

Detecting Education Level Using Facial Expressions

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1 Introduction

1.1 Purpose of this document

The main purpose of this Software Requirements Specification document is to outline the requirements for Detecting Education Level Using Facial Expressions: enhance and detect the accurate next level for each learner. Then the system will give the learner the accurate materials for his level to learn it and enhance the education level for each learner. After learning the materials the learner takes a quiz to know his next level and do this cycle again. The project will be a desktop app connected to a regular web camera to capture facial expressions. This software requirements specification (SRS) document defines how our team, and audience see the product and its functionality.

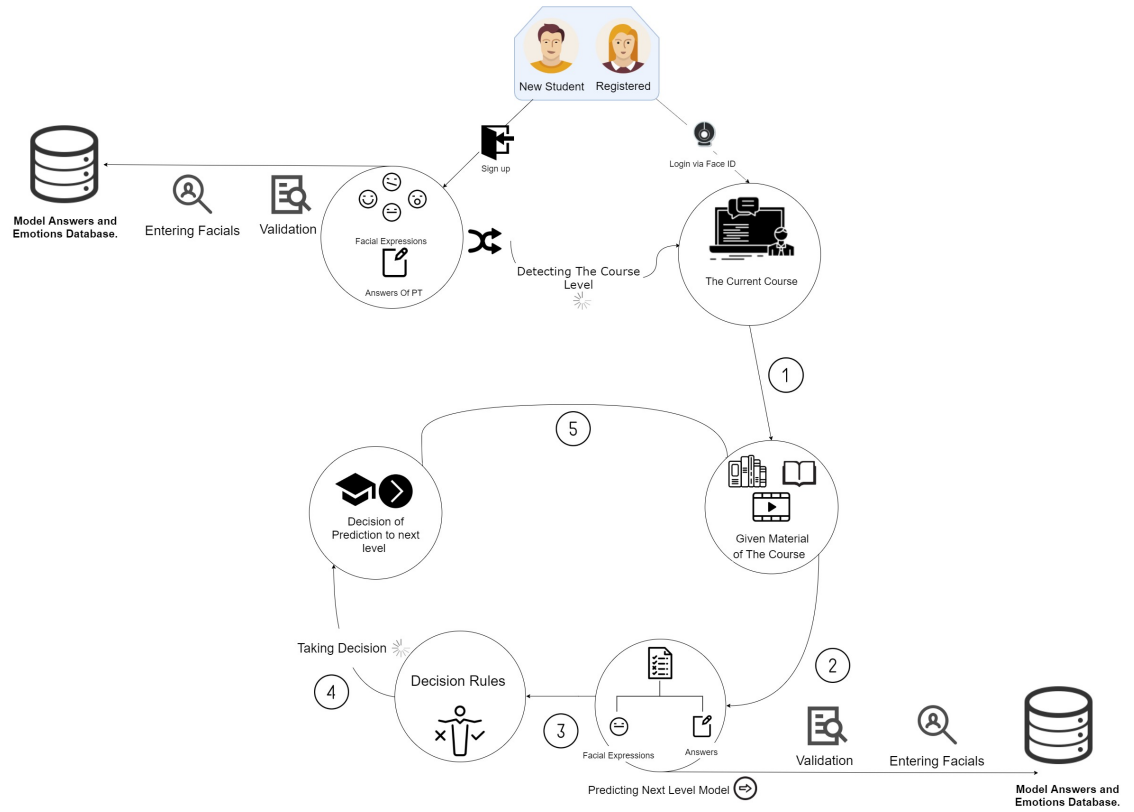
1.2 Scope of this document

- The system works to improve the level of education by using facial expressions such as angry, happy, sad, surprise, and disgust, neutral by using a webcam with quick and accurate results.
- The system works on three phases:
 - In the first phase, the learner enters the course and take a placement test to detect his current level.
 - After tested him the system takes both the facial expressions result and his score of the exam.
 - Make some decision making such as fuzzy rules, confusion matrix, analytic hierarchy process (AHP) and frame attention network. Those operations will detect the accurate next level in the course.

- The system works based on deep learning techniques, the whole system will be offline after recording the facial expressions and can't be used in a dark mood using the test.

