VIDEO MINING

Software Design Document

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VidiMi - CS305

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Table of Contents

1. Introduction

1.1 Purpose

Face detection and video surveillance systems have been used in various domains since the last few decades such as crime prevention, human behavior understanding, identifying hazardous actions, traffic monitoring, attendance systems, etc.

1.2 Scope

The software is a web-based application that can be used for various purposes such as surveillance, monitoring people, detection of people in the photo and hazardous activities, etc.

The database will contain all the photos with a person's ID linked to it. This can be expanded by the user. This database will be linked to the surveillance system to monitor people. This will prove beneficial in tracking criminals and also can be used for automatic attendance marking system.

1.3 Overview

This document contains the architectural design of the project. It has the UML diagrams, context diagram, data flow diagram, deployment diagram and various decisions that led to choosing the described softwares for the development of the project. It contains the description of software which were used why they were used over other prominent softwares for the same task.

2. SYSTEM OVERVIEW

This product will be developed in two parts. One will be an API and others will be a GUI. The API can be incorporated with other software. The GUI will be a standalone web application that can be accessed by end-users.

The API can be used in a larger project whose core idea is face detection/IDing in a photo or a video.

Product Functions

Major functions that the product provides to the user:

- Just to identify the individual in a photo.
    - Option to upload a zip file of photos of a person/object to be detected.
    - Option to upload a photo in which the individual has to be identified.
    - A button to submit the uploaded items.
- Just to identify an individual in a video.
    - Option to upload a zip file of photos of a person/object to be detected.
    - Option to upload a video in which the individual has to be identified.
    - A button to submit the uploaded items.
- To ID all the people in the uploaded photo/video or detect a person in the photo/video using the ID.

Major functions that the product provides to the administrator in the API:

- Option to connect a database of photos and IDs with the API for which the client wants to operate.
- Feature to search individuals in video or photo who exist in the connected database based on the photos or IDs.
- Option to alter the database.

3. SYSTEM ARCHITECTURE

3.1 Architectural Design

This project is divided into 2 parts:-

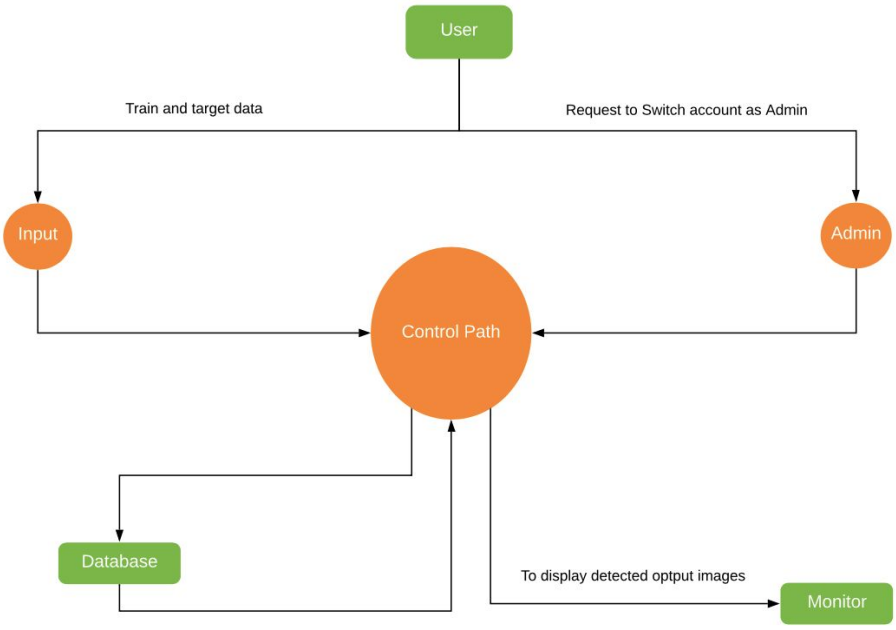
- GUI (Web Application)
- API (Provided to the client)

The GUI part is a demonstration of the API. The web application user will be provided with basic three functions :

