Software Requirement Specification Document for Educational Metaverse Platform

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May 3, 2023

Table 1: Document version history

Version	**Date**	**Reason for Change**
1.0	15-Nov-2022	SRS First version's specifications are defined.
2.0	2-May-2023	SRS Final Version.

Contents

Abstract

Many educational institutes have recently converted to online systems as it reduces alot of the tutoring costs but none of them gave the end users an experience like they were actually on campus. The main issues are that students often tend to lose focus due to the surrounding environment which is not necessarily prepared for education and they miss out on all the social interactions. Our system aims to utilize the Unity game engine to give the students and professors an immersive experience in which they could meet up and chat via VoIP (Voice Over IP) and an added feature of character customization as well as attend lectures using VR headsets in virtual lecture halls modeled to mirror our real lecture halls which reduces the costs of hosting the students on campus.

1 Introduction

1.1 Purpose of this document

The document's goal is to mention the software requirements in details for an educational metaverse platform. As well as, mentioning and describing all the tools used in developing the system.

1.2 Scope of this document

Since this document targets the stakeholders and developers, similar systems, system overview, scope context and requirements are provided. Also, the project plan is discussed with all milestones.

1.3 Business Context

The aim is to build a 3D Virtual World of an university. The system will facilitate the learning process. As well as, using the system in case of any natural pandemic. More students could be able to enroll in the university's programs, as the number of educational buildings won't be limited. Also, the system can be used in case of any fuel problems happen in the future. Our project will be good marketing for our university as not many universities have these features.

2 Similar Systems

2.1 Academic

- **Li Wang and Lizhen Wang, "Design and Implementation of Three-Dimensional Virtual Tour Guide Training System Based on Unity3D,"** aims to automate the tour guides training process to reduce the process cost and increase it's efficiency in terms of people taking training at the same time and the transportation from/to training locations. They created a three-dimensional educational system for training the tour guides. Learning module where the trainee can learn about tour guiding, scenic spot module where the tour guide can go through scenic spots and simulation module where trainee can practice what he learned. They collected the photos and geographical data about the places to be modeled using 3ds max and then imported to unity game engine. the features of the system was complicated and interleaved which made the system not clear in the user experience.[1]

Figure 1: Scenic Spot

- **Curtis Maines and Stephen Tang in An Application of Game Technology to Virtual University Campus Tour and Interior Navigation** used advanced game technologies to create a web-based university virtual tour. The application's main purpose is to create an interactive virtual campus tour away from common techniques like still image gallery and video gallery. They created a virtual view of the 7th Floor of James Parson Building in the virtual campus environment where user can interact with it. they used adobe Photoshop for the textures and used Autodesk 3Ds max for 3D assets. then imported to unity game engine to integrate it with the game environment. According to this paper, the system requirements and scope were limited compared to the tools used capabilities.[2]

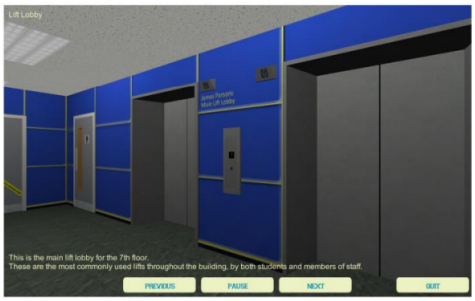

Figure 2: Screenshot from System

2.2 Business Applications

- VR Chat is an online multiplayer VR game that allows users to interact with each other through 3D character models[3] on thousands of virtual grounds as shown in figure 3 made by developers and launched on the gaming platform "Steam". The app is designed mainly to be used with VR headsets to allow an immersive experience but it is also playable without VR using a mouse and keyboard. The game supports hand and head motion detection and mimicking so gestures can appear to other players which allowed a great social experience for all players.

Figure 3: VR Chat Game

3 System Description

3.1 Problem Statement

As the online presence in education increased in the past few years, the existing systems that are currently being used lack communication, synergy and interaction[4]. Since, the students need an interactive educational environment to be able to focus more. Therefore, an engaging and interactive platform is needed.

