FACULTY OF ENGINEERING

SCHOOL OF COMPUTING

SEMESTER 1/20212022

SECP1513 – TECHNOLOGY INFORMATION SYSTEM

SECTION 02

PROJECT - PHASE 2 (PROJECT REPORT)

[AUGMENTED REALITY IN EDUCATION]

LECTURER: DR IZYAN IZZATI KAMSANI

GROUP NO: 5

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Introduction

Fourth Industrial Revolution or Industry 4.0 has been around for the past few years and since its introduction, has become a driving force that revolutionized the way we currently live and work. Industry 4.0 is the new era of the Industrial Revolution that emphasises the use of automation, machine learning and also rely on the interconnectivity between physical objects such as sensors, machines and devices so that they can be connected between each other and the Internet to create an entirely new working ecosystem that is more efficient, collaborative and holistic. Industry 4.0 offer a wide range of solutions such as Artificial Intelligence(AI), machine learning, Internet of Thing(IoT), big data and analytics, cloud computing and many more which will allow any company that are investing in these technologies to analyse and predict future trends, increase the manufacturing productivity, reducing cost and enabling access to real-time resources. Augmented reality or AR is one of the technologies that are brought by Industry 4.0 and the solution that we want to highlight in this project.

Augmented reality can be said to be an enhanced version of the real world as it overlays a lot of sensory information such as audio, images or any related information and projects it as a 3D virtual object into the real world. One of the fundamentals purposes of augmented reality is to stress out distinct features and characteristics of the physical object in the real world, help the user to develop an understanding of the features of the object and make smart deductions from the data from the AR to get an insight that can help the company or organization to make a better decision on what action that they should take moving forward. IKEA, one of the most renowned house furniture retailers in the world, already released an app called IKEA Place which is a good example of the application of AR. This application enables the users to place any furniture virtually anywhere in their house, office, school and also studio. The application will aid the users to choose their furniture with the right size, design and also features as all the furniture projected by the AR function is 3D and true to the scale of the actual furniture thus enhancing the users' shopping experience.

In our project tough, we will not implement the AR technology into the business world yet, instead, we opt to focus more on the educational system as our current educational system has been hit hard by the COVID-19 pandemic resulting in the shifting of our educational system as face-to-face classes being replaced by online classes. Online learning is very advantageous as it offers flexibility, efficiency and give the students and teachers access to a lot of resources. Despite all the advantages that can be gained from online learning, it also has its own drawbacks such as lab activities which can not be done virtually as it can only be done with specific materials and apparatus therefore we are aiming that developing our application with AR function will be able to complement the limitations that are present in online learning.

Project Outline

(Steps and descriptions related to the project)

DATE	TIME	ACTIVITY	PLATFORM
PHASE I			
8/11/2021 (Mon)	2:00pm - 5:00pm	● Project release by Dr. Izyan Izzati ● A brief explanation from Dr. Izyan about the project	**Google Meet** http://meet.google.com/tnt-avjt-tuk
16/11/2021 (Tue)	9:30pm - 11pm	● First discussion of the group ● Understanding the project requirements ● Do research and studies on: - Cloud architecture - 4IR technology ● Brainstorming ideas for targeted industry - Review industries available in Malaysia - Search for client to provide input and problem scenarios	**Google Meet** https://meet.google.com/spq-wybx-xad (refer Appendix 1) **WhatsApp Group**
20/11/2021 (Sat)	2:00pm - 4:00pm	● Industry and client selection - Analyze problem scenarios ● Finding the solution of the problem scenarios given: - Suitable 4IR technology - System development - Cloud architecture design ● Task allocation to group members - Wan Amirul Hafiq 1. Cloud architecture planning and	**Google Meet** https://meet.google.com/hje-tgdp-qnt (refer Appendix 2) **WhatsApp Group**

		design 2. Selection of 4th IR technology (AR) - Muhammad Naquib 1. Cloud architecture planning and design 2. Selection of 4th IR technology (cloud computing) 3. Problem background (solution, objectives) - Muhammad Izzuddin 1. Problem background (overview, problem statement) 2. Major user views - Sarah Wardina 1. Major user views 2. Conclusion (benefits, limitations, summary)	
28/11/2021 (Mon)	2:30pm - 3:30pm	● Group work progress and updates - Cloud architecture planning - Program flow (major user views) ● Project clarification ● Resolve any issues faced by group members	**Google Meet** https://meet.google.com/ywf-frrs-tke (refer Appendix 3) **WhatsApp Group**
20/12/2021 (Mon)	3:00pm - 5:00pm	● Project proposal updates with Dr. Izyan Izzati ● Consultation session for section 02 with Dr. Izyan Izzati - Corrections and improvements	**Google Meet** http://meet.google.com/tnt-avjt-tuk (refer Appendix 4)
		● Group work progress and updates	**Google Meet**

20/12/2021 (Mon)	3:30pm - 4:00pm	● Project clarification ● Resolve any issues faced by group members	https://meet.google.com/qaz-wwpy-fqw (refer Appendix 5)
26/12/2021 (Sun)	-	● Proposal touch-up ● Final run through of proposal	**WhatsApp Group**
27/12/2021 (Mon)	4:30pm	● Project proposal submission	**E-learning UTM** (refer Appendix 6)
PHASE II			
3/1/2022 (Mon)	9:30pm - 11:00pm	● Discussion of project phase 2 - AWS architecture design - Detailed description of the project (problem, solution, team working) - Business process flow diagram - User interface (UI) design (mock-up) ● Task allocation to group members for first assessment: - Wan Amirul Hafiq 1. Provides low-fidelity mock-ups using Figma 2. Reflection - Muhammad Naquib 1. Provides low-fidelity mock-ups using Figma 2. Designs AWS architecture 3. Reflection - Muhammad Izzuddin 1. Project introduction 2. Business flow diagram	**Google Meet** https://meet.google.com/xxd-bxzq-hmw (refer Appendix 7)