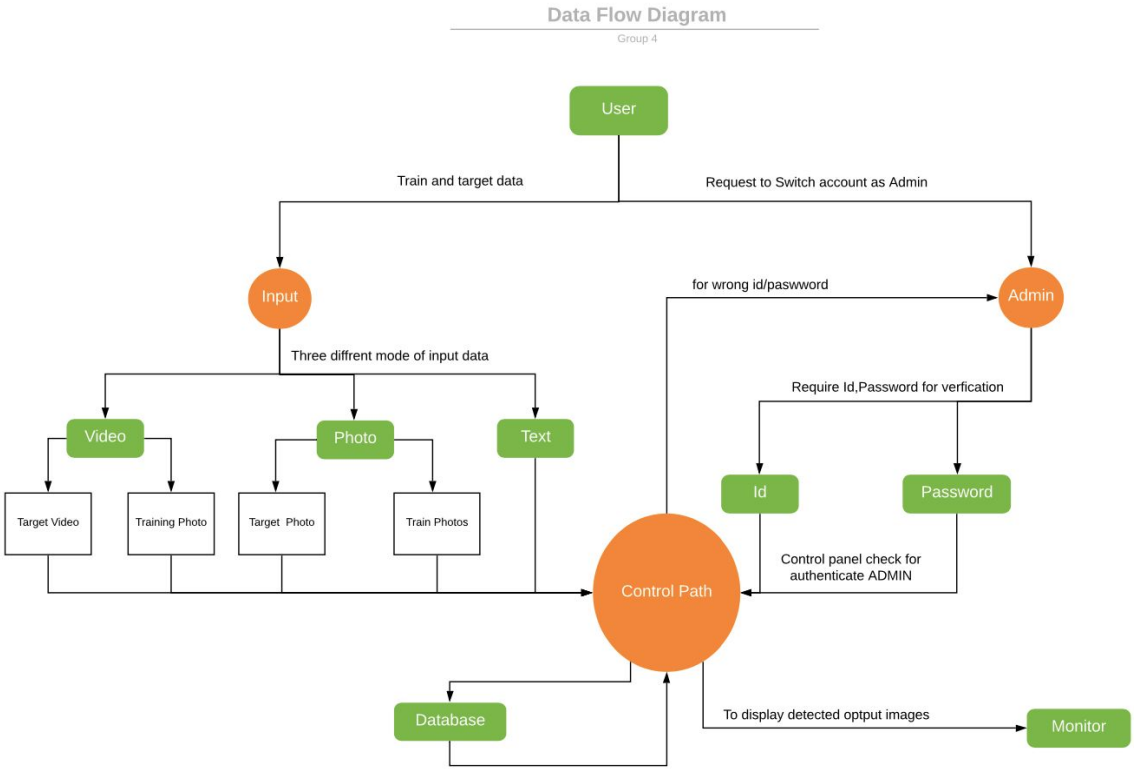
A. Detecting the person in given set of video or photo.
B. To get the information of a particular person from the database using some set of images.
C. To detect hazardous activity from a given set of videos.

3.2 Decomposition Description

Level 0 Data Flow Diagram:-



Level 1 Data Flow Diagram:-



ADMIN:

Authentication for admin is required for that it needs ids and passwords which will be verified by CONTROL PATH using DATABASE.

INPUT:

We are Handling three cases

- Detect object in an image for that we are required
    - set of train images
    - target image
- Detect object/person in an frame of video for that we are required
    - set of train images
    - target video frame.
- Search in database using text/id for that we require
    - Text field

CONTROL PATH:

This act as brain of our system which take decisions and do following works:

- Authenticate Whether the given user is admin or not.
- Take input (text) and search in database and give output to monitor.
- Take photos (trained) and check whether the object/person is present in given photo(target)

DATABASE:

It contain following things

1. Id and password of ADMIN.
2. Photos of objects/people with their id's.

MONITOR:

We are Handling three cases

- Detect object in an image and the output is
    - Monitor will show the target image with the encircled face of detected object/person.
    - If nothing is detected then it will show a text "NOTHING FOUND".
- Detect object/person in an frame of video for that we are required

    - It will show the images (screenshot from video) with the encircled face of the detected object/person.
    - The timing at which given subject is present.
    - If nothing is detected then it will show a text “NOTHING FOUND”.
- Search in database using text/id for that we require
    - Monitor will show the image with the encircled face of the detected by checking in database
    - If nothing is detected then it will show a text “NOTHING FOUND”.

3.3 Design Rationale

- **Python Modules/Libraries:**

Using PyImageSearch and scikit-learn python libraries along with:

Option Selected: OpenCV-DNN (Deep Neural Network) (Very fast on GPU)

Pros:

- It has high value on the accuracy scale.
- It is fast and can detect variable size of faces in image (can detect small faces in image).
- Detects faces at various angles.

Option Rejected: Dlib HoG (fastest method on CPU)

Cons: It can’t detect small faces (< 70*70) in images. As we will not know what the size of the faces are in video feed or images it will be detrimental to the scope of the project.

Option Rejected: The OpenCV Haar Cascade Face detector method.

Cons: It is slower than the option chosen as well as less accurate.

- ***Coding Platform (Editor):***

Option Selected: VSCode

Pros:

- It is an Open Source software and available on Windows, Ubuntu and macOS.
- Auto-completion for variable types, function definitions, and imported modules.
- Debugging with breakpoints, call stacks, and interactive console.

Option Rejected: Sublime Text

Cons:

    - No package manager.
    - The Software Package which offers complete features is paid.

- ***Database:***

Option Selected: PostgreSQL

- *Pros:*
    - Postgres has a strongly typed schema that leaves very little room for errors
    - You can change tables in PostgreSQL without requiring to lock it for every operation.
    - Postgres stores information more efficiently and data isn't unnecessarily duplicated across tables.

