SYSTEM DESIGN DOCUMENT

For

Project no. 7

Classroom Visualization App1

Team no. 16

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1.Introduction

This document contains the complete design description of the Classroom Visualization App1. This includes the architectural features of the system down through details of what operations each module will perform and the database layout. In short, this document is meant to equip the reader with a solid understanding of the inner workings of the Classroom Visualization App1.

1.1 Purpose

The purpose of this software design document is to provide a low-level description of the Classroom Visualization App1, providing an insight into the structure and the design of each component. It also shows how the function detailed in the SRS will be implemented in the system using this design.

1.2 Scope

It is assumed that the reader has read the SRS, since this document also defines the implementation details of the desired behaviour given the requirements within it. The Classroom Visualization App1 system is a user-side application that receives user's video. It detects the faces in it, recognizes the students present in the class and displays colour coded boxes around their faces. This app can also be used to take attendance. The system is based on image processing and machine learning.

1.3 Definitions, Acronyms and Abbreviations

- **DFD**: Data Flow Diagram. A data flow diagram is a graphical representation of the "flow" of data through an information system, modelling its process aspects. A DFD is often used as a preliminary step to create an overview of the system without going into detail.
- **ERD**: Entity Relationship Diagram. An entity relationship diagram shows the relationships of entity sets stored in a database. An entity in

this context is a component of data. In other words, ER diagrams illustrate the logical structure of databases.

- **Process Decomposition Diagram:** It explains the breakdown of processes within a project or business area or functional area. The purpose is to show all the processes and identify relationships and dependencies among them.

1.4 References

- Tools for creating diagrams
  - Lucidchart.com
- Other Sources for reference
  - 1.R. S. Pressman, Software Engineering: A Practioner's Approach, 7th Ed., McGraw Hill, 2010.
  - http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Soft%20Engg/New_index1.html

1.5 Overview

The remaining chapters and their contents are listed below.

- Section 2 - Design Rationale which captures the reasoning of the designer that led to the system as designed and the justifications of those decisions.
- Section 3 - Use Cases depicting actions or event steps that typically defines the interactions between a role (known as an actor) and a system to achieve a goal.
- Section 4 - Data Flow Diagrams. DFD is a graphical representation that describes the flow of data or information into and out of a system
- Section 5 - Data Dictionary which is used to create and store definitions of data, location, format for storage and other characteristics.
- Section 6 - Process Decomposition Diagram which explains the breakdown of processes within a project or functional area.
- Section 7 - Data Structure Design. It depicts the relationship between different entities in the Database using Entity Relationship Diagram.

