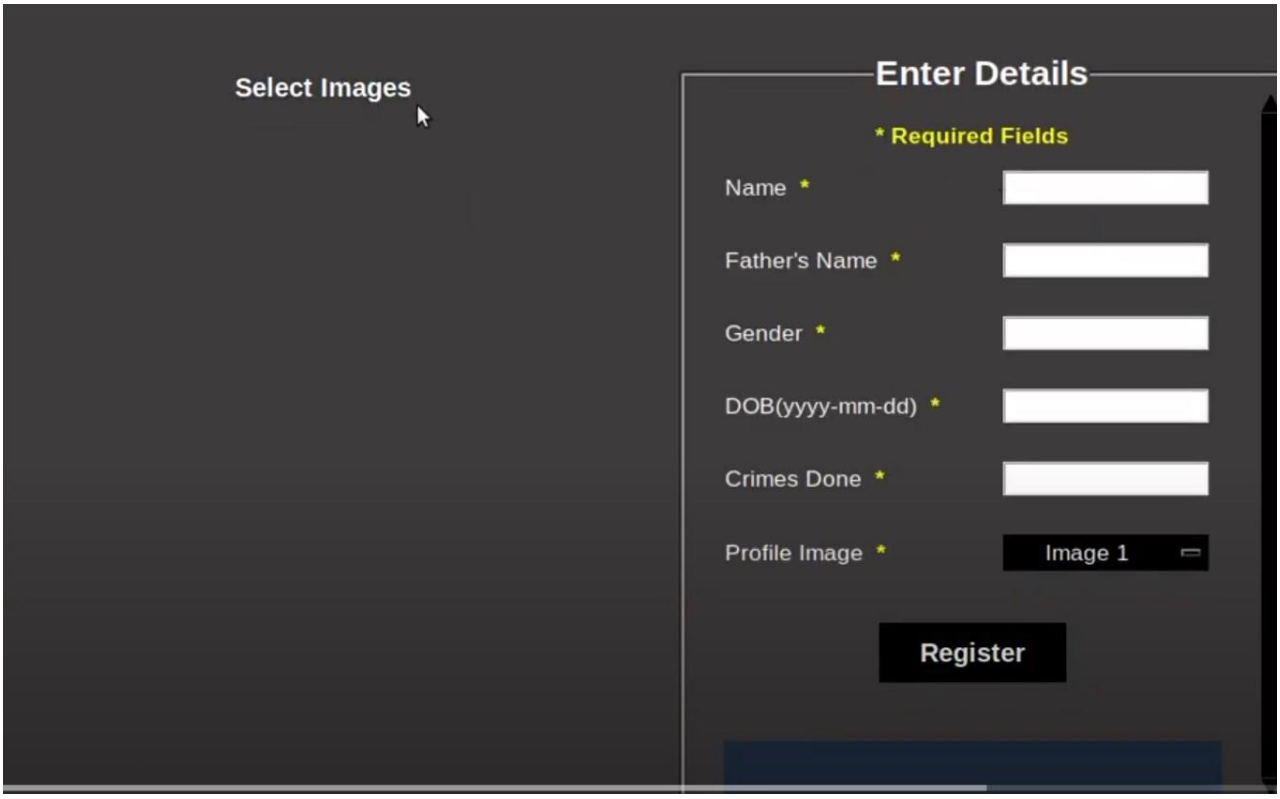
6.1 Output Screen:

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.



Selecting Image :

