VELLORE INSTITUTE OF TECHNOLOGY

CSE3001

Software Engineering

Title: - Facial Recognition for Criminal Identification

Final Report

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ACKNOWLEDGEMENT

We would like to take this opportunity to thank VIT University for encouraging and giving us the opportunity to perform this project. The School of Computer Science and Engineering had given us guidance and opportunity in their labs which we required in our project. We could never have proceeded with our project if we did not get the correct resources. We would also like to thank our Project Guide, Associate Professor Thenmohzi for guiding us through every step of this project. Lastly, we would like to thank our family and friends for their unconditional support towards us.

Table of Contents

1. Introduction

- This project is for the facial recognition done for the criminal recognition where the security expert will input an image of the person and based on databases, image processing algorithm and training process identifies the criminal.
- The system will first preprocess the image which will cause unwanted elements such as noise to be removed from the image.
- After that, the system will then classify the image based on its landmarks for example, the distance between the eyes, the length of the jaw line, etc. Then, the system will run a search through the database to find its perfect match and display the output.
- This work is focusing on implementing the system for criminal identification.

Scope Statement

The sole purpose of this software is to detect the facial structure of an individual with high accuracy. This software as being user-friendly and simple to maneuver will help all the detective companies which cannot afford expensive hardwares and softwares to use to detect criminals. It's objective is to spot a criminal face in the internet database and the records of the criminal database or in a crowd of unknown individuals. The goal is that it could be used by companies all around to secure themselves and small crime investigation company all around the world could use it as well.

Potential Applications

- Current practice of thumbprint identification which is simple and easy to be implemented can be challenge by the use of latent thumbprint and sometimes cannot be acquired from the crime scene.
- The criminals have become cleverer and normally are very careful in leaving any thumbprint on the scene. This system encompassed face database and an image processing algorithm to match the face feed with faces stored in the database. Software such as this makes it easy to spot the criminal data if the face attribute is fed to the software which can help spot the face all around the world from CCTV footage or any other media capturing devices.

- Our system could be improved in the future through the development of a face detection algorithm which is less prone to incorrectness, failure and performs well regardless of the skin color. A more extensive feature set would also prevent the chance of tricking the system through the alteration of facial features.

Process Model

- An iterative life cycle model does not attempt to start with a full specification of requirements by first focusing on an initial, simplified set user features, which then progressively gains more complexity and a broader set of features until the targeted system is complete. When adopting the iterative approach, the philosophy of incremental development will also often be used liberally and interchangeably

- In this project firstly, we code using the necessary algorithm firstly to detect the face of the particular person. Then slowly in a iterative process we feed database of information and train the face attributes. Then in the next process we work in removing the noises from the image to get a clear picture of the suspect. Over time with a iterative process the software becomes more accurate and it can detect the face with high accuracy and success.

Justification for selecting prototyping as our model of development

The strength of this application is having a user friendly, interactive user interface.

- There are two parts vital to the success of this system; detection and recognition. Face detection is one of the most important steps in a face recognition system and can be classified into four principle categories; knowledge based, feature invariant, template matching and appearance-based methods. In recognition, two stages are required; training process and evaluation process. In a training process, the algorithm is fed samples of the images to be learned and a distinct model for each image is determined while in an evaluation process, a model of a newly acquired test image is compared against all existing models in the database.

1. Introduction

1.1 Purpose

The purpose of this project is to recognize criminal individuals faces which can are registered in the input visual devices through algorithm and neural network training. The first release of the version from the iterative process will be CriminalDetector v0.1 and the scope of this product is for Digital Forensics Company to track criminals and for the government to find highly suspected individual.

1.2 Document Conventions

When writing SRS document for Facial Recognition For Criminal Identification the following terminologies are:

To make the document more effective and readable we have used font style, font heading as bold.
We have created hierarchical number system which makes the reader less confusing.

1.3 Intended Audience and Reading Suggestions

This Software Requirements Specification is suitable and can be understood surfacely about what the product is and what is it's functions by any of the users, project managers, marketing stuff and document writers. While this document is purely intended to be understood all in's and out's by the individuals such as developers and testers. The rest of SRS contents is divided into Groups which are further divided into sub-groups to explain them in detail what is that we are talking about like: Description Group contains sub-groups like functions, perspective, classifications,etc. The sequence for reading this document will be as:

- Overall Description of The Project,
- Software and hardware requirements,
- System features and
- Other non-functional requirements
- Appendix for any problematic words or abbreviation.

1.4 Product Scope

The sole purpose of this software is to detect the facial structure of an individual with high accuracy. This software as being user-friendly and simple to maneuver will help all the detective companies which cannot afford expensive hardwares and softwares to use to detect criminals. It's objective is to spot a criminal face in the internet database and the records of the criminal database or in a crowd of unknown individuals. The goal is that it could be used by companies all around to secure themselves and small crime investigation company all around the world could use it as well.

1.5 References

1. Yu, S., Lu, Y., Zhou, J.: A survey of face detection, extraction and recognition. J. Comput. Inf. 22, 163–195 (2003)

2. Sharif, M., Naz, F., Yasmin, M., Shahid, M.A., Rehman, A.: Face recognition: a survey. J. Eng. Sci. Technol. Rev. 10(2), 166–177 (2017)

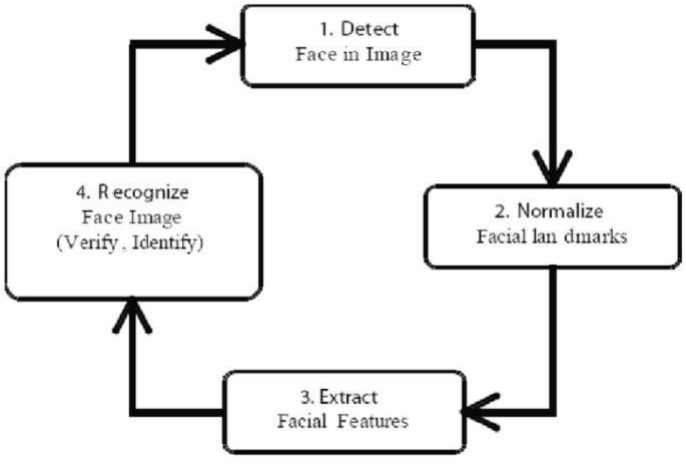
3. Patel, R., Rathod, N., Shah, A.: Comparative analysis of face recognition approaches: a survey. Int. J. Comput. Appl. 57(17), 50–61 (2012)

4. Abdullah, Nurul Azma & Saidi, Md & Rahman, Nurul & Chuah, Chai Wen & A Hamid, isredza rahmi. (2017). Face recognition for criminal identification: An implementation of principal component analysis for face recognition.

2. Overall Description

2.1 Product Perspective

The origin of the product became possible as soon as photo capture technology and neural network training became possible in the world. The old way of tracking a person by their old tracks and receipt became very hard and time consuming so that's why this technique gained very much traction in this current decade. This product is not a new unique creation but a replacement or different versions of already existing face recognization technology out there.



2.2 Product Functions

- Captures the image of the persons
- The system pre-process the image of unwanted elements
- Removes the unwanted elements such as noise.
- System then classifies the image based on its landmarks for ex: The distance between the eyes, length of the jawline,etc
- System searches through the database to find it's perfect match.
- Display the output

2.3 User Classes and Characteristics

Normal User: They are the kind of user who needs this kind of software occasionally when they are in the need. When some people are to be found or to be searched they use the software but only for that moment. Beside that they don't put it to use.

Customers / Frequent User: These are the types of user who will use it as their most benefits. They are the crime investigation organizations, Government Organization and detectives. They require this current software for their daily usage of the work as it is their software to recognize the criminals they are searching.

2.4 Operating Environment

The software will operate in Windows platform which will be operating in version Windows 10. It can also be operated in android mobile as well. The hardware used is Laptop and a smartphone containing camera to capture the facial details of the person which will have Windows 10 and Android 10. It requires a software like CodeBlocks and Microsoft Visual Studios.

2.5 Design and Implementation Constraints

The constraints complicate all the policies regarding privacy as the image of various individual is being stored for optimization and are stored in the databases for the future comparisons. It may violate the privacy policies and the right to privacy for individual who doesn't even know that they are being

captured by the product. It has hardware limitations because processing the image by removing the noises and calculating the distinct features in the face as it requires parallel processing at the same time. High processing powerful chip is required and the device which cannot handle multi-threading won't be able to perform this process. High camera resolution which can capture and attain details of the face is compulsory so a low resolution camera cannot be used.

2.6 User Documentation

1. Open the software in your operating system of computer or android.
2. Allow access to the camera from your device for the feature extraction or any other camera hardware like CCTV, computer, cameras, etc.
3. Let the software capture the features of the person for some time and don't interrupt the camera.
4. Don't shake the camera and put the camera in a fixed position.
5. The database must be always available so internet access to the software must always be present.
6. The features extracted is then processed and compared to the database to find a match.
7. After the details of the match is confirmed the output is provided.

2.7 Assumptions and Dependencies

We assume the following states:

1. The hardware and software supports multi-threading capabilities.
2. The camera will have high resolution capture.
3. The database contains the features of the specific individuals to be compared.
5. The camera will be positioned in a stationary manner.
6. The processing power is be obtained from multi-core processor.

The dependencies of the software are:

1. High resolution camera which has high pixel density for capture.
2. High processing capabilities to perform parallel processing.
3. Computer device to run the specific code on a integrated developer enviroment.

3 External Interface Requirements

3.1.1 User Interface

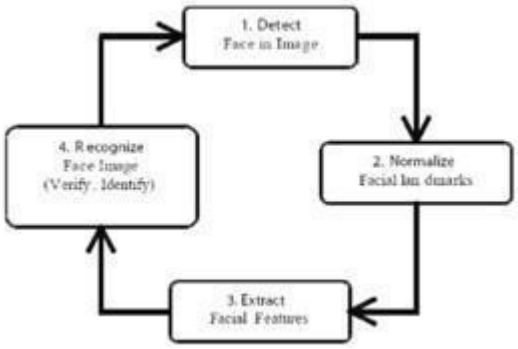
The analysis and design process of a user interface is iterative and can be represented by a spiral model. The analysis and design process of user interface consists of four framework activities. User, task, environmental analysis, and modeling: Initially, the focus is based on the profile of criminals who will be detected by the system i.e. understanding, the physical knowledge, type of crime committed, etc. . Based on the requirements developers understand how to

develop the interface. Once all the requirements are gathered a detailed analysis is conducted. In the analysis part, the tasks that the officers perform to establish the goals of the system are identified, described and elaborated.

Interface Design: The goal of this phase is to define the set of interface objects and actions i.e. Control mechanisms that enable the user to perform desired tasks in order to maintain crime records. Indicate how these control mechanisms affect the system. Specify the action sequence of tasks and subtasks, also called a user scenario. Always follow the three golden rules stated by Theo Mandel. Design issues such as response time, command and action structure, error handling, and help facilities are considered as the design model is refined. This phase serves as the foundation for the implementation phase.

Interface construction and implementation: The implementation activity begins with the creation of prototype (model) that enables usage scenarios to be evaluated. As iterative design process continues a User Interface toolkit that allows the creation of windows, menus, device interaction, error messages, commands, and many other elements of an interactive environment can be used for completing the construction of an interface.

Interface Validation: This phase focuses on testing the interface. The interface should be in such a way that it should be able to perform tasks correctly and it should be able to handle a variety of tasks. It should achieve all the user's requirements. It should be easy to use and easy to learn. Users should accept the interface as a useful one in their work.