Option Rejected: MongoDB

Cons: Documents in the same collection (aka table in the old world) do not need to have the same set of fields or structure, and common fields in a collection's documents may hold different types of data. It puts a very high degree of responsibility on developers' shoulders to get things right. This can lead to duplication of data if not handled properly.

- ***Server*:**

Option Selected: Apache

Pros:

- Processes dynamic content within a server.
- Allows additional configuration on a per-directory basis via .htaccess files.
- It fully supports windows.
-

Option Rejected: NGINX

Cons:

- It does not process dynamic content.
- Doesn’t allow additional configuration.
- Supports windows partially.

- **HTML5 and CSS:** It helps in designing and styling the web page.
- **JAVASCRIPT**: JavaScript is a text-based programming language used both on the client-side and server-side that allows you to make web pages interactive. This will make the website more dynamic and less dependent on the server.

4. DATA DESIGN

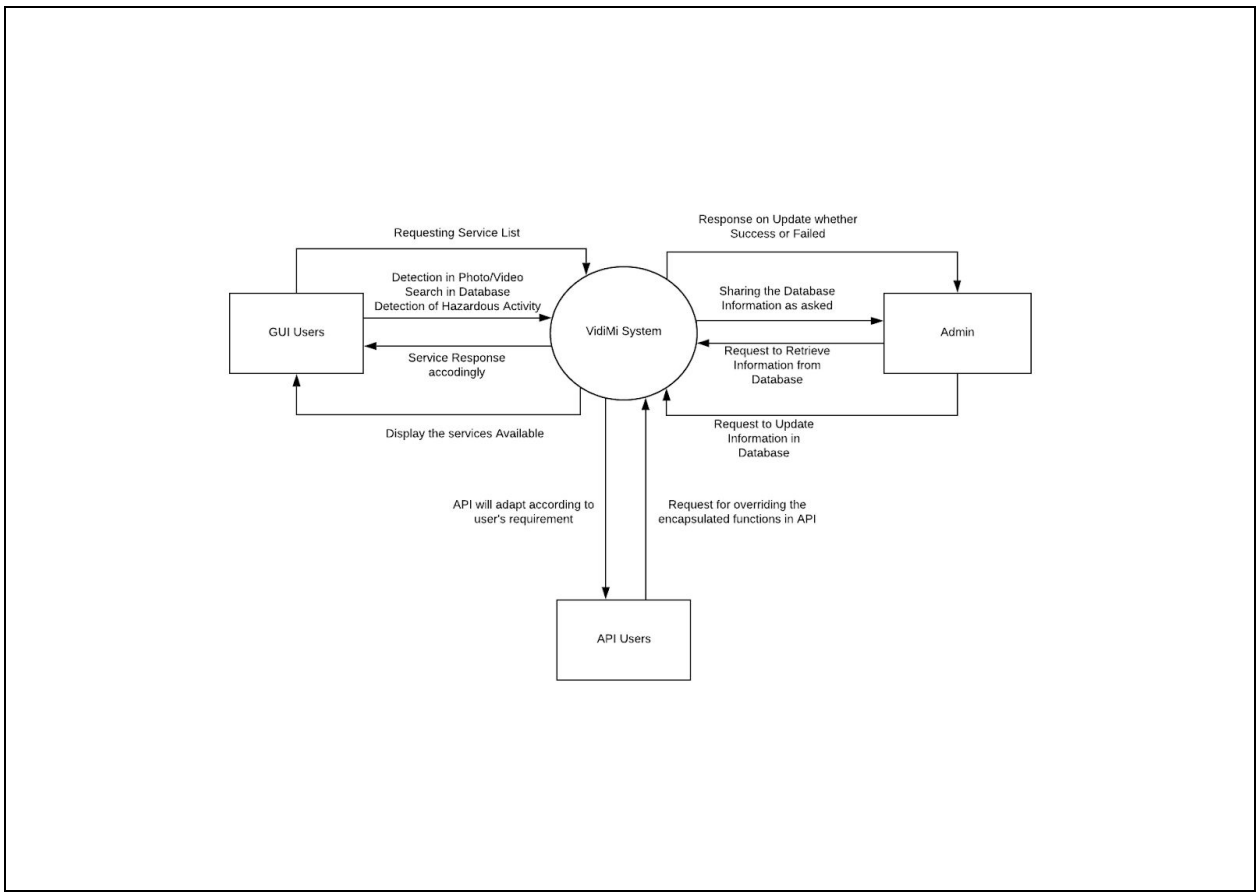
4.1 Data Description

Database is required to store the IDs of the pre-trained image sets (metadata). It will also be used to temporarily store the uploaded zip file and the target image/video.

5. CONTEXT DIAGRAM

A system context diagram (SCD) in engineering is a diagram that defines the boundary between the system, or part of a system, and its environment, showing the entities that interact with it. This diagram is a high level view of a system. It is similar to a block diagram.