3.2 System Overview

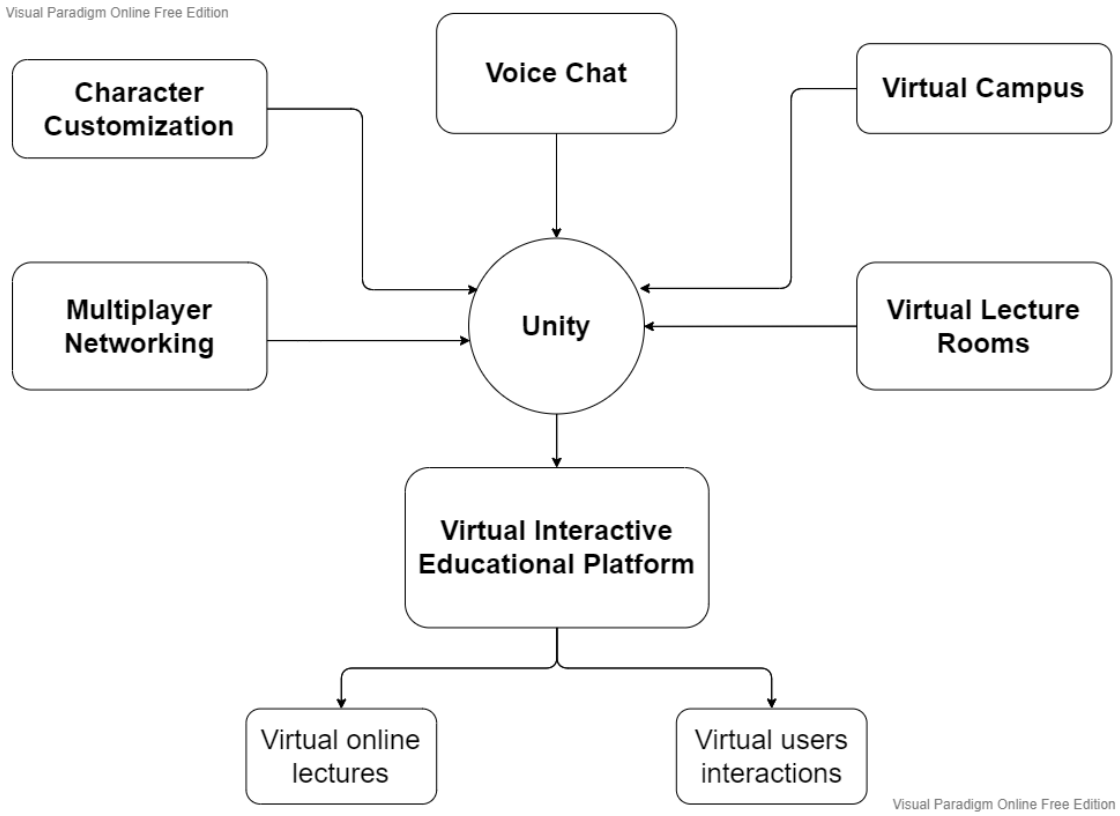

Figure 4: System Overview

An Educational Metaverse Platform will be created by 3D modeling buildings and the campus as whole using Blender Software, Unity Pro Builder and 3Ds Max. These models will be then integrated with Unity engine. In order to achieve accessibility and give the users the best real experience, a meta application shall be built along with a desktop application. The System shall give the students a real educational experience in which students can attend lectures and meetings virtually. Students can also interact with each other on campus using voice chat feature that was implemented using Photon Pun2 and Photon Voice[5]. Students have the option to customize their own avatars using a built-in avatar customization system making education a fun gamified[6] and realistic experience.

3.3 System Scope

The virtual tour and educational system software aims to facilitate communication, interaction and learning process this shall be achieved by:

- The Software will be integrated on “Oculus Meta Quest 2” virtual reality glasses to give the best real experience of our university.
- All the exterior of the buildings will be 3d modeled, but the interior won’t be completely modeled there will only be one lecture hall and a corridor per building floor.
- Users could communicate using real time voice chat when they are at a specific distance from each other to simulate the real experience of social interaction.
- Users can attend lectures using real time video conferencing.
- Users can customize their own avatars to achieve realism as much as possible[7].

