

Detecting Education Level Using Facial Expressions

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1 Introduction

1.1 Purpose

This Software Design Document provides the design details of detecting education level using facial expressions, which detect the education level of the learner through some rules and facial expressions. This document contains the software architecture, the design choices and the traceability matrix of the system.

1.2 Scope

Detecting educational level using facial expressions is a web application that aims to help the instructors to detect the current level and predict the next level easily. Educational places will benefit from our software because the educational level for each learner will be more accurate.

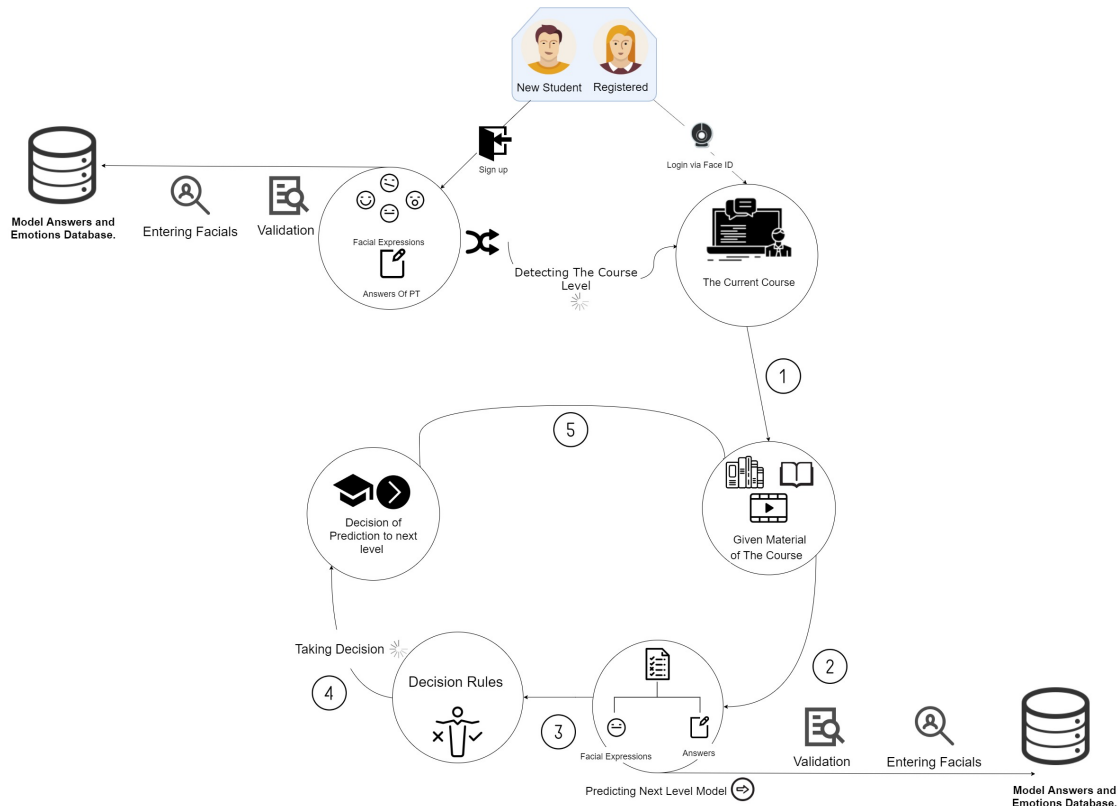
1.3 Overview

This document is arranged as follows: Introduction, System Overview, System Architecture, Data Design, Component Design, Human Interface Design and Requirements Matrix. Our system will work on increasing the accuracy of detecting the education level for each learner because we include facial expressions during taking the decision to get accurate results.

1.4 Definitions and Acronyms

Term	Definition
Software Design Document (SDD)	Used as the primary medium for communicating software design information.
MVC	Model View Controller
CNN	Convolutional Neural Network
SVM	Support Vector Machines