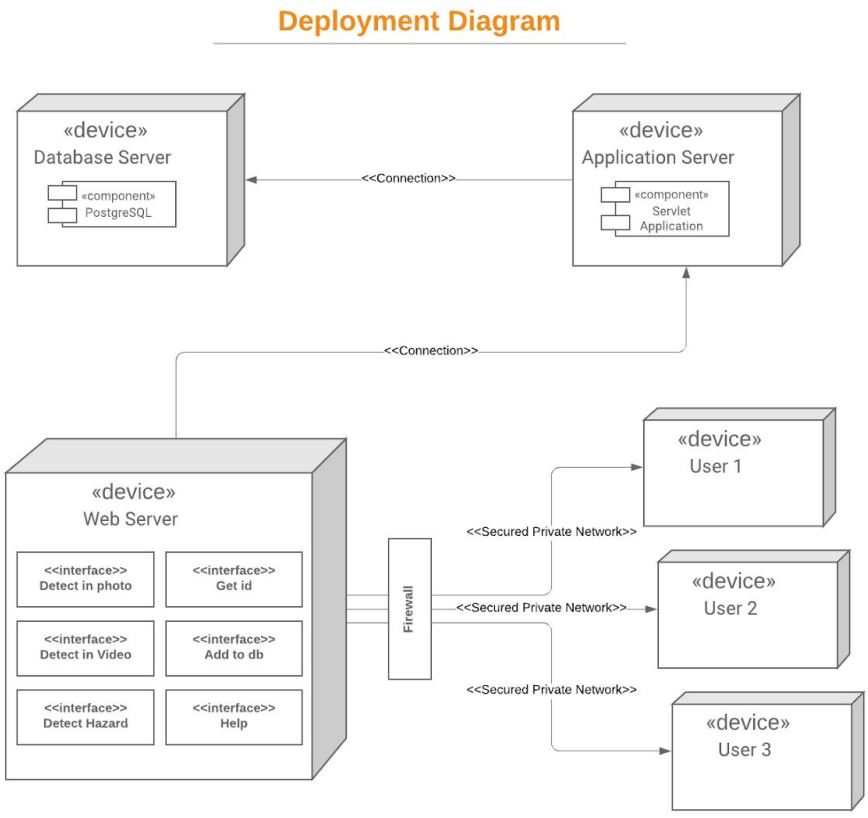
Reference: https://en.wikipedia.org/wiki/System_context_diagram



6. DEPLOYMENT DIAGRAM

Deployment diagrams are used to visualize the topology of the physical components of a system, where the software components are deployed.Deployment diagrams are used to describe the static deployment view of a system. Deployment diagrams consist of nodes and their relationships.
In this Deployment Diagram we are visualizing the overall working of our system. The system is going to be used by various users through a web server . All the users will get various functionalities such as Detection in photo, Detection the hazardous activity etc. Now according to the user need the respective request will be going to Application Server to get a post request.After this the Database Server will be going to help in the sending and storing the data to web server.

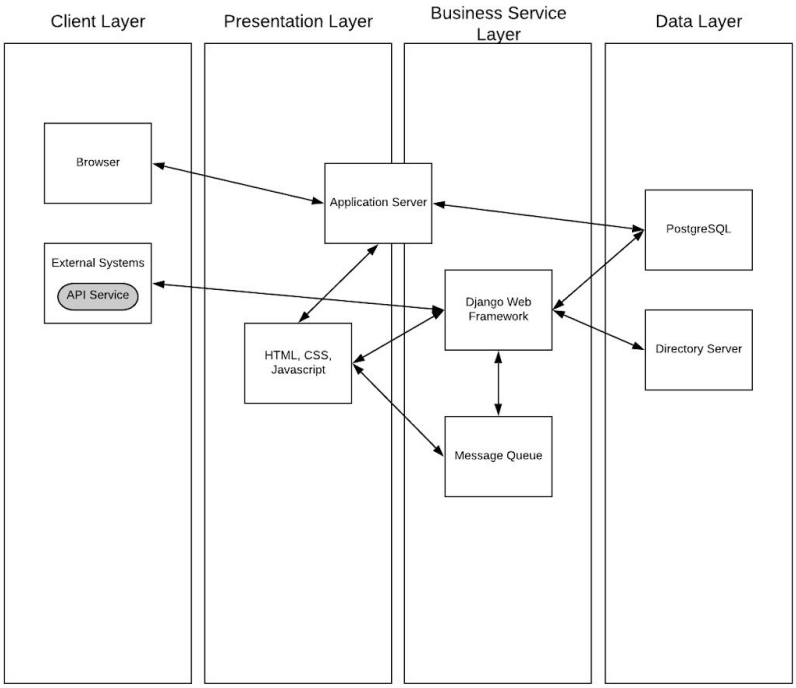
Reference: https://www.tutorialspoint.com/uml/uml_deployment_diagram.htm



7. LOGICAL STRUCTURE DIAGRAM

Logical structure refers to the way information in a document is organized; it defines the hierarchy of information and the relation between different parts of the document.
Logical structure is mainly used in the context of XML document to distinguish the logical organization of the content from its physical organization, to distinguish the flow of content from the documents layout and from the presentation of the document.

