



American International University-Bangladesh (AIUB)

Department of Computer Science

Faculty of Science & Technology (FST)

Generative Education using Augmented Reality (AR)

A Software Engineering Project Submitted

By

Semester: Spring_23_24		Section: A	Group Number: 04	
SN	Student Name	Student ID	Contribution (CO3 + CO4)	Individual Marks
1	Ammar Bin Mahmud	22-46524-1	20%	
2	Md. Tahsin Hasib	22-46026-1	20%	
3	Rafin Abrar Rono	22-47226-1	20%	
4	Muhtadi Mansib	22-47083-1	20%	
5	Khushbu Alam Rahi	22-46947-1	20%	

The project will be Evaluated for the following Course Outcomes

CO3: <i>Select</i> appropriate software engineering models, project management roles and their associated skills for the complex software engineering project and evaluate the sustainability of developed software, taking into consideration the societal and environmental aspects	Total Marks	
	Appropriate Process Model Selection and Argumentation with Evidence	[5 Marks]
	Evidence of Argumentation regarding Process Model Selection	[5 Marks]
	Evaluate the sustainability of the developed software in terms of both society and the environment (Impact identification)	[5 Marks]
Submission, Defense, Completeness, Spelling, grammar, and Organization of the Project report	[5 Marks]	
CO4: <i>Develop</i> project management plan to manage software engineering projects following the principles of engineering management and economic decision process	Total Marks	
	Develop the project plan, its components of the proposed software products using WBS and testcases	[5 Marks]
	Identify all the activities/tasks related to project management and categorize them within Project estimation, and schedule of the tasks using appropriate resources	[5 Marks]
	Identify all the potential risks in the specific project and prioritizing/categorizing those, and also mitigation plan to overcome the risk factors.	[5 Marks]

Description of Student's Contribution in the Project work

Student Name: Ammar Bin Mahmud

Student ID: 22-46524-1

Contribution in Percentage (%): 20%

Contribution in the Project:

- Background and Solution to the Problem
- Functional Requirements
- Use Case Diagram
- Process Model Selection : Reasoning behind choosing this model
- Wireframe Design (Natural Language Interface, Student Monitoring, Holographic communication)
- Test Planning - Objectives
- Test Cases Design (FR_13, FR_14, FR_15)
- WBS
- Constructive Cost Method
- Timeline Chart – 01
- Timeline Chart – 02
- EVA
- Risk Management (RMMM)

Ammar Bin Mahmud

Signature of the Student

Student Name: Md. Tahsin Hasib

Student ID: 22-46026-1

Contribution in Percentage (%): 20%

Contribution in the Project:

- Functional Requirements
- Use Case Diagram
- Class Diagram
- Sequence Diagram
- Process Model Selection: Selected Process Model
- Wireframe Design (Institutional Signup, Assessment Preparation, Distribution, Teacher Dashboard)
- Test Planning – Introduction
- Test Cases Design (FR_02, FR_07, FR_09, FR_12)
- WBS
- Constructive Cost Method
- Timeline Chart – 01
- Timeline Chart - 02
- EVA
- Risk Management

Md. Tahsin Hasib

Signature of the Student

Student Name: Rafin Abrar Rono

Student ID: 22-47226-1

Contribution in Percentage (%): 20%

Contribution in the Project:

- Functional Requirements
- Class Diagram
- Sequence Diagram
- Process Model Selection: Project Role Identification
- Wireframe Design (Time based learning modules, Detecting Equation)
- Test Planning – Test Deliverables
- Test Cases Design (FR_06_A, FR_06_B, FR_10)
- WBS
- Constructive Cost Method
- Timeline Chart – 01
- Timeline Chart – 02
- EVA
- Risk Management

Rafin Abrar Rono

Signature of the Student

Student Name: Muhtadi Mansib

Student ID: 22-47083-1

Contribution in Percentage (%): 20%

Contribution in the Project:

- Functional Requirements
- Use Case Diagram
- Class Diagram
- Activity Diagram
- Project Model Selection: Project Role Responsibilities
- Wireframe Design (Student Signup, AR field trip, Live Streaming)
- Test Planning - Objectives
- Test Cases Design (FR_03, FR_08, FR_11)
- WBS
- Constructive Cost Method
- Timeline Chart – 01
- Timeline Chart - 02
- EVA
- Risk Management

Muhtadi Mansib

Signature of the Student

Student Name: Khushbu Alam Rahi

Student ID: 22-46947-1

Contribution in Percentage (%): 20%

Contribution in the Project:

- Functional Requirements
- Activity Diagram
- Process Model Selection: Project Role Identification & Responsibilities
- Wireframe Design (Login, Guest User Mode, Forgot Password)
- Test Planning – Overview and Conclusion
- Test Cases Design (FR_01, FR_04, FR_05)
- WBS
- Constructive Cost Method
- Timeline Chart – 01
- Timeline Chart – 02
- EVA
- Risk Management

Khushbu Alam Rahi

Signature of the Student

1. PROJECT PROPOSAL

1.1 Background to the Problem

When it comes to meaningfully developing knowledge and effectively interacting, the traditional classroom approach frequently falls short. Students often receive knowledge as a passive learning paradigm such as teachers or textbooks. Many educational concepts are taught in an abstract form without meaningful connections to the real world which hinders their ability to apply it in real-world situations and limits their ability to remember it. Moreover, many students feel struggling and frustrated with the educational process because the one-size-fits-all approach to education does not account for a variety of learning styles and preferences.

The root cause of the problem lies in the limitations of conventional education systems, which often struggle to engage and immerse learners effectively. This problem is crucial to address as it impacts the effectiveness of education in various domains, hindering the development of critical skills and knowledge in learners. Numerous STEM (Science, Technology, Engineering, and Mathematics) concepts continue to be taught in analog ways within traditional classrooms. Despite the rapid advancements in technology, many educational institutions still rely on conventional methods, such as textbooks and static visual aids, to convey complex STEM concepts. This persistence of analog teaching methods poses a significant challenge as it limits the dynamic and interactive nature of STEM education.

1.2 Solution to the Problem

Our solution is to develop an immersive generative education system using Augmented Reality (AR) with assisted hardware. This system will help students and teachers alike to visualize, interact and simulate specific scenarios and procedures implemented by 3D projection technology.

At the very basic, the system can help visualize complex mathematical problems with graphs and appropriate visuals. One can easily select any equation and see it in 3D space to analyze the shapes and equations in real life. Teachers can create engaging spatial content for their students. Teachers can also request Content Creators to create engaging contents for them. As this device will be used for education it is necessary that the control remains to the teachers. So, our device will have a dashboard where the teacher can manage every student's device. What apps they can use, how long they can interact with it. They can even take assessments in a controlled environment where every app and resource will be either blocked off or unavailable made by the teacher. The device can use its GPS to automatically geo-fencing the virtual environment. Students can use this device to revise their notes or skim through lecture videos. Students can also take AR Field Trips in the lab. Guest users can join the field trips too. Our target users are Institutions with teachers and students belonging to educational institutions in a lab environment. They can also communicate in the holographic environment with directional speech. Institutions can customize the device to their needs. The field of AR is not very new but the advancement in this field has only caught up recently because we did not have enough computing power in the past for this kind of projects. But now we can easily run these solutions on ARM mobile SoCs. Many of the mobile processor even comes with Neural and Visual engine to support the computation that our device needs. This project is feasible more than ever before and in future with the advancement of CPUs this will only go lower. Some existing solutions include [Apple Vision Pro](#), [Microsoft Hololens](#), [Zappar](#), [Quiver](#) or Google Expeditions AR (Currently merged with Google Arts & Culture), which range from interactive textbooks, 3D learning experiences to virtual explorations. Our system extends the existing solutions by adding a natural language interface, immersive reading experience, a 3D model view for pre-specified structures to improve understanding the design and simulation of related procedures.

This project is a category A for Bangladeshi education landscape and category B for international landscape.

2. SOFTWARE DEVELOPMENT LIFE CYCLE

2.1 Process Model

Selected process model:

For our generative education system using AR, the initial requirements of the project are vague and may be subjected to changes as development progresses. Hence an agile process model will be appropriate in this scenario. Considering the fact that our project will deal with continuous

changes due to customers changing requirements, we may need to release the system in steps. And so, the Scrum framework will be the best choice for the project.

Reasons for choosing this model:

Scrum is one of most widely used agile process models, due to its lightweight management practices, transparency among developers as well as frequent consumer feedback. Scrum uses an approach that is both iterative and incremental. There is also a benefit of regular inspection of the progress. Everyone can see every part of the project, from inside and outside the team which helps customers/stakeholders to observe if the features are working as desired.

In this model, the development process is divided into shorter intervals, called 'sprints'. For each sprint the requirements are prioritized and developed accordingly. Additionally the product Backlog list is constantly updated with new and more detailed items. An iteration continues until the customer is satisfied with the features implemented. As our project relies on customer feedback, we will be able to review our progress before release.

Scrum emphasizes collaboration and frequent communication between team members and stakeholders. This is beneficial for developing learning modules, course contents, and progress tracking functionalities as it allows for continuous refinement based on feedback.

Scrum promotes regular communication through daily stand-up meetings, sprint reviews, and sprint planning sessions. This supports the development of collaborative communication features, n-way communication between teachers and students, and live interaction functionalities.

Overall, the Scrum process framework will nicely fit within the scope of our project as it provides the best approach for development with continuous progress tracking & feedback as well as deep customer engagement.

Why are other models insufficient?

Since our project requirements initially are not well defined, the plan driven frameworks will fail in this regard. So, the agile process is best suited in terms of ambiguous & changing requirements.

Extreme Programming (XP) focuses heavily on technical practices such as pair programming and test-driven development which could be beneficial for ensuring high-quality code and timely delivery. But XP might not provide as much structure for managing the overall development process and stakeholder collaboration as Scrum does. Scrum provides clearer roles and artifacts to focus on specific goals than XP.

DSDM emphasizes the importance of frequent delivery and active user involvement. While this aligns well with the requirements for iterative development and stakeholder engagement, DSDM's focus on fixed time and cost constraints might not be as flexible for accommodating evolving requirements as Scrum. DSDM focuses on engineering activities and may include roles beyond the development team, meanwhile Scrum focuses on the operational team with more standardized terminologies.

FDD focuses on features and may require extensive planning beforehand. Moreover, in FDD the operational team consists of a large group which are then divided into smaller groups to work in parallel. Scrum focuses on smaller teams and is more oriented towards customer feedback to improve its results.

2.2 Project Role Identification and Responsibilities

In a development project, members of the team will be given specific roles, each with their own sets of obligations to ensure the development progress continues as planned. The number and scope of these roles will vary with the complexity & needs of the project. For our project the following roles are included:

- **Scrum Master:**

- Make sure the development team abides by Scrum principles and track their progress through daily Scrum meetings & reviews.
- Prevent team from over committing to elusive requirements during sprint planning as well as aid in estimation of task progress and sub-task creations.
- Assist product owner in managing & prioritizing product backlogs to achieve clear requirements for the project.
- Advise development team on organization of tasks & manage internal obstacles through workflow improvements.

- **Product Owner:**

- Communicate with the development team to define the product goal for the Scrum team.
- Create & manage product backlog as well as review & finalize tasks related to product backlog.
- Prioritize & verify requirements defined in the backlog.
- Represent the needs of shareholders and discuss with them to change or create additional requirements for the backlog.