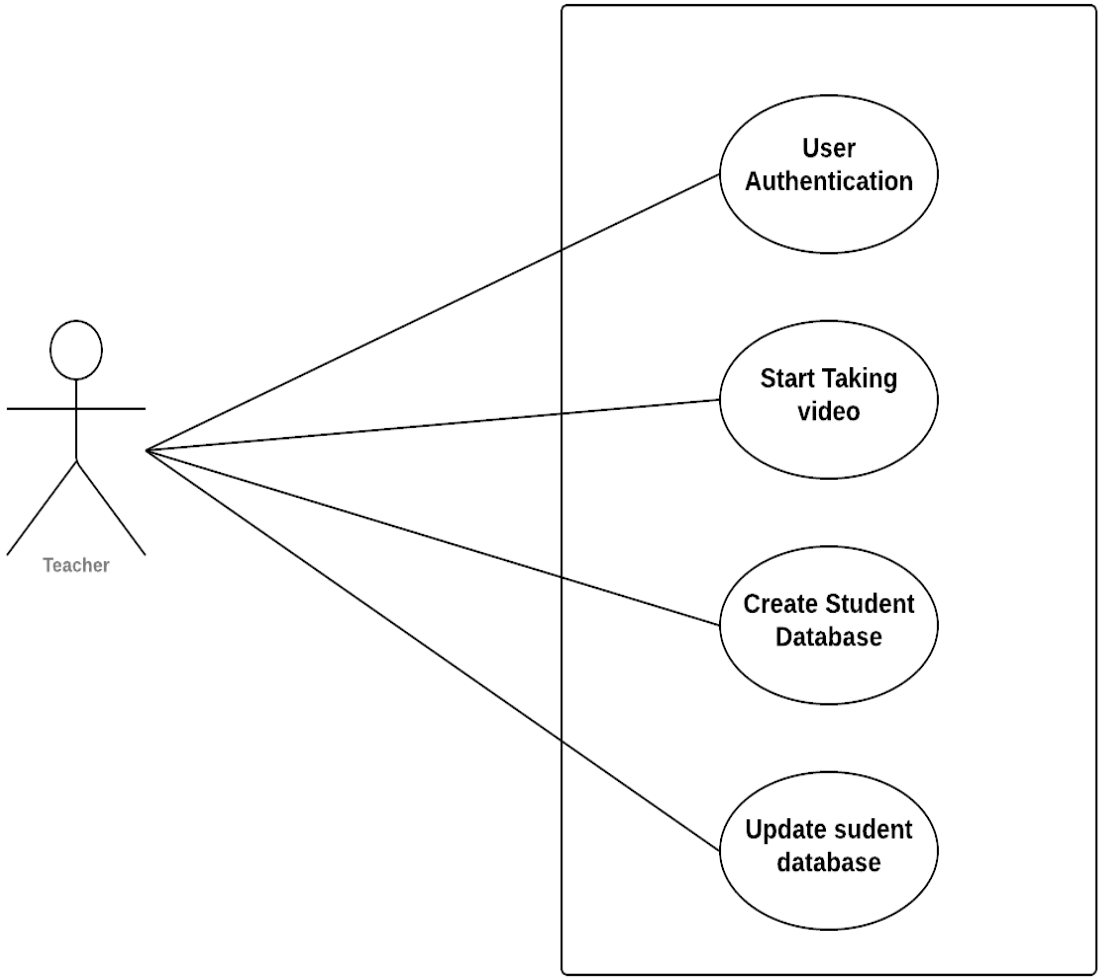
2. Design Rationale

In this design of the Classroom Visualization App1, we are converting the video from the user into a set of images. As image processing is capable to work on still images effectively. Every video is a continuous stream of images and hence can be broken down into some fixed number of snapshots (15 in our case).

Every face has basic features like eyes, nose, lips, etc. which can be extracted from the image frames to detect faces and differentiate between the students. The original database is used to compare these facial features to recognize the students.

3. Use Cases

Following figure shows pictorial view of use cases
(U1: User 1)



3.1 U1: User Authentication

Actors: Teacher

Scenario 1: Mainline Sequence:

1. User : Requests the login page.
2. System : Prompts to enter details.
3. User : Enter the details i.e username and password.
4. System : Displays Login acknowledgement and available options.

Scenario 2: At step 4 in mainline sequence:

4. System : Indicates error in case of incorrect and/or empty username and password combination.

Scenario 3: At step 1 in mainline sequence:

1. User : Requests the Sign-up page.
2. System : Prompts to enter details.
3. User : Enter the details i.e username and password.
4. System : Displays Home panel.

Scenario 4: At step 4 in scenario 3:

4. System : Shows error message if any field left empty or username already taken.

3.2 U1: Take Video

Actors: Teacher

Prerequisites : User is logged in .

Scenario 1: Mainline Sequence:

1. User : Selects start video option .
2. System : Starts real time video.
3. User : Points Camera towards class.
4. System : Shows color coded boxes around detected faces.

3.3 U1: Create Student Database

Actors: Teacher

Prerequisites : User is logged in .

Scenario 1: Mainline Sequence:

1. User : Requests to create new database.
2. System : Prompts to enter details(new Student’s name and pictures) .
3. User: Enters details.
4. System : Shows confirmation message.

3.4 U1: Update Student Database

Actors: Teacher

Prerequisites : User is logged in .

Scenario 1: Mainline Sequence:

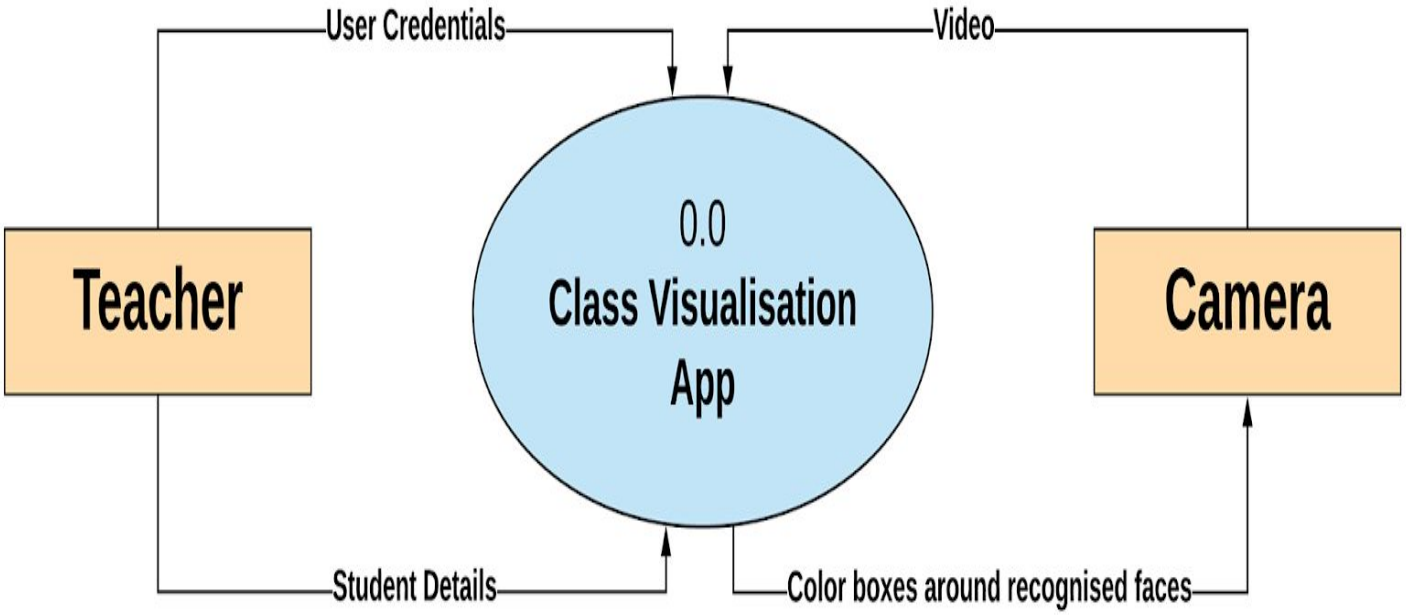
1. User : Requests to update details(Delete ,change) .
2. System : Prompts to enter student details .
3. User : Enters details.
4. System : Confirmation message.