Reference: https://link.springer.com/referenceworkentry/10.1007%2F978-0-387-39940-9_213

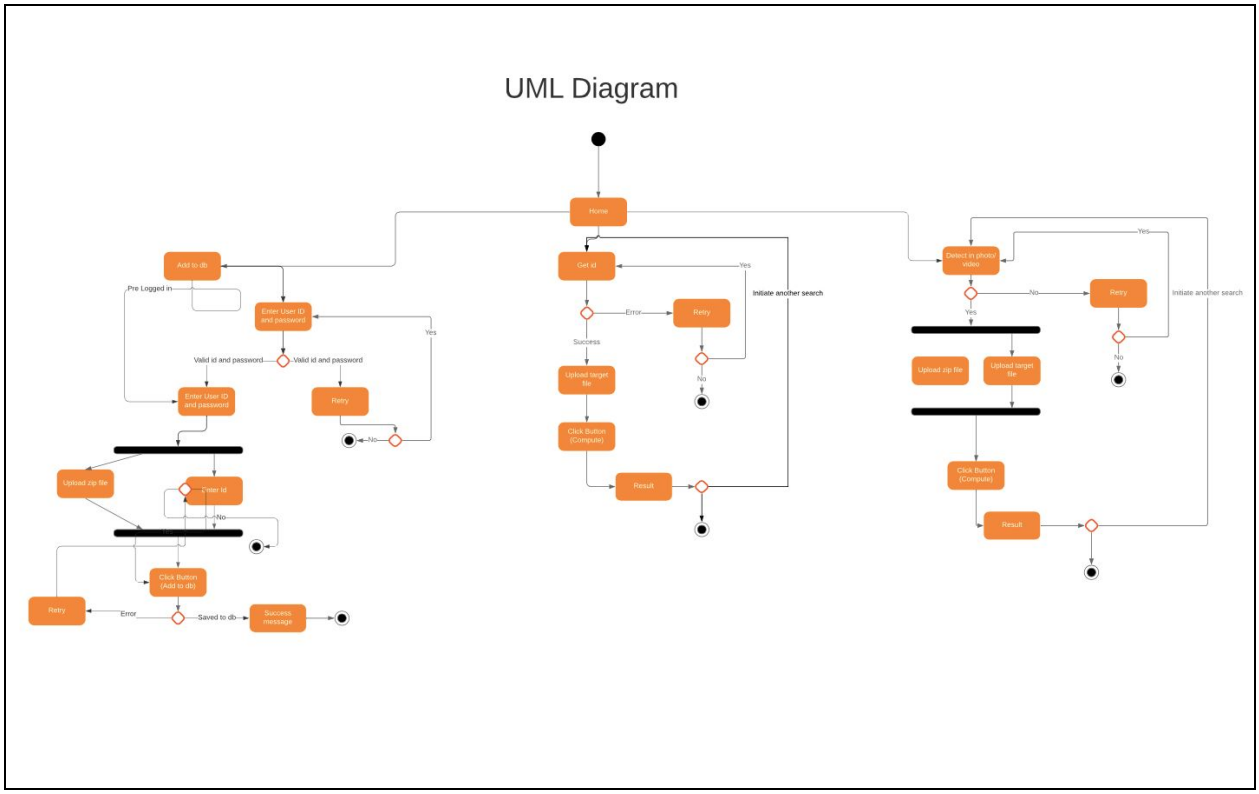


8. UML DIAGRAM

Unified Modeling Language (UML) is a general purpose modelling language. The main aim of UML is to define a standard way to visualize the way a system has been designed. It is quite similar to blueprints used in other fields of engineering.
UML is not a programming language, it is rather a visual language. We use UML diagrams to portray the behavior and structure of a system. UML helps software engineers, businessmen

and system architects with modelling, design and analysis. The Object Management Group (OMG) adopted Unified Modelling Language as a standard in 1997. Its been managed by OMG ever since. International Organization for Standardization (ISO) published UML as an approved standard in 2005. UML has been revised over the years and is reviewed periodically.