- **Scrum Development Team**

- Produce increments of working software based on product backlog requirements.
- Ensure product quality through identifying the best approach for development. This can be achieved through consulting with the Scrum master, testing prototype builds and including quality assurance tasks.
- Create an estimation of the time required for a sprint as well as commit to the necessary goals to achieve during that sprint.
- Collaborate with Scrum Master and other members of the team to organize & delegate tasks to suit overall development progress.

- **Management Group**

- Manage the overall project by interacting with both the developers and shareholders to ensure smooth delivery of the product.
- Participate in review meetings to ensure backlog requirements are met as demanded from the shareholders.
- Take part in final decision makings and make sure all agreements between developers and shareholders are met accordingly. Also make sure all standards and necessary protocols are maintained throughout the project.

2.3 Project Sustainability in terms of Society and Environment

The software has positive social impacts by enhancing education through immersive learning experiences. It promotes engagement, empowerment of teachers, and collaboration among students and teachers. However, it's essential to ensure that the system remains accessible to all socio-economic groups and does not exacerbate existing educational inequalities.

The environmental impact of the hardware components has been assessed, particularly in terms of energy consumption and material use. Since the system utilizes AR technology, which often involves complex hardware components, efforts are made to ensure energy efficiency and the use of sustainable materials. Additionally, considering the potential for increased electronic waste, proper lifecycle management and disposal practices are also in our extended vision.

The project has the potential for sustainability, given its alignment with market needs, technological advancements, and social benefits. However, further research, planning, and ongoing assessment will be necessary to ensure sustained success. Additionally, addressing environmental considerations and ensuring responsible business practices will be essential for long-term viability.

3. SOFTWARE REQUIREMENTS ANALYSIS

Functional Requirements

1. Device Login

- 1.1. The device shall allow users to login with their given username and password.
- 1.2. The credentials will be matched against the system database.
- 1.3. If the credentials match the database, the login will be successful, and users will be taken to the home screen.
- 1.4. If the credentials do not match, then users will be notified about the wrong credentials and will be given 3 chances for the login attempt.
- 1.5. If a user attempts more than 3 times with wrong credentials the device will be locked for 10 minutes. A countdown timer will be shown to the user for next tries.
- 1.6. If the user has 2 Factor Authentication enabled, then an OTP code will be sent to the user's email address or phone number (whichever is setup before).

- 1.7. If an OTP code was sent, upon login the system will ask for the OTP code for successful login.

Priority Level: High

Precondition: The device must be registered with the system and users shall have valid credentials.

Cross-references: N/A

2. Institutional Signup

- 2.1. The system shall provide a signup form for Institutions in the Admin control panel.
- 2.2. Admin should fill up the sign-up form with appropriate information from the paperwork.
- 2.3. Institutions should provide their unique EIIN number to signup.
- 2.4. Institution should provide their required number of devices.
- 2.5. The system shall generate a unique ID for each of the student's account and a one-time password which will be handed over to the students, which they have to change after their first login.
- 2.6. Admin will handover the Institution account dashboard to the designated Teachers from the Institution upon a successful sign up.

Priority Level: High

Precondition: Institutions must provide their official documents including paperwork from Government issued documents.

Cross-references: N/A

3. Student Signup

- 3.1. Teachers should collect the emails of their students to assign device accounts to them.
- 3.2. Teachers should also assign additional information such as their Name, Semester, Taken courses,
- 3.3. Teachers should set a timeframe for validity of the students account.

Priority Level: High

Precondition: Teachers should have access to institutional account all the student's email to sign up accounts for them.

Cross-references: N/A

4. Forgot Password

- 4.1. The system shall provide a "Forgot Password" option in the login interface.
- 4.2. Users should be able to provide their unique ID to identify their account in order to create a new password.

- 4.3. The system shall send a Password reset link to the user's email.
- 4.4. The system should check if the account has 2 factor authentication enabled and ask for the OTP code in that case.
- 4.5. The system should check that the new password does not match with any old password.

Priority Level: High

Precondition: The account must exist on the system.

Cross-references: N/A

5. Guest User Mode

- 5.1. The system should provide a limited access account for the Guest user.
- 5.2. The Guest user account should be able to join AR Trips without logging in.
- 5.3. The system should do a check for the account type before the Guest user joins the AR Trips and limits collaborative access.
- 5.4. Access limitations for guest users shall be clearly communicated by the system through notification.

Priority Level: High

Precondition: The account must exist on the system.

Cross-references: N/A

6. Time based learning modules

- 6.1. The teacher should provide learning modules related for current semester to the students.
- 6.2. The system shall expire the modules based on semester timespan.
- 6.3. The teacher should be able to revoke access for the learning modules at any time.

Priority level: High

Precondition: N/A

Cross reference: N/A

7. Assessment Preparation

- 7.1. The teachers should be able to create new assessments for the students.
- 7.2. Assessment parameters such as time limits and grading criteria shall be customizable by teachers.
- 7.3. The system shall provide analytics tools for analyzing assessment results and tracking student progress.
- 7.4. The teachers should have access to previously set questions from the system.

Priority level: High

Precondition: N/A

Cross reference: N/A

8. Live streaming for teachers

- 8.1 The system should provide a live class session for the students.
- 8.2 After starting the live session the students would be able to join the session.
- 8.3 Before joining the live session the teacher should give permission to each students.
- 8.4 Live streams shall support real-time interaction with students, including chat and Q&A features.

Priority level: High

Precondition: The teacher must have a valid and active user account on the streaming platform.

Cross reference: N/A

9. Assignment Distribution

- 9.1 Teachers shall have the ability to create and distribute assignments to individual students or groups.
- 9.2 Assignment details such as instructions, due dates, and resources shall be provided within the system by the teacher.
- 9.3 Students shall receive notifications and reminders about assigned tasks.

Priority Level: High

Precondition: N/A

Cross-references: N/A

10. Detect visualizable equations on the fly

- 10.1 The system shall analyze text inputs to identify mathematical equations.
- 10.2 After identifying the mathematical equations, the students will be provided options to visualize the equations.
- 10.3 Upon choosing the option, the student would be able see the graphical representation of the mathematical equations.

Priority Level: High

Precondition: The system should be able to detect mathematical equations.

Cross-references: N/A

11. AR Field Trips for every user

- 11.1 The system would allow the teacher to upload 3D videos covering various educational topics and destinations.
- 11.2 After uploading the 3D videos, the system would allow access to any kind of user.
- 11.3 In the user interface, the system shall offer a selection of AR field trips to the user.
- 11.4 After selecting the options, the users would be able to join the AR field trip.

Priority Level: High

Precondition: The teacher shall upload 3D videos.

Cross-references: N/A

12. Assignment Distribution

- 12.1 The system would allow the teacher to create and distribute assignments to individual students or groups.
- 12.2 While creating, the teacher should fill in the assignment details such as instructions, due dates, and resources shall be provided within the system.
- 12.3 After assigning the assignment, notifications would be sent to the students.
- 12.4 The system would send reminders to students at least 3 days before submission.

Priority Level: High

Precondition: N/A

Cross-references: N/A

13. Natural Language Interface

- 13.1. The user should be able to control the system using natural language instructions.
- 13.2. The system should support real-time translation of voice input from one language to another, selectable from predefined lists of languages.

Priority Level: Low

Precondition: The system must incorporate a natural language interface with real-time translation capabilities.

Cross-references: N/A

14. Student Monitoring for Teachers

- 14.1 Teachers should be directed to a comprehensive dashboard after logging in.
- 14.2 The dashboard must display metrics related to student engagement, including Login frequency, Assignment completion status.
- 14.3 Based on the gathered metrics, teachers should have the capability to send notifications to students as needed.

Priority Level: High

Precondition: The system must incorporate a dashboard for the teacher.

Cross-references: N/A

15. Holographic communication

- 15.1 The system should provide a communication method between teachers and students while using the AR device.
- 15.2 The holographic communication method should show an avatar of both the parties communicating.
- 15.3 The communication method should work in a directive way such that when a user looks in the direction of someone, they can initiate a conversation.

Priority Level: High

Precondition: The system must track the user's head movement to accurately point to other users in the holograph.

Cross-references: N/A

16. Content Creation

16.1 The system should facilitate a hub for content creators to see available works for them.

16.2 The teachers should be able to place requests for making new content to the content creators.

16.3 The system should provide a space for content creators to upload their contents.

Priority Level: High

Precondition: Content creators should be logged in.

Cross-references: N/A

17. Simulate Virtual environment

17.1 The system shall allow students to simulate live generative experiments with the help of AR.

17.2 Upon choosing the option, students can generate data based on the lab experiment and save for later use.

17.3 Teachers will be able to evaluate students on the virtual lab based on their simulated performance.

Priority Level: High

Precondition: The students should be allowed first to enter virtual environment by respective teachers.

Cross-references: N/A

Non – Functional Requirements

Usability: The AR interface should be intuitive and easy to use, especially for users with varying levels of technical expertise.

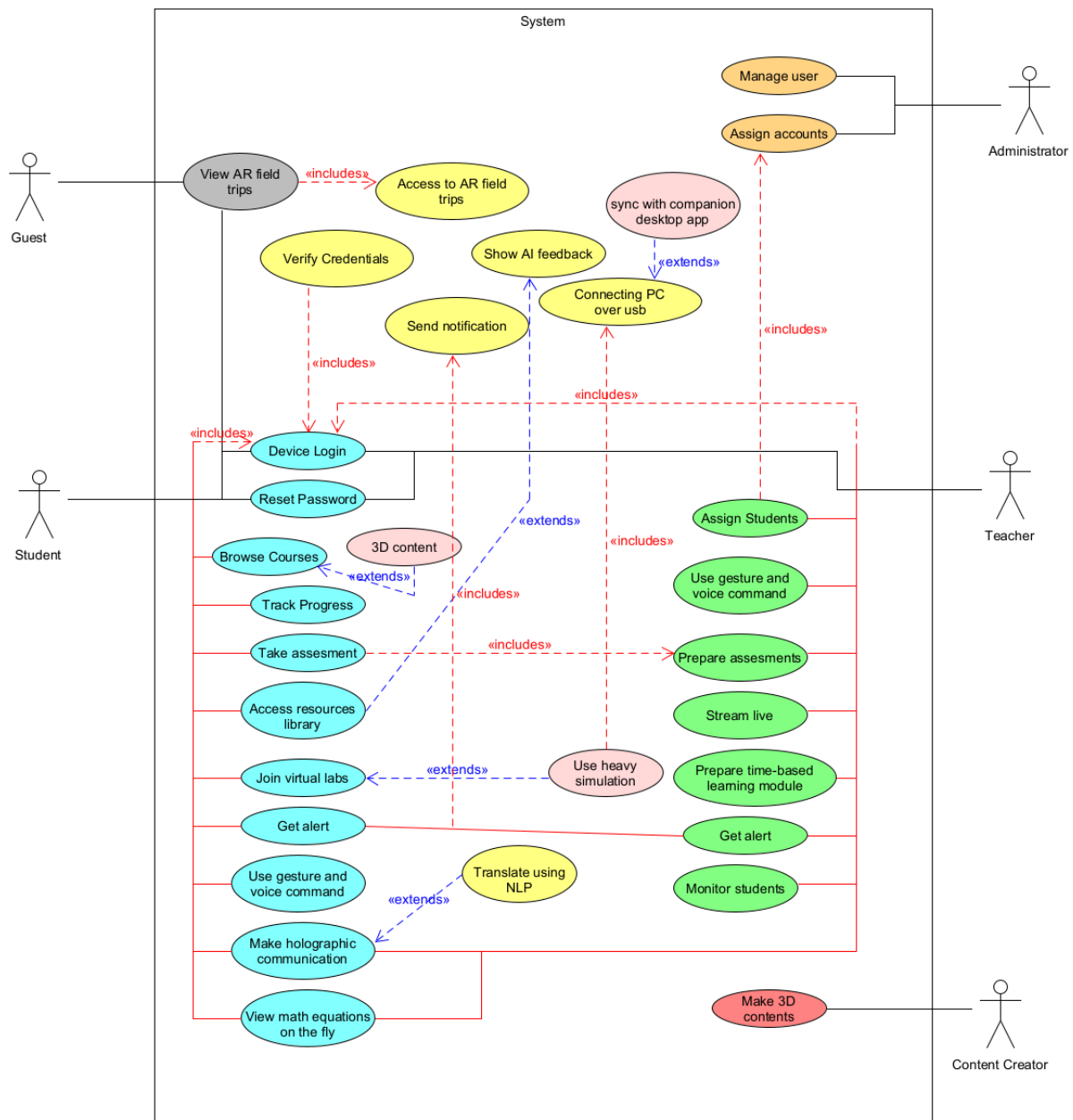
Reliability: The system should be available and accessible to users whenever needed, with minimal downtime for maintenance or updates. The system should be resilient to failures, with mechanisms in place to recover gracefully from errors without data loss. AR content and educational data should be stored securely and accurately to prevent corruption or unauthorized access.