2 System Overview

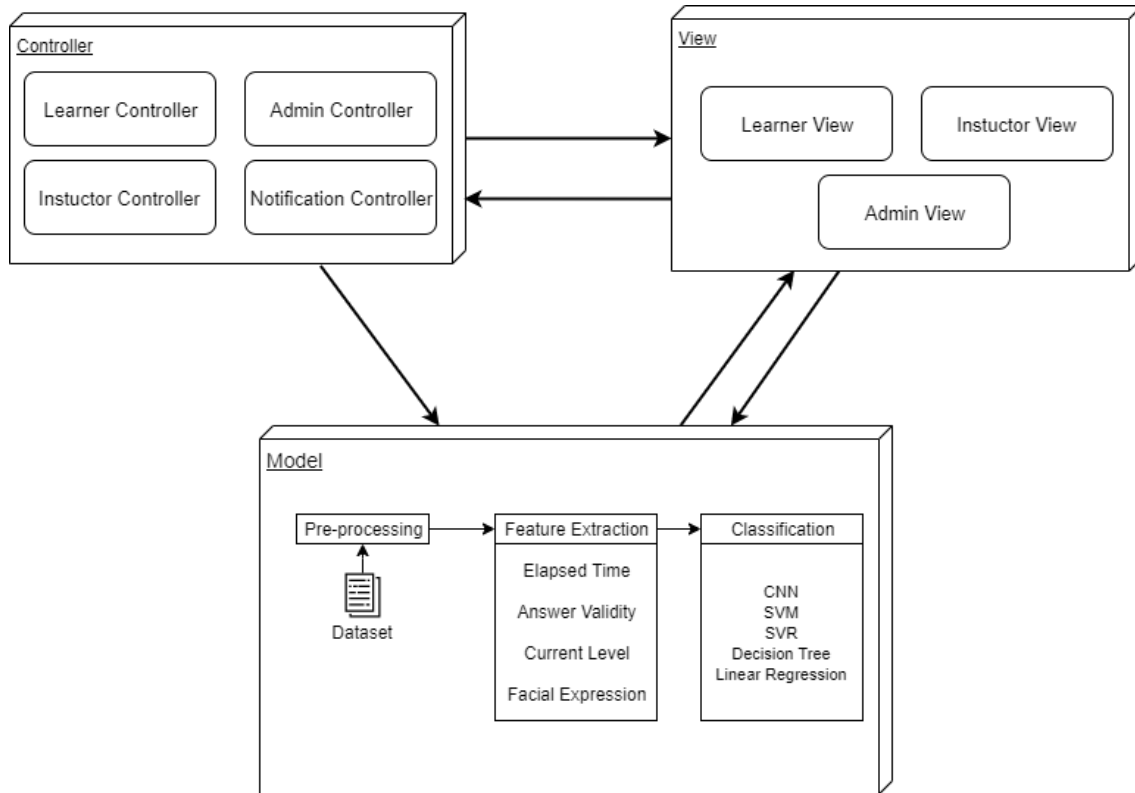


The system's goal is to detect several types of facial expressions such as angry, happy, sad, surprise, disgust and neutral within the education level of the

learner. The first step to being applied to the learner having the placement test for the first time (entry-level) to detect his level for setting him on his specific level. The learner then will be tested for example during the whole period of the course, so we will get more get him/her the exam for extracting the full expression, elapsed time and current level. Deep Learning Algorithm such as CNN classification applied at phase of recording facial expressions and have 2D array which has at the first array these expressions and the second array have the exams with their times, so the final output based on this array and his answers we will make some mathematical operations such mean or mode on the total facials and combine them with decision-making techniques called fuzzy interference system. Those Operations use to detect the next level in the course for the learner. The result of decision-making techniques will be in the form of a matrix. There are a lot of data-sets for facial expressions but by choosing FER/2013 we can do more because it shows more accurate results. They have a lot of data that can help us in choosing the right expressions in the data-set by identifying or matching them. In the first stage of explaining how our system will be working, we start with stage preprocessing: we collect the input data to our model from a webcam live stream by using the webcam and student's answers in the quizzes and saving these in database. In the second stage of our system is processing: by logging in user the system by face ID, The given material of the course is qualifying the student to improve his knowledge. By testing the student and getting his facial expressions the system takes all of them to make the decision using decision rules. Secondly, based on the students' answers the machine's role is to compare model answers and the answers of students (answer validity). The final stage of our system is the output: which proposed results are to know the current education level of the students, after that during the course exams our model should predict the next level of the students and the loop will be repeated.