3.1.2 Hardware Interface

A hardware interface is a combination of mechanical electrical and logical signals that define how a piece of hardware communicates with the system.

Hardware interface design (HID) is a cross-disciplinary design field that shapes the physical connection between users and technology in order to create new hardware interfaces that transform purely digital processes into analog methods of interaction. It employs a combination of filmmaking tools, software prototyping, and electronics bread boarding. Through this parallel visualization and development, hardware interface designers are able to shape a cohesive vision alongside business and engineering that more deeply embeds design throughout every stage of the product. The development of hardware interfaces as a field continues to mature as more things connect to the internet.

3.1.3 Software Interface

A software interface may refer to a wide range of different types of interface at different "levels": an operating system may interface with pieces of hardware.

Applications or programs running on the operating system may need to interact via data streams, filters, and pipelines; and in object-oriented programs, with the users; objects within an application may need to interact via methods. A key principle of design is to prohibit access to all resources by default, allowing access only through well-defined entry points, i.e., interfaces. Software interfaces provide access to computer resources (such as memory, CPU, storage, etc.) of the underlying computer system; direct access (i.e., not through well-designed interfaces) to such resources by software can have major ramifications—sometimes disastrous ones— for functionality and stability.

Software Maintenance - After the deployment of a new interface, occasional maintenance may be required to fix software bugs, change features, or completely upgrade the system. Once a decision is made to upgrade the interface, the legacy system will undergo another version of the design process, and will begin to repeat the stages of the interface life cycle.

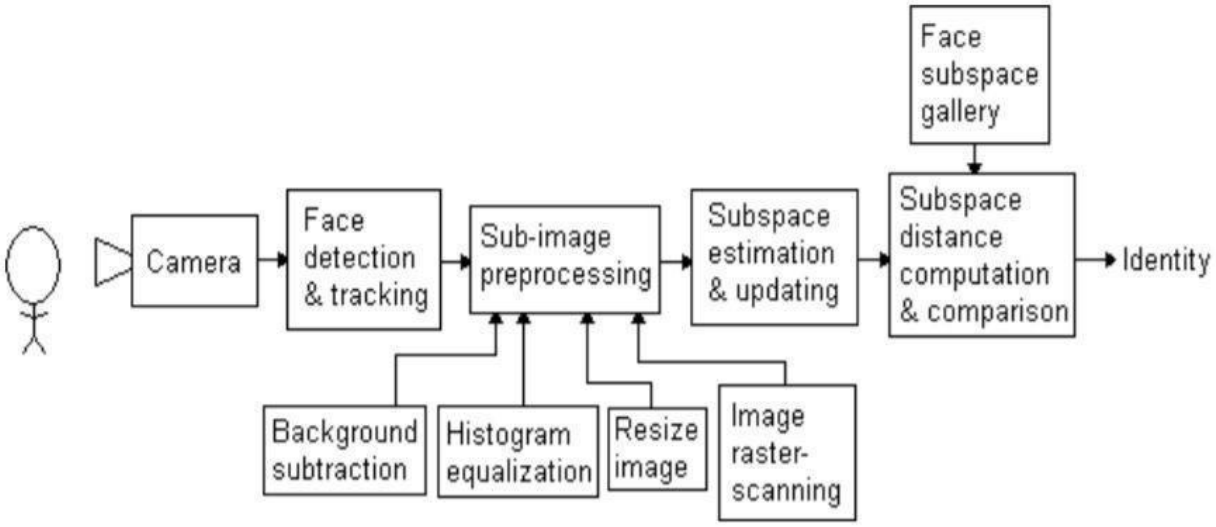
3.1.4 **Communication Interface**

The communication interface allows the users to communicate with the operating system.

Software interface - the languages and codes that the applications use to communicate with each other and with the hardware.

Hardware interface - the wires, plugs and sockets that hardware devices use to communicate with each other.

An interface defines the signature operations of an entity; it also sets the communication boundary between two entities, in this case two pieces of software. It generally refers to an abstraction that an asset provides of itself to the outside. The main idea of an interface is to separate functions from implementations. Any request that matches the signature or interface of an object may also be sent to that object, regardless of its implementation. Since it does not matter which implementation of a specific class is used, a class can be exchanged easily without changing the code of the calling class. The concept of an interface is fundamental in most object-oriented programming languages. In some, objects are known only through their interfaces so there is no way to access an object without going through its interface.



4. System Features

Face recognition opens up a lot of features that could be exploited by the business market as well as the private sector.

a. Predictive Analysis

4.1.1 Description and Priority

The right set of analytics can help large enterprises prevent future crimes. First, it's crucial for enterprises to be able to view aggregate data across multiple store locations. Face recognition analytics should help companies easily identify which times of day and which locations are experiencing the highest number of matches, so that each location can be accurately staffed up.

4.1.2 Stimulus/Response Sequences

- The system inputs the facial expression during a certain time and period of the day
- The system compares the emotion that a man conveys through the database.
- Then through past learning's it can predict the response one shows during a certain period.

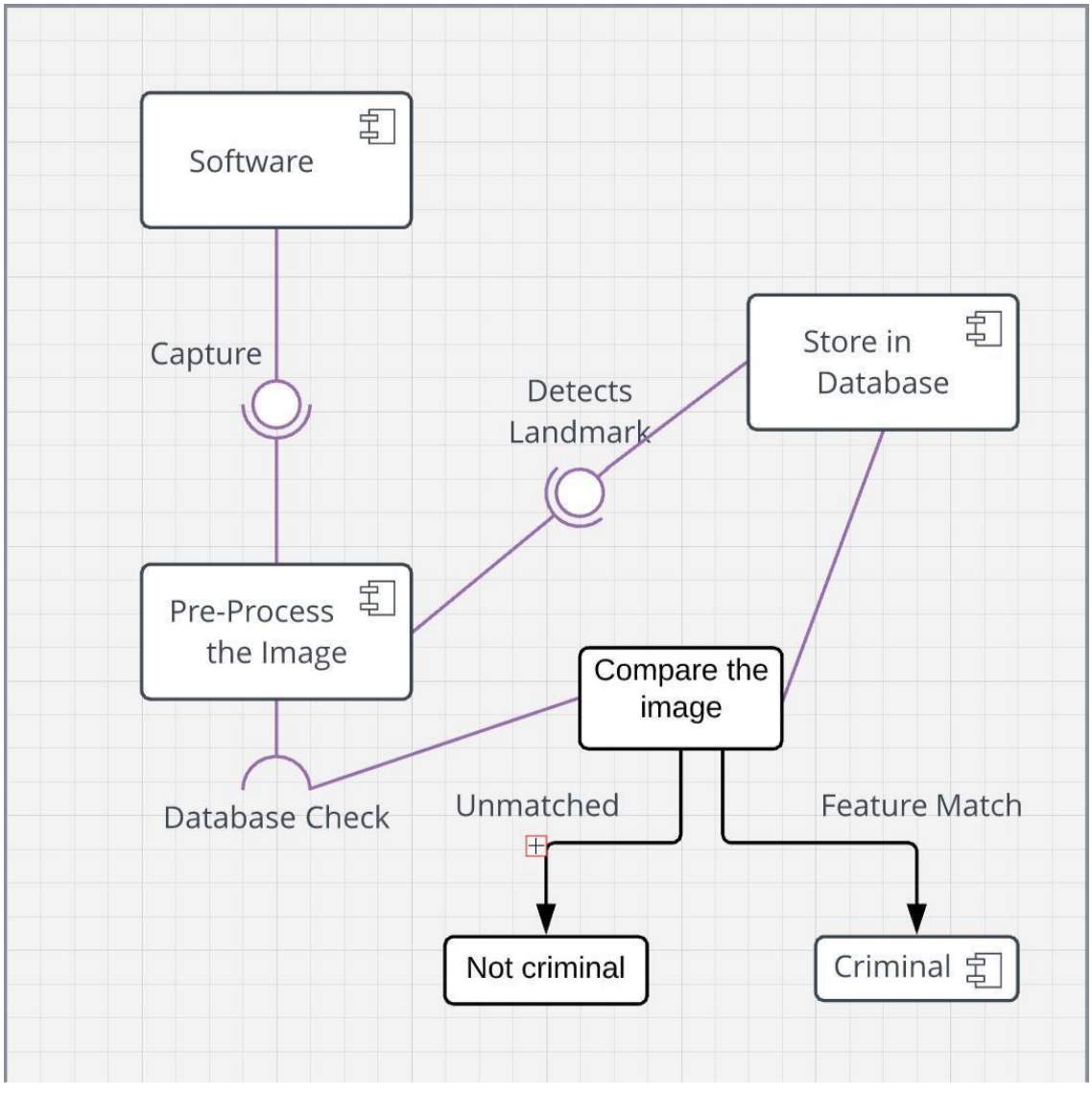
4.1.3 Functional Requirements

REQ-1: The user must be allowed to surf through the database to validate the person's features.

REQ-2: The image taken must be firstly pre-processed by removing the noises contained in it and features must be extracted by using points in the faces.

REQ-3: The processing must be required to be done in parallel process so that it can extract multiple features at a single time and compare them with databases.

REQ-4: The database of individuals must be kept private under proper policies so there is no misuse of privacy.


Software
Capture
Detects
Landmark
Store in
Database
Pre-Process
the Image
Compare the
image
Database Check
Unmatched
Feature Match
Not criminal
Criminal

5. Other Nonfunctional Requirements

a. Performance Requirements

1. Speed: The system must return searched data in less than three seconds and employ a proper searching algorithm.

2. Response Time: It must have a response time of at least 3 seconds.
3. Resource Consumption: The application requires physical storage on a server to store data. This amount can be varied depending upon the scale of the targeted department. Also, the system requires a good network connection, whether wired or wireless, and needs to have the bandwidth proportional to the usage across the work site.

b. Safety Requirements

1. The system should not mismatch the criminal with the innocent personnel. The system should be accurate while performing the detection and classification.

c. Security Requirements

1. The finished product needs to have strong security features that enable only the concerned users to access the data and no one else.

2. There need to be a proper entry and registration procedures for users to maintain their data privacy

d. Software Quality Attributes

1. Documentation: The product will be thoroughly documented such that users can find it easy to navigate and utilize.

2. Aesthetics: The product will have a clean interface such that loading time can be minimized in order to boost browsing speed across devices.

e. Business Rules

1. Frequency/Severity of failure: The system must be up 365 days a year with 99% uptime. Downtime will be used for server maintenance.

2. Recoverability: The servers will have a backup hard drive such that failure of the primary hard drive will not result in loss of data.