Efficiency: The system should use resources (such as CPU, memory, and bandwidth) efficiently to optimize performance and minimize operational costs.

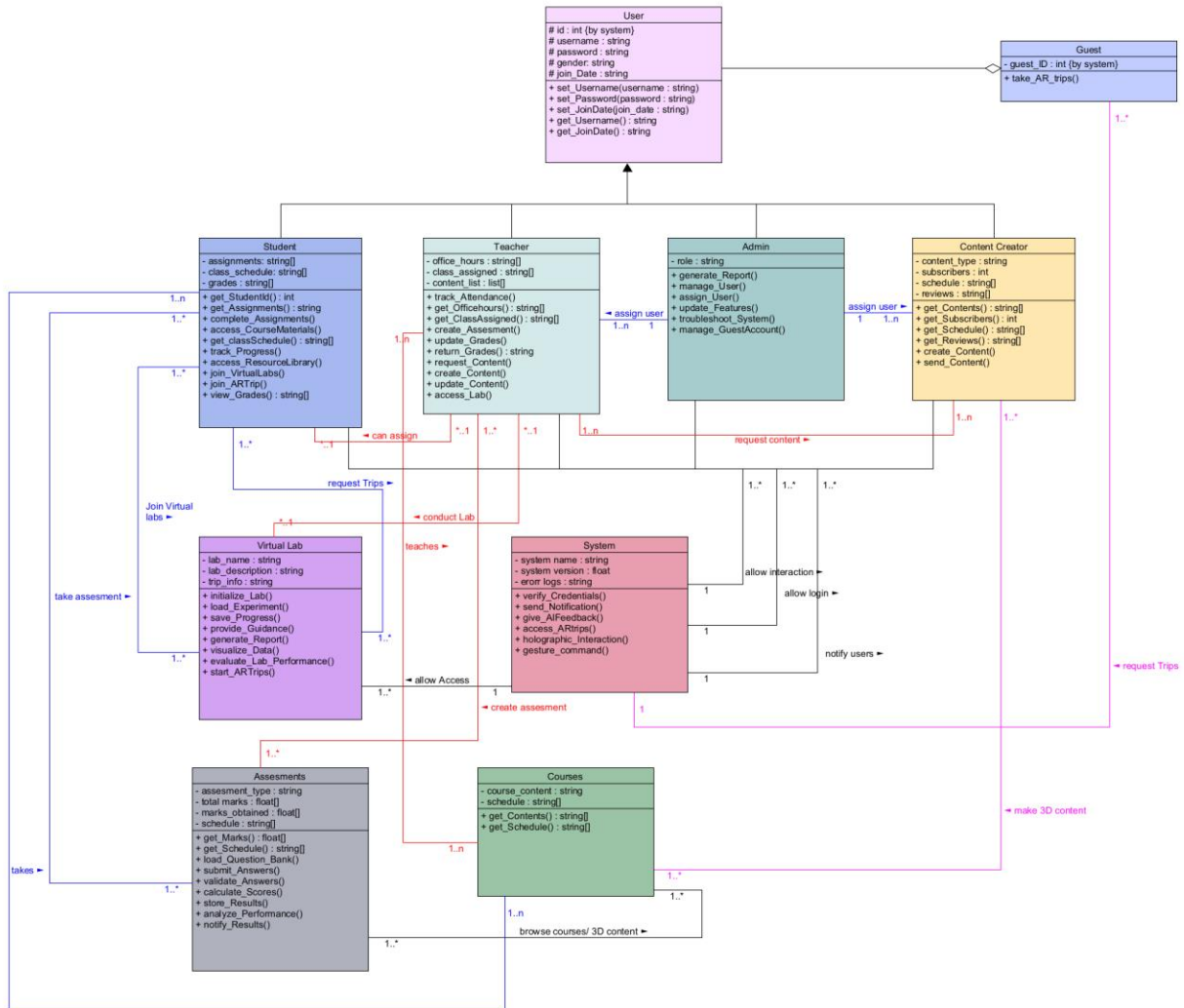
Performance: The system should provide real-time or near real-time response when interacting with AR devices.