Scenario 2: At line 4 of mainline sequence:

4. System : Shows error message if entered student id isn’t found.

4. Data Flow Diagrams

4.1 Contextual/Level-0 DFD

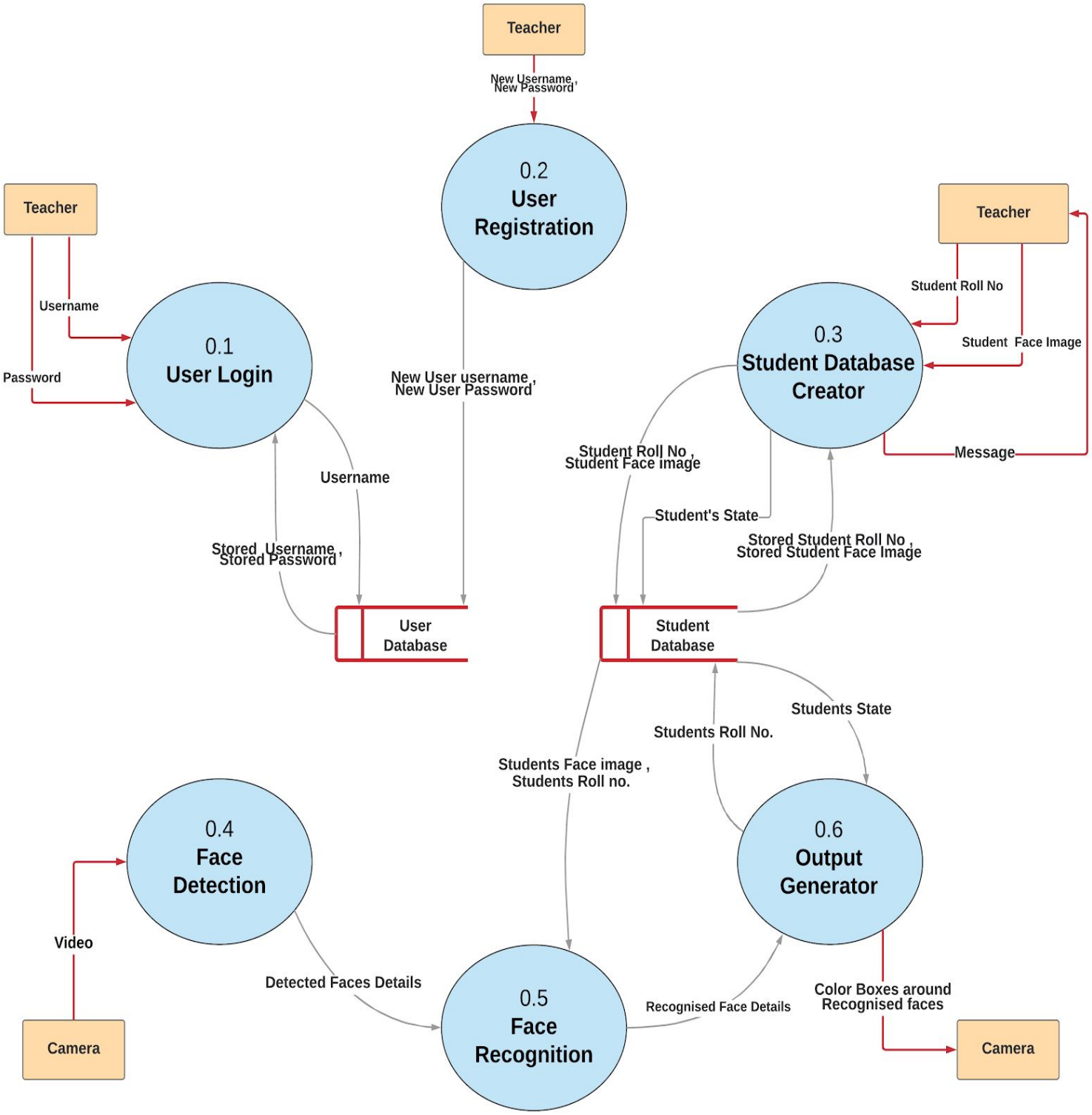


Convention :

Red Arrow (→ **):** For data flow to other level of DFD.

Black Arrow (→ **):** For data flow within the same level of DFD.