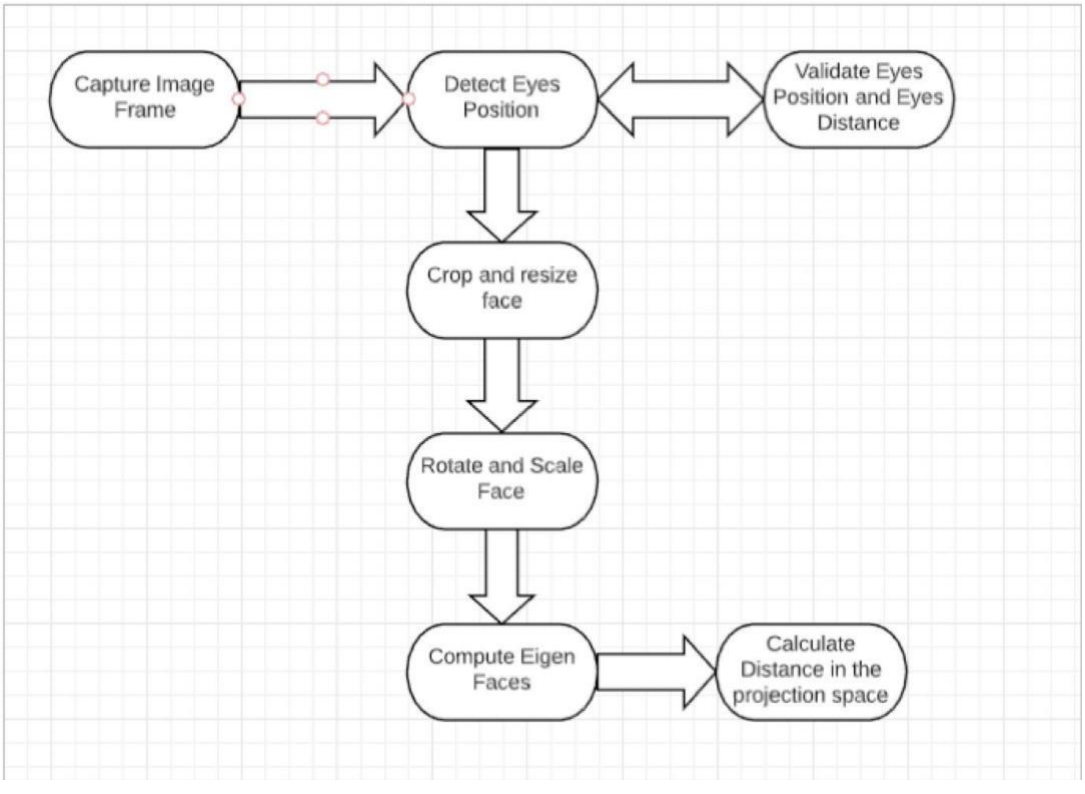
3. Predictability: Server maintenance and data analysis will usually be carried out during hours of minimal traffic.

6. Other Requirements

1. The product will be compatible with all windows operating system above windows 7.

2. Maintainability: The investigator officer will be responsible for updating data as well as addition of any new criminal record.