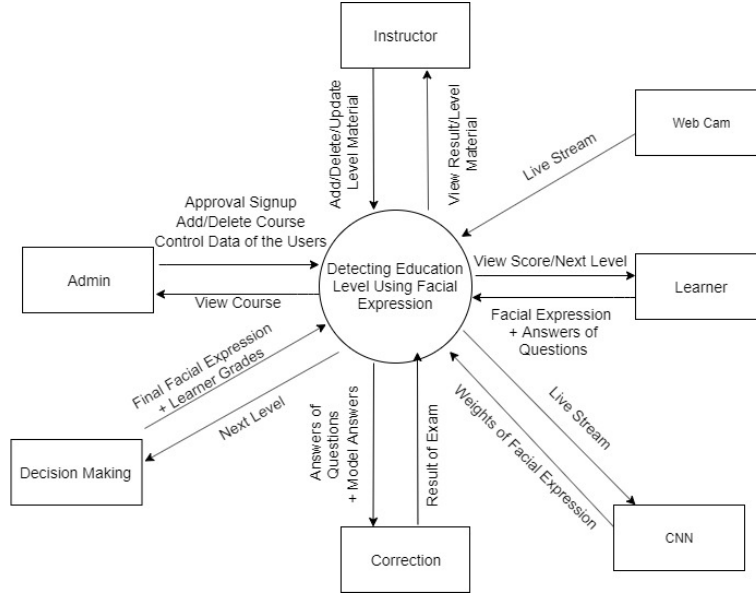
1.3 Overview

Our system aims to detect several types of facial expressions such as angry, happy, sad, surprise, disgust and neutral. The first step to being applied to the learner having the placement test for the first time (entry-level) to detect his level for putting him in his specific place. The learner then will be tested five times for example during the whole period of the course, so we will have 6 facial expressions that recording through the webcam in each time he will be examined. 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 such as confusion matrix [include 7 classes of facial expressions divided into rows and columns as a matrix], analytic hierarchy process (AHP) [divided attributes and values into level depends on comparison and analysis] and frame attention network [divide the video into frames then these frame as a input so he can detect the facial expression as a output]. Those Operations use to detect the next level in the course for the learner, so this phase will be offline. The result decision making techniques of will be in the form of 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 recorded video 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: firstly, 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 take all of them to take 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 and quizzes our model should predict the next level of the students and the loop will be repeated.



1.4 Business Context

Our system aims to provide an efficient facial expression detection for e-learning system method that allows the learner to have a placement exam to detect his current education level with using his facial expressions, the system also aims to provide a method to give the learner materials during the course to study them and then detecting his next education level in the course based on his answers in the and facial expressions during the whole period of the course.



2 General Description

2.1 Similar System Information

In other systems, They aim to achieve the best features in learning by enhancing the way of concentration throw understanding and interpolating the emotional state of the learner during a learning engagement. They identify and classify the emotions of the students and provide real-time feedback to enhance and encourage the level of education. The way of detection the emotion or concentration by tracking the eyes and head movement [1] . They classify learner involvement and interest in the topic which are plotted as feedback to the instructor to improve the learner experience. By extracting three levels of concentration: High, Medium and Low level of concentration.the idea of taking the expression of the students for enhancing the way of education for getting the best results. By getting the expression of the student and give the instructor feedback about the mood and his weighted emotional state that he felt in this situation[3]. Other introduced a method based on facial recognition to identify students understanding of the entire distance learning process and proposed an emotion recognition model for learning and The proposed solution uses a python platform and OpenCV library to detect eyes and mouth and identify all kinds of emotions using the neural network method.[5]. Also other systems proposed a CNN model for classifying the facial expressions and comparing their model with other CNN models to get the final expression of the learner and do operations as aggregation function[2]. Other systems to offered a solution for supervising students ' work and answering their questions in real time while maintaining contact with the learning environment by understanding the student's facial

expressions while reading the statement of the particular work, depending on two sides, and also continuing to control student awareness[4]. And the system that implements the idea has set of fuzzy rules to determine the complexity of the next exercise, considering the program implementation time, validation and compilations, and current difficulty level[6].

2.2 User Characteristics

- Instructor: Must have the materials and the resources of the courses to upload them for students.
- Learner: Must have basic knowledge of using the system.
- Admin: Must have basic knowledge in using the system and managing instructor , learners and courses.

2.3 User Problem Statement

It's hard to detect education level by just only the answers of questions exam because it's maybe the learner's answer by luck or not understand the question. So we propose the system that detects the current level and next level of educational course by using facial expressions and answers of questions.

2.4 User Objectives

The learners want time flexibility to engage in the learning process with save time and money. Everyone needs to learn new things and know his accurate level with the lowest effort. And another objective case, Managers need to create a training course for his staff and this course must be with automatic decision to give the staff materials and test them. After testing the system must be known the accurate level for each one of them. The system must use facial expressions to keep up with the feelings of learners. It is an important factor in any learning process.

2.5 General Constraints

One of the most important constraints of the system is the connection between webcam and website to take facial expressions during the exam. So the learner must check if the webcam put in the right position or not. The system needs medium speed processing.

3 Functional Requirements

FID	FR1.
Name	Registration (Sign Up).
Description	New Learners or new Instructors are signed up to can use the system.
Input	Information on Learners or Instructors.
Output	None.
Pre-condition	No data can access.
Post-condition	Signup successful without failure.
Action	Whether if the user Learner or Instructor signs up the system leads the user to his profile page.
Dependencies	None.
Criticality	10/10

FID	FR2
Name	Login.
Description	All Learners or Instructors should log in to use the system. So, they must have an account
Input	Username and Password
Output	Login Successful/ Login Failed
Pre-condition	No data can access.
Post-condition	Login successful without failure.
Action	It takes the username and password to check if he/she had a valid account or not and also the password must be encrypted.
Dependencies	Sign Up (FR1).
Criticality	10/10

FID	FR3.
Name	Approval Signup.
Description	Approval signup of the Learner and Instructor.
Input	Accept or Reject signup both of users (Learner and Instructor).
Output	The user can use the web application.
Pre-condition	Admin still not make an action on the signup accounts.
Post-condition	Learners and Instructors can use the accounts after approval.
Action	Admin will choose the user types of users who are registered.
Dependencies	Signup (FR1).
Criticality	10/10.

FID	FR4.
Name	Add Courses by Admin.
Description	Add Courses in the Courses table in Database by the Admin.
Input	Course ID.
Output	Data inserted in the Courses Database.
Pre-condition	The Course is not inserted.
Post-condition	The Courses Inserted Successfully in Database.
Action	It takes the Course Name from the Admin and inserted it to the Database.
Dependencies	Login (FR2).
Criticality	10/10.