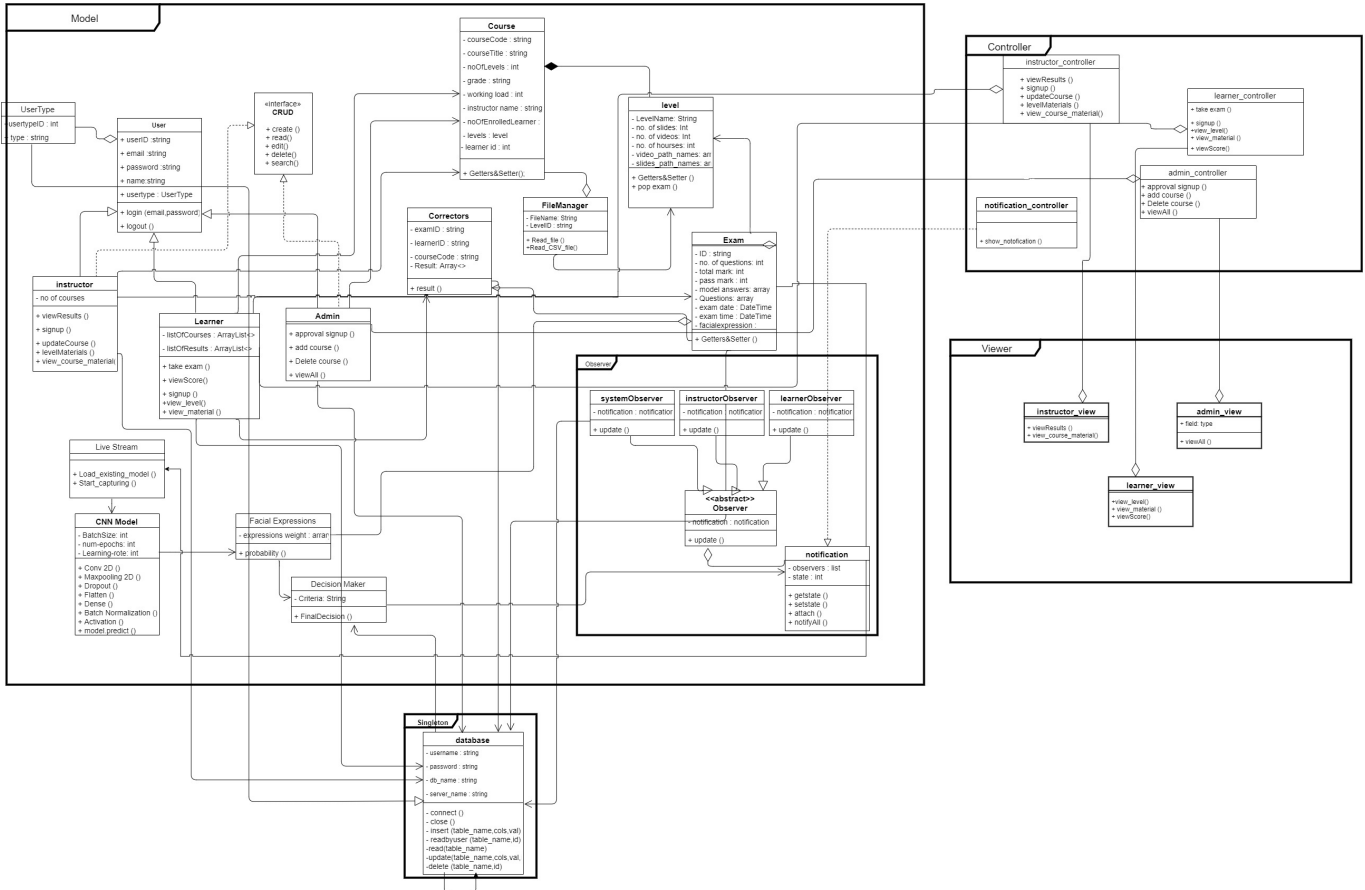
3 System Architecture

3.1 Architectural Design



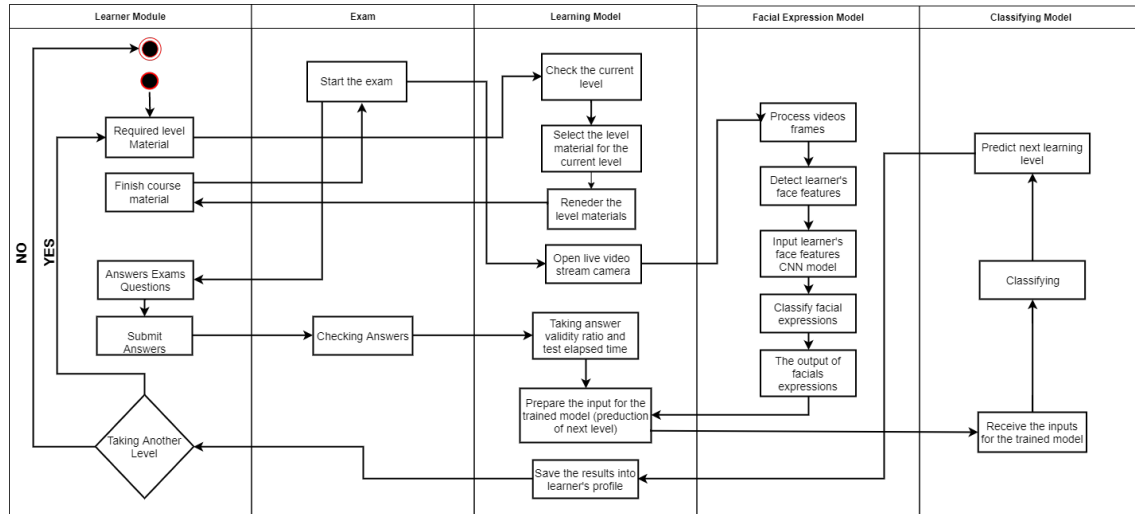
3.2 Decomposition description

3.2.1 Class Diagram

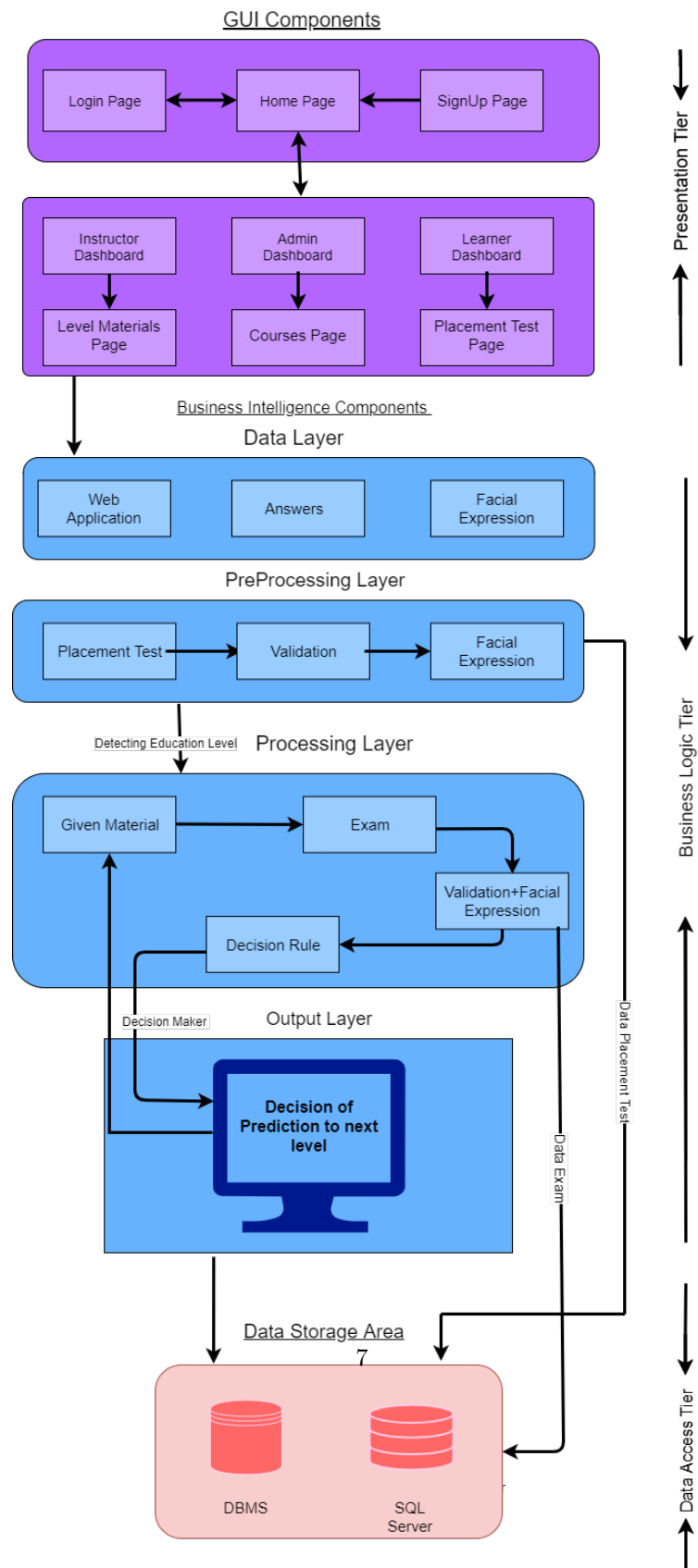


- MVC Design Pattern:**
 Model-View-Controller is utilized to partition the application's concerns. We are using MVC to create each portion of the system at it is own which helps for making many views as we need to create a web application.
- Observer Design Pattern:**
 A way of notifying change The observer pattern is utilized when there's a one-to-many relationship between objects such as in case one object is modified, its dependent objects are to be notified automatically. (A way of notifying change) We are using it for notifications.
- Singleton Design Pattern:**
 A class of which as it were a single instance can exist. We are using it for the database connection.