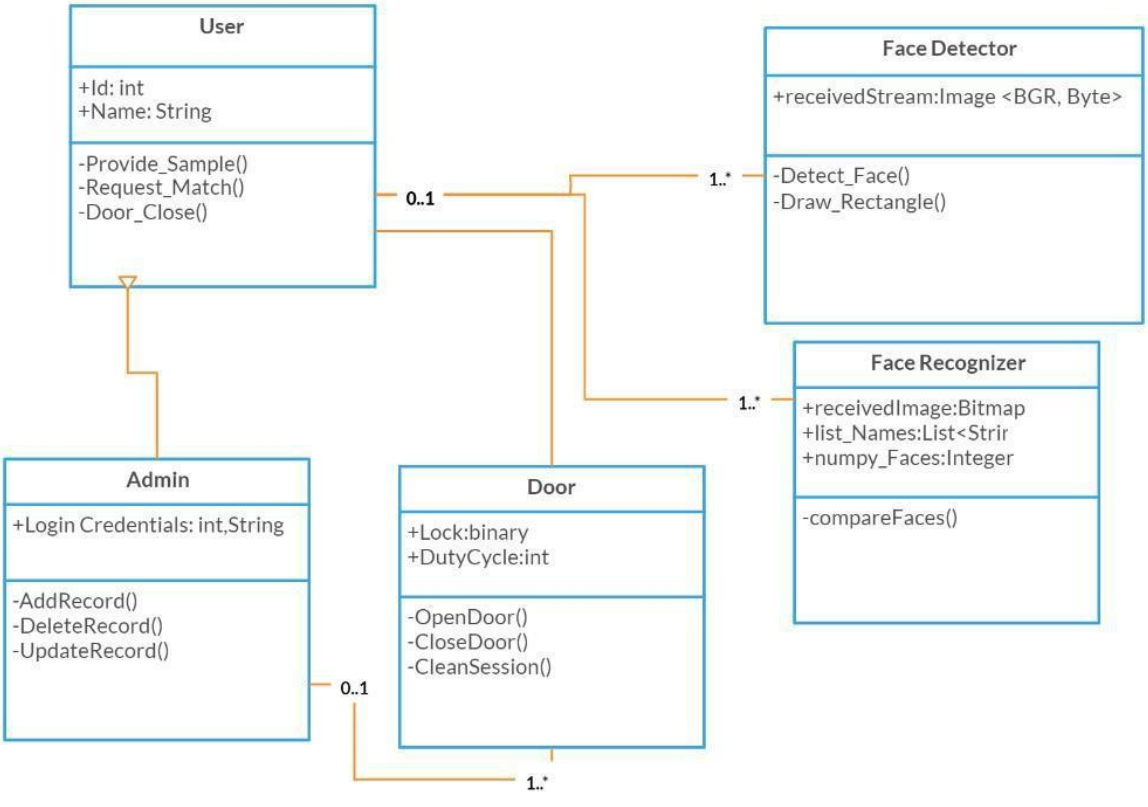
Appendix A: Analysis Models



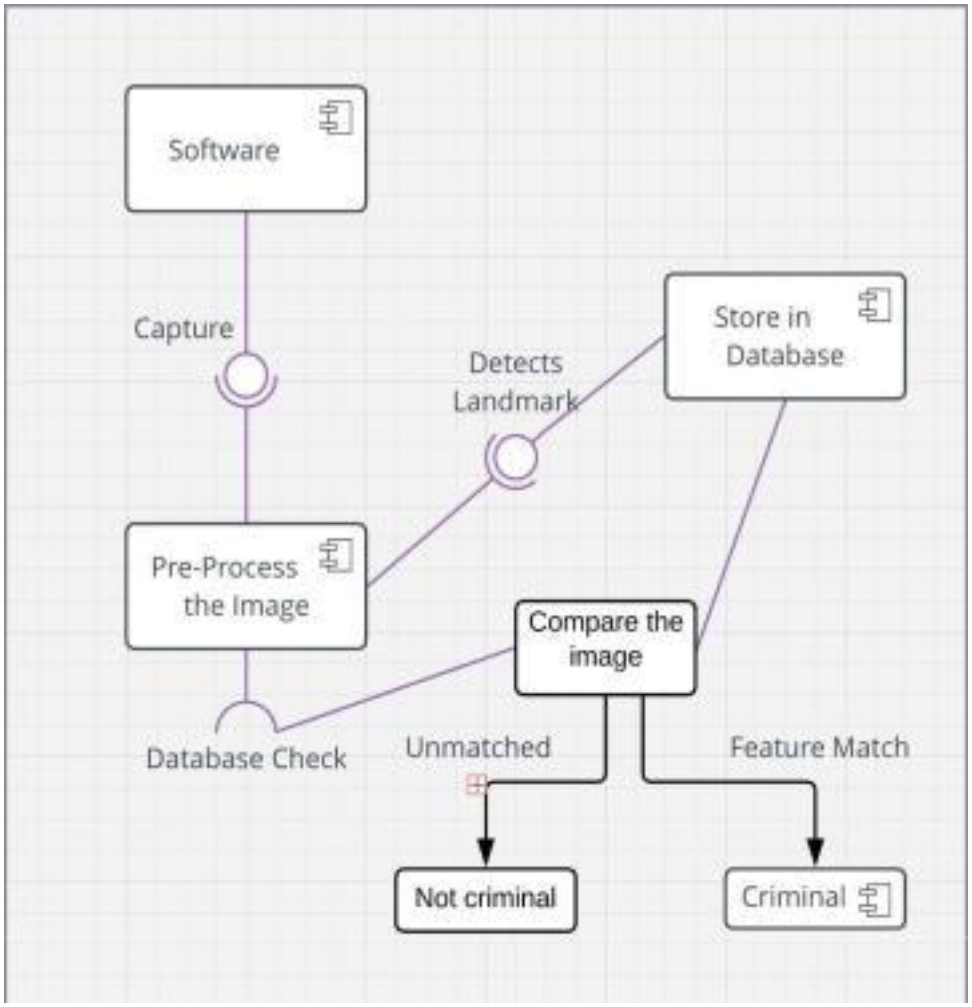
State Diagram

1. Structure Diagrams

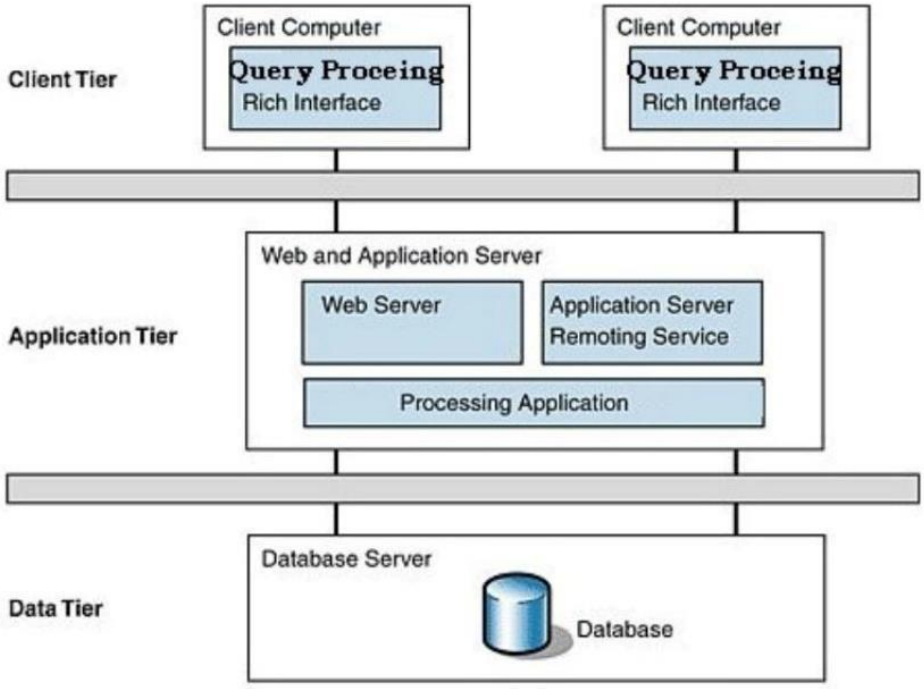
Class Diagram



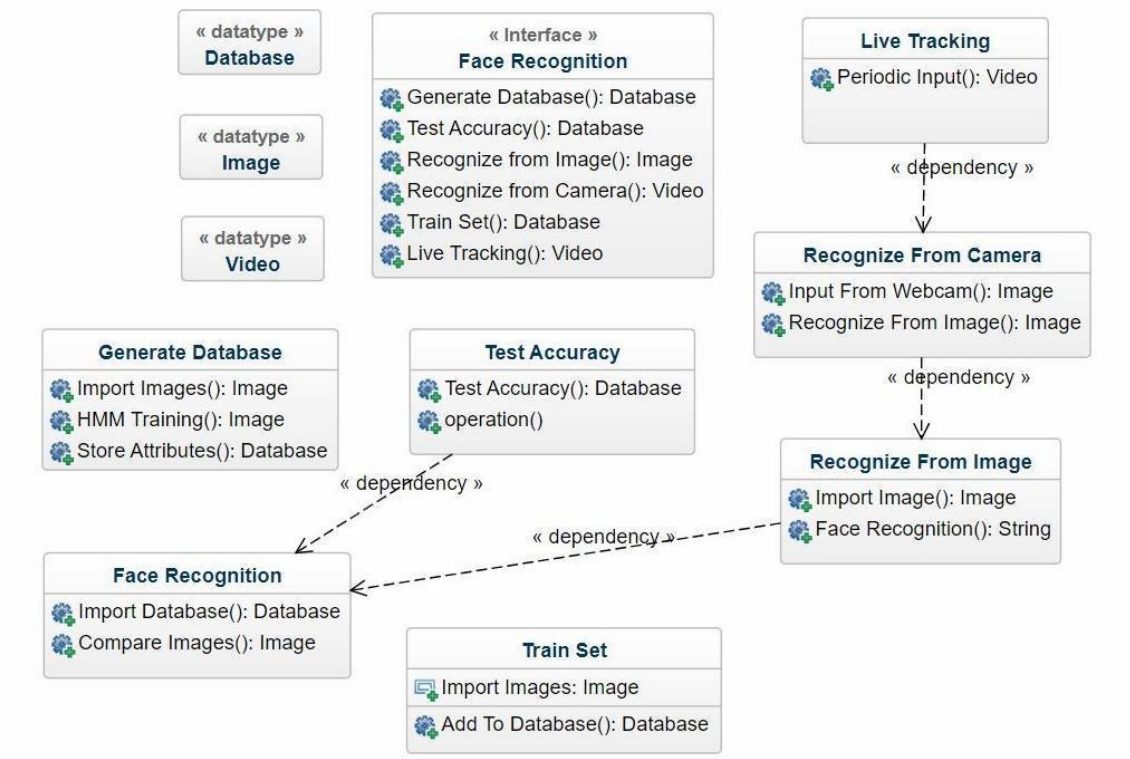
b. Component Diagram



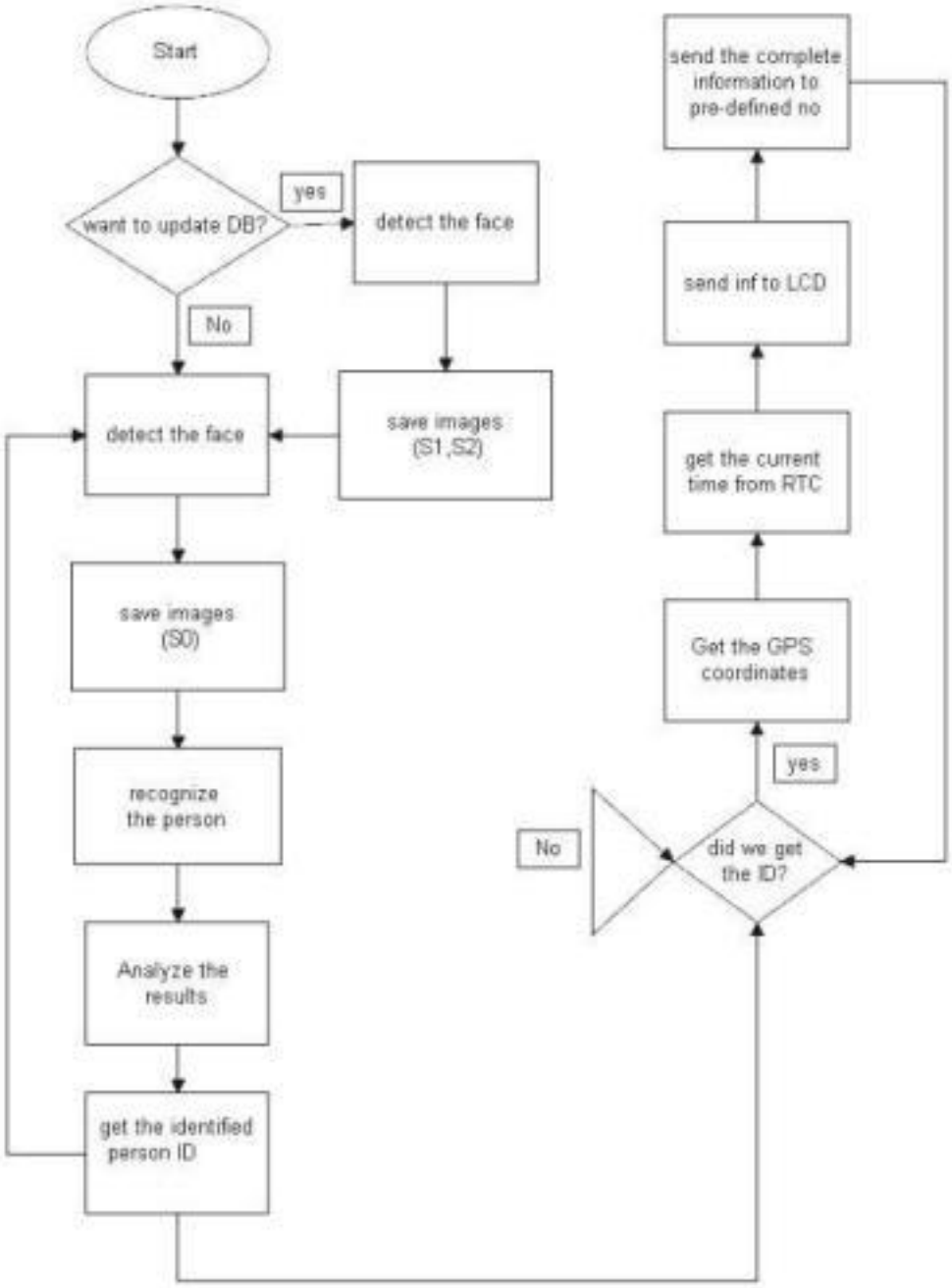
c. **Deployment** Diagram



d. **Object Diagram**

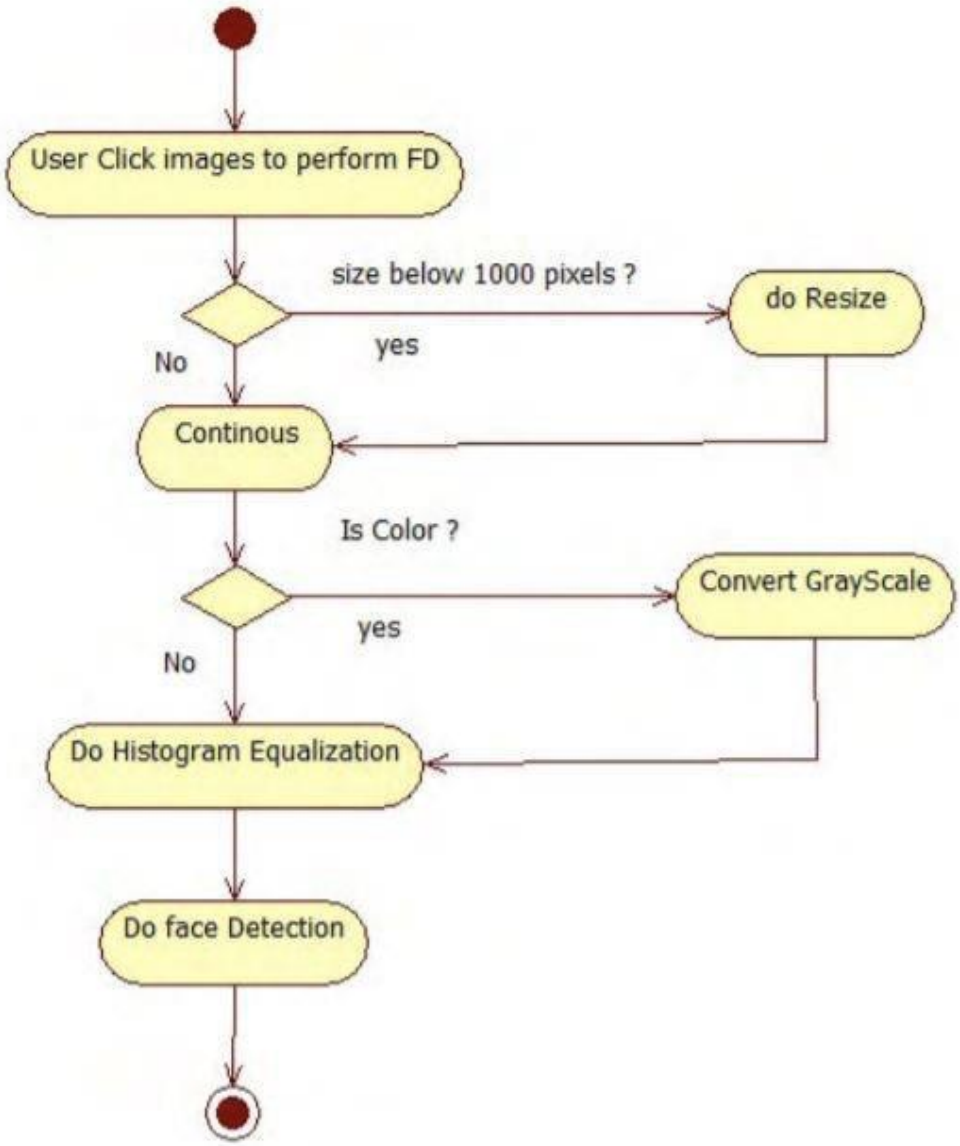


e. Package Diagram

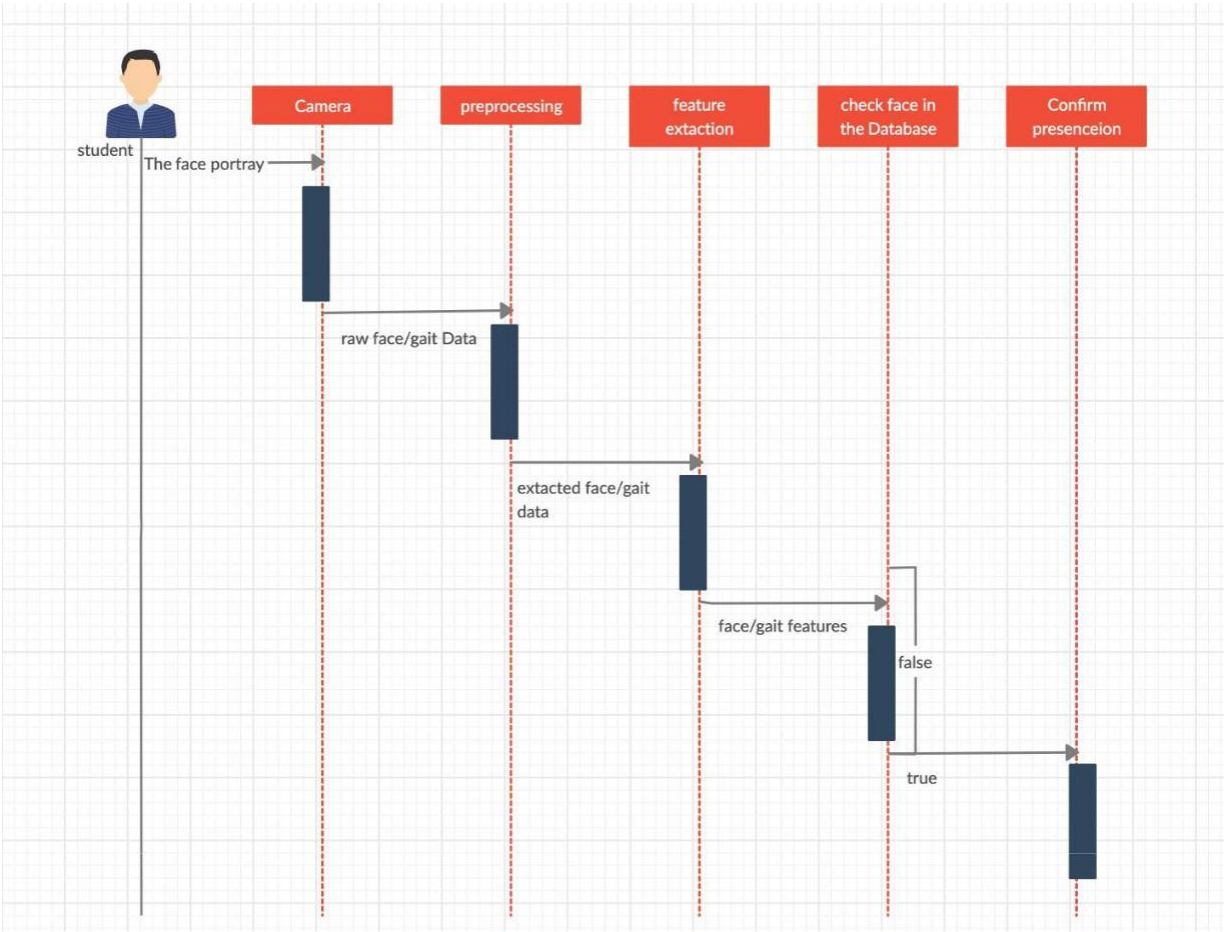