FID	FR5.
Name	Search for Learners, Instructors, and Courses.
Description	Admin can search for Learners, Instructors, and Courses.
Input	Learners ID, Instructors ID, and Course ID.
Output	Information for Learners, Instructors, and Courses.
Pre-condition	Having the ID of the Learners, Instructors, and Courses.
Post-condition	Get all records of Learners, Instructors, and Courses.
Action	Search for Learners, Instructors, and Courses from the Database.
Dependencies	Login (FR2).
Criticality	7/10

FID	FR6.
Name	List Learners, Instructors, and Courses.
Description	List all Learners, Instructors, and Courses for the Admin.
Input	Learners ID, Instructors ID, and Course ID.
Output	List all the Learners, Instructors and Courses for the Admin.
Pre-condition	List of Learners, Instructors and Courses are not available.
Post-condition	The record of the Learners, Instructors, and Courses are listed successfully.
Action	It takes the data of Learners, Instructors, and Courses from the Database and listed to the Admin.
Dependencies	Login (FR2).
Criticality	7/10

FID	FR7.
Name	Edit Learners, Instructors, and Courses.
Description	Edit Learners, Instructors information and Courses in the Database by the Admin.
Input	Learners ID, Instructors ID, and Course ID.
Output	Records of Learners, Instructors, and Courses.
Pre-condition	The old records of Learners, Instructors, and Courses from the database.
Post-condition	The new records are inserted successfully in the Database.
Action	Takes the ID of the record to allow the Admin to update the new record in the Database.
Dependencies	Search for Learners, Instructors, and Courses (FR5).
Criticality	7/10

FID	FR8.
Name	Delete Learner, Instructor, and Courses.
Description	Delete Learners, Instructors information and Courses in the database by the Admin.
Input	Learner ID, Instructor ID, and Courses ID.
Output	Records of Learners, Instructors, and Courses.
Pre-condition	Get records of Learners, Instructors, and Courses from the database.
Post-condition	The records are deleted successfully in the Database.
Action	Takes the ID of the record to allow the Admin to delete the record in the Database.
Dependencies	Search for Learners, Instructors, and Courses (FR5).
Criticality	7/10

FID	FR9.
Name	Add Level Material by Instructor.
Description	Add Level Material in the Courses table in Database by the Instructor.
Input	Level Material.
Output	Data inserted in the Level Material Database.
Pre-condition	The Level Material is not inserted.
Post-condition	The Level Material Inserted Successfully in Database.
Action	It takes the Material of the Level from the Instructor and inserted it into the Database.
Dependencies	Login (FR2).
Criticality	8/10.

FID	FR10.
Name	Search by Instructor.
Description	The instructor can search for Learners and Level Material.
Input	Learner ID and Course ID.
Output	Information on Learners and Level Material.
Pre-condition	Having the ID of the Learners and Level Material.
Post-condition	Get all records of Learners and Level Material.
Action	Search for Learners and Level Material from the Database.
Dependencies	Login (FR2).
Criticality	6/10

FID	FR11.
Name	List Learners and Level Material by Instructor.
Description	List all Learners and Level Material.
Input	Learners ID and Course ID.
Output	List All the Learners and Level Material for the Instructor.
Pre-condition	List of Learners and Level Material are not available.
Post-condition	The List of the Learners and Level Material are listed successfully from Database.
Action	It takes the data of Learners and Level Material from the Database and listed to the Instructor.
Dependencies	Login (FR2).
Criticality	8/10

FID	FR12.
Name	Edit Level Material by Instructor.
Description	Edit Level Material in the Database by the Instructor.
Input	Level ID.
Output	Records of Level Material.
Pre-condition	The old records of Level Material from the database.
Post-condition	The new records are inserted successfully in the Database.
Action	Takes the ID of the Level to allow the Instructor to update the new record in the Database.
Dependencies	Search by Instructor (FR10).
Criticality	7/10

FID	FR13.
Name	Delete Level Material by Instructor.
Description	Delete Level Material in the Database by the Instructor.
Input	Level ID.
Output	Records of Level Material.
Pre-condition	Get records of Level Material from the Database.
Post-condition	The records are deleted successfully in the Database.
Action	Takes the ID of the Level to allow the Instructor to delete the record in the Database.
Dependencies	Search by Instructor (FR10).
Criticality	7/10

FID	FR14.
Name	Courses.
Description	Each Learner will see his own listed Courses and information of each Course.
Input	Course ID.
Output	List all the Courses for the Learners.
Pre-condition	List of Courses are not available.
Post-condition	The List of the Courses is listed successfully.
Action	It takes the data of Courses from the Database and listed to the Learner.
Dependencies	Login (FR2).
Criticality	10/10

FID	FR15.
Name	Levels.
Description	Each Learner will see his own listed Level and Material of each Level.
Input	Level ID.
Output	List all the Levels for the Learners.
Pre-condition	A list of Levels is not available.
Post-condition	The List of the Level is listed successfully.
Action	It takes the data of Level from the Database and listed to the Learner.
Dependencies	Courses (FR14).
Criticality	10/10

FID	FR16.
Name	Exam.
Description	Each Learner should have an exam at the end of the level.
Input	Level ID.
Output	List the exam of the level to the learner.
Pre-condition	The exam is not ready.
Post-condition	The exam is ready for the learner to take it.
Action	It takes the exam from the database and lists it to the learner.
Dependencies	Level (FR15).
Criticality	10/10