4. SYSTEM DESIGN SPECIFICATION

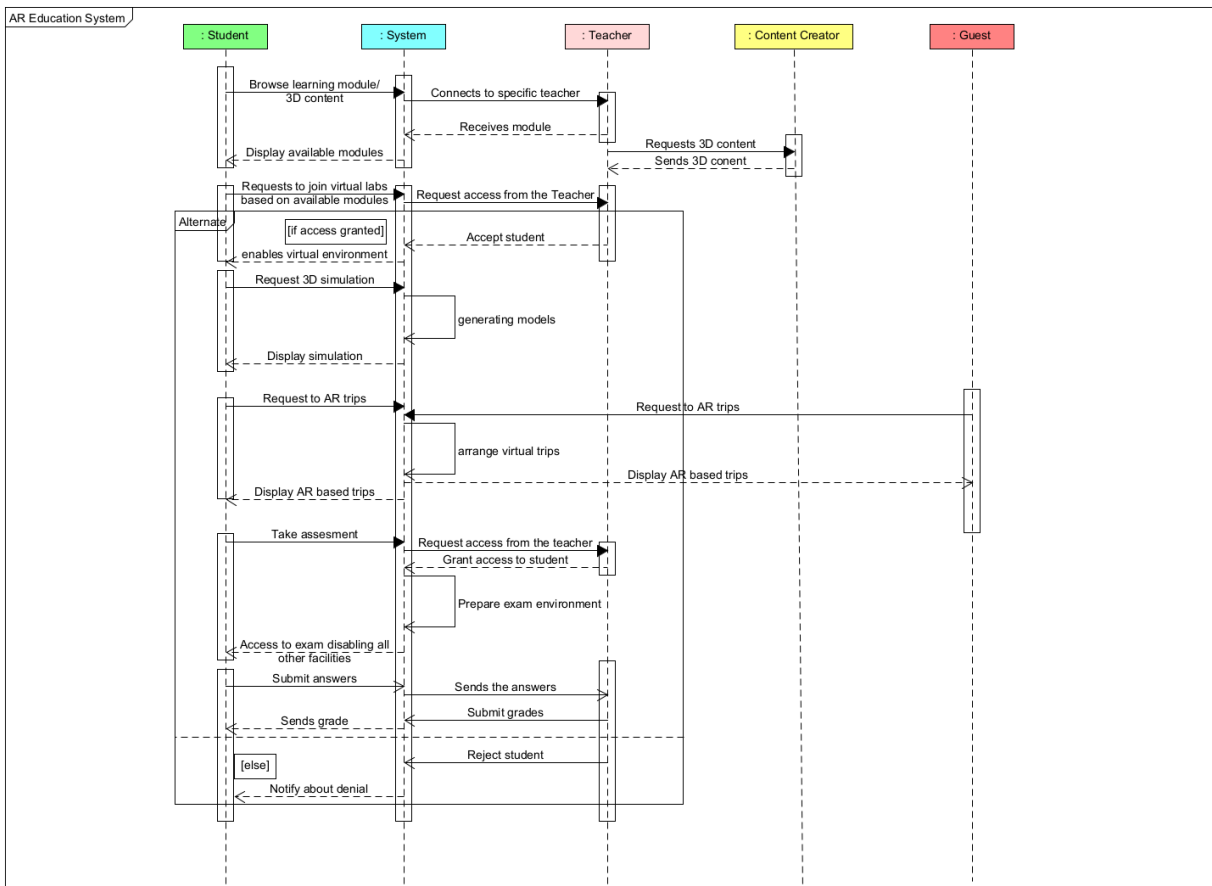
4.1 Use Case Diagram



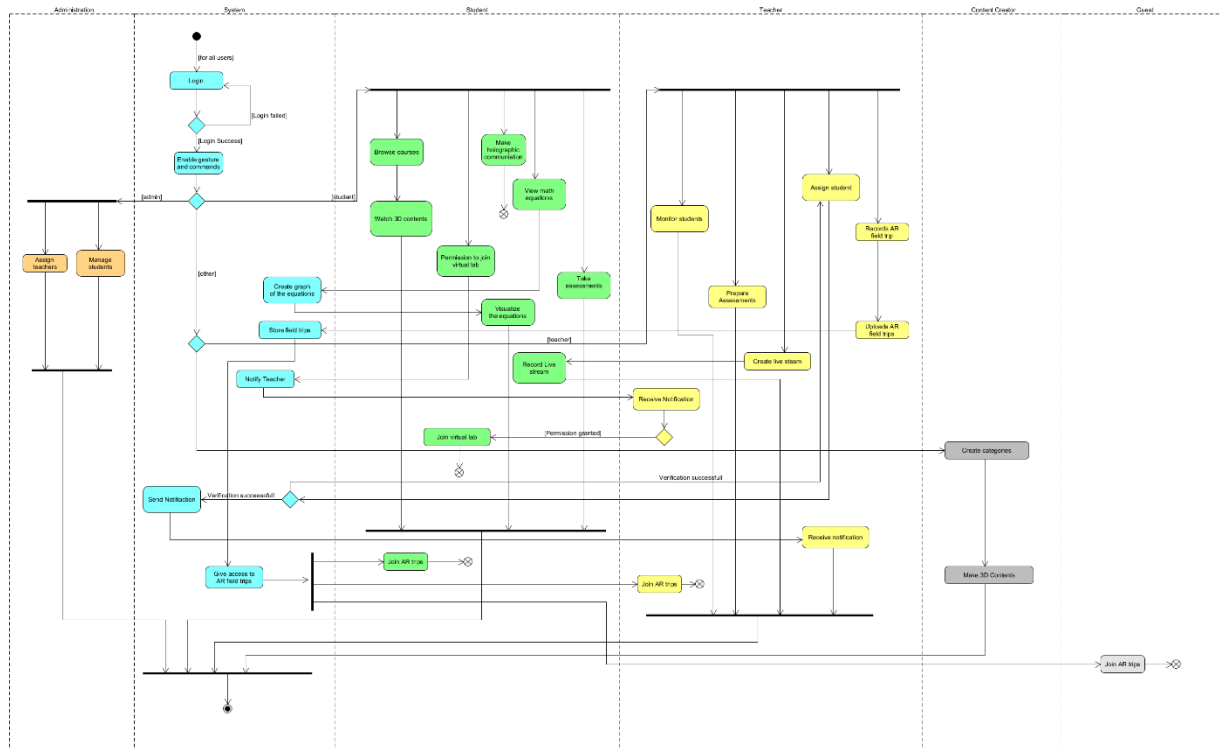
4.2 Class Diagram



4.3 Sequence Diagram



4.4 Activity Diagram

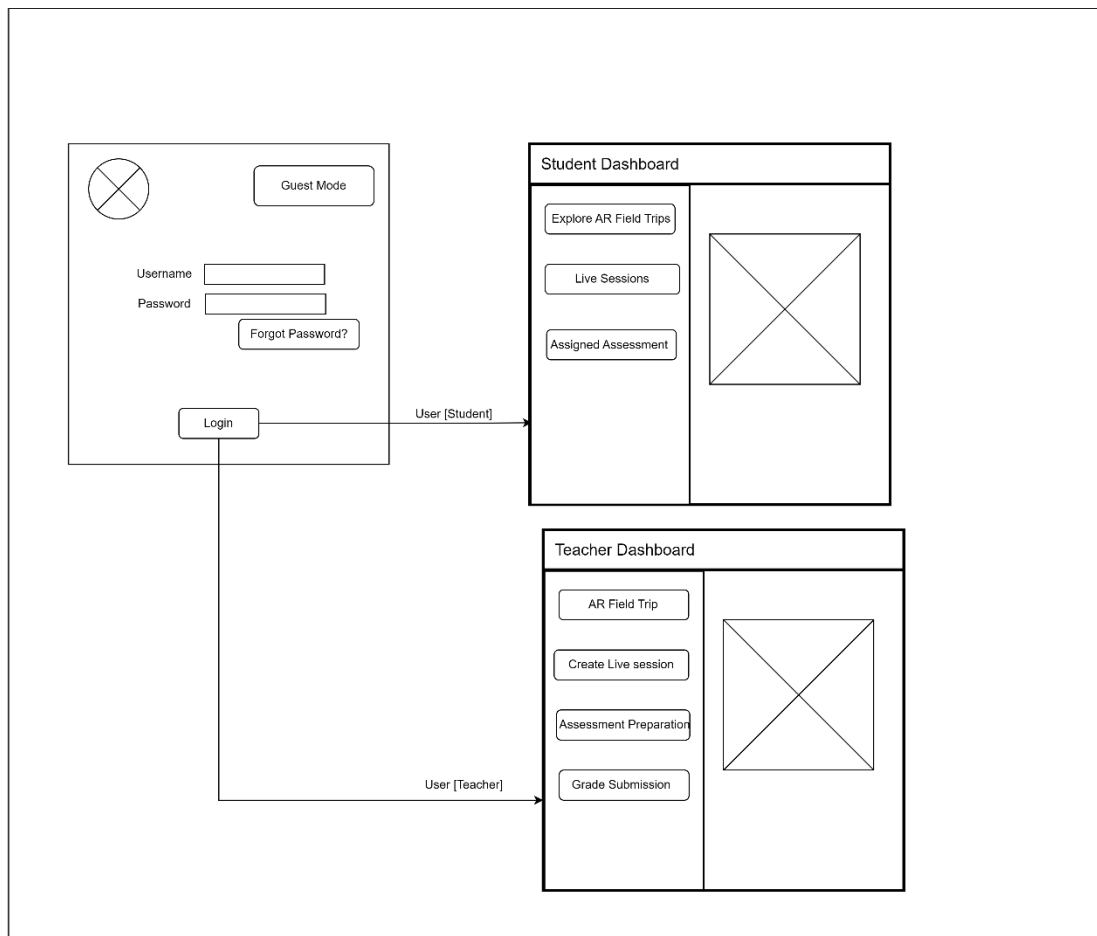


5. Wireframes

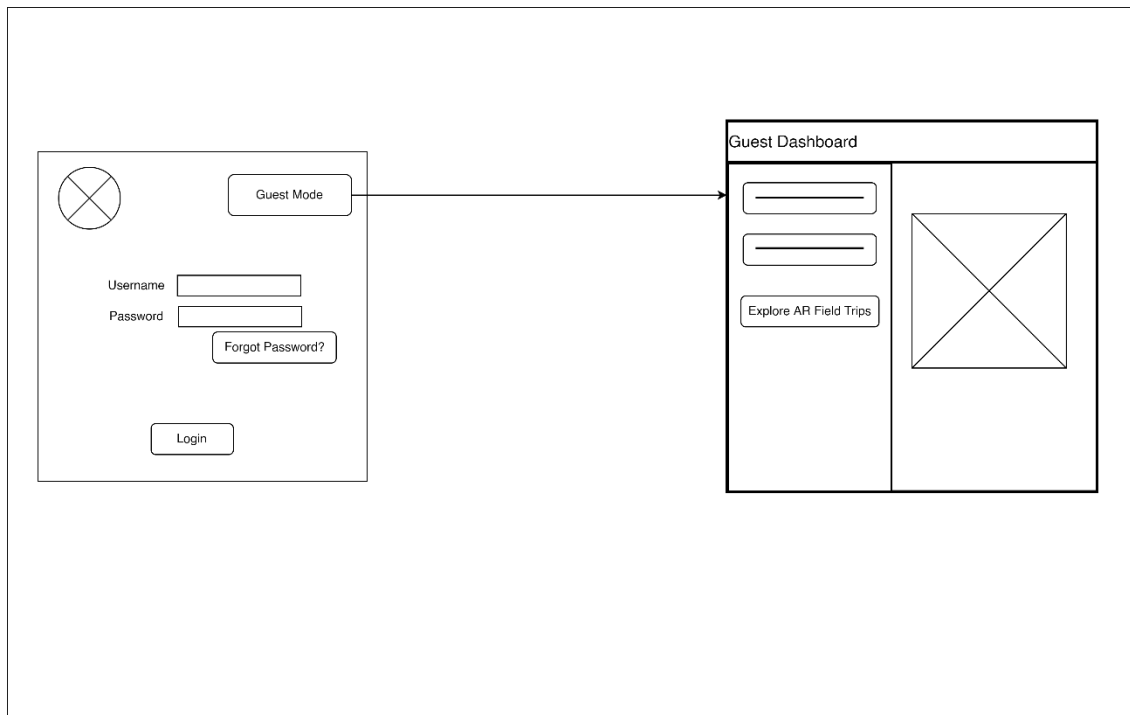
Khushbu Alam Rahi	Login, Guest User Mode, Forgot Password
Muhtadi Mansib	Student Signup, AR field trip, Live Streaming
Rafin Abrar Rono	Time based learning modules, Detecting Equation
Md. Tahsin Habib	Institutional Signup, Assessment Preparation, Distribution, Teacher Dashboard
Ammar Bin Mahmud	Natural Language Interface, Student Monitoring, Holographic communication

Khushbu Alam Rahi:

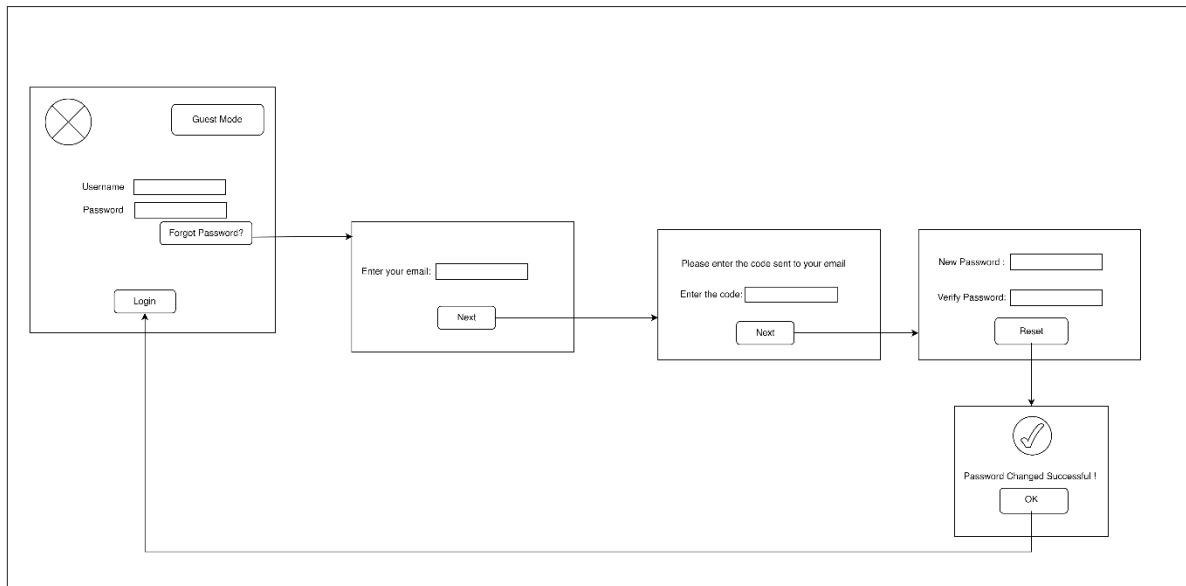
Device Login



Guest User Mode

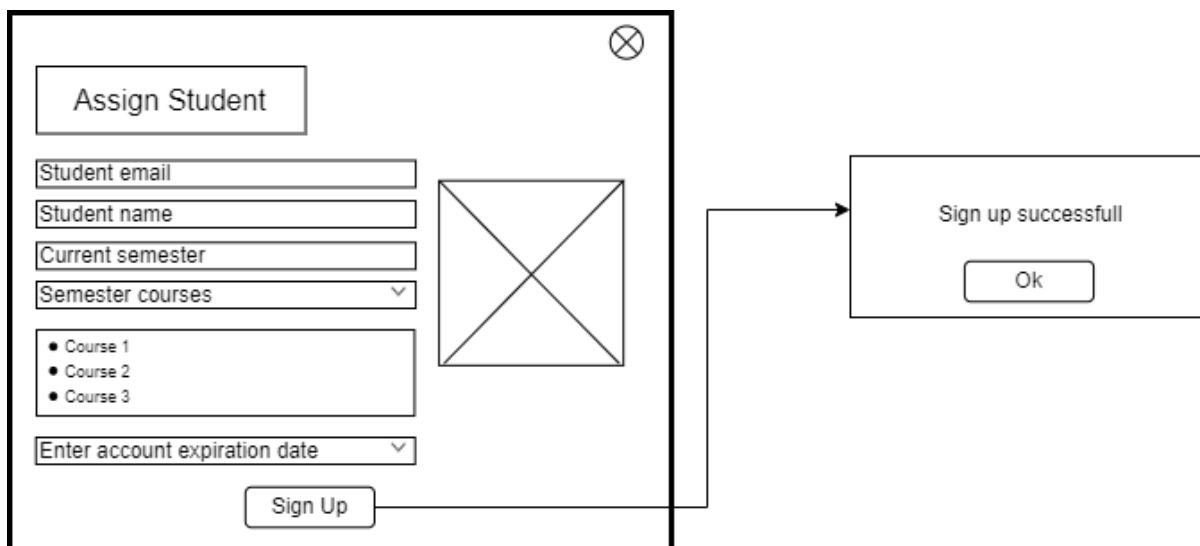


Forgot Password

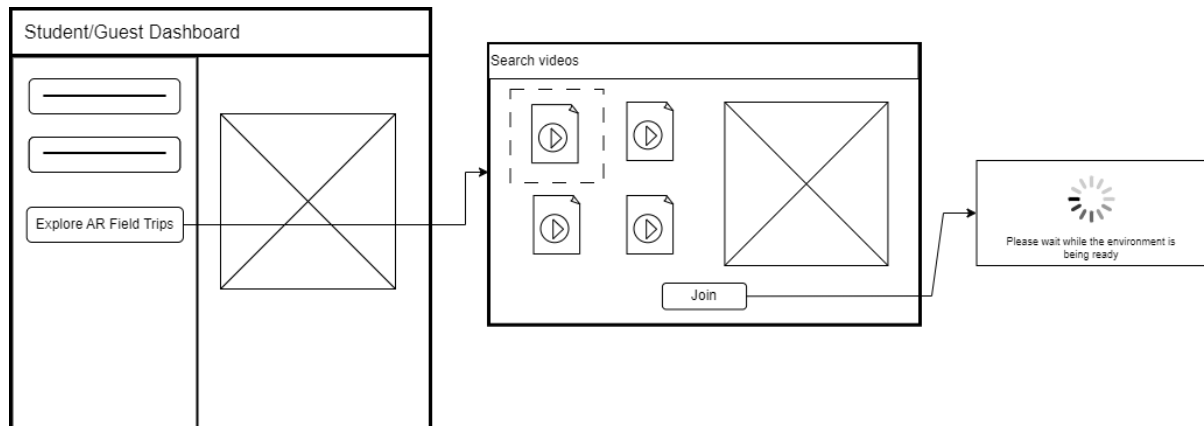


Muhtadi Mansib:

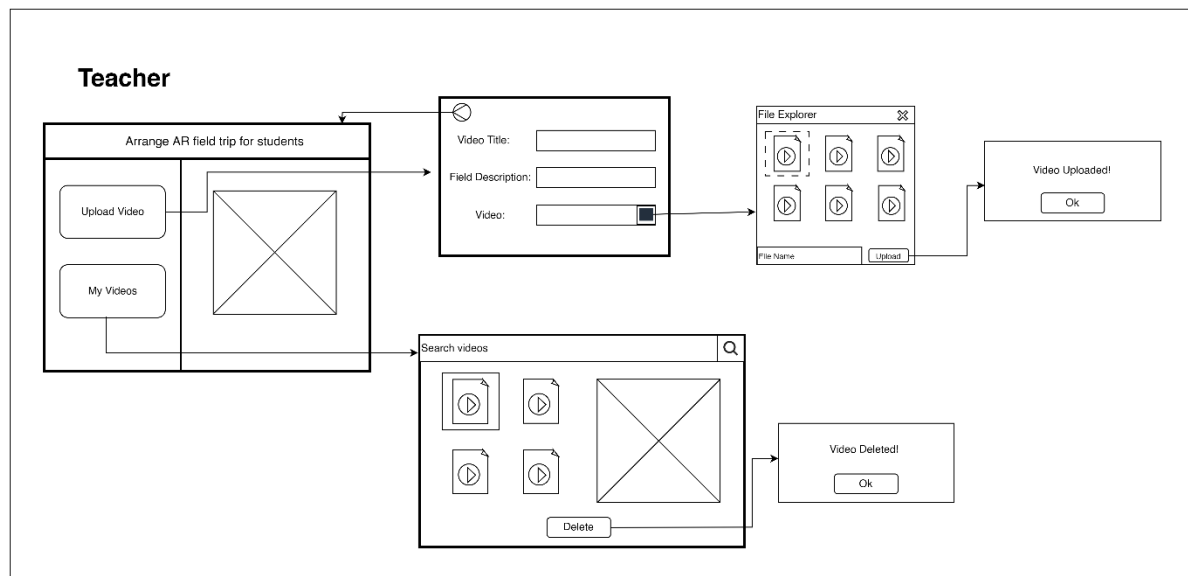
Student Signup



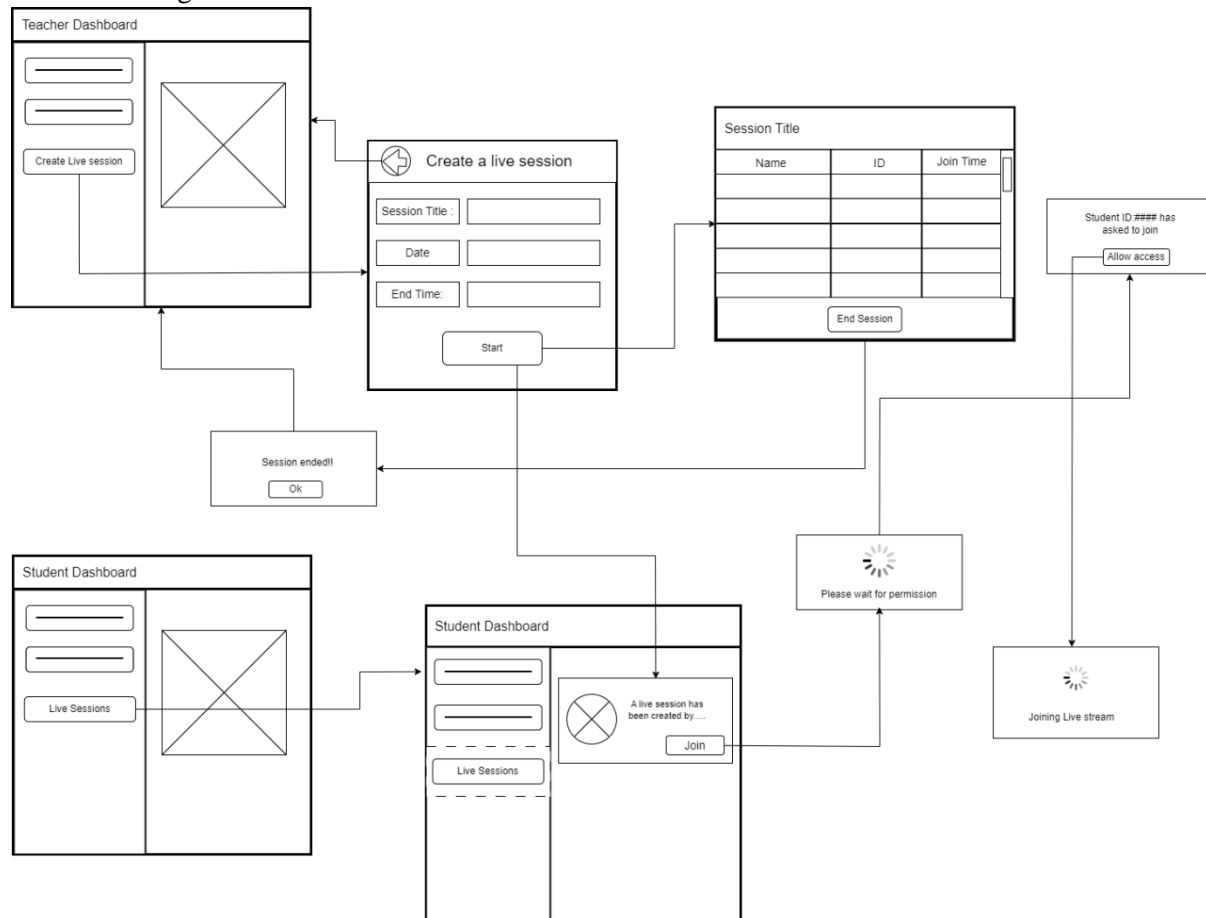
AR Field Trip



Upload Video

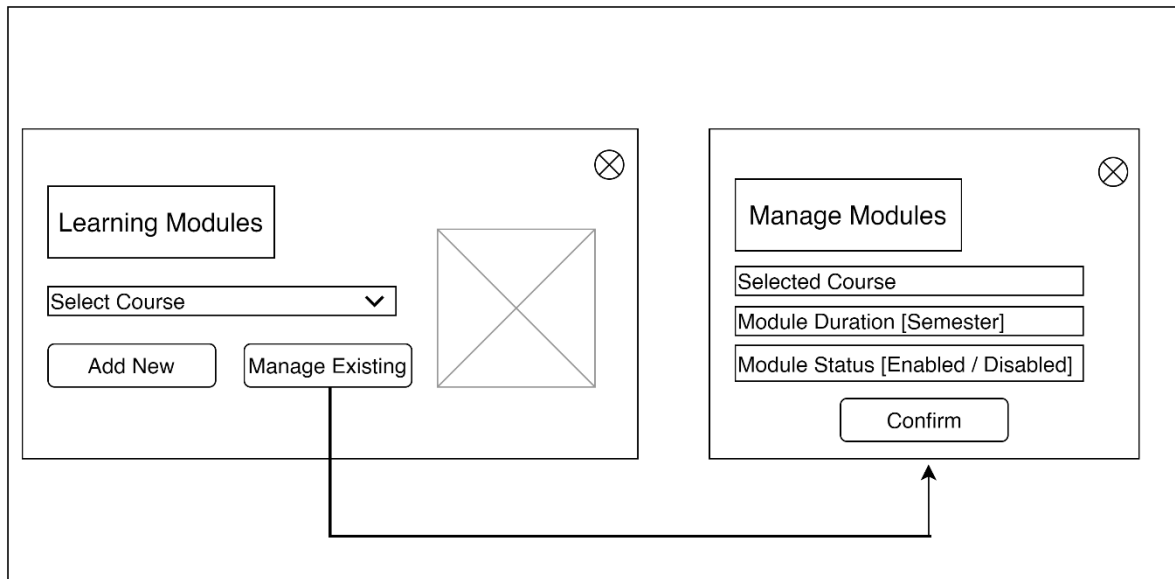


Live Streaming

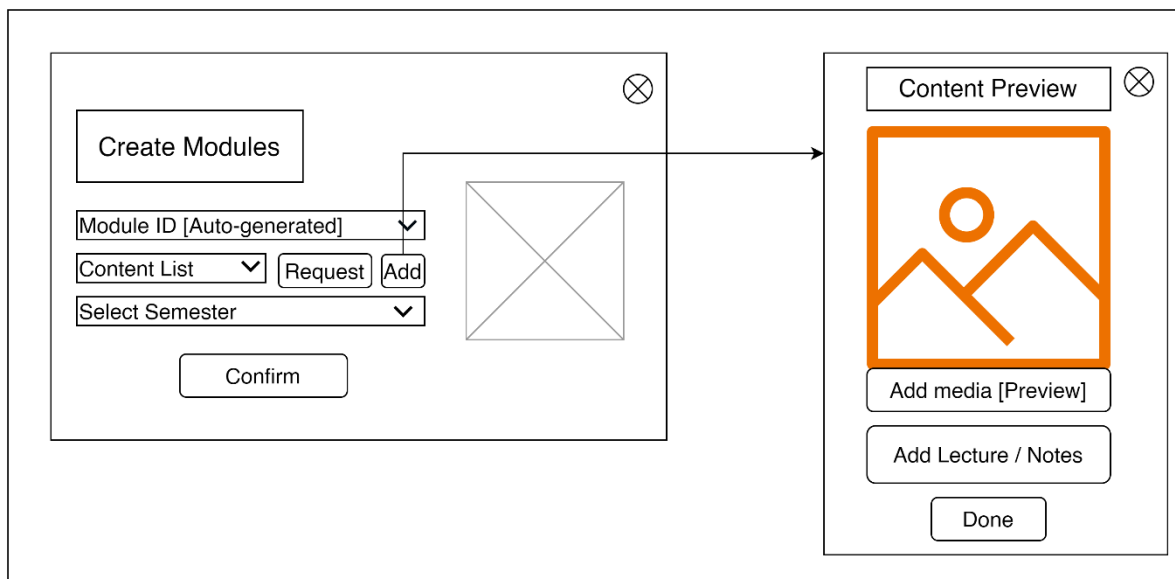


RAFIN ABRAR RONO

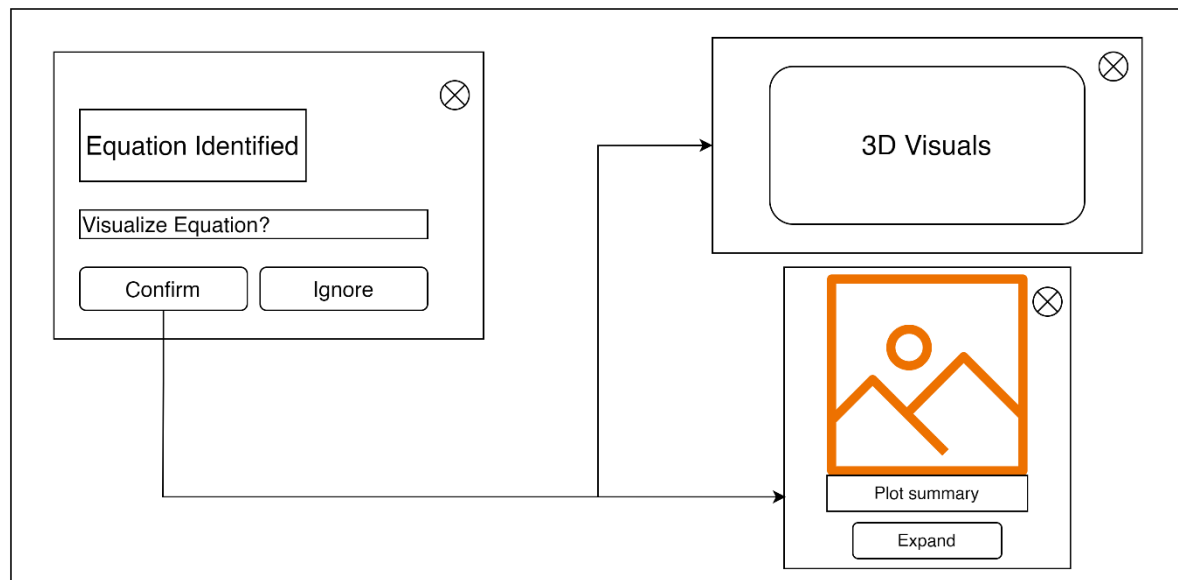
Learning Module



Create Module

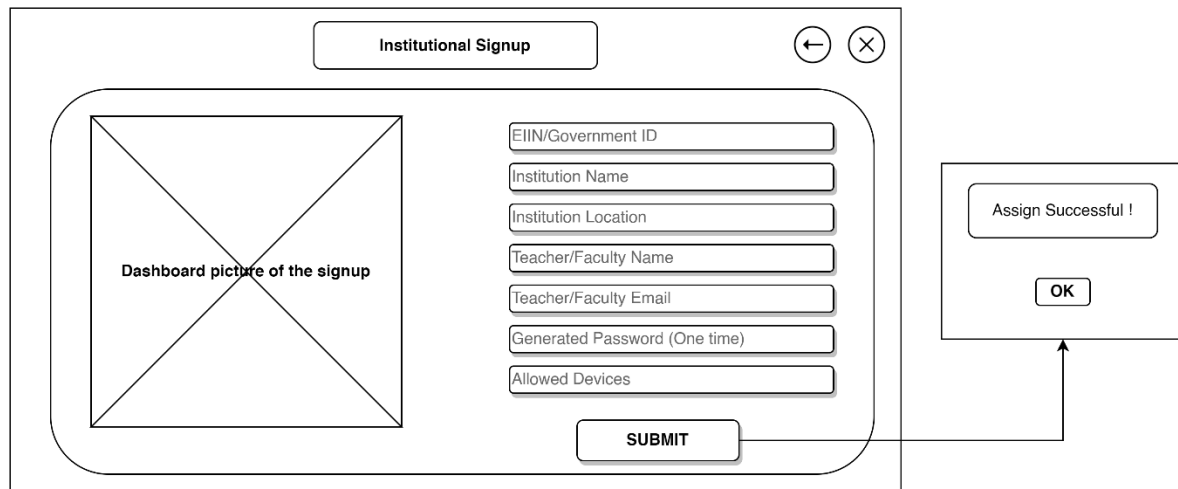


Detecting Equation

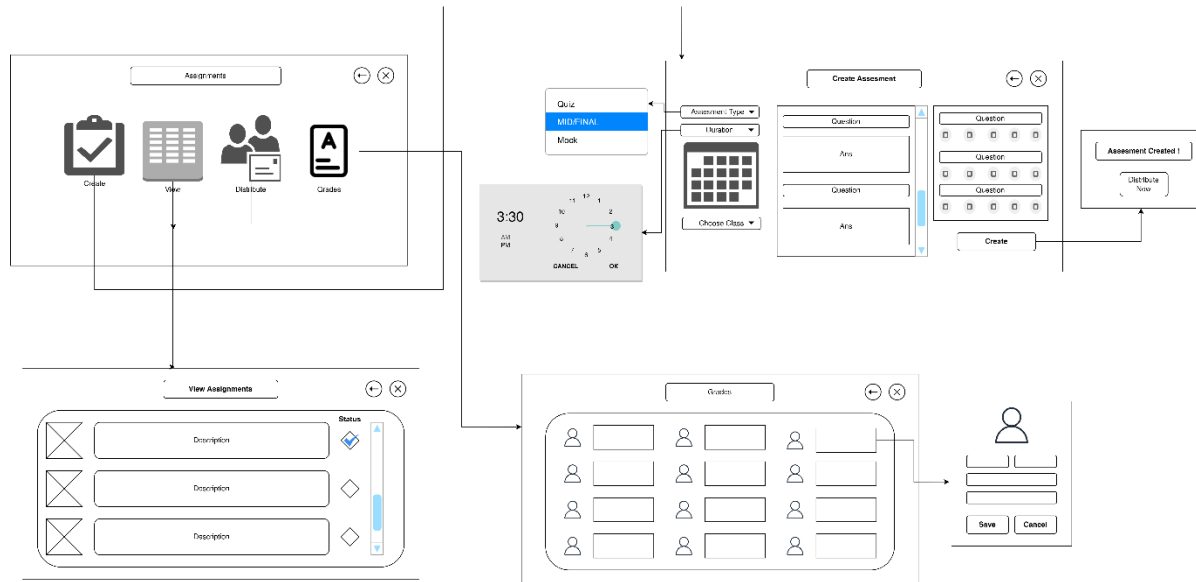


MD. TAHSIN HASIB

Institutional Signup

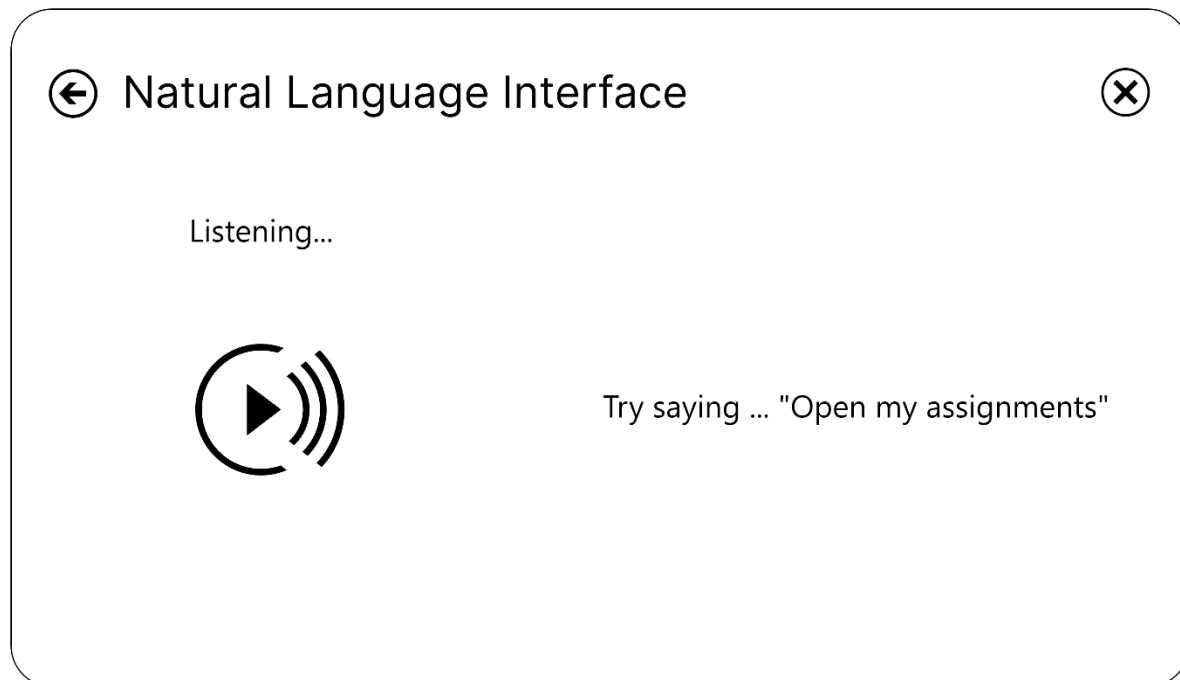


Assignments, View Assignments, Teacher Dashboard, Grades, Assessment creation



Ammar Bin Mahmud

Natural Language Interface



Student Monitoring

Student Monitoring

Students				
Sl	Name	ID	Results	Actions
1	B----- F----	123456	A+	Actions ▾
2	M----- R-----	123457	A	Actions ▾
3	A----- C-----	123450	A+	Actions ▾

Send notification
Remove
Update

Holographic communication

Holographic Communication

Connected People

Name
Name
Name
Name

Start conversation

6. Test Plan

Introduction

This test plan outlines the testing approach, objectives, and scope for the Generative AI for Education project. The purpose of this plan is to ensure that the software meets the specified requirements, functions as intended, and delivers a high-quality educational experience. We will follow a Unit testing plan for this project. Unit testing will focus on verifying the correctness and functionality of isolated units of code. The Developers will conduct the Unit testing. After the successful completion of Unit Testing, we will conduct a Integration testing which will be lead by a developer. Then we will do a System Testing. At the very end when we are preparing the documentation we will follow with an Acceptance Testing after successful deployment.