2. Behavior Diagrams

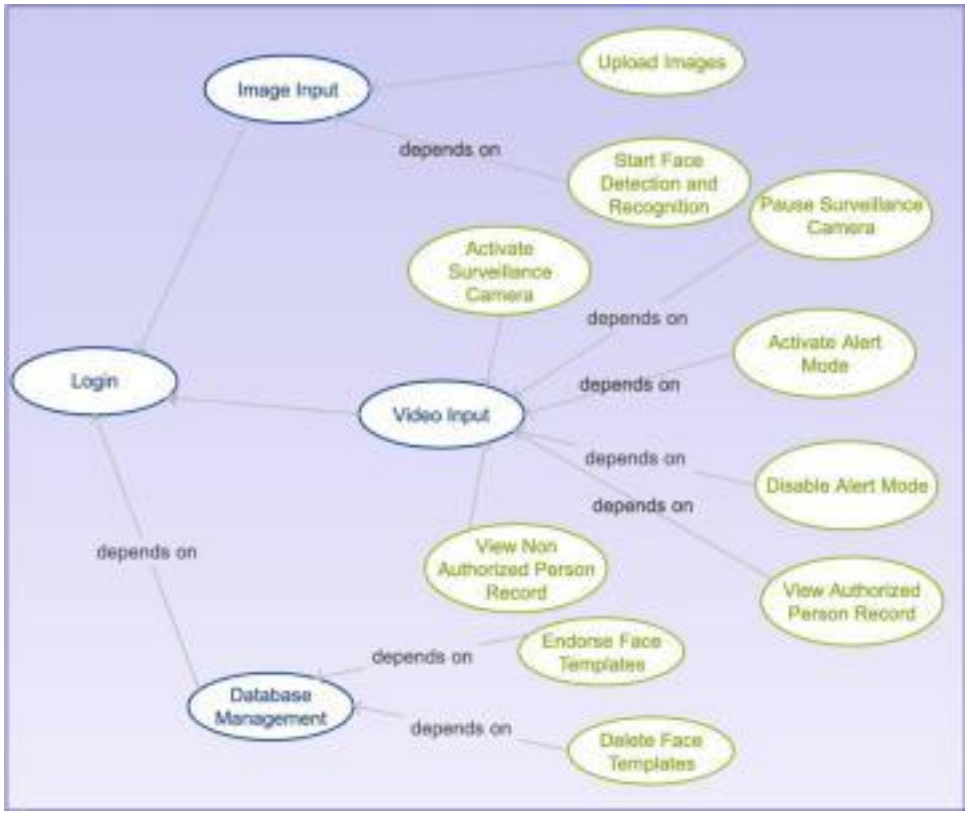
a. Activity Diagram



b. State Machine Diagram

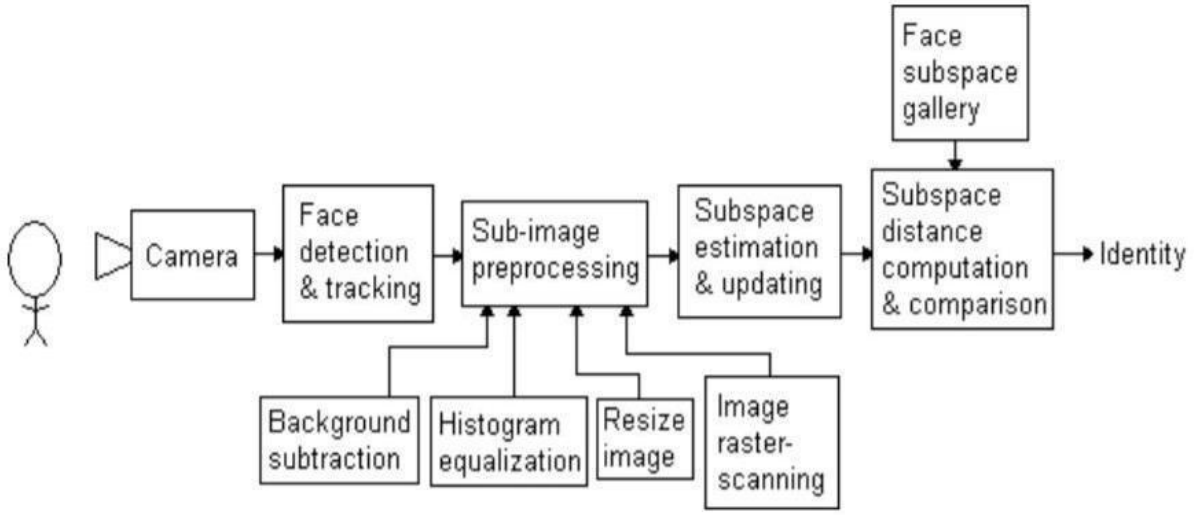


c. Use Case Diagram

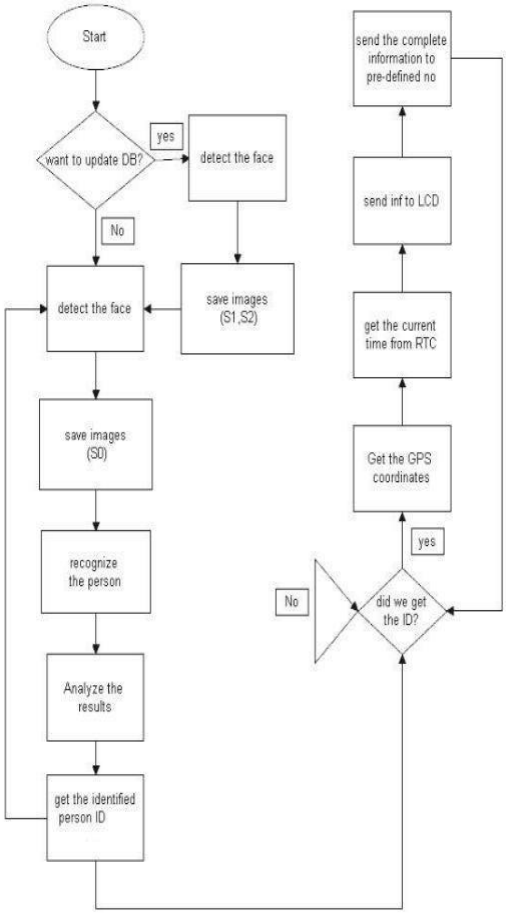


3. Interaction Diagrams

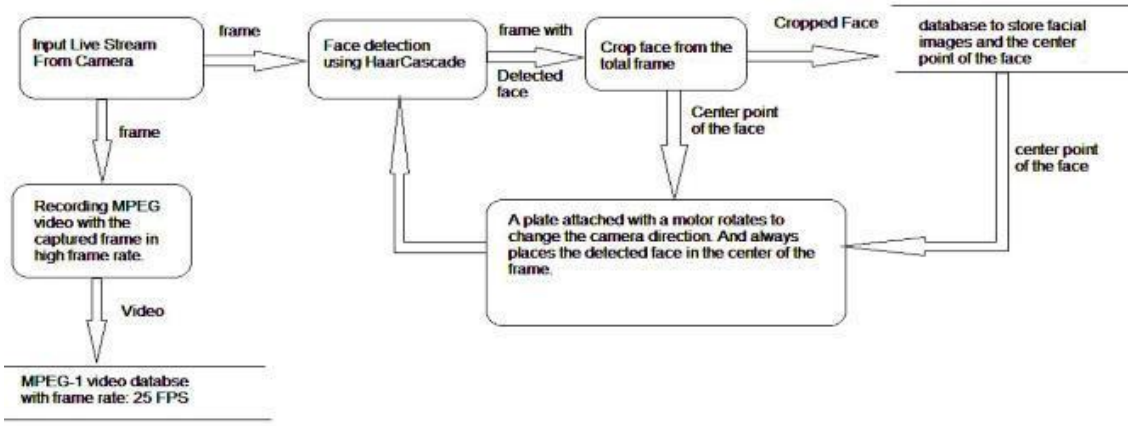
a. Communication Diagram



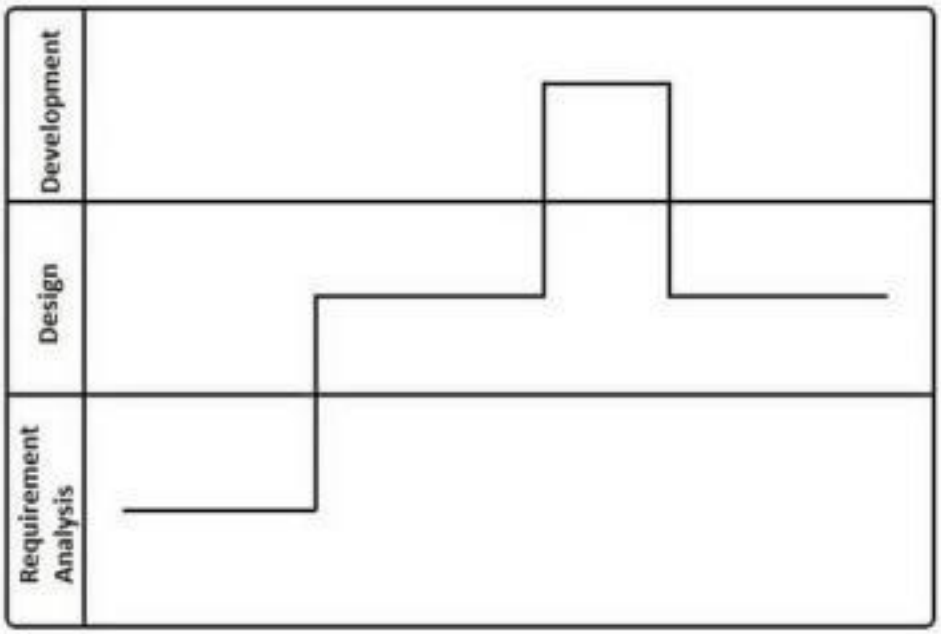
b. Interaction Diagram



c. Dataflow Diagram



d. Timing Diagram



Test Cases

Pre-conditions: User has input minimum 5 images.