3.4 System Context

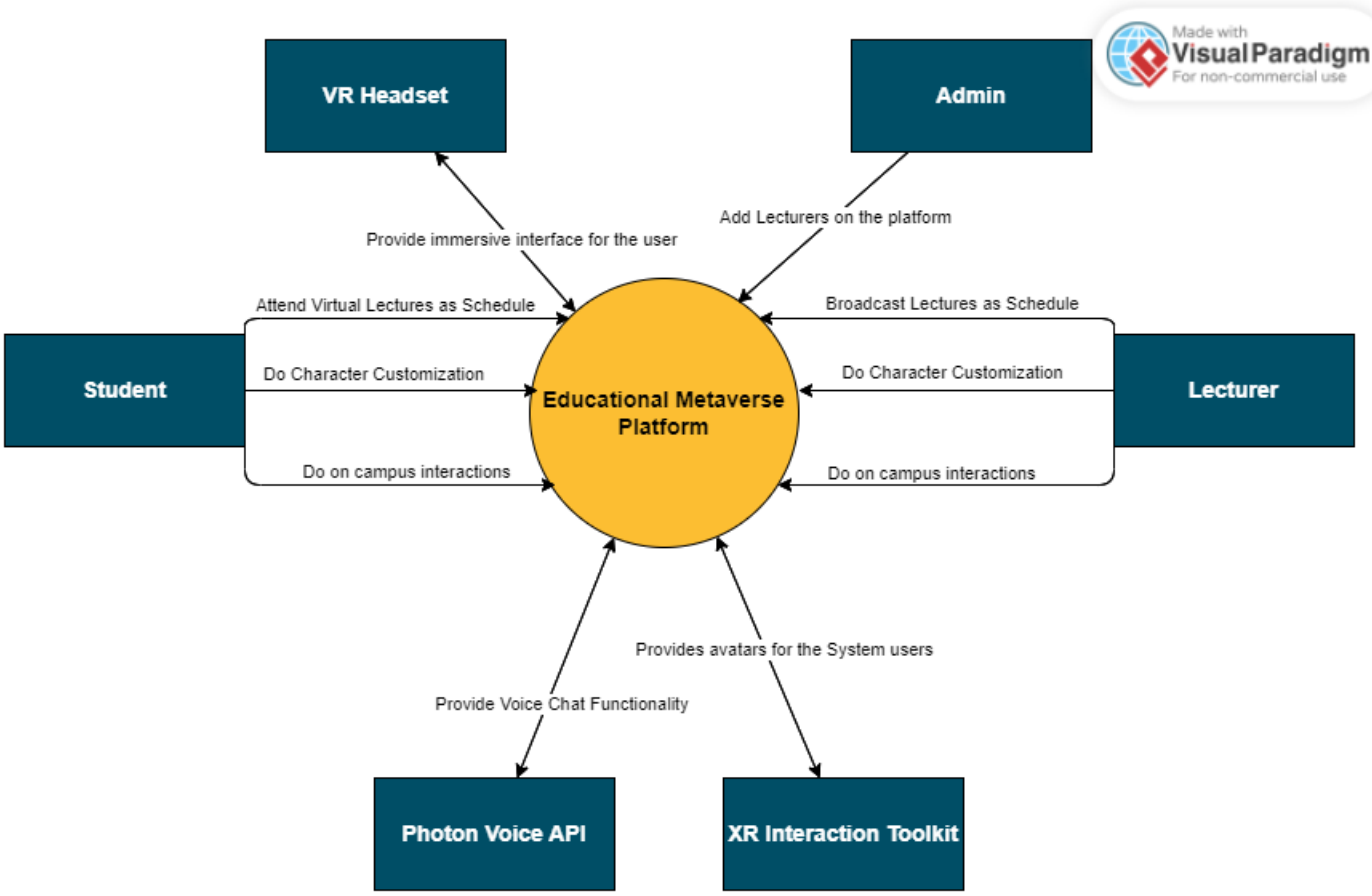

Figure 5: Context Diagram

3.5 Objectives

- We will create a virtual tour for the university by 3d modeling and creating all of the buildings and the campus as a whole. This will help new students to get familiar with our university. This phase should be completed by 12/3/2023.
- We will build and construct 3d models for the whole campus to give the user a real experience in both education and in touring and exploring the university this phase is expected to end by 15/12/2022.
- We will create an online interaction system between users that will allow users to interact with each other's using real-time voice chat this phase is expected to end by 12/2/2023.
- We will make video conferencing system which will make the students and the professors communicate easily through our integrated video conferencing system. This phase is expected to end by 10/1/2023.
- We will create an avatar customization system this will help students customize their own characters. This phase is expected to end by (30/4/2023).
- We will write the SRS document to meet with IEEE 830-1998 standard, which will be delivered by 18/12/2022.

3.6 User Characteristics

- User could be a school student or a university student to access only the virtual tour.
- User shall be a student or professor of Misr International University to access the educational environment and all other features of the system.
- User must have a basic understanding on how to use a computer.