4.2 Level-1 DFD

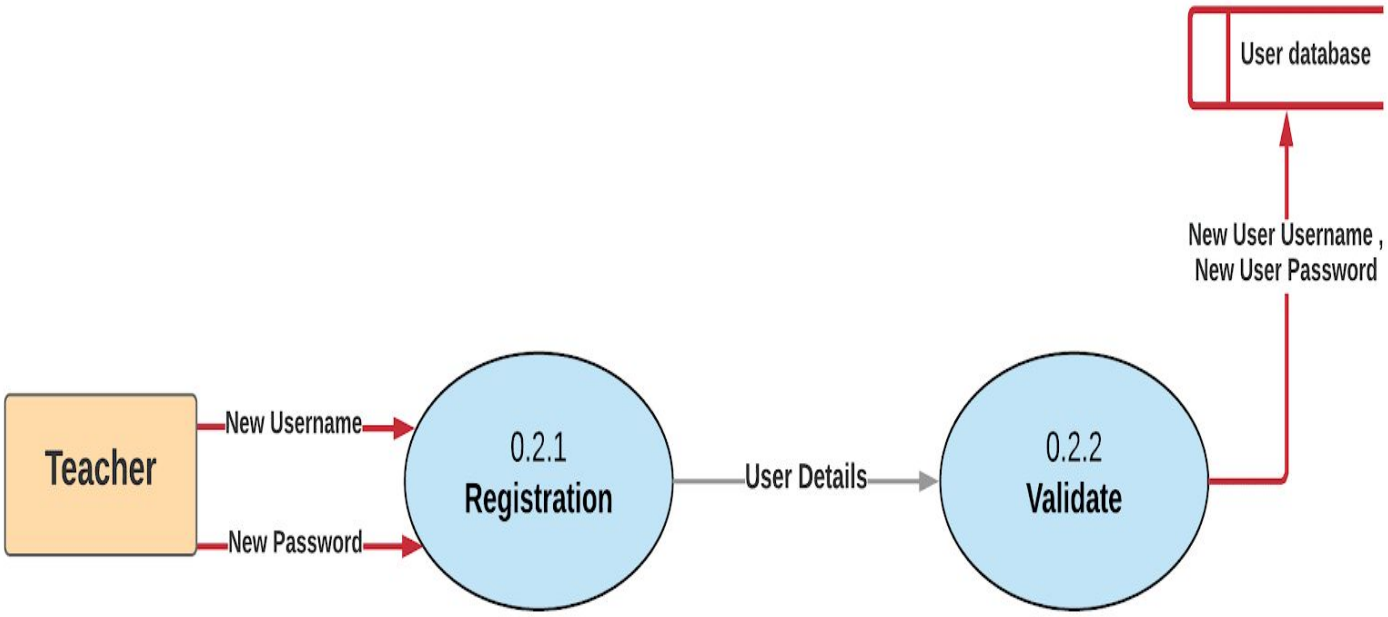


4.3 Data Dictionary (for 0 and 1 level DFD):

- User credentials : [Username + Password] Credentials of teacher's account.
- Username : [string] Username of teacher's account.
- Password : [string] Password of teacher's account.
- Video : [video format]Real Time Camera View of classroom.
- Color Boxes around recognised faces : Color boxes corresponding to states of the recognised students.
- New Username : [string] Username of teacher new to the app.
- New Password : [string] Password of teacher new to the app.
- Stored Username : [string] Username of teacher stored in user database.
- Stored Password : [string] Password of teacher stored in user database.
- Student Details : [Student Roll No. + Student Face Image] Details of the students.
- Student Roll No. : [integer] Roll no. of the student.
- Student Face Image : [image format] Face images of students.
- Stored Student Roll No. : [integer] Roll No. of the student stored in database.
- Stored Student Face Image : [image format] Face images of students stored in database.
- Student's State : [integer] Random Integer from 1- 10 allocated to each student.
- Message : [Message1 + Message2 + Message 3] Confirmation / error message after changes in student database.
- Detected Face Details : [double 2-tuple] x-y coordinates of all the detected faces
- Recognised Face Details : [Recognised face coordinates + Recognised student Roll No.] Details of recognised faces.