Test Case ID: Test_Case_1

Test Priority (Low/Medium/High): Med

Module Name: Criminal Face Input

Test Title: Face Input

Description: Take input of various images of Criminal for training

Test Designed by: Sangat Baral

Test Designed date: Sharad Bastola

Test Executed by: Bhaibav Singh

Test Execution date: 29th February

Test Case ID: Test_Case_2

Test Priority (Low/Medium/High): High

Module Name: Training Face Patterns

Test Title: Face Training Algorithm

Description: T
neural network

Test Designed by: Sangat Baral

Test Designed date: Sharad Bastola

Test Executed by: Bhaibav Singh

Test Execution date: 10th March

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to input page	example@gmail.com	User should be able to login	User is navigated to	Pass	
2	Provide valid username	Password: 1234		dashboard with successful		
3	Provide valid password	Uppercase and Lowercase including numbers		login	Pass	
4	Fill the Criminal Info	Name, Age, Sex, Photo, Father's Name, Mother's Name, DOB	The database of a particular criminal	Result stored in database	Pass	

Post-conditions:

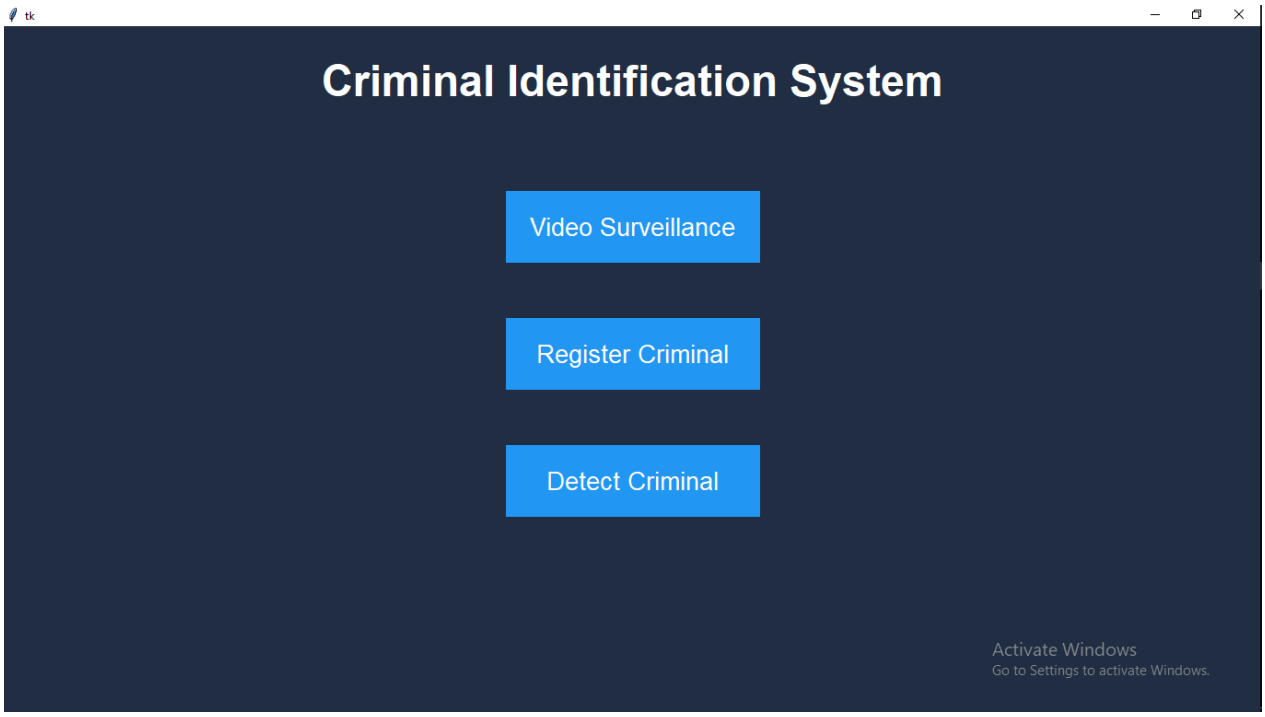
User is validated with database and successfully login to account. The database contains the criminals face features and patterns

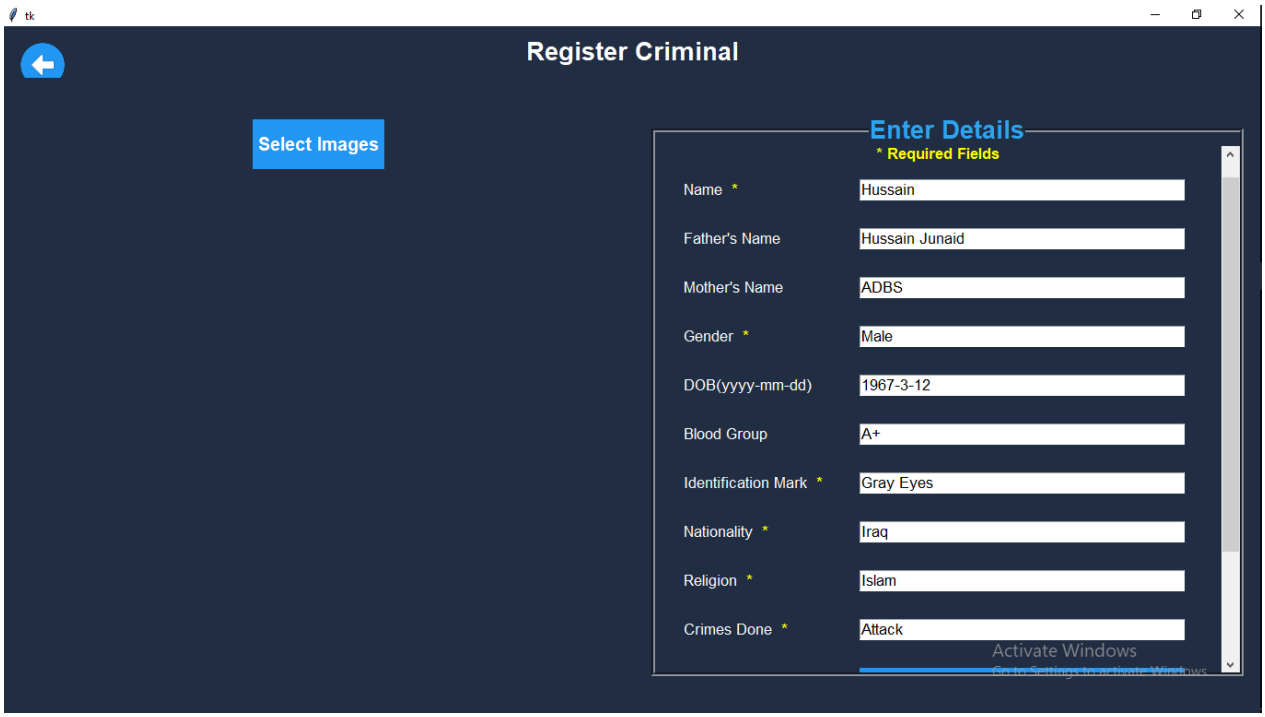
Pre-conditions: User needs the clear image of the person from a reliable source. Nice angles photos if possible
Dependencies:

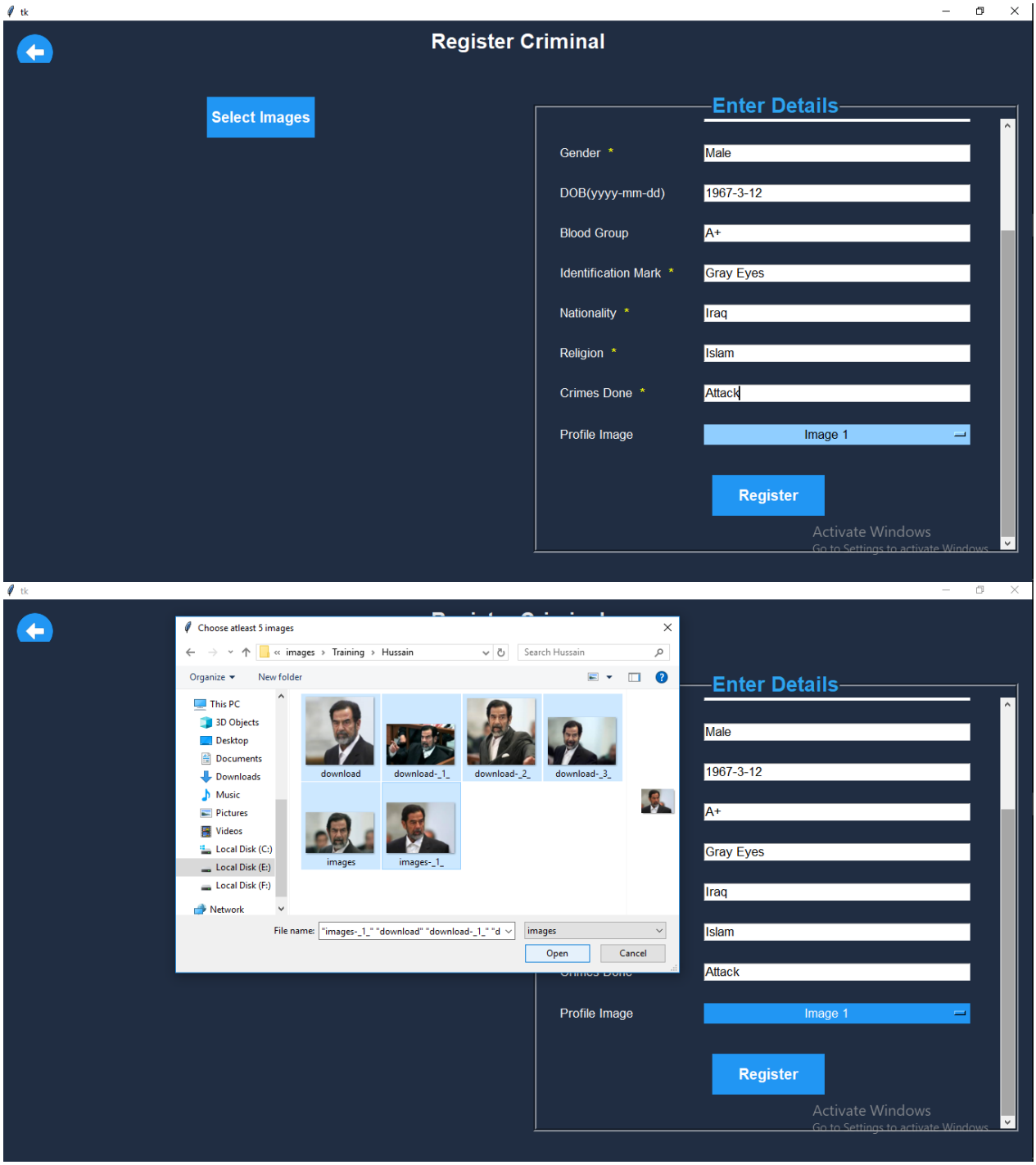
Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Input the potetntial criminal faces	The input image from camera	Compare the patterns with this image	Comparison	Pass	
2	Test the similarities among the pictures	Pattern from input image	Number of similarities	Similar or not	Pass	
3	Input other similar sample image to make sure	Image of the suspect from different angle	Same patterns similarities	Final recognization	Pass	
4	Finalize	All collection of criminal images	Same face detection	The face of criminal is same as the sample face	Pass	

Post-conditions:
User is validated with database and successfully detected the face.