4 Functional Requirements

4.1 System Functions

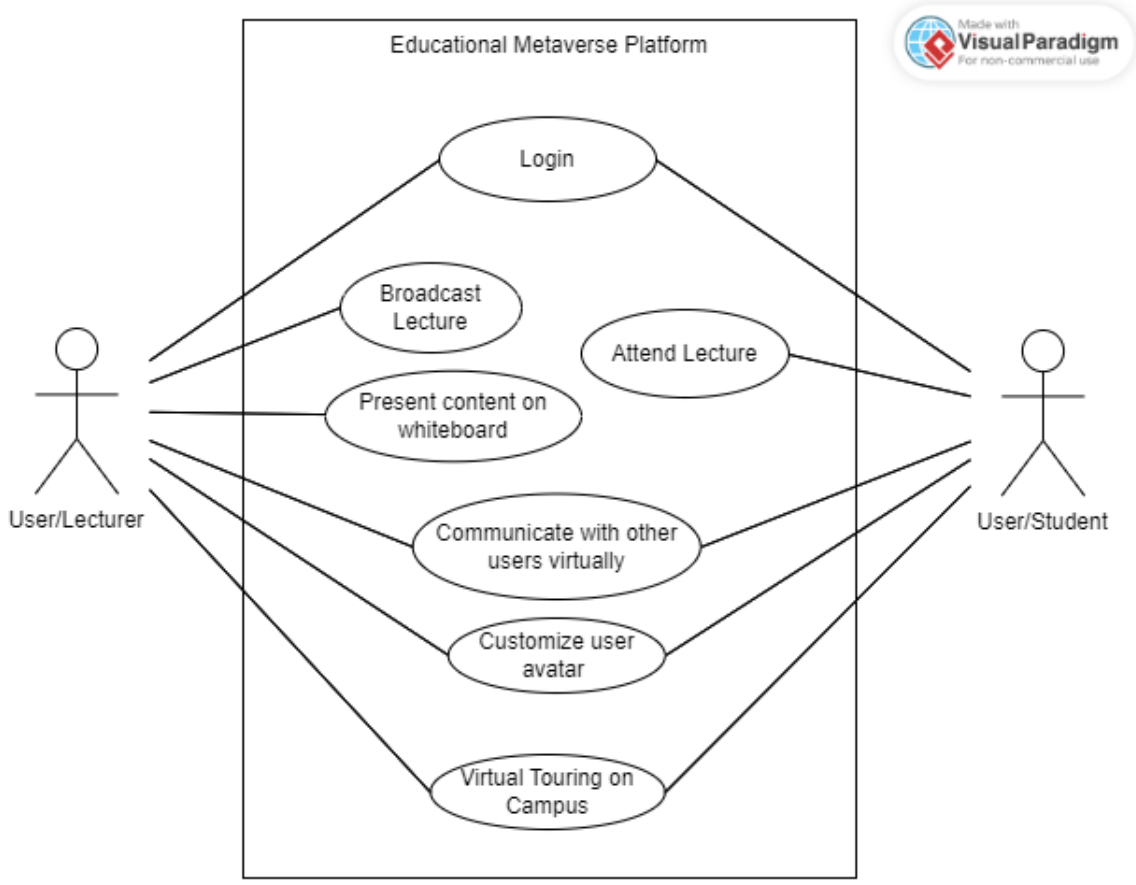

Figure 6: User Use Case Diagram

1. The user shall be able to log in to the system with the university email
2. The user **(Lecturer)** shall be able to give lectures in the system's virtual environment
3. The user **(Student)** shall be able to Attend lectures in the system's virtual environment
4. The user should be able to customize his own avatar in the Virtual Environment
5. The user should be able to interact with other users Virtually in the system through voice chat
6. The user may take a tour in the Virtual university environment
7. The Guest user can take a virtual tour on the campus

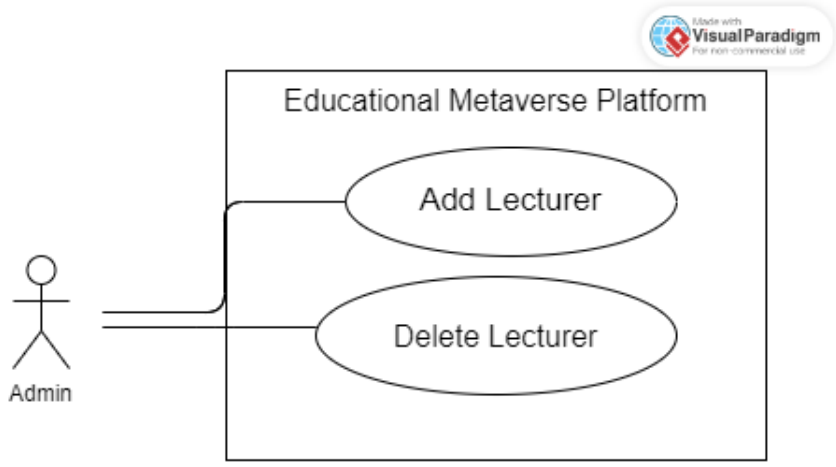

Figure 7: Admin Use Case Diagram

1. The admin shall be able to add a lecturer.
2. The admin shall be able to delete a lecturer.

4.2 Detailed Functional Specification

name	Student/lecturer(User) Login
code	F1
priority	high
critical	the user needs to be registered in the university
Description	The shall enter his Email and password saved in the university systems to be able to use the system
Input	Email and password
Output	The user logged in to the system
Pre-Condition	the user offline from the system
Post-Condition	the user is online and active on the system
Dependency	internet connection and correct email and password
Risk	the user enter wrong email or password