FID	FR17.
Name	Correction.
Description	The system takes the answers from the exam's learner and model answer to compare them together.
Input	Exam ID, Learner ID, and Course ID.
Output	List the result to the Learner.
Pre-condition	The system is not ready.
Post-condition	The score of the exam will be listed to the learner
Action	It takes the answers of the learner and compares it to the model answer in the database.
Dependencies	Exam (FR16).
Criticality	10/10

FID	FR18.
Name	Search by Learner.
Description	Learners can search for Level Material.
Input	Level ID.
Output	Information on Level Material.
Pre-condition	Having the ID of the Level Material.
Post-condition	Get all records of Level Material.
Action	Search for Level Material from the Database.
Dependencies	Login (FR2).
Criticality	6/10

FID	FR19.
Name	List Level Material by Learner.
Description	Each Learner will see his own listed Materials.
Input	Level ID.
Output	All the Level Material for the Learners.
Pre-condition	List of Level Material are not available.
Post-condition	The List of the Level Material is listed successfully.
Action	It takes the data of Level Material from the Database and listed to the Learner.
Dependencies	Login (FR2).
Criticality	7/10

FID	FR20.
Name	Learner Having Exam.
Description	The Learner after taking his courses he should take the exam to detect his next education level automated by the system.
Input	Answers of the Learner + his facial expressions.
Output	The grade of his course + detects the next education level.
Pre-condition	The learner didn't take the exam.
Post-condition	The learner takes the exam successfully and gets his facial expressions.
Action	Learners took the exam and the automated system start to detect the next education level.
Dependencies	Login (FR2)
Criticality	10/10

FID	FR21.
Name	List Learner's Results by Instructor.
Description	The instructor can view the result of the learners.
Input	Results of Exam.
Output	List All results of the Learner.
Pre-condition	A list of Results of the Exam is not available.
Post-condition	The List Results of Exam are listed successfully.
Action	It takes the Results of Exam from the Database and listed to the Instructor.
Dependencies	Learner Having Exam (FR20).
Criticality	6/10

FID	FR22.
Name	List Learner Current Level by Learner.
Description	The learner can view his own Current Level.
Input	None.
Output	List his/her own Current Level.
Pre-condition	List Current Level are not available.
Post-condition	The List Current Level is listed successfully.
Action	It takes the current level from the Database and listed to the Learner.
Dependencies	Courses (FR14).
Criticality	6/10

FID	FR23.
Name	Take Data for fuzzy engine from the Learner.
Description	The system during the exam of the Learner must take 7 classes of facial expressions.
Input	Take facials, current level, time and answer validity.
Output	Next predicted level.
Pre-condition	The webcam is turned off.
Post-condition	Degree of probability for each facial expression.
Action	Adding all of the input in the fuzzy engine to get the next level
Dependencies	Learner Having Exam (FR20).
Criticality	10/10

FID	FR24.
Name	CNN Classify.
Description	This algorithm is used to train data with the best accuracy.
Input	Dataset.
Output	Accuracy + Model Trained.
Pre-condition	Divide the dataset into training, testing, and validation.
Post-condition	Training and testing compared with each other.
Action	Take the dataset and start training on it by a constant number of epochs.
Dependencies	Take Facial Expression from the Learner (FR23).
Criticality	10/10

FID	FR25.
Name	Aggregation Function
Description	Put the facial expressions in the matrix with the degree of probabilities of expressions and do some operations as max or average.
Input	Facial Expressions and the degree of probability.
Output	Matrix with all facial expressions and degree of probability.
Pre-condition	No degree of probability to insert.
Post-condition	A full matrix can get from it the highest degree of the matrix.
Action	The matrix can work by taking the maximum of the maximums of degree.
Dependencies	Take Facial Expression from the Learner (FR23).
Criticality	10/10