3.2.2 Activity Diagram



3.3 Block Diagram



3.3.1 Sequence Diagram

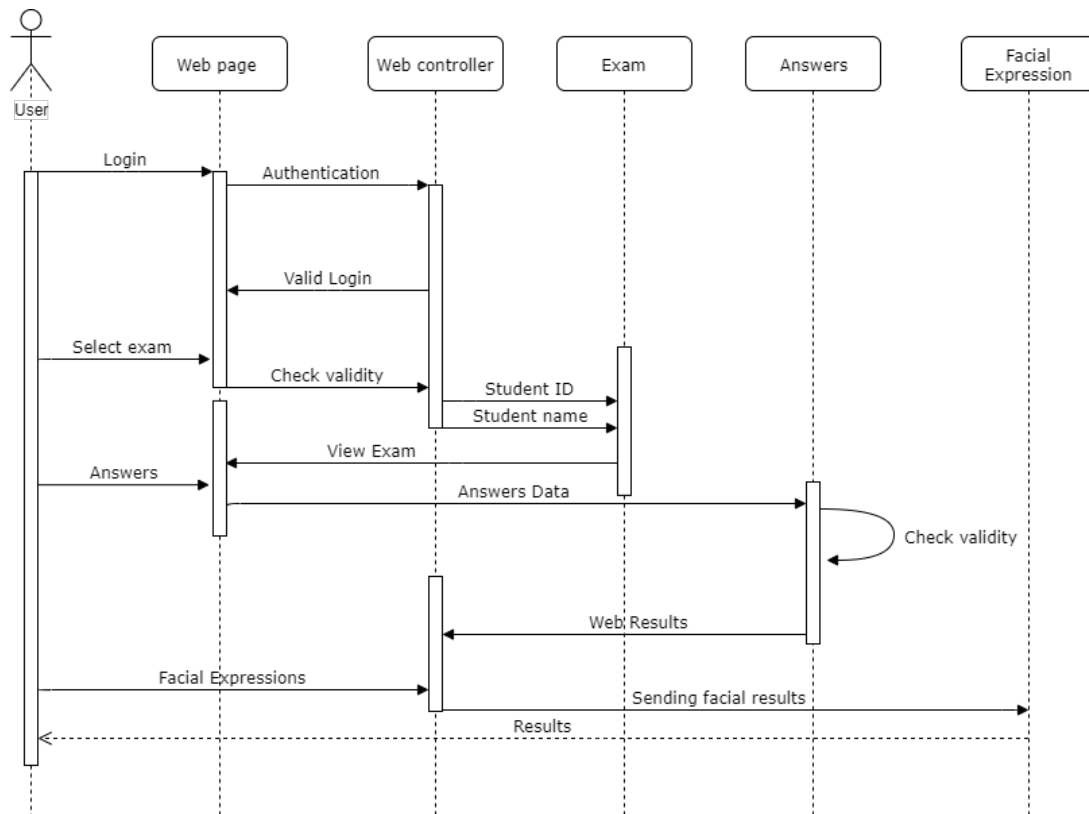


Figure 1: Taking Test

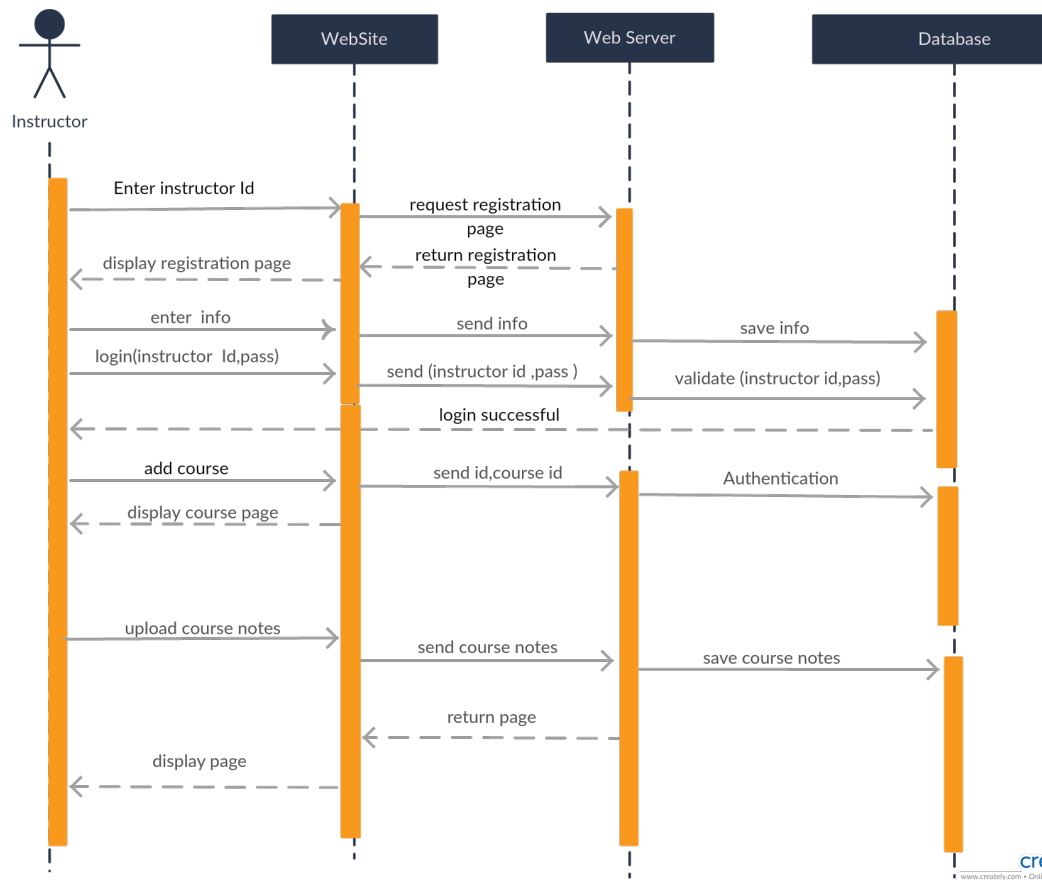


Figure 2: Add Course

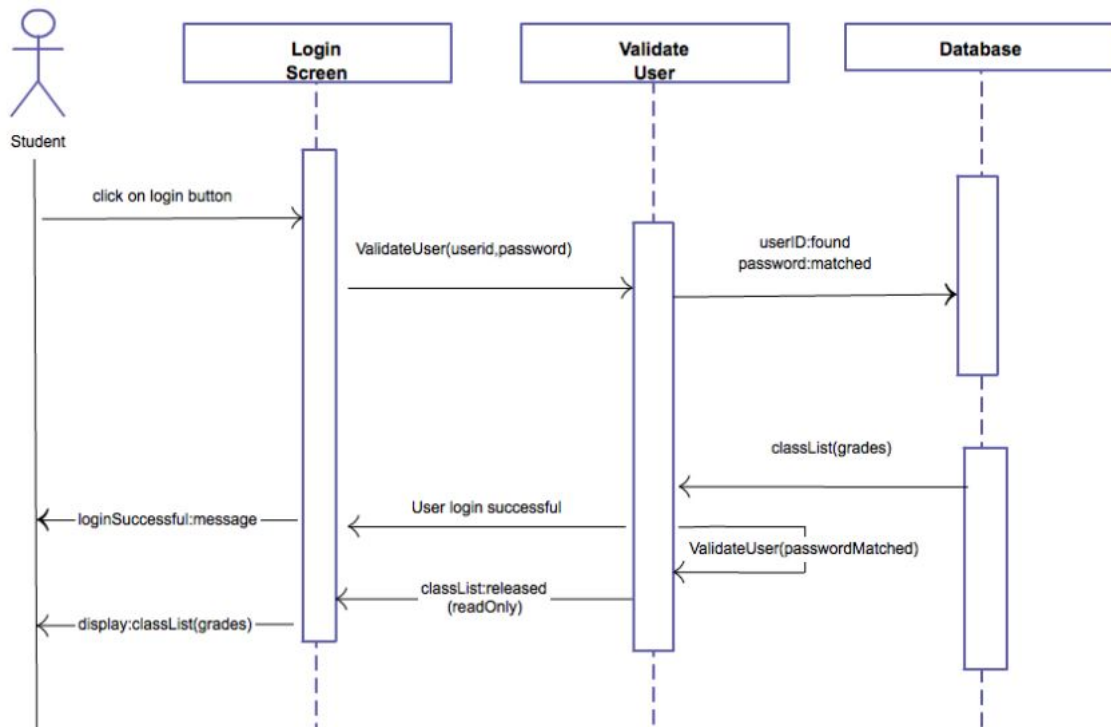


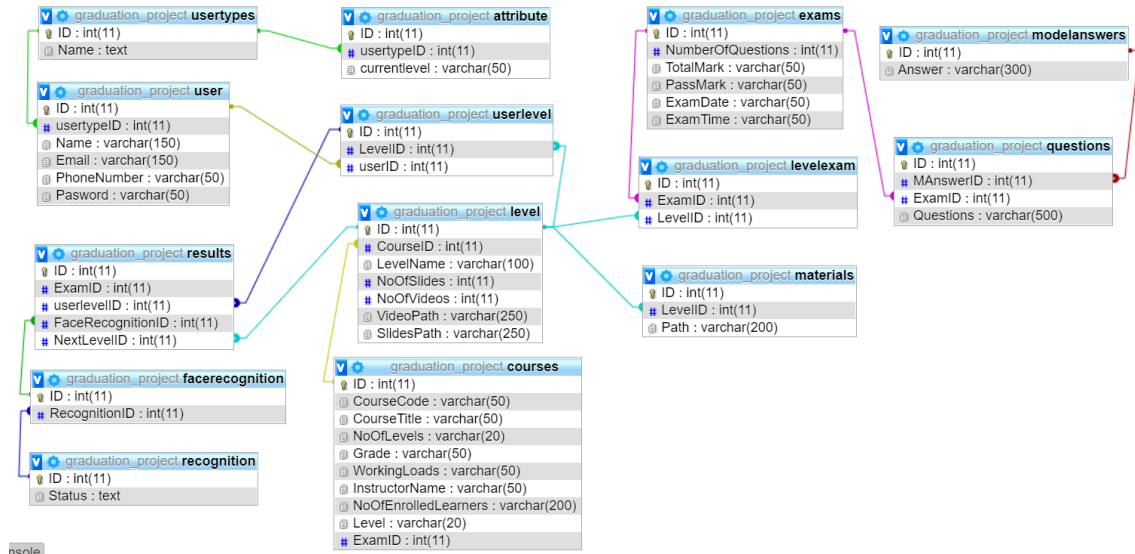
Figure 3: Login

3.4 Design Rationale

Our project is based on MVC design pattern. It is a software design pattern that makes creating applications easy, where the model manages the back-end processing while the controller takes the data from the model and deliver it to the view but the view deals with user interface. The main advantages of using MVC is for Re usability of code, better maintenance and development of the application becomes fast.

4 Data Design

4.1 Data Description



4.2 Data Dictionary

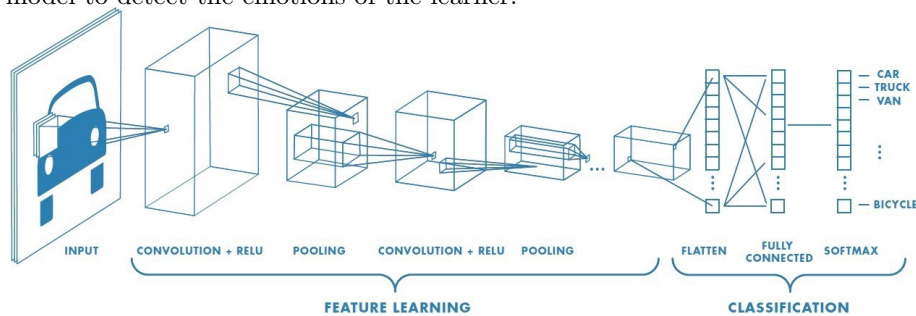
- **User types:** In table user type indicates to the user type, user can be instructor or admin or learner. Every type has id and type name.
- **Attribute:** this table contains the different attributes of each user type.
- **User:** The table user carries all the info of users like name, username, password, age, email, and ID. This table used to profile the user and get access in his account Also connected by user type by user type id to know the user type if admin Or instructor or learner and every time have his access in the system and have a different Functionality.
- **Exams:** this table will hold information about the exam as a number of questions, total marks, passes mark and so on. Model Answers: this table will hold the answers to the questions of the exam.
- **Questions:** this table will contain the questions of every exam by the id of the exam.
- **Courses:** this table will contain some info about the course and how many levels this course includes. Levels: this table holds some info about the current level and in which course this level.
- **User level:** this table holds level id and the user id that shows to the learner in which level in the course.

- **Materials:** This table holds the materials of the levels of each course.
- **Level exam:** this table contains the exam for each level.
- **Recognition:** this table holds the seven facial expressions (sad, happy, angry, disgust, surprise, fear and neutral).
- **Results:** this table holds the next level of the learner, the exam id, user-level id.
- **Face recognition:** this table contains the face recognition id.