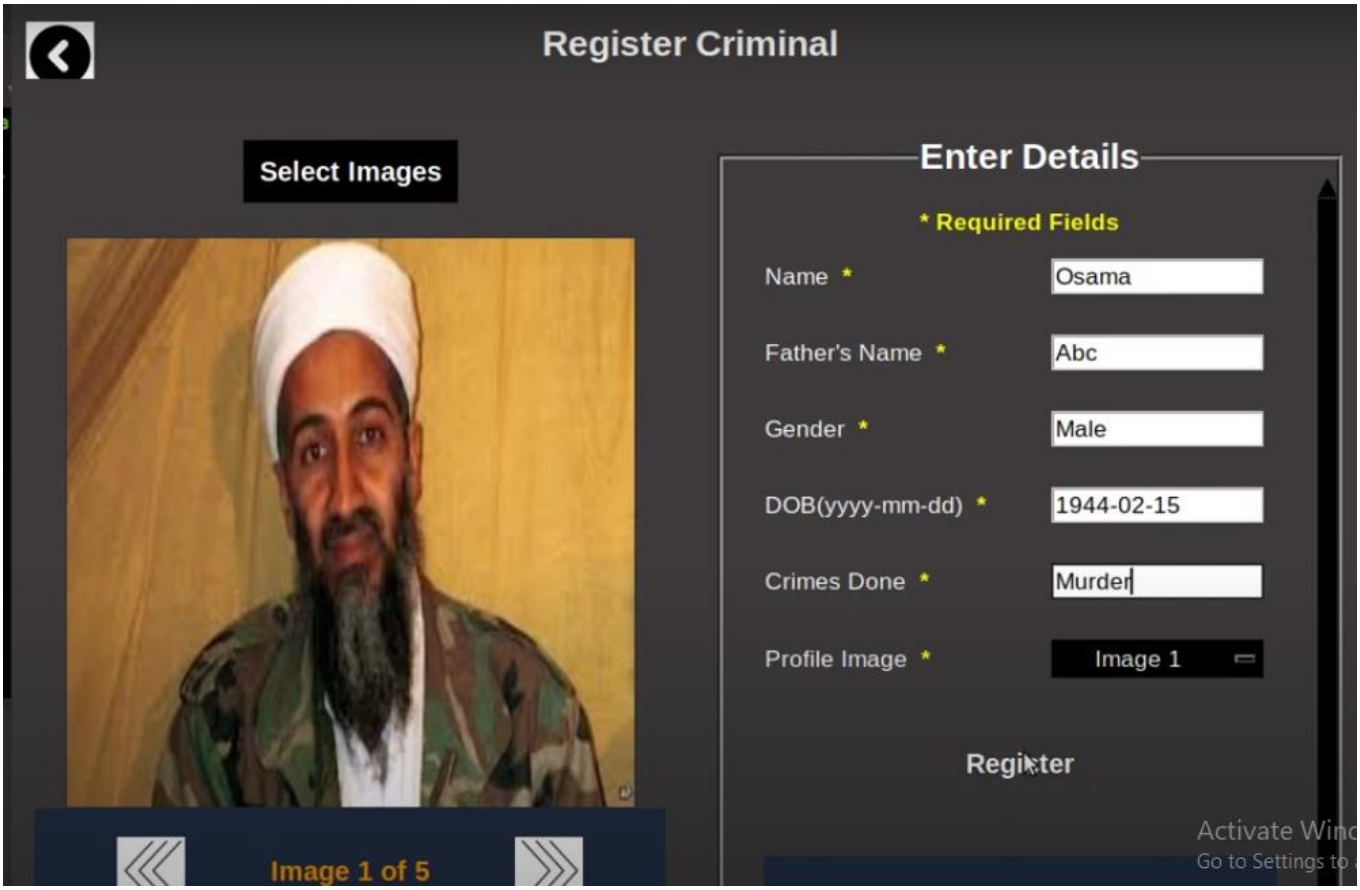
This is the interface provided by the system for selecting an image for identification.

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.

In This section we select the images from our file that we want to upload in our system ,As well as we can manage the data-files here.

When choosing files for detection purposes, users should prioritize high-quality, well-lit images to ensure accurate and reliable results. Opt for files with unobstructed subjects, minimizing distractions to enhance detection capabilities. Adhering to specific guidelines provided by the detection application or software is crucial for optimal performance. Keeping the software up-to-date ensures compatibility with the latest detection algorithms and improvements. Additionally, consider privacy settings to balance efficient detection with the responsible handling of sensitive information within the selected files.



In this section we are able to match face with our previous stored data ,so it would identify the system detects the face from video footage.

When utilizing a system that employs a green rectangle for face detection and associates it with name identification, users should ensure they select well-lit images with clear visibility. Opt for files where faces are unobstructed, as this enhances the accuracy of the green rectangle's detection. Follow any specific guidelines provided by the system to achieve optimal results during the identification process. Regularly updating the system ensures it incorporates the latest advancements in face detection technology. Mindful consideration of privacy settings is essential to strike a balance between effective face detection and responsible handling of personal information linked to identified names within the system.

Chapter 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: 6 weeks
- Development: 16 weeks
- Testing: 8 weeks
- Deployment: 4 weeks

Chapter 8: 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.

Chapter 9: Reference

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