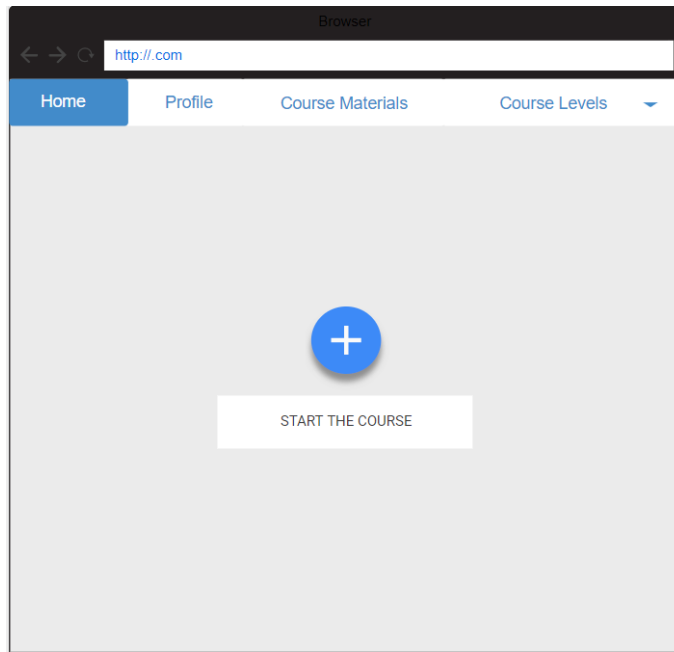
4 Interface Requirements

4.1 User Interfaces

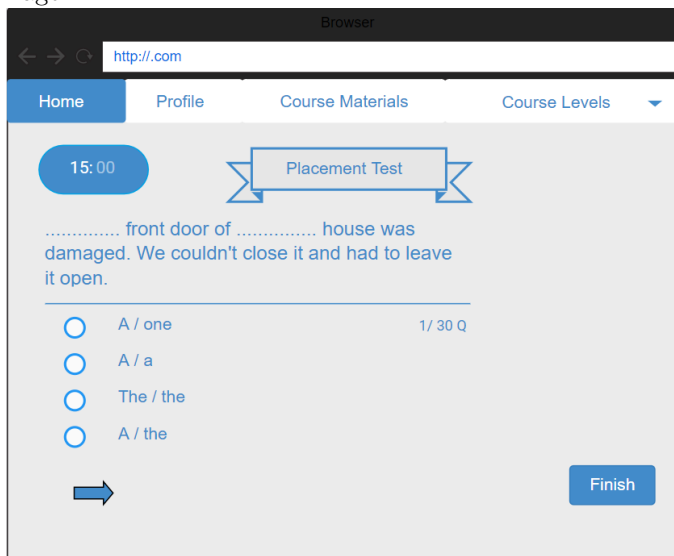
The image shows a web browser window with the address bar displaying 'http://.com'. The main content area has a light gray background and contains the following elements:

- The title 'Login Form' in blue text.
- A blue circular icon with a white face, labeled 'FacelD' in blue text below it.
- The word 'OR' in black text.
- An 'Email' input field with an envelope icon on the left.
- A 'Password' input field with a star icon on the left.
- Two blue buttons at the bottom: 'Login' and 'Signup'.

Sign up Login



Home Page



Placement Test

Browser

http://.com

Home Profile Course Materials Course Levels

Image

Username

E-mail

Password

Current Level

Home

Profile

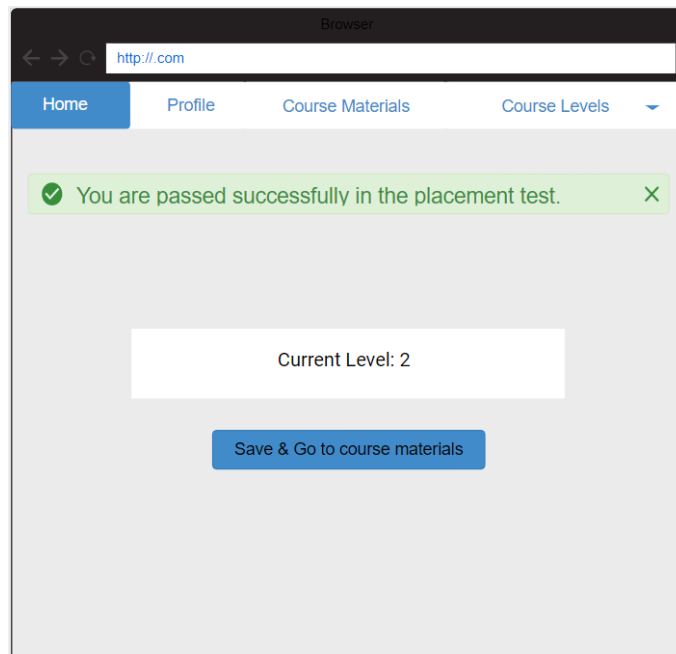
Browser

http://.com

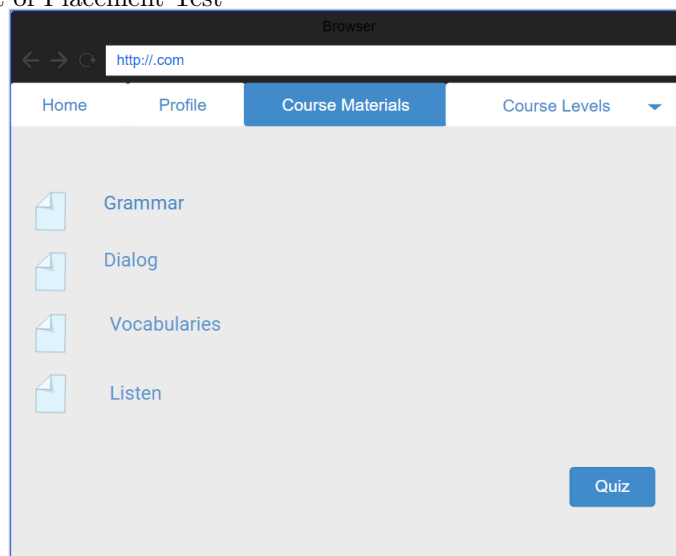
Home Profile Course Materials Course Levels

Level 1	Level 9	Level 17
Level 2	Level 10	Level 18
Level 3	Level 11	Level 19
Level 4	Level 12	Level 20
Level 5	Level 13	
Level 6	Level 14	
Level 7	Level 15	
Level 8	Level 16	