Implementation Screenshots






tk
Register Criminal
Select Images
Enter Details
Gender *
Male
DOB(yyyy-mm-dd)
1967-3-12
Blood Group
A+
Identification Mark *
Gray Eyes
Nationality *
Iraq
Religion *
Islam
Crimes Done *
Attack
Profile Image
Image 1
Register
Activate Windows
Choose atleast 5 images
images › Training › Hussain
Search Hussain
Organize
New folder
This PC
3D Objects
Desktop
Documents
Downloads
Music
Pictures
Videos
Local Disk (C:)
Local Disk (E:)
Local Disk (F:)
Network
download
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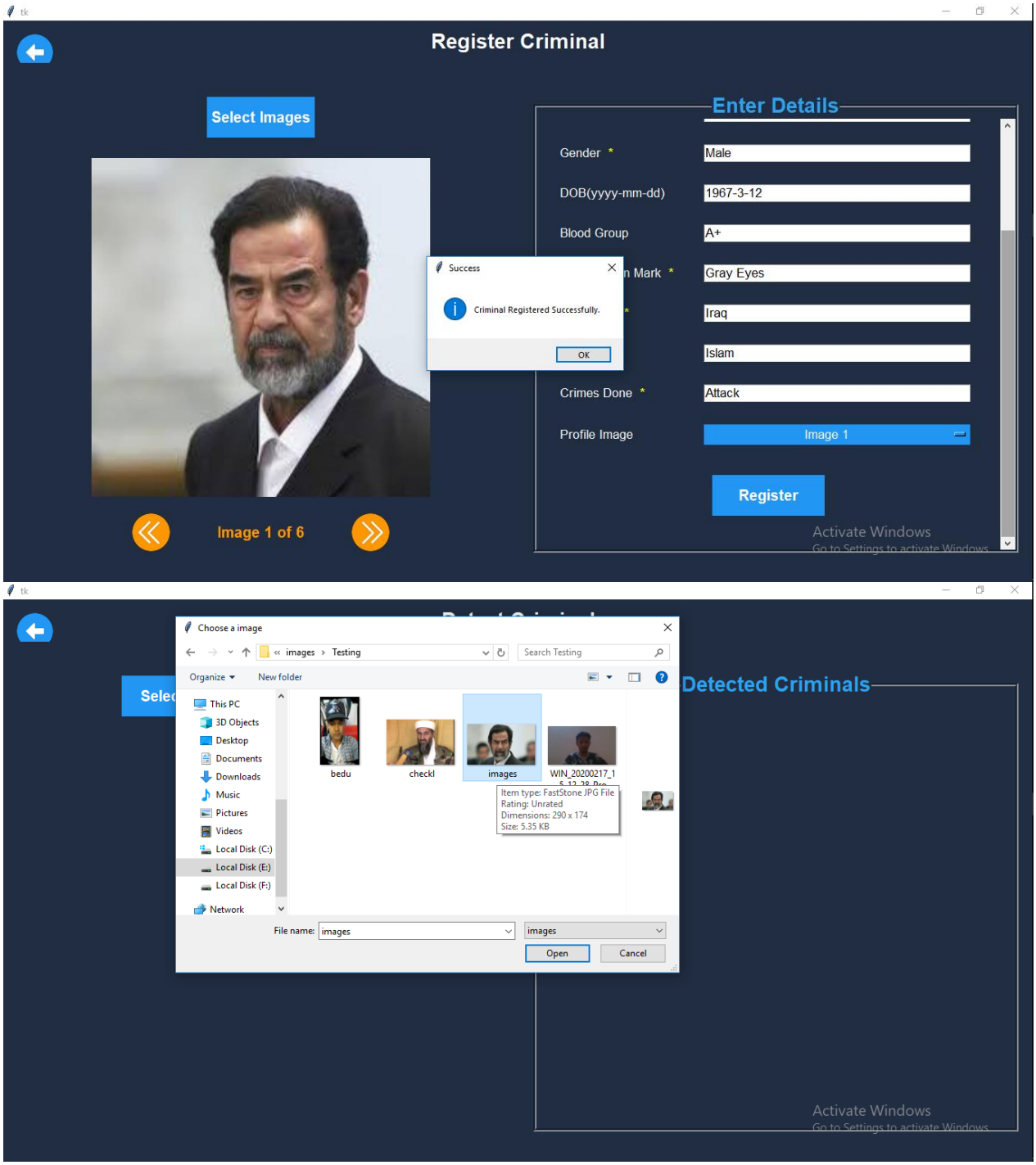
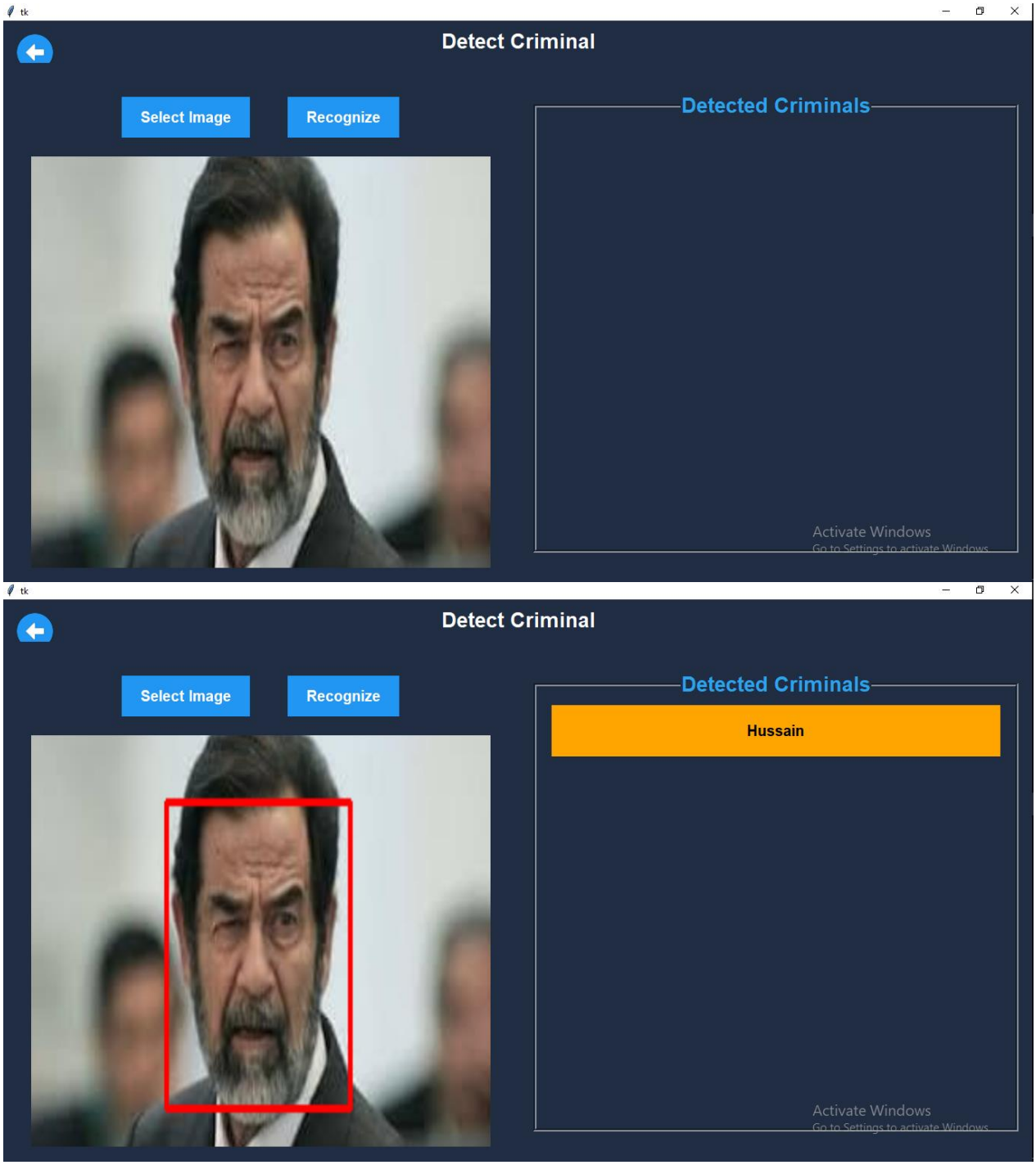
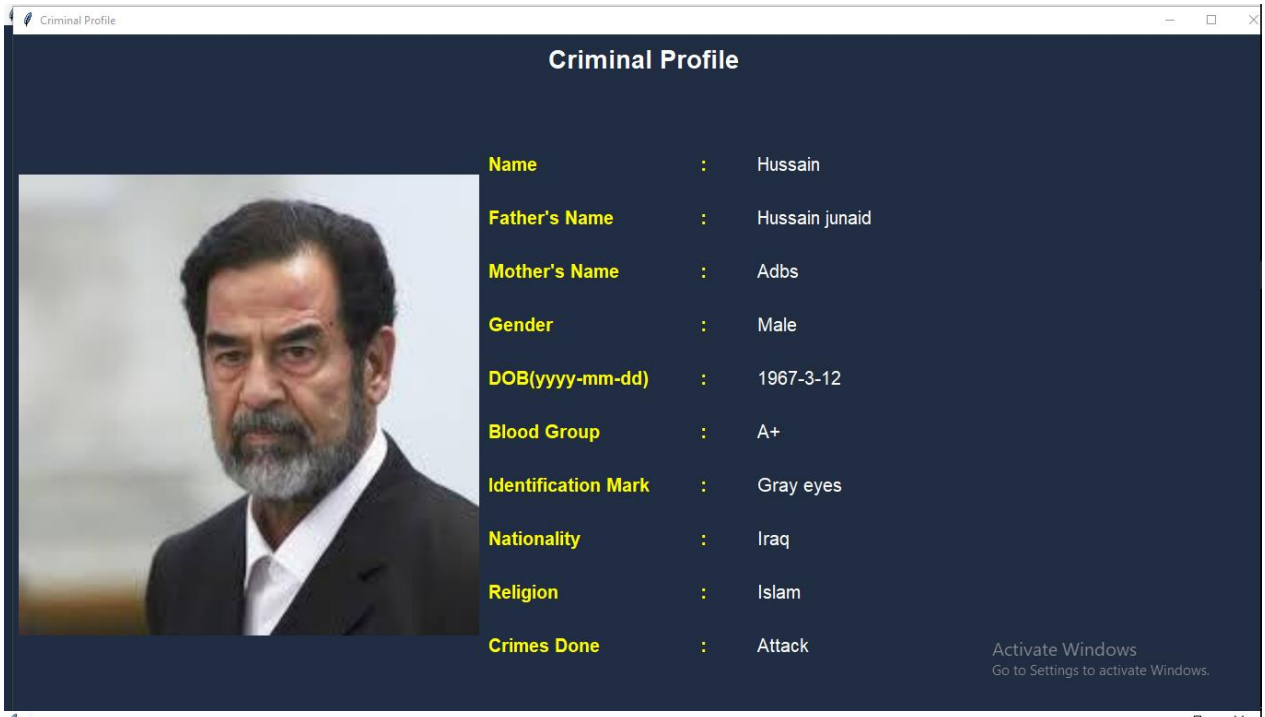
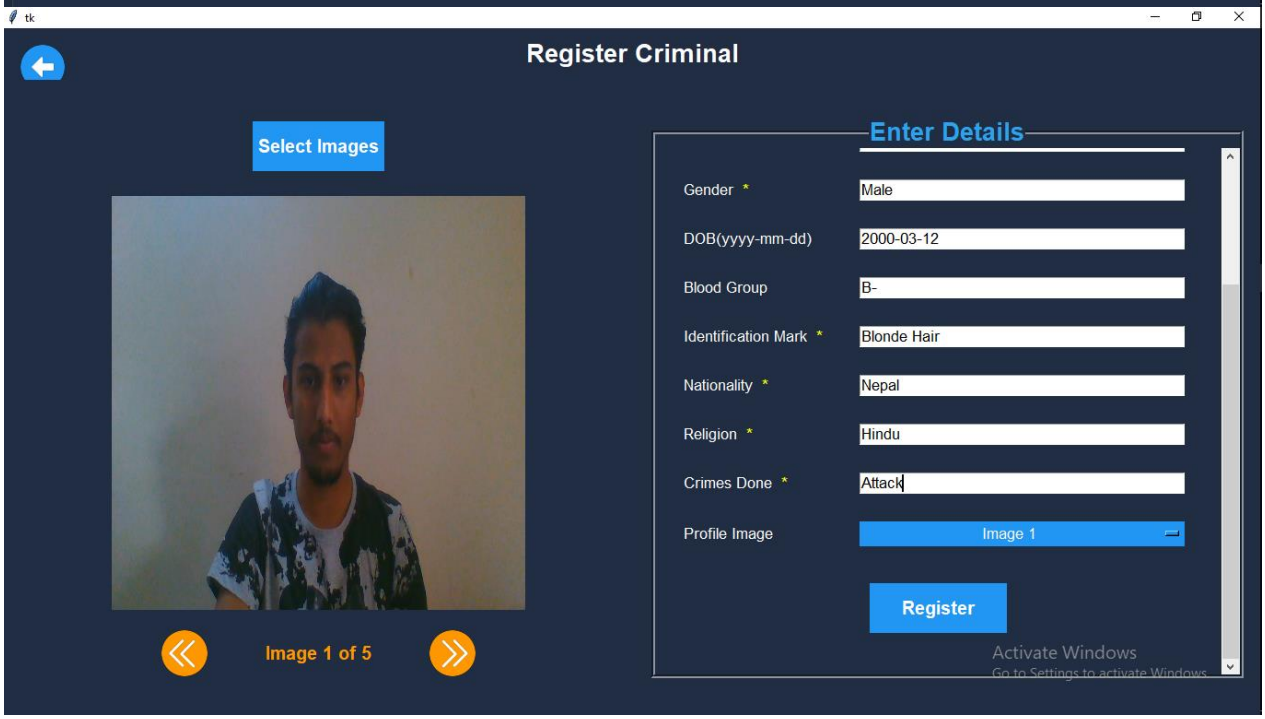
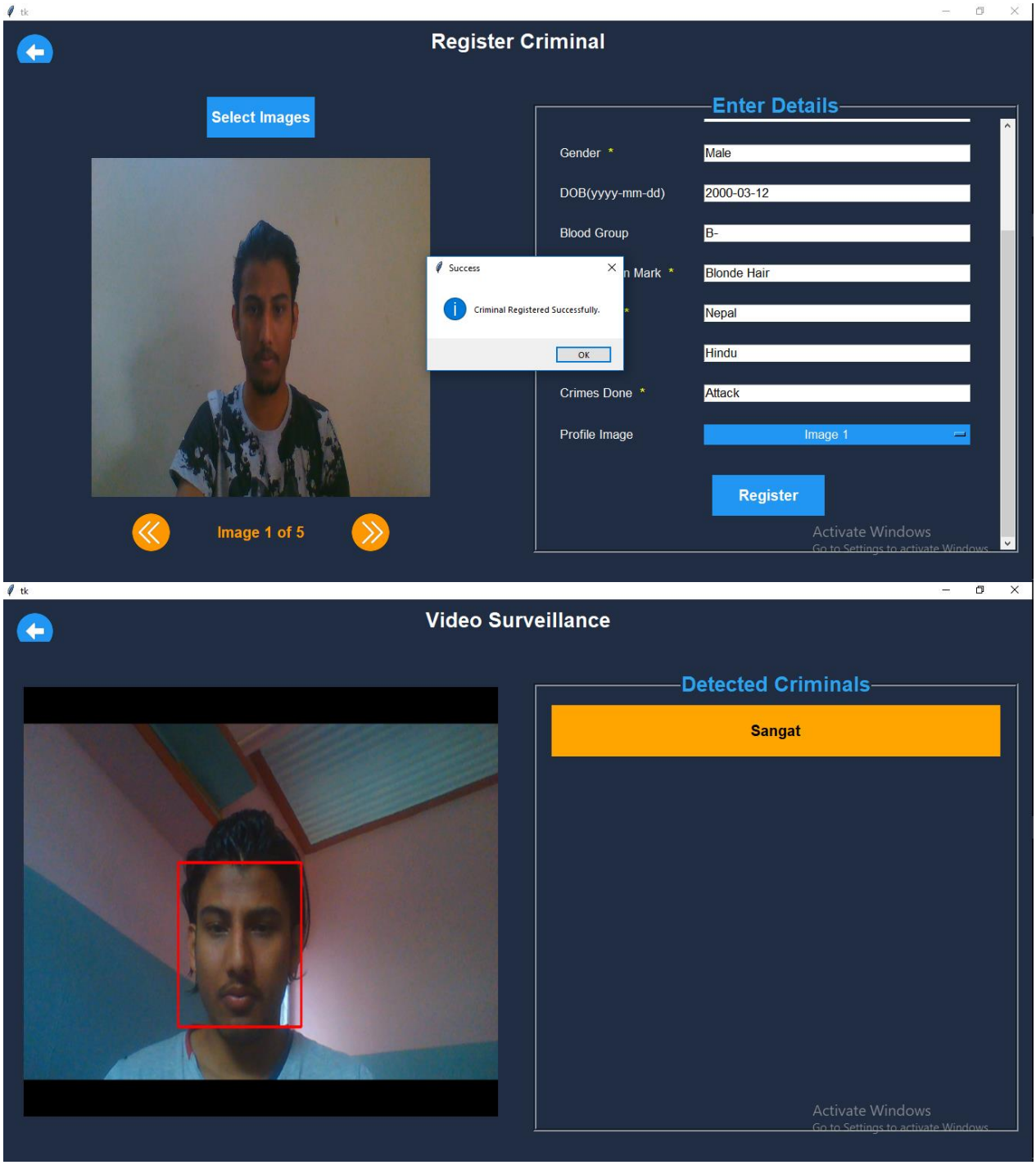
images-_1_
File name: "images-_1_" "download" "download-_1_" "d
images
Open
Cancel