4.4 Level-2 DFD's

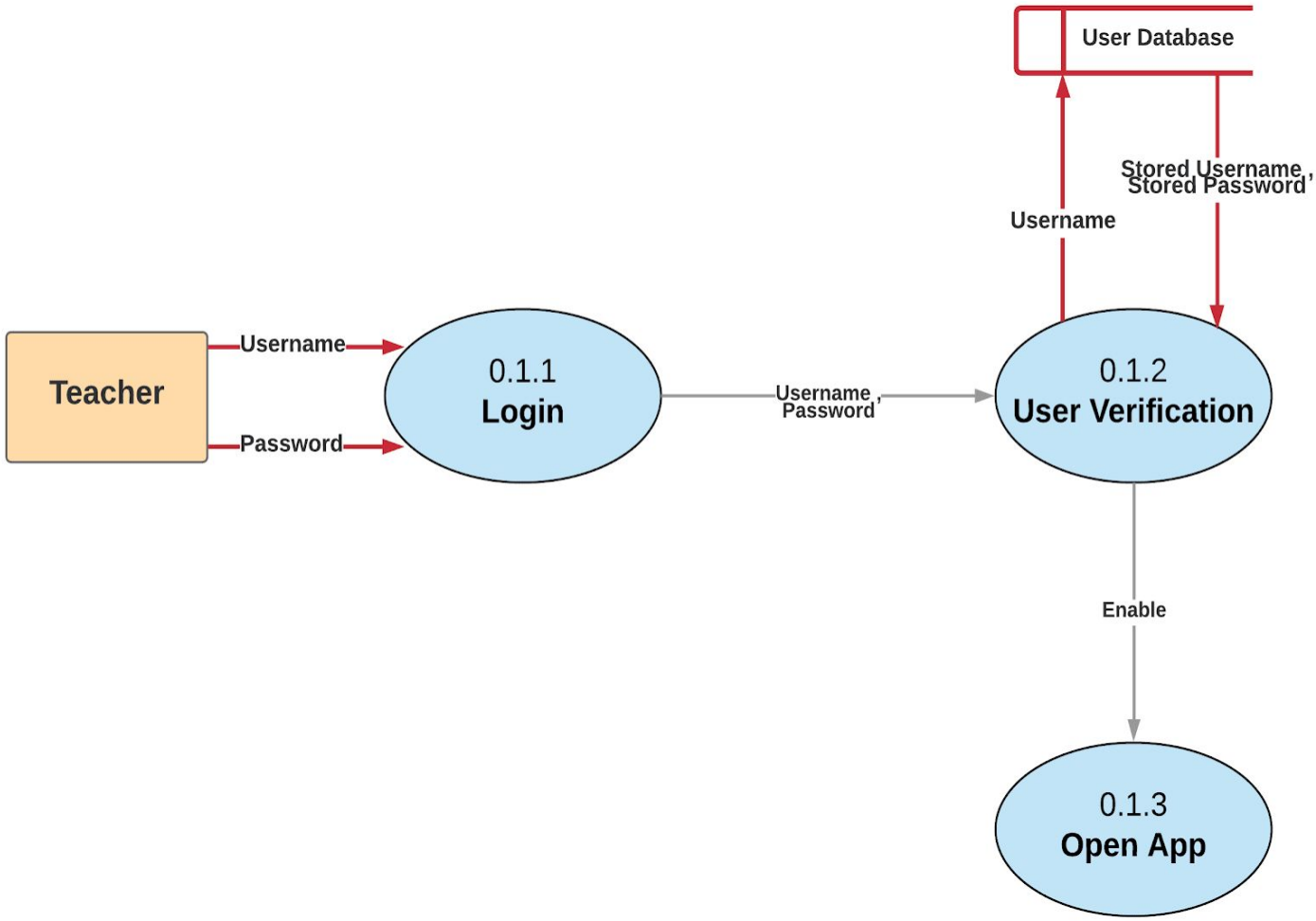
4.4.1 User Registration



Addition to Data Dictionary:

➢ User Details : [username + password] [string] username and password entered by new user.