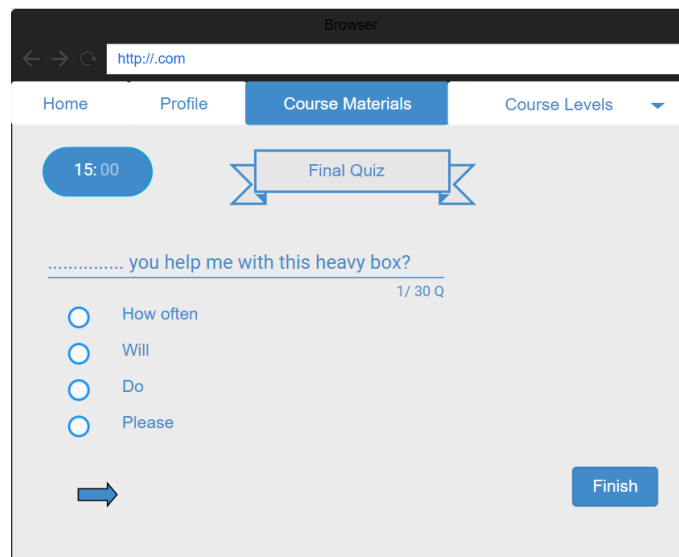
Current level after placement test



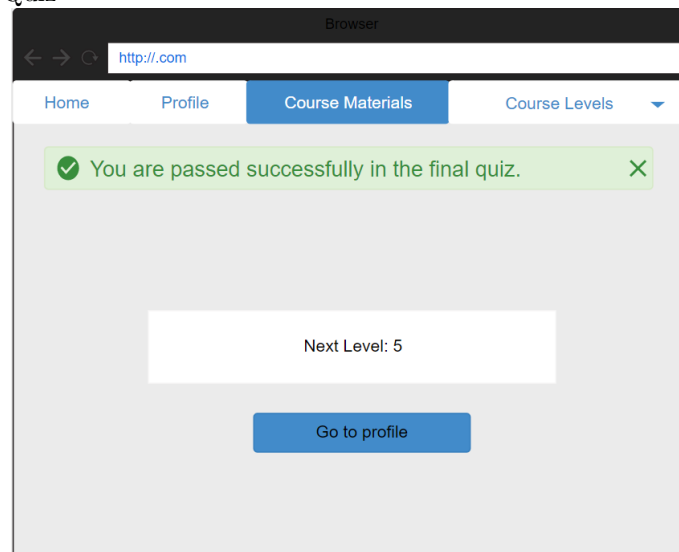
Result of Placement Test



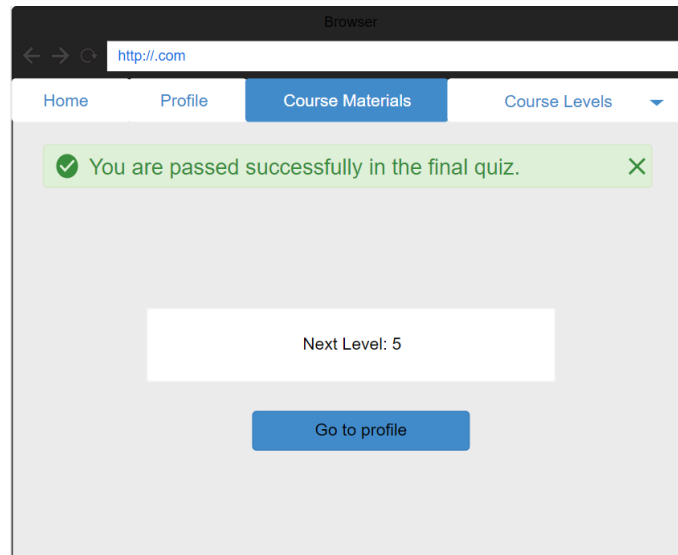
Course Materials



Final Quiz



Result of final quiz



Current level after Final Quiz

4.2 Communications Interfaces

The system requires only a connection to the internet.

5 Performance Requirements

The system must be powerful to handle huge training data sets to make sure model accuracy. The system will have large number of images and videos in the data sets so the system needs specific hardware machines to perform within the best way.

6 Design Constraints

6.1 Hardware Limitations

No strict hardware limitations as its a web application so, it works on the devices that supports the internet access.

6.2 Software Language

Python, PHP, CSS, HTML and FLASK will be used.

7 Other non-functional attributes

7.1 Availability

The system should be available all the time and the database should be able to access at anytime of the day.

7.2 Reliability

This system trains on a huge data set which raises the accuracy of classification. So the system should be assured that result is precise.

7.3 Usability

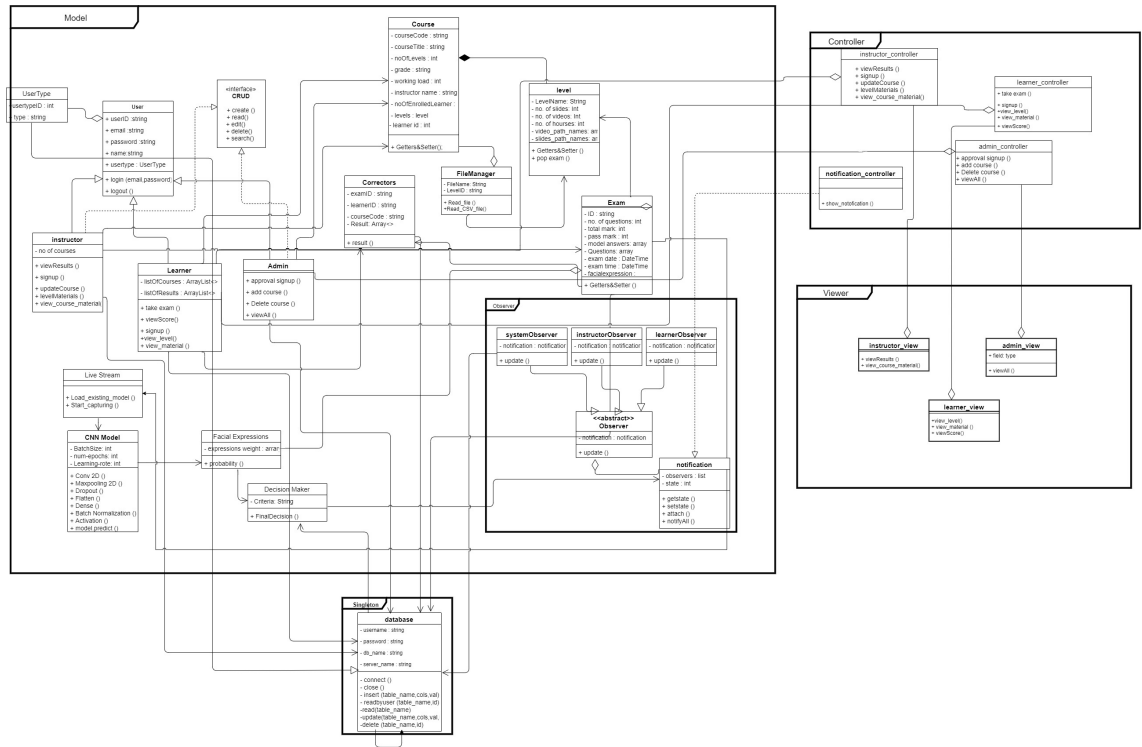
The system is easy to learn and use it. The functionality of the system didn't need time to be learned. With a small number of tasks, the user gets used to remembering all the functions of the system.