Testing Objectives

- Verify the correctness of individual functions and methods within the codebase.
- Ensure that each unit of code performs its intended functionality.
- Validate the behavior of edge cases and error-handling scenarios.
- Identify and address any defects or regressions introduced during development.
- Verify that the entire system meets the specified functional requirements outlined in the project's user stories and acceptance criteria.
- Assess the system's performance under normal and peak load conditions to ensure optimal response times and resource utilization.
- Evaluate the user interface and overall user experience to ensure ease of navigation, clarity of instructions, and accessibility for diverse user demographics.
- Identify and address potential security vulnerabilities, such as unauthorized access, data breaches, or injection attacks.
- Validate the system's reliability and availability by simulating various failure scenarios and assessing the system's ability to recover without data loss or downtime.

Testing Approach

- Writing unit tests before writing code to ensure test coverage from the outset.
- Testing each unit of code in isolation, mocking dependencies as necessary.
- Aiming for high code coverage to ensure that all critical paths are tested.
- Integrating unit tests into the CI/CD pipeline to automate test execution and ensure early detection of defects.
- Refactoring code as needed to improve testability and maintainability.

Test Deliverables

- Unit test cases covering all functions, methods, and modules.
- Test reports summarizing the results of unit test execution.
- Code coverage reports showing the code covered by unit tests.
- Defect reports for any issues identified during unit testing.