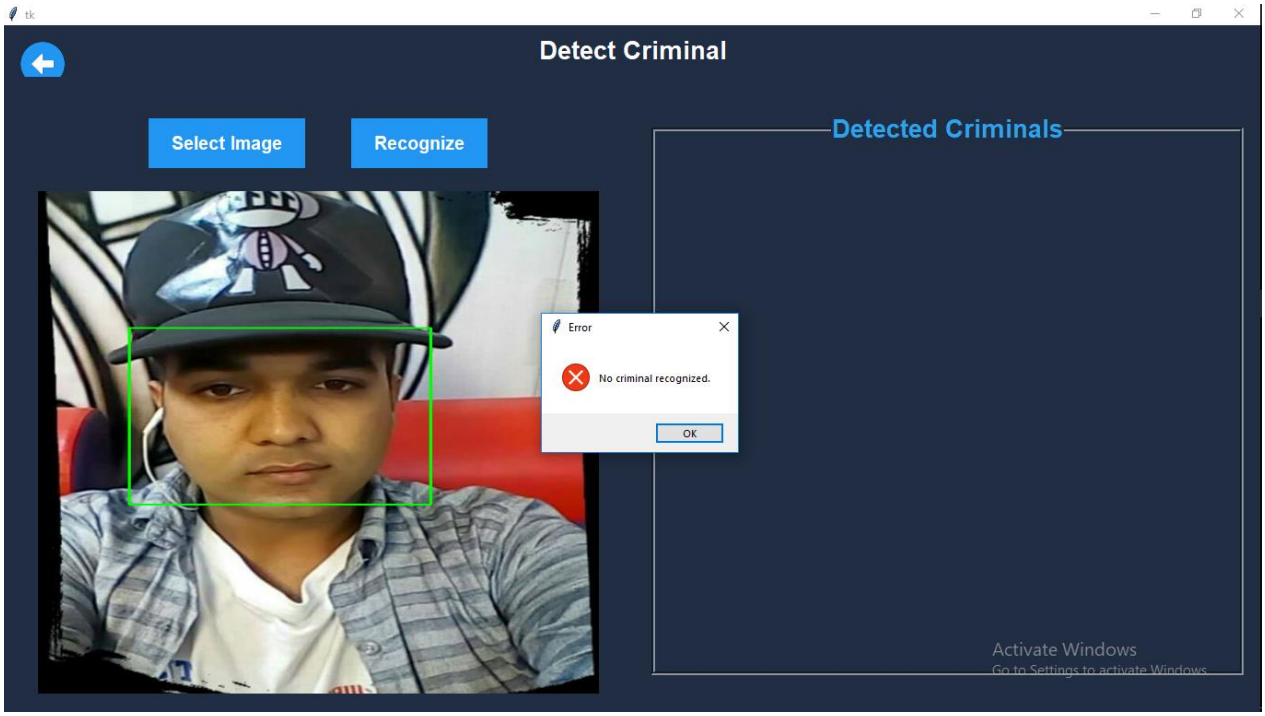

Register Criminal
Select Images
Image 1 of 6
Enter Details
Gender *
Male
DOB(yyyy-mm-dd)
1967-3-12
Blood Group
A+
Gray Eyes
Iraq
Islam
Crimes Done *
Attack
Profile Image
Image 1
Register
Success
Criminal Registered Successfully.
OK
Choose a image
images › Testing
Search Testing
Organize
New folder
This PC
3D Objects
Desktop
Documents
Downloads
Music
Pictures
Videos
Local Disk (C:)
Local Disk (E:)
Local Disk (F:)
Network
bedu
checkl
images
Item type: FastStone JPG File
Rating: Unrated
Dimensions: 290 x 174
Size: 5.35 KB
File name: images
Open
Cancel
Detected Criminals
Activate Windows


tk
Detect Criminal
Select Image
Recognize
Detected Criminals
Activate Windows
Go to Settings to activate Windows.
tk
Detect Criminal
Select Image
Recognize
Detected Criminals
Hussain
Activate Windows
Go to Settings to activate Windows.


Criminal Profile
Criminal Profile
Name : Hussain
Father's Name : Hussain junaid
Mother's Name : Adbs
Gender : Male
DOB(yyyy-mm-dd) : 1967-3-12
Blood Group : A+
Identification Mark : Gray eyes
Nationality : Iraq
Religion : Islam
Crimes Done : Attack
Activate Windows
Go to Settings to activate Windows.


tk
Register Criminal
Select Images
Image 1 of 5
Enter Details
Gender * Male
DOB(yyyy-mm-dd) 2000-03-12
Blood Group B-
Identification Mark * Blonde Hair
Nationality * Nepal
Religion * Hindu
Crimes Done * Attack
Profile Image Image 1
Register
Activate Windows
Go to Settings to activate Windows.


Register Criminal
Select Images
Image 1 of 5
Enter Details
Gender *
Male
DOB(yyyy-mm-dd)
2000-03-12
Blood Group
B-
Blonde Hair
Nepal
Hindu
Crimes Done *
Attack
Profile Image
Image 1
Register
Success
Criminal Registered Successfully.
OK
Activate Windows
Video Surveillance
Detected Criminals
Sangat
Activate Windows



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