Table 2: User Login

name	Student Attend Virtual lectures
code	F2
priority	high
critical	the Student shall log in to attend virtual lecture
Description	after the user login he can navigate through the application to enter the virtual lecture room
Input	The lecture code
Output	The entrance of the lecture
Pre-Condition	logged in as a user to be able to enter lecture
Post-Condition	presence in the virtual lecture
Dependency	F1
Risk	student enter wrong lecture code

Table 3: Student Attend Virtual Lectures

name	User to communicate with other users
code	F3
priority	medium
critical	the user shall log in to be able to communicate with other users
Description	the user can communicate and socialize with other users through voice chat
Input	action to start virtual conversation
Output	the response of the other user to the conversation starter user
Pre-Condition	you need to be logged in to start virtual conversation
Post-Condition	the communication = between two or more users through virtual chat
Dependency	F1
Risk	The user does No communications with other online users

Table 4: User to Communicate with other users

name	User Customize Their own Avatar
code	F4
priority	medium
critical	the user have to be logged in to be able to customize their own characters
Description	the user should be able to customize their own characters which appear to other users as they want
Input	the desired customization
Output	the customized user avatar as the user adjusted
Pre-Condition	the default avatar for the users
Post-Condition	the customized avatar as user wants
Dependency	F1
Risk	The user uses the default avatar without customizing doing customization

Table 5: User Customize Their own Avatar

5 Design Constraints

5.1 Standards Compliance

The application needs internet access and a server as there are data pushed and pulled from the database.

5.2 Hardware Limitations

The minimum requirements for operating the Meta 2 application on a Personal-Computer

- CPU: Intel i5-4590 / AMD Ryzen 5 1500X or greater.
- RAM: 8 GB.
- OS: Windows 10.
- VIDEO CARD: NVIDIA GeForce GTX 970 / AMD Radeon 400 Series or better.

5.3 Other Constraints as appropriate

The SDK used for voice chat(Photon) has limitations it can be used for free tier up to 20 online users at a time.

6 Non-functional Requirements

6.1 Security

System security is accomplished by hashing passwords of all users. In addition to filtering all inputs to prevent some security attacks as SQL injection.[8]

6.2 Ease of use

The application shall provide a tutorial when the user first sign in. This tutorial should be able to facilitate and make the user more familiar with the application.

6.3 Maintainability

The system shall be done in a manner which will allow the system to be updated and extended easily with more features. which is achieved through clean code, a well managed architecture and the integration of reliable SDKs.[9]

6.4 Accessibility

The System can be accessed from different platforms as desktop or meta glasses.

7 Data Design

The Database consists of Five main tables. table Students and Lecturer to store and deal with the data of the users. while table lecture rooms deals with Virtual lecture rooms in the system where the table holds its id, known room code(which is displayed to the users) and status where it is busy or empty. While User-Attributes defines the character appearance attributes of each user using the system. And table lecture deals with the lecture attributes like course, time and where it will be conducted.[10]