In conclusion, the testing approach for the Generative AI for Education project will begin with Unit Testing, led by developers, to verify the correctness and functionality of isolated units of code. Subsequently, Integration Testing, also led by developers, will focus on validating the interaction between integrated components. Following this, System Testing will ensure the overall functionality and performance of the system. Finally, Acceptance Testing, conducted after successful deployment and during documentation preparation, will validate that the software meets specified requirements and delivers a high-quality educational experience. This comprehensive testing strategy aims to ensure the reliability, functionality, and user satisfaction of the Generative AI for Education project.

7. Test Cases

Project Name: Generative education with AR		Test Designed by: Khushbu Alam Rahi		
Test Case ID: FR_01		Test Designed date: 5 April, 2024		
Test Priority (Low, Medium, High): High		Test Executed by:		
Module Name: Login		Test Execution date:		
Test Title: V erify login with valid username and password				
Description: Test validates user Login with valid credentials				
Precondition (If any): User must have valid username and password				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Open the Login Page 2. Enter username 3. Enter password 4. Click Login	Username: Khushbu Alam Rahi Password: 321	User should login into the application		
Post Condition: User is validated with database and successfully login to account. The account session details are logged in the database.				

Project Name: Generative education with AR		Test Designed by: Md. Tahsin Hasib		
Test Case ID: FR_02		Test Designed date: 5 April 2024		
Test Priority (Low, Medium, High): High		Test Executed by:		
Module Name: Institutional Signup		Test Execution date:		
Test title: Verifying the creation of institutional accounts				
Description: Test validates successful creation and assigning of institutional accounts for a specific institution				
Precondition (If any): Institutions must provide their official documents including paperwork from Government issued documents.				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Log into the system as an administrator. 2. Provide appropriate details according to the official documents provided by the institution in the EIIN/Govt ID, Name, Location, Faculty Name, Email, Allowed number of devices. 3. The system will automatically generate a first-time unique password for each user. 4. Click “Submit”.	Institution: Name, Location, Govt ID. Faculty: Name, Email, Generative Password. System: Allowed devices.	Administrators should be able to assign accounts to specific institution.		
Post Condition: Institutions must provide their official documents including paperwork from Government issued documents.				

Project Name: Generative education with AR		Test Designed by: Muhtadi Mansib		
Test Case ID: FR_3		Test Designed date: 05/04/2024		
Test Priority (Low, Medium, High): High		Test Executed by:		
Module Name: Student Sign Up		Test Execution date:		
Test Title: Verification of assigning a student				
Description: Test validates successfully assigning a student				
Precondition (If any): Teachers should have access to institutional account for the student’s email to sign up accounts for them.				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Log into the user(Teacher) account. 2. Click on assign student from teacher dashboard. 3. Enter student email. 4. Enter student name. 5. Enter current semester. 6. Select courses for the current semester. 7. Set time validity for the student’s account	Student email: <u>221123@student.in</u> <u>st.edu</u> Student name: Arif Rahman Current Semester: 3rd Courses: 1. Electrical Circuit 2. Chemistry 3. Physics Account expiration date: 05/08/2024	Teacher should assign the student into the system.		
Post Condition: After assigning the student into the system the student will be able to log into the system with a given username and password.				

Project Name: Generative education with AR		Test Designed by: Khushbu Alam Rahi		
Test Case ID: FR_04		Test Designed date: 5 April, 2024		
Test Priority (Low, Medium, High): High		Test Executed by:		
Module Name: Forgot Password		Test Execution date:		
Test Title: V erify password reset process with valid user e-mail				
Description: Test verifies user can reset password using a registered email address				
Precondition (If any): User must have a registered email address with the system.				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1.Navigate to Login Page 2. Click Forgot Password 3. Enter e-mail and click next 4. Enter the code and click next 5. Enter new password 6. Enter verify password 7. Click Reset 8.Click Ok	E-mail:22-46947-1@student.aiub.edu Code:5505505 New password:9091929394 Verify Password: 9091929394	The system should confirm the successful password reset		
Post Condition: User is able to login in using the newly set password				

Project Name: Generative education with AR		Test Designed by: Khushbu Alam Rahi		
Test Case ID: FR_05		Test Designed date: 05 April, 2024		
Test Priority (Low, Medium, High): Medium		Test Executed by:		
Module Name: Guest User		Test Execution date:		
Test Title: Verify the guest mode functionality on Login Page				
Description: Test Guest Mode functionality on login page for limited access in Generative Education with AR				
Precondition (If any): User must have valid username and password				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1.Open the Login Page 2.Click Guest Mode 3.Observe the interface for any changes indicating successful entry into Guest Mode		The system should allow the user to enter Guest Mode, providing access to limited features or content without requiring authentication.		
Post Condition: The user is in Guest Mode and can explore the available features without logging in.				

Project Name: Generative education with AR			Test Designed by: Rafin Abrar Rono	
Test Case ID: FR_6_A			Test Designed date: 5 April 2024	
Test Priority (Low, Medium, High): High			Test Executed by:	
Module Name: Learning Module			Test Execution date:	
Test Title: Verifying the addition of learning modules				
Description: Test validates successful addition of learning modules for a specified semester				
Precondition (If any): N/A				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
<div>1. Log into the system as a teacher.</div> <div>2. Click on “Learning Modules” tab from the dashboard.</div> <div>3. Select a course from the drop-down menu.</div> <div>4. Click on “Add new”.</div> <div>5. Select the semester during which the module will remain available.</div> <div>6. Click on “Add”.</div> <div>7. Select media content to add to module.</div> <div>8. Select lecture notes to add to module.</div> <div>9. Click on “Done”.</div> <div>10. Browse “Content List” to preview modules or add new ones.</div> <div>11. Click “Confirm”.</div>	<div>Course: Electrical Circuit Design</div> <div>Semester: Summer 2023-24</div> <div>Media: ECD_Basics.mp4</div> <div>Notes: Intro_ECD.pptx Instructions.pdf</div>	Teachers should be able to add new modules for a specified course.		
Post Condition: The created module will be available to each student assigned for the course. The module will only remain active for the designated semester.				

Project Name: Generative education with AR			Test Designed by: Rafin Abrar Rono	
Test Case ID: FR_6_B			Test Designed date: 5 April 2024	
Test Priority (Low, Medium, High): High			Test Executed by:	
Module Name: Learning Module			Test Execution date:	
Test Title: Verifying the management of existing modules				
Description: Test validates the successful revocation of an existing module				
Precondition (If any): There must be existing modules for the specified course				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
<div>1. Log into the system as a teacher.</div> <div>2. Click on “Learning Modules” tab from the dashboard.</div> <div>3. Select a course from the drop-down menu.</div> <div>4. Click on “Manage Existing”.</div> <div>5. Select a module from the menu.</div> <div>6. Select the semester during which the module will remain available.</div> <div>7. Click on “Module Status”.</div> <div>8. Select “Disabled”</div> <div>9. Select lecture notes to add to module.</div> <div>10. Click “Confirm”.</div>	<div>Course: Electrical Circuit Design</div> <div>Semester: Summer 2023-24</div> <div>Status: Disabled</div>	The system disables the access to the selected module for that course.		
Post Condition: The disabled module will not be available to any student enrolled for the course the module belonged to.				

Project Name: Generative education with AR			Test Designed by: Md. Tahsin Hasib	
Test Case ID: FR_07			Test Designed date: 5 April 2024	
Test Priority (Low, Medium, High): High			Test Executed by:	
Module Name: Assessment Preparation			Test Execution date:	
Test title: Verifying the successful creation of Assessment by Teachers				
Description: Test validates successful creation of assessments by Teacher.				
Precondition (If any): N/A				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
<div>1. Log into the system as a teacher.</div> <div>2. Click on “Assessment Preparation” tab from the dashboard.</div> <div>3. Select Assessment Type, Duration, Choose Class, Schedule date from the drop-down panel and selection calendar.</div> <div>4. Add questions in the appropriate question fields and the correct answers int the answer fields.</div> <div>5. For MCQ add questions in the appropriate question fields and the correct answers int the answer boxes.</div> <div>6. Click “Create”.</div>	Assessment: Type, Duration, Date, Questions, Answers, MCQs	<div>The teachers should be able to create new assessments for the students.</div> <div>Assessment parameters such as time limits and grading criteria shall be customizable by teachers.</div> <div>The system shall provide analytics tools for analyzing assessment results and tracking student progress.</div> <div>The teachers should have access to previously set questions from the system.</div>		
Post Condition: N/A				

Project Name: Generative education with AR		Test Designed by: Muhtadi Mansib		
Test Case ID: FR_8		Test Designed date: 05/04/2024		
Test Priority (Low, Medium, High): High		Test Executed by:		
Module Name: Live streaming for teachers		Test Execution date:		
Test Title: Verifying the live session created by teachers				
Description: Test verifies that a teacher can create live sessions for students which will send notification to the student’s account				
Precondition (If any): User must have a registered email address with the system.				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Log into the user(Teacher) account. 2. Click on create live session for students. 3. Enter session title. 4. Enter the date. 5. Enter the end time. 6. Click on start	Session Title: Exploring Human analogy Date: 05/04/2024 2:00 PM End Time: 4:00 PM	Session creation should be confirmed by the system.		
Post Condition: After creating session, the students are notified about the session in their account.				

Project Name: Generative education with AR			Test Designed by: Md. Tahsin Hasib	
Test Case ID: FR_09			Test Designed date: 5 April 2024	
Test Priority (Low, Medium, High): High			Test Executed by:	
Module Name: Assignment Distribution			Test Execution date:	
Test title: Verifying the successful distribution of assessments to students.				
Description: Test validates successful distribution of assessments to students.				
Precondition (If any): N/A				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
<div>1. Log into the system as a teacher.</div> <div>2. Click on “View Assignments” from the main dashboard and assessments will appear.</div> <div>3. Give check to the status beside specific assessment for distributing it to the class.</div> <div>4. The system will notify the students at least 3 days before the submission.</div>		<div>The system would allow the teacher to create and distribute assignments to individual students or groups.</div> <div>While creating, the teacher should fill in the assignment details such as instructions, due dates, and resources shall be provided within the system.</div> <div>After assigning the assignment, notifications would be sent to the students.</div> <div>The system would send reminders to students at least 3 days before submission.</div>		
Post Condition: N/A				

Project Name: Generative education with AR			Test Designed by: Rafin Abrar Rono	
Test Case ID: FR_10			Test Designed date: 5 April 2024	
Test Priority (Low, Medium, High): High			Test Executed by:	
Module Name: Detect visualizable equations			Test Execution date:	
Test Title: Verify the detection of equations and visualizing them				
Description: Test validated the successful detection and visualization of equations from the environment				
Precondition (If any): The hardware of the system should be able to detect mathematical equations				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
<div>1. Log into the system as a student or a teacher.</div> <div>2. Observe the surroundings for mathematical equations.</div> <div>3. Once detected, click on “Confirm”.</div> <div>4. Choose to “Expand” plot summary for the detected equation.</div>		The system should provide the visual representation and a plot summary for the detected equation.		
Post Condition: The equation details will be stored for future reviewing.				