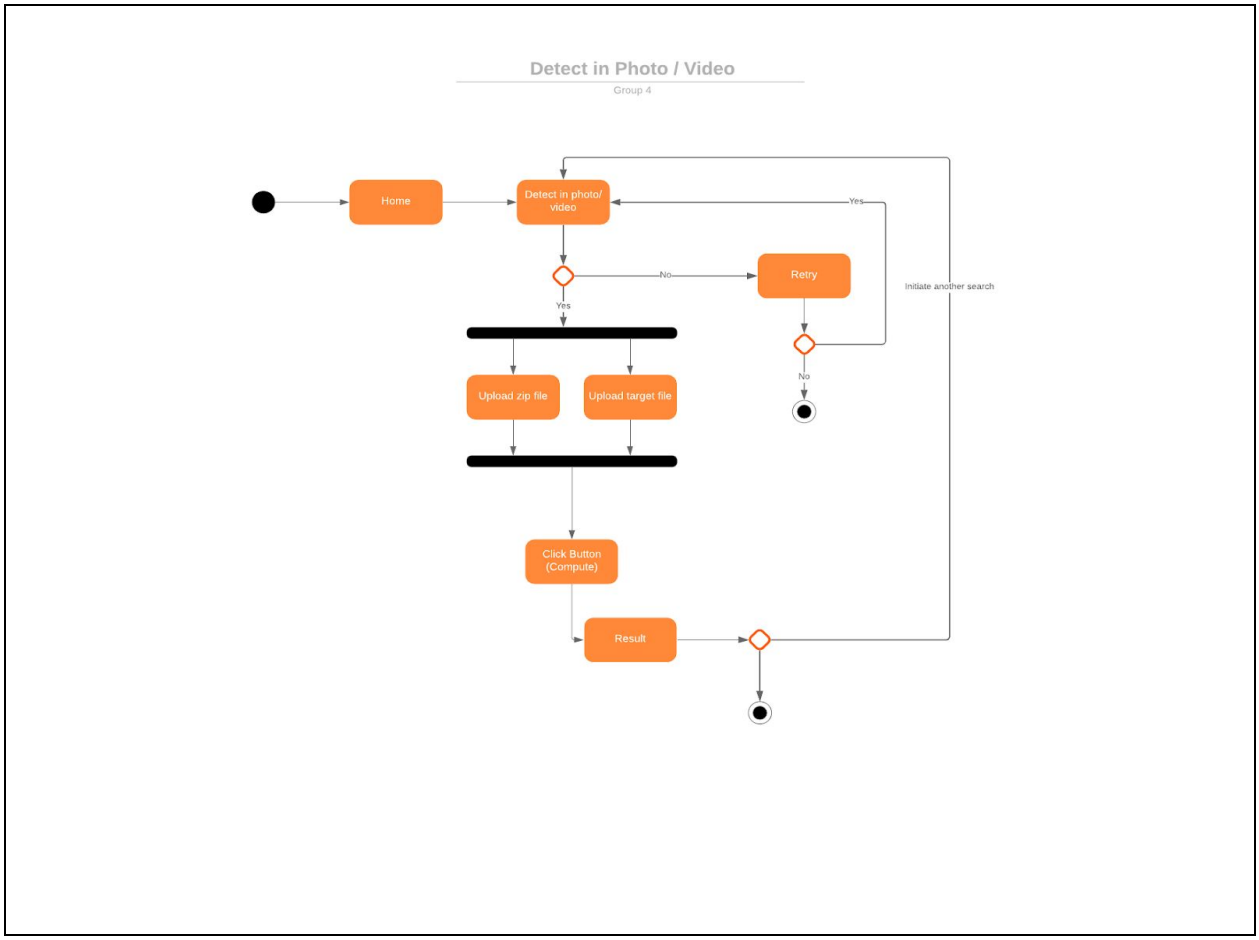
Reference: https://www.geeksforgeeks.org/unified-modeling-language-uml-introduction/