7.4 Performance

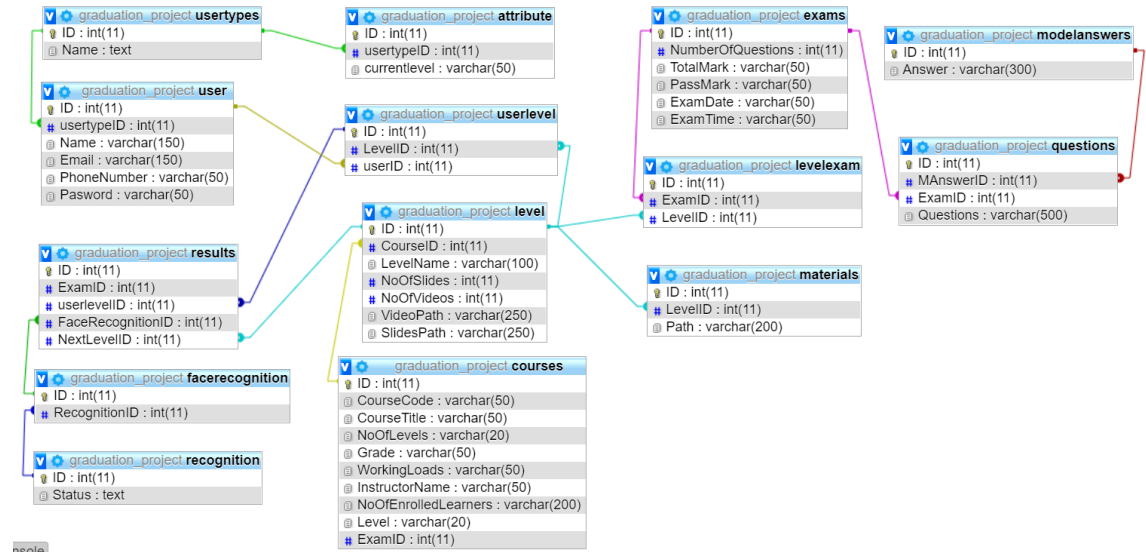
The system should be always working properly and have high performance by using real-time database as fire-base because it's very efficient and it should be accessible at anytime of the day so that will be affordable for any of the users at any time.