Project Name: Generative education with AR		Test Designed by: Muhtadi Mansib		
Test Case ID: FR_11		Test Designed date: 05/04/2024		
Test Priority (Low, Medium, High): High		Test Executed by:		
Module Name: AR field trips for every user		Test Execution date:		
Test Title: Testing on AR field trips				
Description: The testing allows teachers to upload 3D videos for AR trip and students to join the AR trip				
Precondition (If any):				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
<div>1. Log into the user(Teacher) account.</div> <div>2. Click on “Arrange AR Field Trip”</div> <div>3. Go to “Upload Videos”</div> <div>4. Enter Video Title.</div> <div>5. Enter field Description.</div> <div>6. Upload the video.</div> <div>7. Click on Submit</div> <div>8. Log into the user(Student) account.</div> <div>9. Go to the “Explore AR field trip” on dashboard.</div> <div>10. Select a field trip 3D video.</div> <div>11. Click on join</div>	<div>Video Title: Visting the Historical Sonargaon</div> <div>Field description: Sonargaon has played an important role in the country's history, acting as a lively center of trade, culture, and handicraft for generations.</div> <div>Video: Sonargaon.SBS</div>	<div>The system would allow the users to join in the field trip provided by the teacher</div>		
Post Condition:				

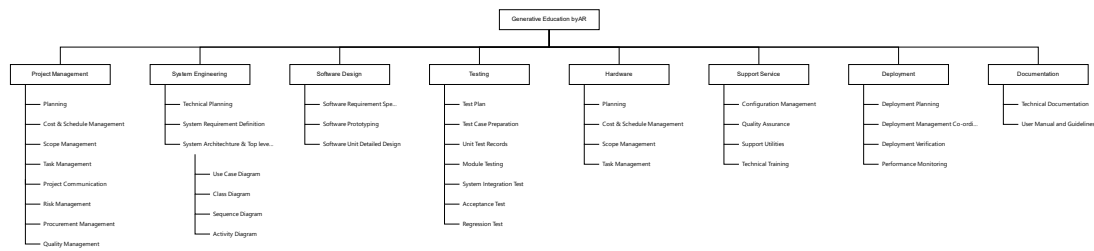
Project Name: Grade Submission		Test Designed by: Md. Tahsin Hasib		
Test Case ID: FR_12		Test Designed date: 5 April 2024		
Test Priority (Low, Medium, High): High		Test Executed by:		
Module Name: Grade submission		Test Execution date:		
Test title: Verifying the successful submission of grades of students.				
Description: Test validates successful upload of student’s grades.				
Precondition (If any): Students should exist in the students list of that teacher.				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
<div>1. Log into the system as a teacher.</div> <div>2. Click on “Grades” from main dashboard and students list containing their info will appear, then select a student to update their grades.</div> <div>3. Select a student and a pop-up window will appear from there type grades of that student.</div>	Student: Name, Marks, Grade	The system would allow teachers to successfully upload their grades.		
Post Condition: N/A				

Project Name: Natural Language Interface		Test Designed by: Ammar Bin Mahmud		
Test Case ID: FR_13		Test Designed date: 5 April 2024		
Test Priority (Low, Medium, High): High		Test Executed by:		
Module Name: Grade submission		Test Execution date:		
Test title: Verifying the Natural Language Interface				
Description: Test validates successful usage of real time translation and command through NLI.				
Precondition (If any): Device is turned on.				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Activate the Natural Language Interface. 2. Upon hearing a beep say predefined commands to control the device. 3. Say “Translate this from Bengali to English” following the sentence to be translated. 4. Ask “What language is this?” followed by a sample sentence.	Predefined commands, Single line sentence prefixed by Translate this or What language is this?	The system would carry out the command or do the translation for the user.		
Post Condition: N/A				

Project Name: Natural Language Interface		Test Designed by: Ammar Bin Mahmud		
Test Case ID: FR_14		Test Designed date: 5 April 2024		
Test Priority (Low, Medium, High): High		Test Executed by:		
Module Name: Grade submission		Test Execution date:		
Test title: Verifying Student Monitoring Module				
Description: Test validates successful usage of student monitoring module and accuracy of data.				
Precondition (If any): Teacher has to be logged on.				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. From a teacher account go to the Student Monitoring Dashboard. 2. See various metrics. 3. If needed send notification, edit, or remove a student.	Student Information	The system would show all the information correctly and carry out the actions.		
Post Condition: N/A				

Project Name: Natural Language Interface			Test Designed by: Ammar Bin Mahmud	
Test Case ID: FR_15			Test Designed date: 5 April 2024	
Test Priority (Low, Medium, High): High			Test Executed by:	
Module Name: Grade submission			Test Execution date:	
Test title: Verifying Holographic Communication				
Description: Test validates successful usage of communication via holograph.				
Precondition (If any): Both persons have to be connected to the network and wear the device.				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
<div>1. In a connected classroom experience open up Holographic Communication module.</div> <div>2. The app window should show you the people around you.</div> <div>3. Click on a person’s name to initiate a holographic communication.</div> <div>4. Wait for the other person to accept.</div> <div>5. Upon accepting start talking like the person is right in front of you.</div>	None	The system would carry out the holographic call without any interruption.		
Post Condition: N/A				

8. WBS



Test is not SVG - cannot display

9. CoCoMo

Constructive Cost Model (COCOMO):

Let's assume Source Line of Code is 6000

So, effort needs to be, $PM = 2.4 \times \left(\frac{6000}{1000}\right)^{1.05} = 15.75$

Development time, $DM = 2.50 \times (PM)^{0.38} = 7.13 \approx 7$

Required number of people, $ST = \frac{PM}{DM} = 2.2 \approx 3$

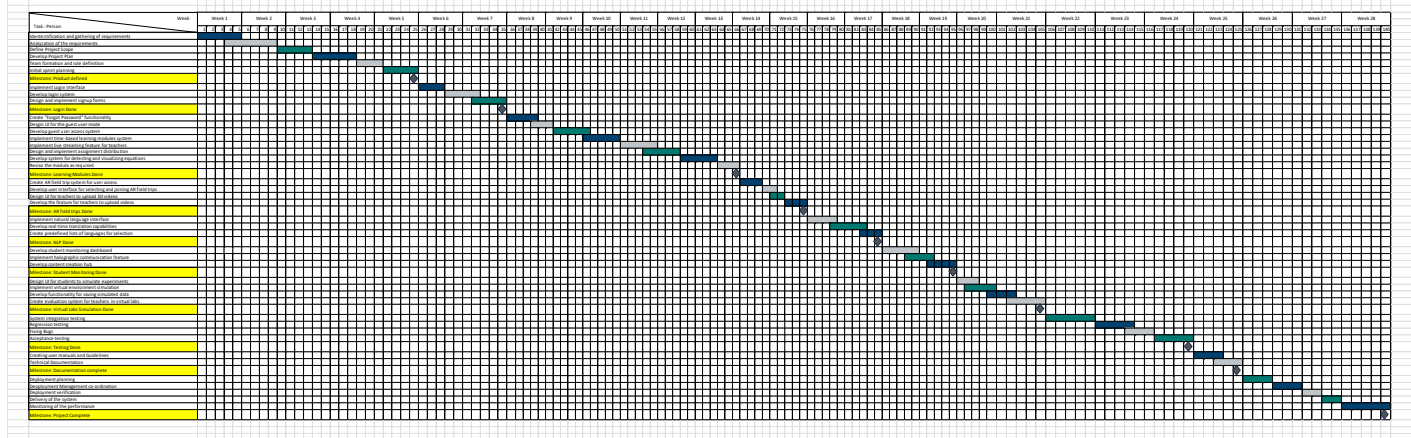
This means we need to work for $(4 \times 7) = 28$ weeks

10. Timeline Chart 1

Week/Person	Pre Game Phase					Sprint - 1				Sprint - 2			
	1	2	3	4	5	6	7	8	9	10	11	12	13
Andy	Product Backlog Creation					Requirements Analysis	Specify Design Module		Product Backlog Update	Requirements Analysis	Specify Design Module		Product Backlog Update
Bill		Project Tools & Resource Estimation					Code for Module				Code for Module		
Mandy				Architectural design			Code for Module		Test Module		Code for Module		Test Module

Week/Person	Sprint - 3				Sprint - 4				Post Game Phase							
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Andy	Requirements Analysis	Specify Design		Product Backlog Update	Requirements Analysis	Specify Design Module		Product Backlog Update	Integration Testing				Documentation			
Bill		Code for Module				Code for Module				System Testing				Acceptance Testing		
Mandy		Code for Module		Test Module		Code for Module		Test Module						Deployment		

11. Timeline Chart 2



12. EVA

Earned Value Analysis (EVA)

The project has 42 planned work tasks that are estimated to require $PM \times 22 = 16 \times 22 = 352$ person-days to complete. At the time, 9 tasks have been completed. However, the project schedule indicates that 12 tasks should have been completed. The following scheduling data (in person-days) are available:

Task	Planned Effort	Actual Effort
1	5	4
2	6	5
3	4	5
4	5	6
5	3	2
6	4	5
7	3	4
8	4	3
9	4	5
10	4	
11	3	
12	5	

- Total Task = 42; Effort Estimated= 352 person-day
- BCWS= 50; BCWP=38; ACWP=39
- BAC = 352.00
- $SPI = BCWP / BCWS = 38 / 50 = 0.76$
- $SV = BCWP - BCWS = 38 - 50 = -12$ person-day
- $CPI = BCWP / ACWP = 38 / 39 = 0.97$
- $CV = BCWP - ACWP = 38 - 39 = -1$ person-day

- % schedule for completion = $BCWS / BAC = 50 / 352.00 = 14.2 \%$
[% of work scheduled to be done at this time]
- % complete = $BCWP / BAC = 38 / 352.00 = 10.8 \%$
[% of work completed at this time]

13. Risk Management

Risks	Category	Probability	Impact	RMMM
Size estimate may be significantly low	PS	50%	2	Revisit size estimation due to potential significant underestimation
Larger number of users than planned	PS	20%	2	Adjust project scalability strategy to accommodate the unexpected increase in user volume.
Less reuse than planned	PS	60%	3	Revise reuse strategy and explore alternative approaches to maximize resource utilization
Resistance from end-users	BU	50%	2	Train the users to use this new technology.
Tightened delivery deadline	BU	40%	3	Prioritize must have feature development to accelerate development
Loss of funding	CU	40%	1	Hold frequent meeting with shareholders to show them the value they will get from funding
Changing customer requirements	PS	70%	3	Follow agile practices to be ready to accommodate quick changes
Technology not meeting expectations	TE	40%	2	Import advanced technology to meet expected quality or custom build from China
Lack of training on development tools	DE	80%	1	Prepare documentation and training materials for the development tools
Inexperienced staff	ST	50%	2	Train the staff with new technologies.
High staff turnover	ST	50%	2	Implement knowledge transfer mechanisms to mitigate the impact of high staff turnover on project continuity
Hardware might malfunction	DE	10%	1	Incorporate redundancy measures and establish contingency plans to address potential hardware malfunctions
Connectivity issues	DE	25%	3	Develop backup communication protocols and establish troubleshooting procedures to mitigate potential connectivity issues
Insufficient battery life	DE	10%	2	Implement power management strategies and provide contingency plans for addressing instances of insufficient battery life
Lack of user training	CU	30%	2	Develop comprehensive user training programs and provide ongoing support to mitigate the impact of a lack of user training

Physical safety hazards	CU	15%	1	Conduct regular safety inspections and implement precautionary measures to mitigate potential physical safety hazards
Incompatibility with existing infrastructure	TE	40%	2	Perform thorough compatibility testing and establish migration strategies to address any incompatibility issues with existing infrastructure
High production costs	BU	30%	2	Optimize resource allocation and explore cost-saving measures to mitigate the impact of high production costs
Delays in developing or manufacturing	PR	25%	2	Implement agile project management techniques and establish contingency plans to address delays in development or manufacturing

Impact Values:

1 – Catastrophic

2 – Critical

3 – Marginal

4 – Negligible