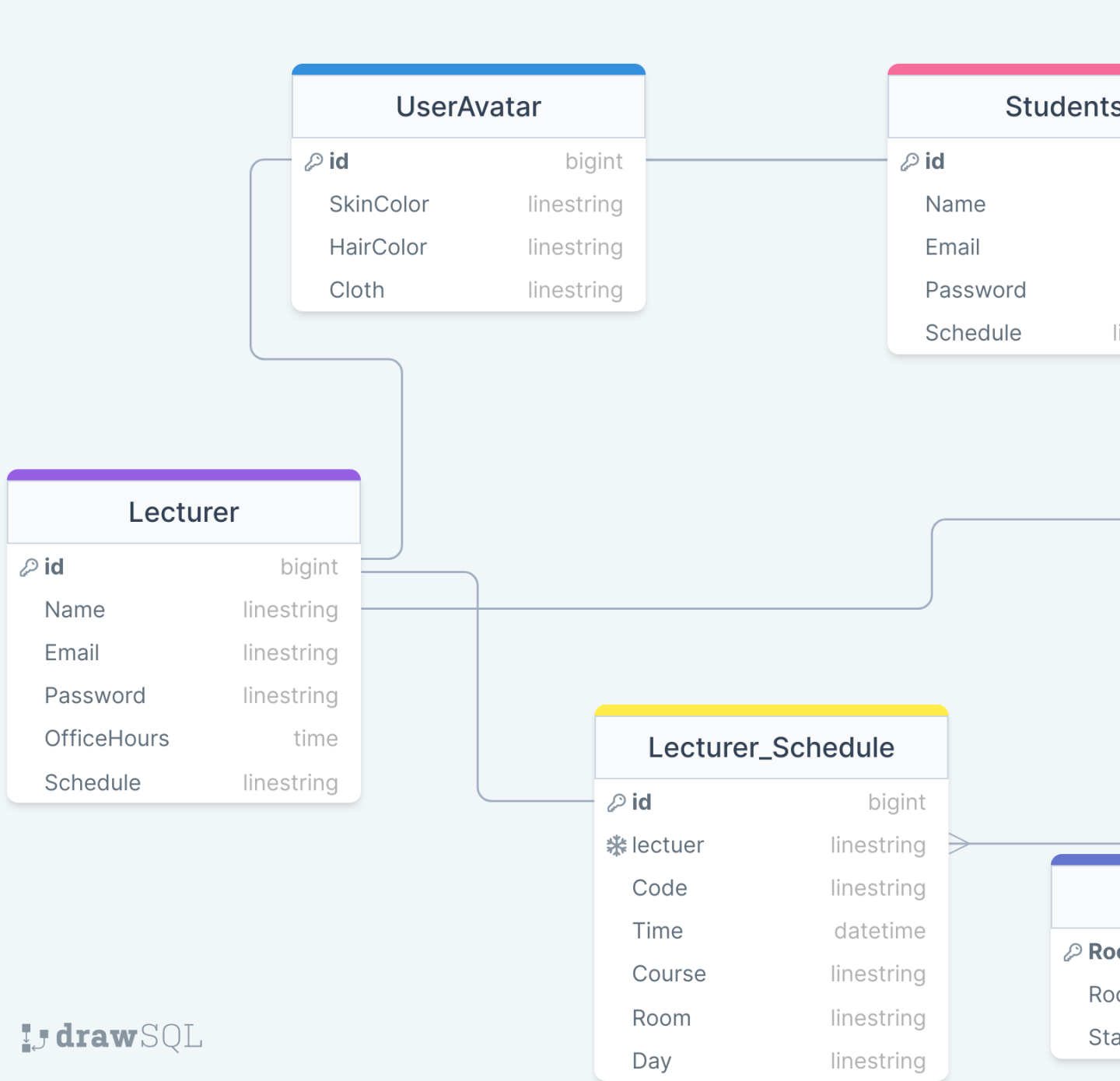

Figure 8: Database Diagram

8 Preliminary Object-Oriented Domain Analysis

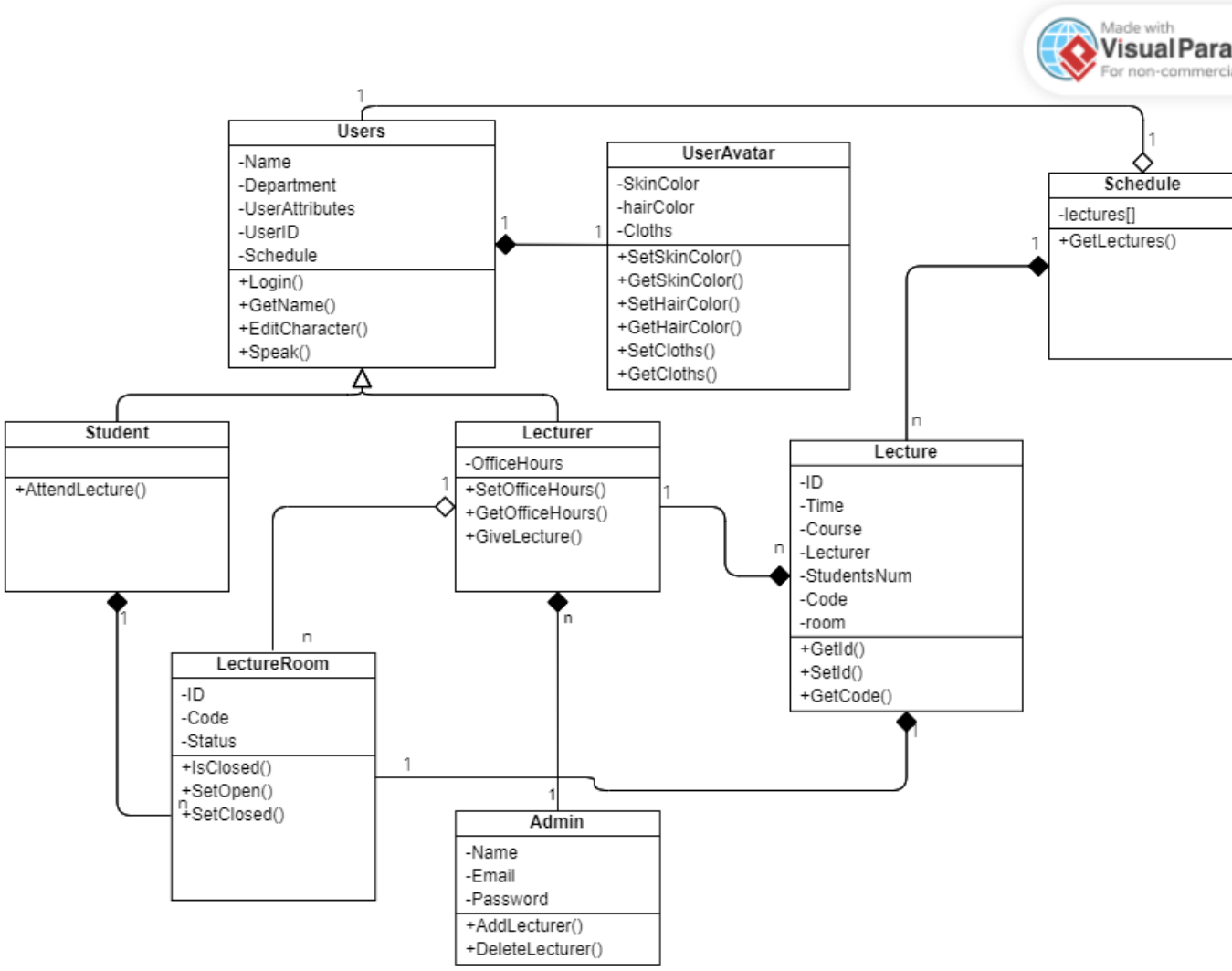

Figure 9: Class Diagram

9 Operational Scenarios

- Users can login using their university emails
- User will be sent to character customization after registration
- User can customize their avatars to look alike to their real faces and bodies.
- User can roam on virtual campus grounds.
- User will go through a tutorial to familiarize them with how the system works.

- User A can meet User B on campus grounds.
- User A can chat through voice chat with User B anywhere on campus
- User can connect their VR headsets to the application.
- User A voice will be reduced to User B if User A is faraway from User B in terms of distance
- Priviliged Users (Professors) will have the ability to host a lecture and share their screens.
- Users (Students) can enter lectures hosted by professors by searching through the lecture rooms list in the main menu and entering the agreed on lecture by entering the invite code sent by the professor.
- User can move their hands and the gestures will be captured and projected in the application

- Users will be able to share their screens in class by going into the menu and enabling share screen if given permission by the Professor
- Users will have the option to turn on their cameras in class.