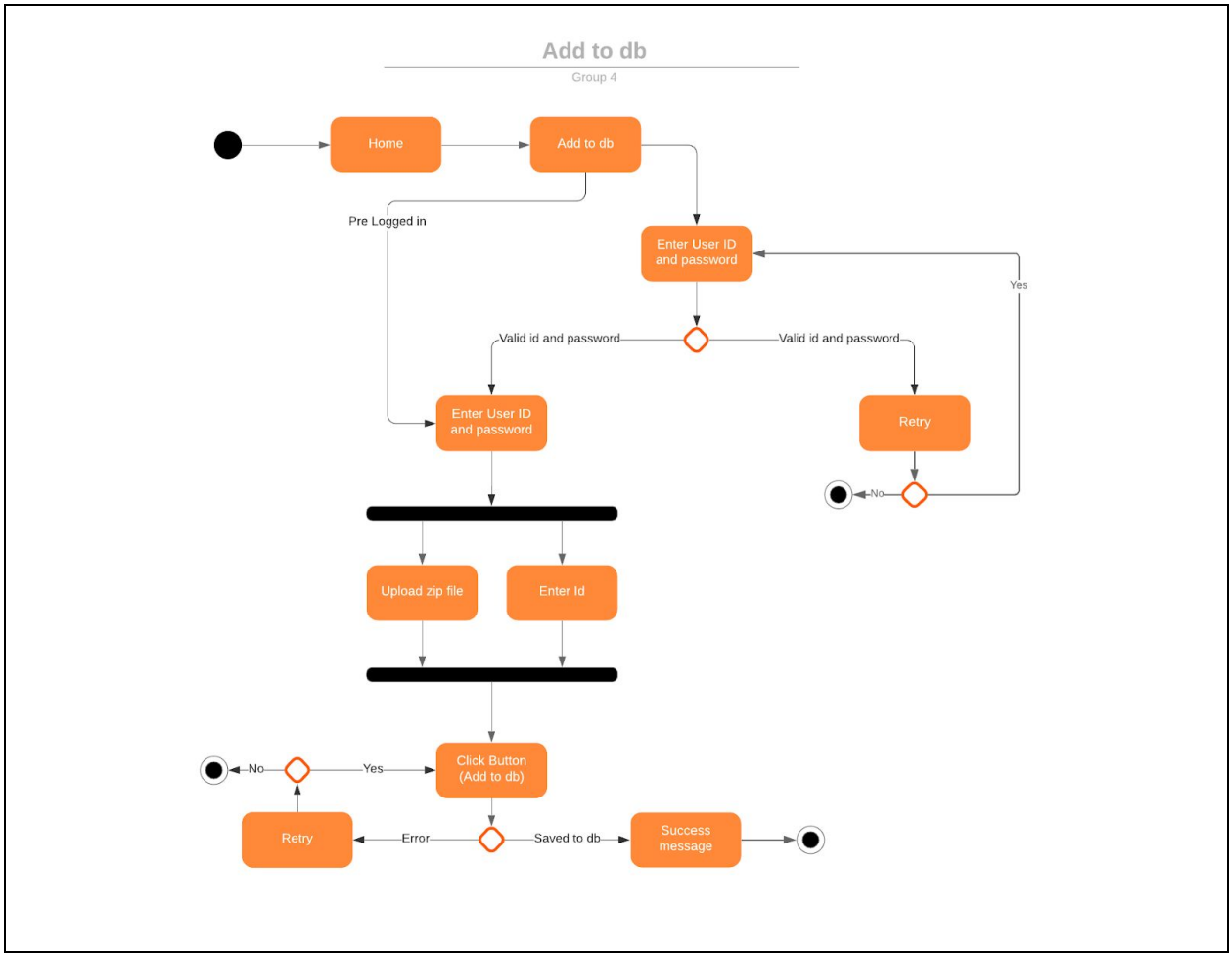
PREVIEW

UML Diagrams of Use cases:

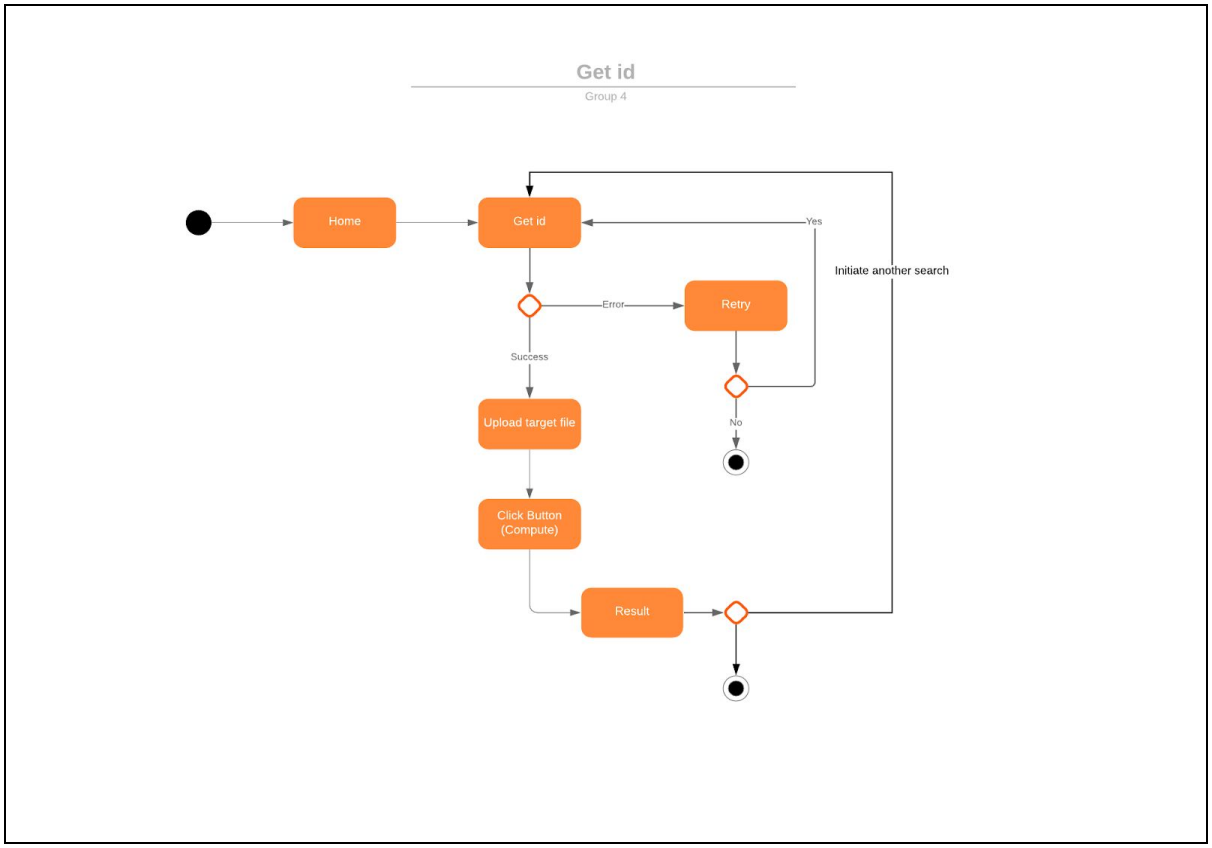
1. Detect In Photo/Video:



2. Add data to Database



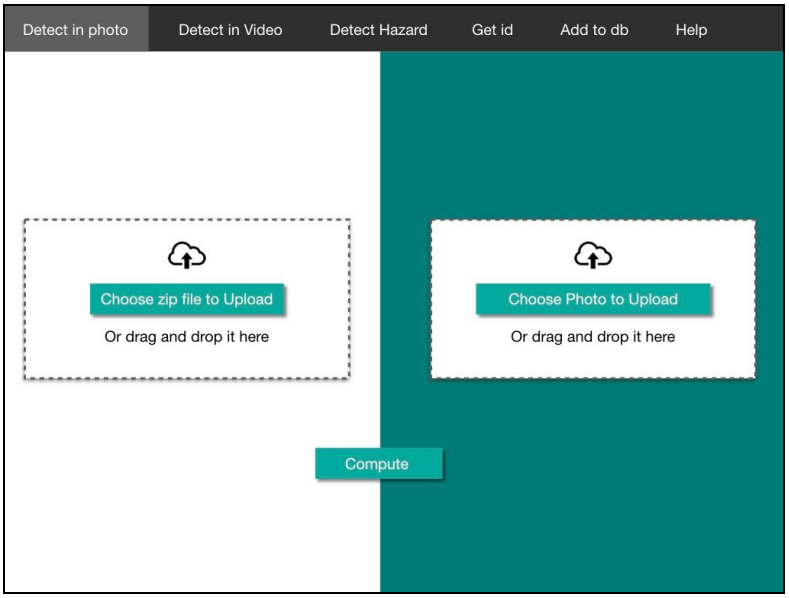
3. To get the information of a particular person from the database using some set of images.



9. HUMAN INTERFACE DESIGN

9.1 Overview of User Interface

To Detect In Photo:

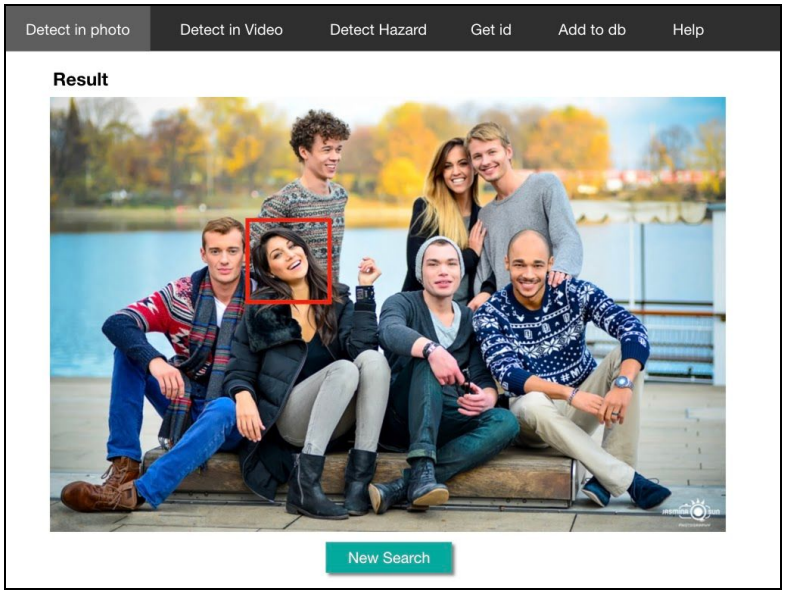


Choose zip file to upload: To open the default dialogue box of the User's system to upload a zip file on the web application.

Choose photo to upload: To open the default dialogue box of the User's system to upload photos on the web application.

Compute: To send the uploaded files to the server.

Search Result of Detect in Photo:



New Search: To start a new search.

For all the cases of the web pages, refer to the Software Requirement Specification document.