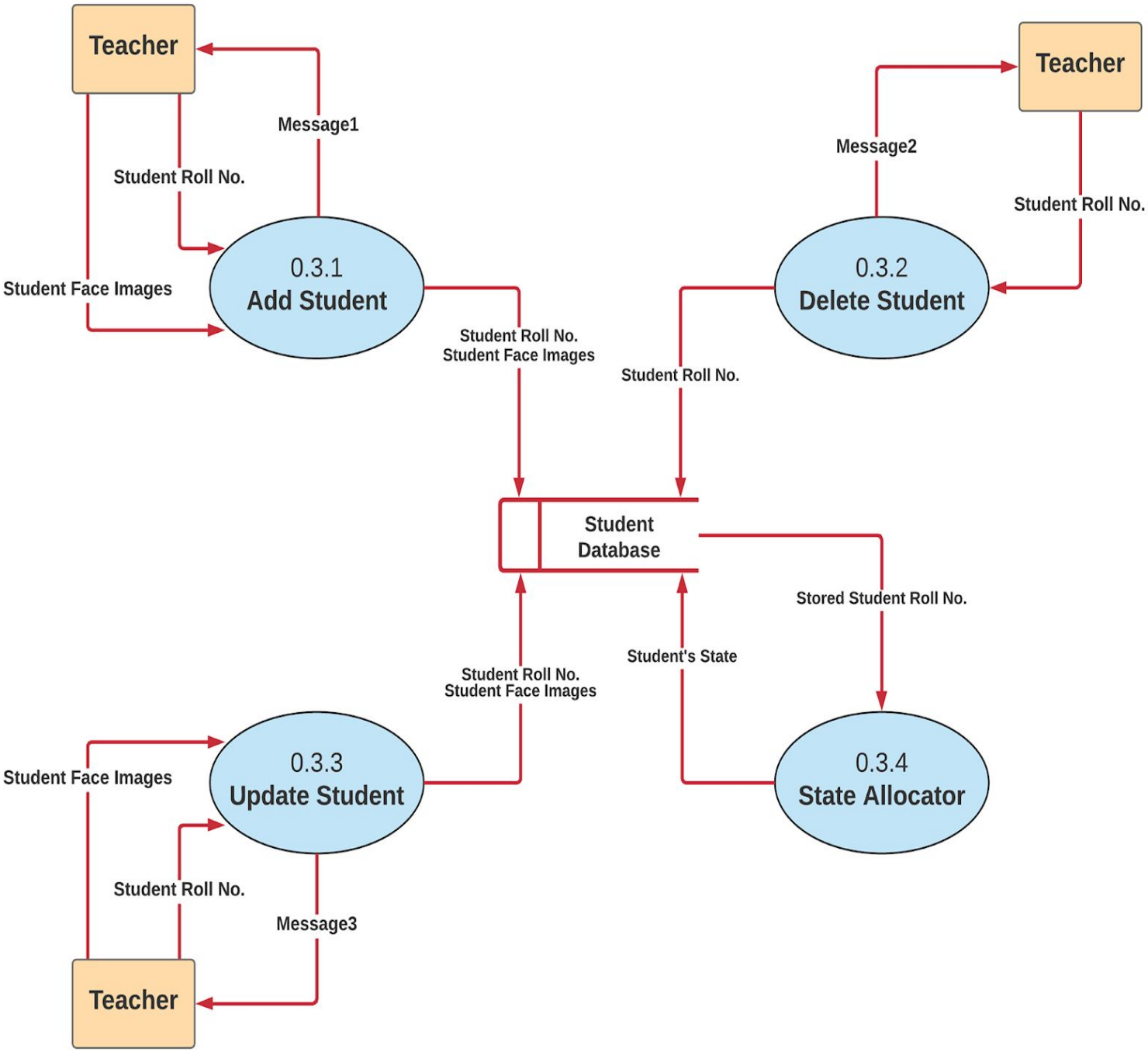
4.4.2 User Login



Addition to Data Dictionary :

➢ Enable : [Boolean] Data which enables login into app.

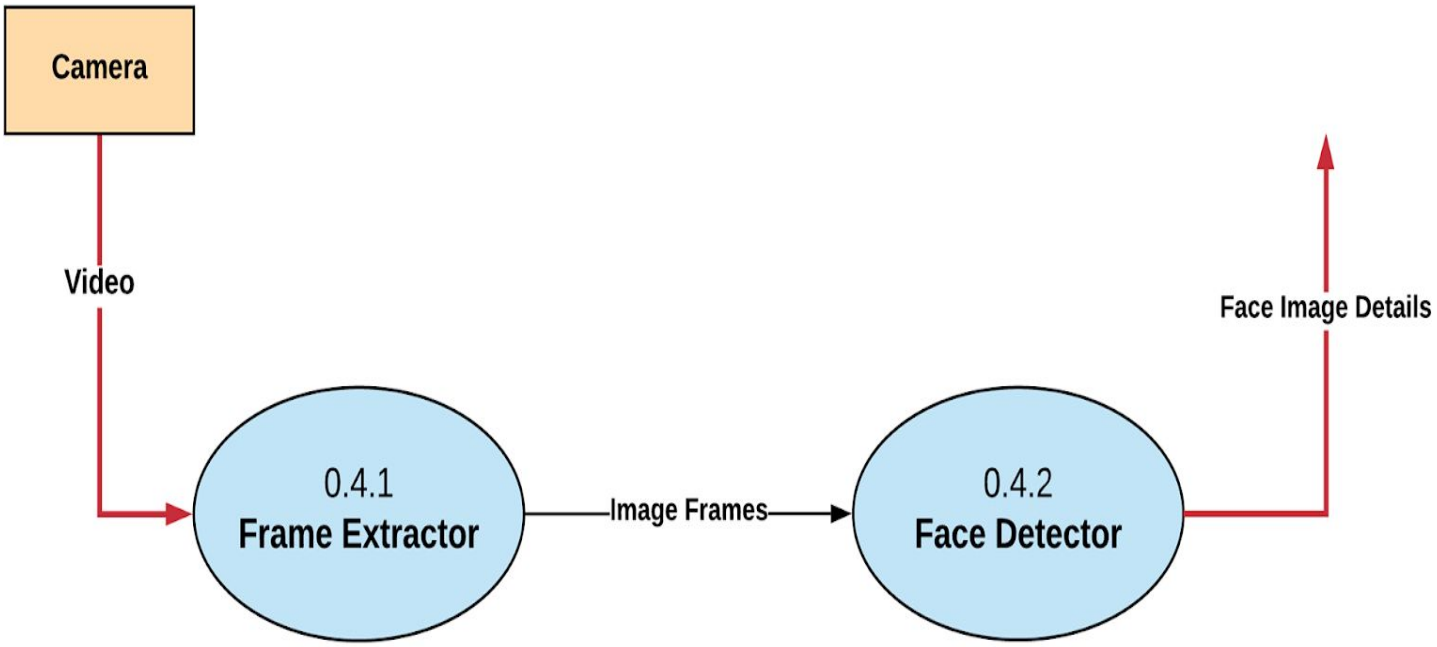
4.4.3 Student Database Creator



Addition to Data Dictionary:

- State Allocator: This functions allocates every student a random state between 1-10.
- Message1: [string] Confirmation / error message after addition of new student.
- Message2: [string] Confirmation / error message after deletion of student details.
- Message 3: [string] Confirmation / error message after updation of student details