10 Project Plan

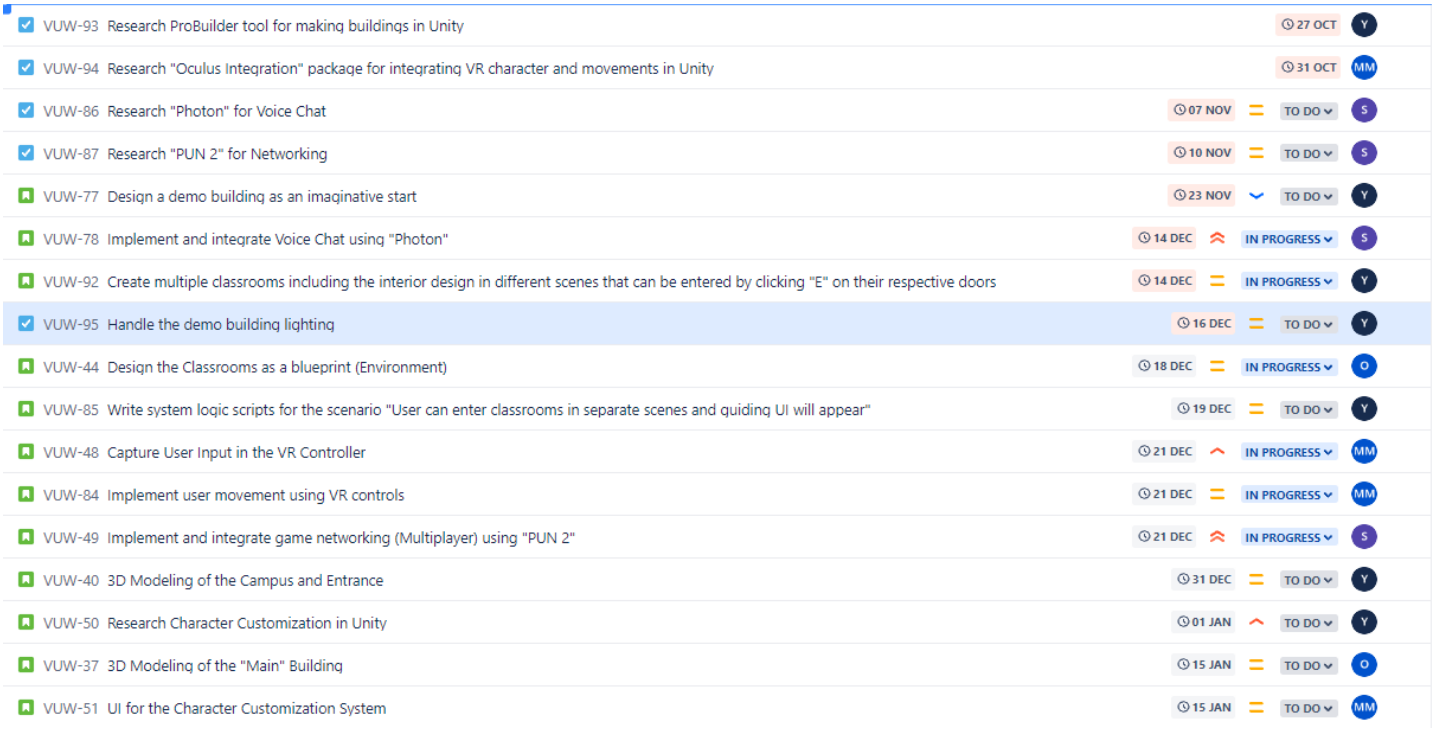

Figure 10: Project Plan

Figure 11: Project Plan

11 Appendices

11.1 Supportive Documents

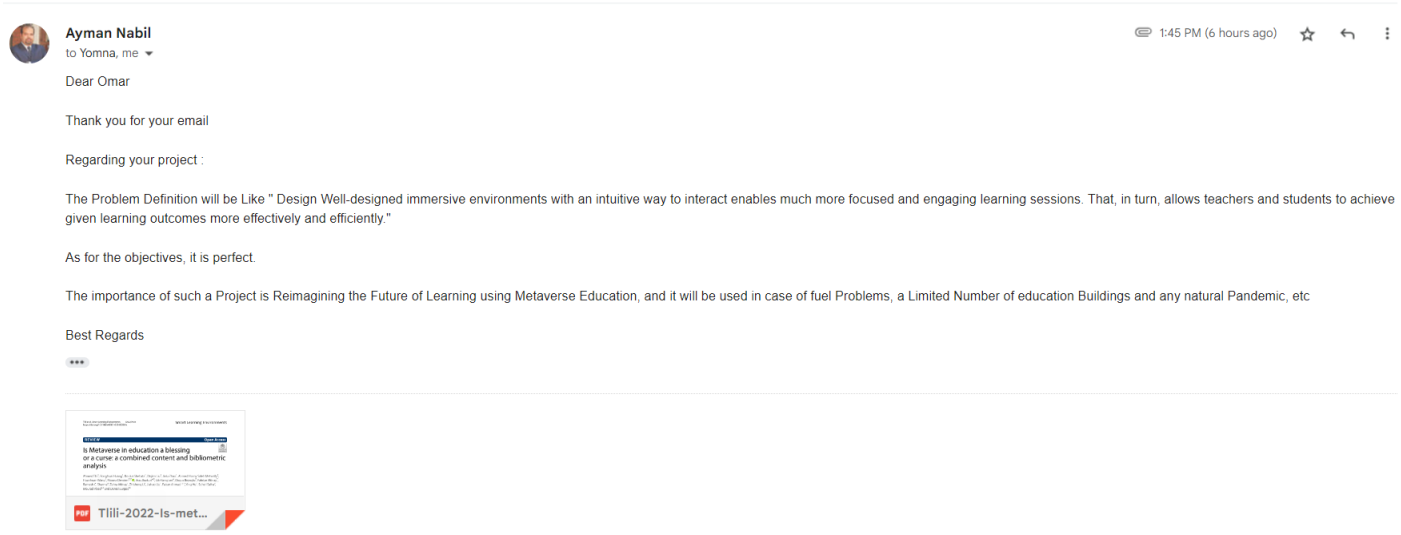

Figure 12: Supportive Email

12 References

References

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