8 Preliminary Object-Oriented Domain Analysis

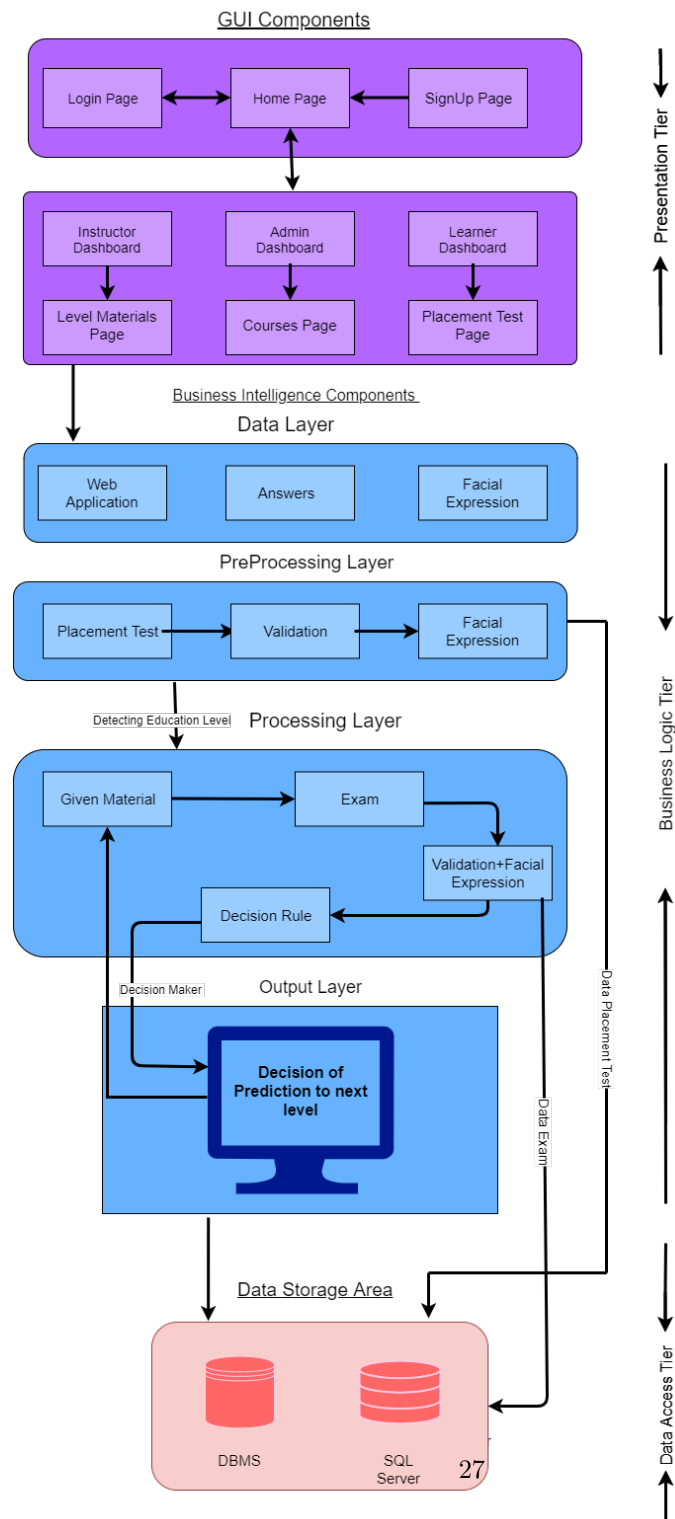
8.1 Class Diagram



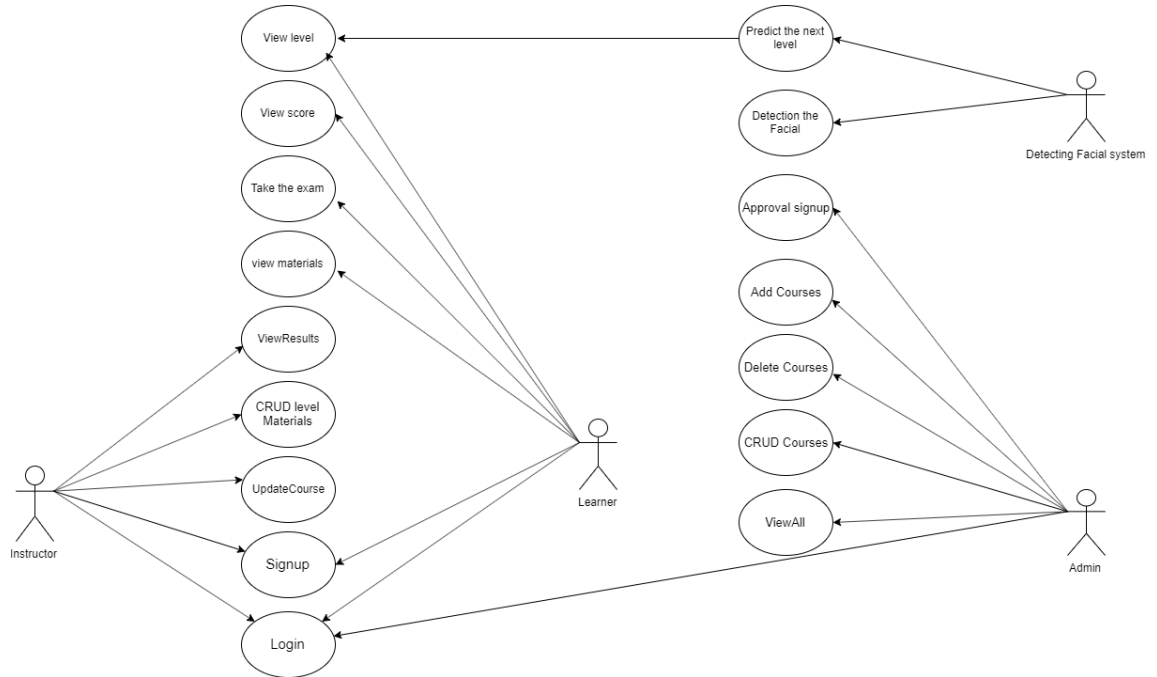
8.2 Database Diagram



8.3 Block Diagram



9 Operational Scenarios



Scenario 1: User handling

The admin control this process. He has some operations such as :

- CRUD users.
- Add/Delete courses.
- Search for the learner.

Scenario 2: learner process

The learner starts the course by taking the placement test. The system will determine the current level for the learner. After that the learner taking the material course to learn it and after finish the course materials, the learner will take the exam to know his next level.

Scenario 3: Instructor process

Only the instructors can CRUD the level materials. He/she also can view the current level for each learner and the results of the student.

Scenario 4: Detection facial system

The facial system detects facial expressions of learners during the exam. After that, the system takes the result of the facial expressions of the learner and his grade to make a decision about the predicted next level.

10 Preliminary Schedule Adjusted

Task	Starting	Ending
Proposal evaluation	7/10/2019	10/10/2018
SRS evaluation	15/12/2019	15/12/2019
SSD Evolution	19/2/2020	19/2/2020
Evaluation implantation	After spring break	After spring break
Technical evaluation	7/5/2020	7/5/2020
Final Thesis	20/6/2020	20/6/2020
Cermoney	24/6/2020	24/6/2020

References

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- [6] Ramón Zatarain-Cabada et al. “Java Tutoring System with Facial and Text Emotion Recognition.” In: *Research in Computing Science* 106 (2015), pp. 49–58.