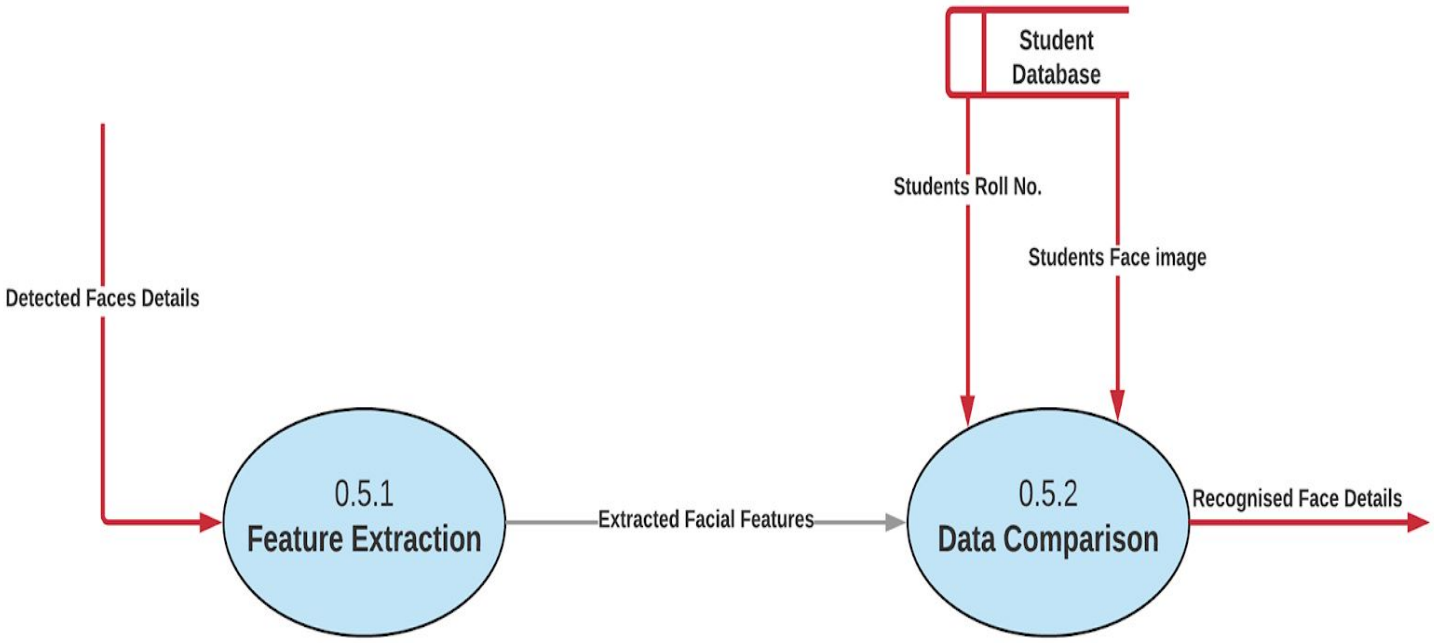
4.4.4 Face Detection



Addition to Data Dictionary:

➢ Image frames: [image format] Frames of Images extracted from the input video from camera.