5 Component Design

5.1 CNN

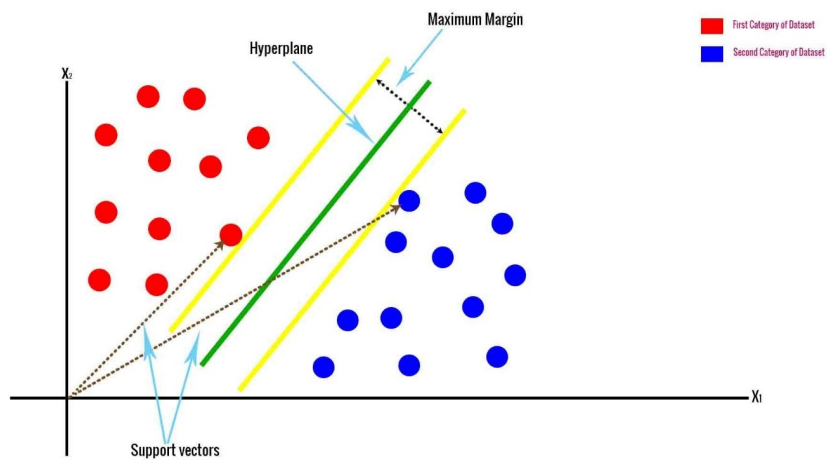
It's a machine learning algorithm for machines to understand the features of the image with foresight and remember the features to guess whether the name of the new image fed to the machine. We used the activation function 'ReLU' stands for the Rectified Linear Unit, it is used in the second layer (convolution layer) in the feed-forward neural network. We use it to remove the negative values in the neural network. This algorithm used it for the facial expression model to detect the emotions of the learner.



5.2 Support Vector Machine

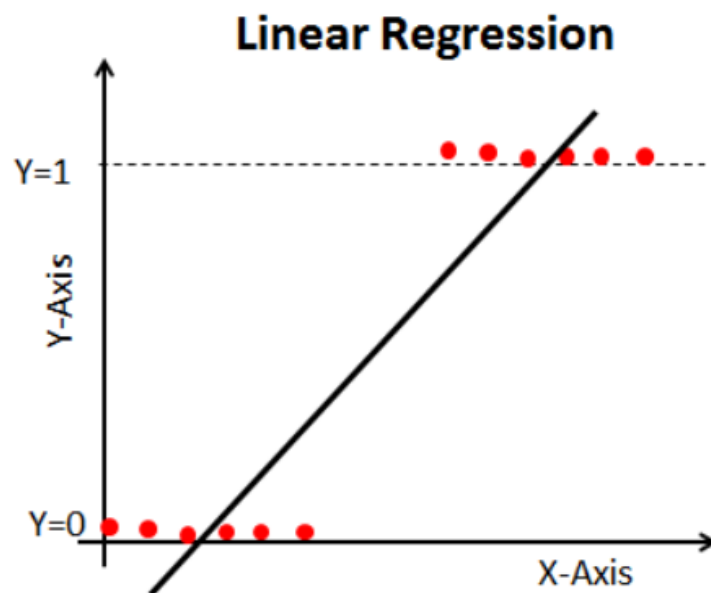
A support vector machine is a classification algorithm where a set of examples is collected and each one has a known class. The algorithm divides the classes byline and puts each value to his class. For instance, it does not suffer the limitations of data dimensionality and limited samples. it's the main core of combining the facial expression model with the e-learning model to make our system and detect the next education level of the learner.

- Libraries: [from sklearn import svm], this Library for import predefined SVM [from sklearn.svm import SVC], this Library to import SVC function.
- Functions: SVC () function provides the Type of Kernal



5.3 Linear Regression

Linear regression is a statistical approach for modeling a relationship between input a dependent variable (response) with a given set of independent variables (features) which is output. It's given us the predict values of the training model.



6 Human Interface Design

6.1 Overview of User Interface

The user interface is going to be very easy to use. First the user is going to sign up for the application after signing up a the Exam page will appear for choosing the exams that will be available. After entering the exam and finish it, Results will be shown to the user. After admin login he can add and remove the exam by it's details and contents from questions to be shown for the users. The system must show at the final of every exam the new current level of education will be appeared for the user throw his facials and his answers ratio.