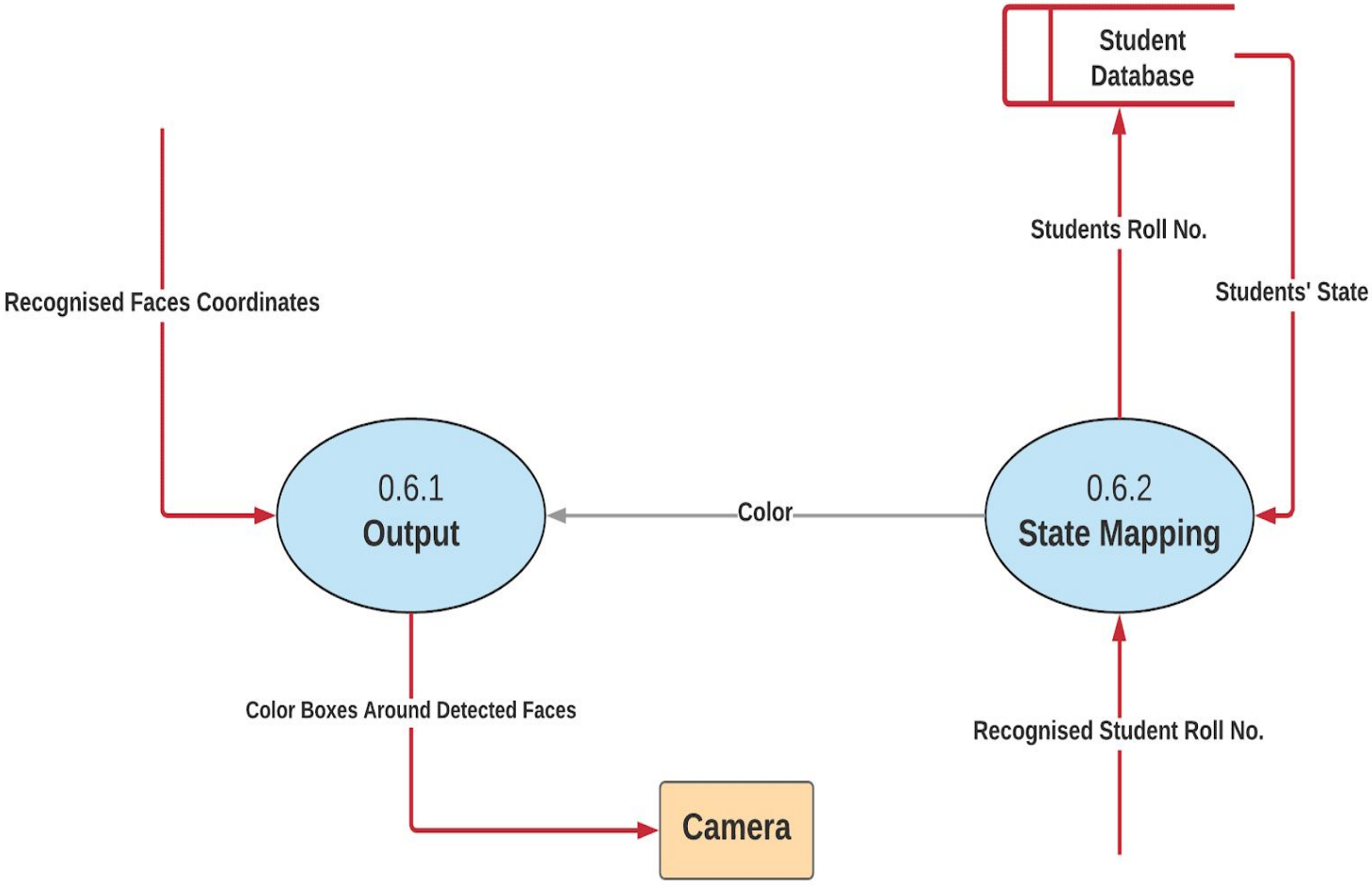
4.4.5 Face Recognition



Addition to Data Dictionary :

➢ Extracted Facial Features: [array] facial features like eyes nose lips etc. will be extracted and compare to already existing data in database.

4.4.6 Output Generator

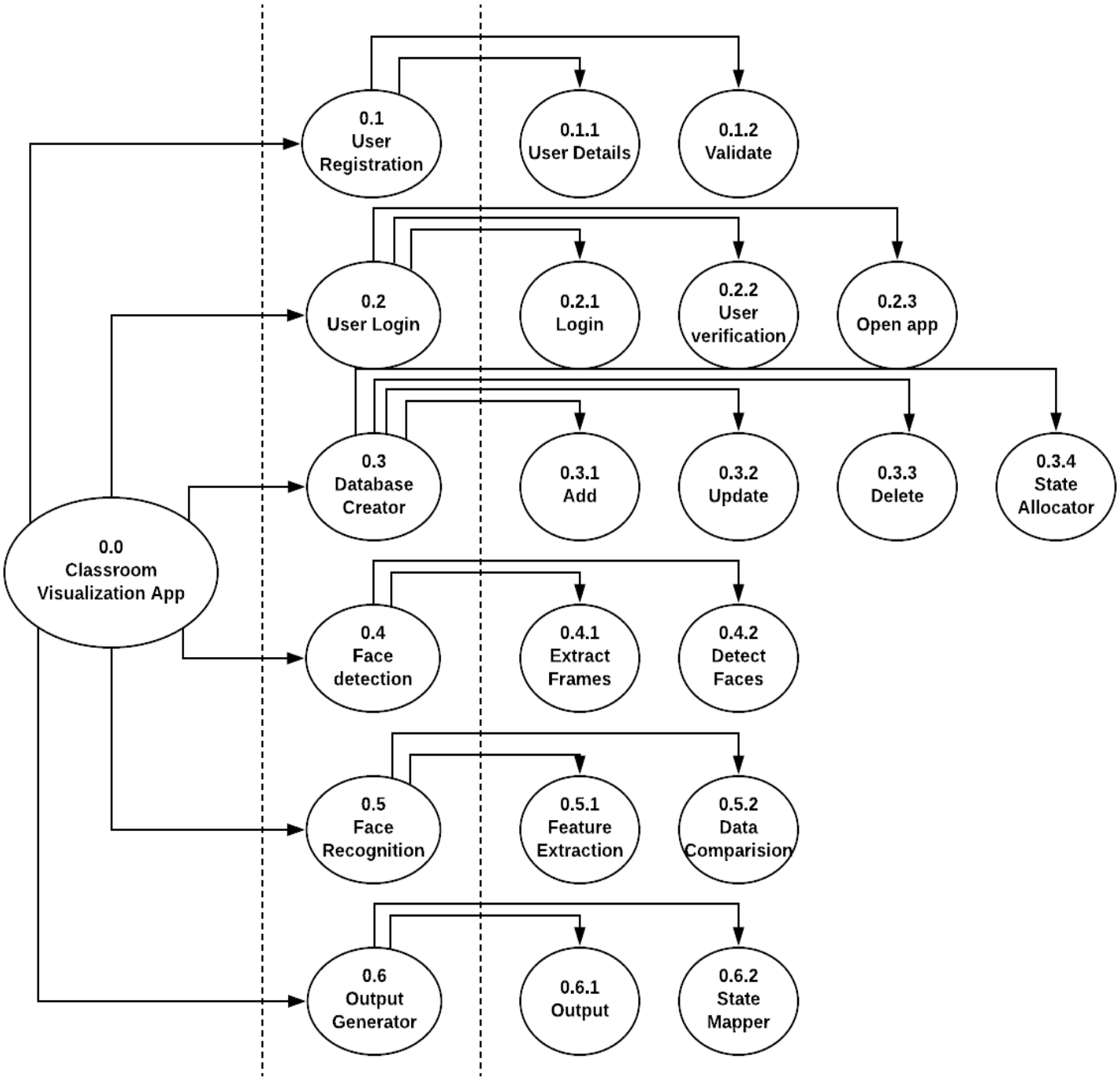


Addition to Data Dictionary :

➢ Color: Color corresponding to the state of the student.

- Red for state 1-4.
- Green for state 5-7.
- Blue for state 8-10.

5. Process Decomposition Diagram



6. Entity Relationship Diagram (Chen's model used)