6.2 Screen Images

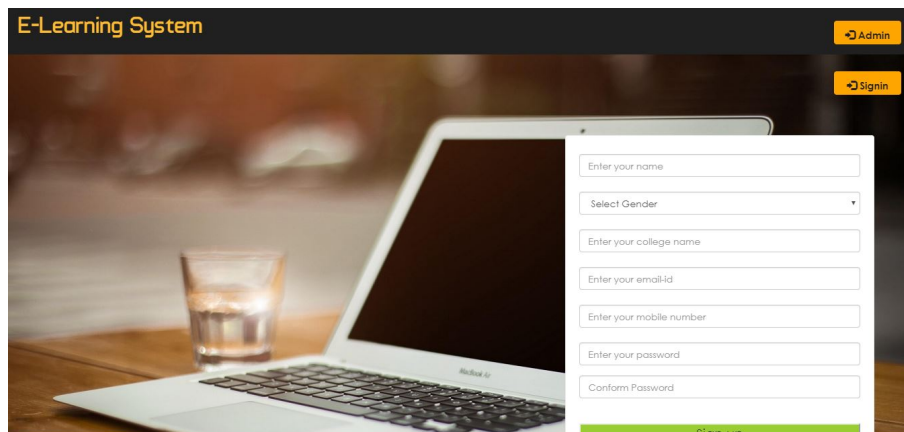


Figure 1: Sign Up

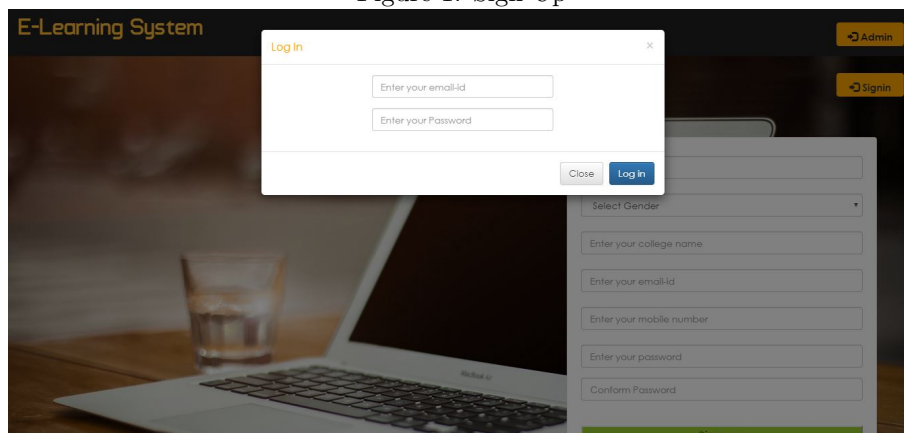


Figure 2: Login

Test Your Skill					
Hello, Mourad			Signout		
Netcamp	Home	History	Ranking	Signout	Enter tag
Search					
S.N.	Topic	Total question	Marks	Time limit	
1	Inventorymanager	3	6	3 min	Start
2	Linux :vi Editor ✓	5	10	10 min	Restart
3	Networking	2	4	5 min	Start
4	C++ Coding	2	4	5 min	Start
5	Php Coding ✓	2	4	5 min	Restart
6	Linux : File Managment	2	4	5 min	Start

Figure 3: Exam Pages

Test Your Skill	
Hello, Admin	
Signout	
Netcamp	Home
History	Ranking
Signout	Enter tag
Search	
<div> <div>Question 2 ::</div> <div>which is a variable of php??</div> <div> <input type="radio"/>int a <input checked="" type="radio"/>\$a <input type="radio"/>long int a <input type="radio"/>int a\$ </div> <div>submit</div> </div>	
About us	Admin Login
Developers	Feedback

Figure 4: Exam

Test Your Skill									
Hello, Admin									
Signout									
Netcamp	Home								
History	Ranking								
Signout	Enter tag								
Search									
<div>Result</div> <table> <tr> <td>Total Questions</td> <td>2</td> </tr> <tr> <td>right Answer ✓</td> <td>2</td> </tr> <tr> <td>Wrong Answer ✗</td> <td>0</td> </tr> <tr> <td>Score ★</td> <td>4</td> </tr> </table>		Total Questions	2	right Answer ✓	2	Wrong Answer ✗	0	Score ★	4
Total Questions	2								
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Score ★	4								
About us	Admin Login								
Developers	Feedback								

Figure 5: Results of Exam

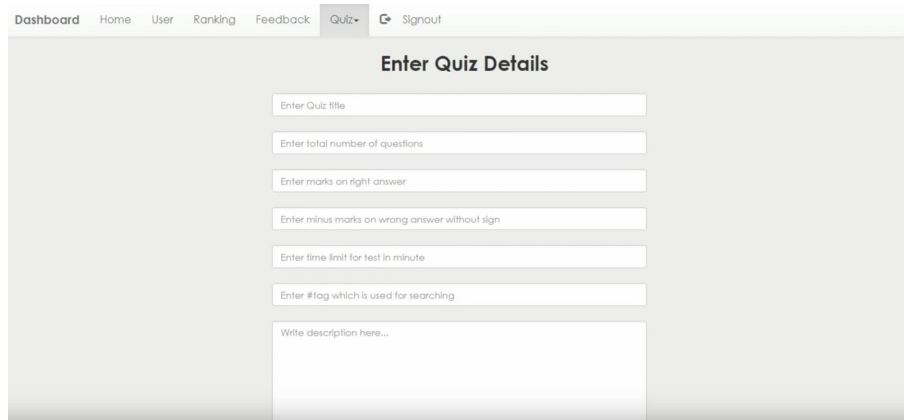


Figure 6: Exam details

6.3 Screen Objects and Actions

- Figure 1 (Sign up): This form is for adding a new user throw taking a specific info the helps in the application it self.
- Figure 2 (Login): The entered data must be match the data in database to enter the application.
- Figure 3 (Exam Pages): This page of showing the available exams for the user that entered the system.
- Figure 4 (The Exam): The exam page is for answering the questions and matching the right answers with the right questions.
- Figure 5 (Results Of Exam): This is results that been shown after the exam, after matching the questions with answers it will appear the right answers and the wrong ones.
- Figure 6 (Exam details): After Adding the exam, we must add it's details for the entering the questions details. After all this process the exam with the new details will be appeared for the users.

7 Requirements Matrix

Requirement ID	Requirement type	Description	Status
1.Login	Required	The user must enter his name and password to open his profile.	Completed
2. Signup	Required	Allow the user to enter his information to make a profile.	Completed
3. Add courses	Required	Add courses in the Courses table in the database by the admin.	Completed
4. Add level materials	Required	Add level materials in the levels table in the database by the instructor.	In Progress
5. Take facial expressions	Required	The system during the exam of the Student must take 7 classes of facial expressions.	Completed
6. Add exam	Required	Make questions and answers to save it in the database.	Completed
7. Take the exam	Required	The learner takes a number of questions to solve it.	Completed

8. Show results	Required	Show the results of the exam for the learner.	Completed
9. Logout	Required	Allow the user to out from his profile. And return him to the home page.	Completed