		3. Reflection - Sarah Wardina 1. Detailed descriptions of the project (project progress timeline, problem, solution, team working) 2. Reflection	
11/1/2022 (Tue)	9:30pm - 11:00pm	● Group work progress and updates - UI design (Figma) - AWS architecture design - Project details - Business flow diagram ● Project clarification ● Resolve any issues faced by group members	**Google Meet** https://meet.google.com/xsh-ogro-qvv (refer Appendix 8) **WhatsApp Group**
15/1/2022 (Sat)	10:00pm - 11:00pm	● Finalization of UI design and project report ● Project video planning (journey of completing the project) ● Task allocation to group members for second and third assessment: - Wan Amirul Hafiq 1. Video director 1 2. Video editor - Muhammad Naquib 1. Video director 2 - Muhammad Izzuddin 1. Slides designer - Sarah Wardina 1. Slides designer	**Google Meet** https://meet.google.com/cid-kfmb-jxk (refer Appendix 9) **WhatsApp Group**
	-	● Completion of PowerPoint slides	**WhatsApp Group**

20/1/2022 (Thu)		- Introduction - Descriptions of project include problem, solution, team working - Description of the low-fidelity prototype ● Assigning team members for presentation recording: - Wan Amirul Hafiq (business process) - Muhammad Naquib (project design) - Muhammad Izzuddin (introduction) - Sarah Wardina (project background)	
25/1/2022 (Tue)	10:00pm - 11:00pm	● Completion of project video ● Video review from team members	**Google Meet** https://meet.google.com/eed-vxsd-jur (refer Appendix 10)
26/1/2022 (Wed)	-	● Project phase 2 touch-up (report, presentation slides, video project) ● Final run through of phase 2 assessments	**WhatsApp Group**
27/1/2022 (Thu)	11.59pm	● Submission of assessment: - Project report - Video project - Video presentation	**E-learning UTM**

Project Background

(Detailed description of the project)

Problem Statement

Since the arrival of COVID-19 virus in Malaysia, our daily routines have changed. The pandemic has forced us to stay at home in order to contain the virus from spreading widely and aggressively. The COVID-19 is an infectious and contagious disease which has taken many lives all around the globe. Many industries were heavily affected, including the education world. Students were not allowed to attend school and classes physically. However, many efforts were made in the educational community to ensure learning continuity throughout this tough time. Children and students have had to rely more on their own resources to continue studying remotely via the Internet. Teachers had to adjust to new teaching concepts and techniques of delivery that they may not have been prepared for.

Open distance learning(ODL) is a learning method that has been proposed by the government to replace the commonly used face-to-face learning process due to the Movement Control Order (MCO) implemented by the government in response to the COVID-19 outbreak in Malaysia. Physical engagement between students and teachers during the learning process had become infeasible as the order forbade any physical interaction between people, therefore, ODL has been introduced as an alternative method for students to continue their learning process.

The concept of ODL aims at providing broad access to education and training to enable the students to be free of time and location limitations, as well as providing flexible learning chances to individuals and groups of learners**.** ODL seems to be a very efficient method for learning purposes, however, this method does have limitations such as conducting lab experiments which require many specific apparatus and materials to be conducted. Lab experiments are very crucial for students as they will help them to understand better what they have learned, develop their observation skills and also give them valuable hands-on experience in conducting an experiment. Therefore, a practical solution for this particular problem must be sought and we believe that the solution for this problem can be achieved by implementing IR 4.0 technology such as augmented reality (AR) with the help of cloud computing technology into the solution.

Solution

The advancement of Fourth Industrial Revolution (IR4.0) technologies have described the growing pattern towards automation and data exchange in technology as well as improved the process within the industry of manufacturing. Technology such as Internet of Things (IoT), Cloud Computing, Artificial Intelligence, Virtual Reality (VR) and Augmented Reality (AR) give many advantages to people and organizations in many aspects.

In our case, we chose Augmented Reality (AR) technology as our solution to solve the ODL problem. AR can enhance a student's experience in the learning process via visual, auditory or other sensory information. AR interacts with people and the reality through the objects in the real world are enhanced by computer-generated perceptual information. Simply said, AR technology is a combination of real and virtual worlds, precise 3D registration of virtual and actual objects, and real-time interaction. In this case, it can help students to improve their experiences in the learning process just from their home or anywhere by using AR technology.

In addition to this solution, we construct a cloud architecture based on AWS services. There are some AWS services that we used in designing this application including Amazon Amplify, Amazon CloudFront, Amazon Cognito, Amazon S3, Amazon Sumerian, AWS AppSync and DynamoDB. Cloud computing is now so important because it offers flexibility, data recovery, little to no maintenance, easy access and a higher level of security. For instance, Amazon Sumerian is used to easily create and run augmented reality (AR) applications which can be used in our project to design AR applications for learning purposes.

The implementation of AR in education could provide a new breath into either physical or virtual classrooms, bringing extra creativity and interactivity and more engagement to any subject in school. One of the highlight benefits is that AR learning helps students to decrease the time they take to grasp new topics or complex concepts. Implementation of augmented reality into the educational process could benefit not only students but also teachers to enhance the environment of learning.

Teamworking

Teamwork is an important element when it comes to working in a group of people. One of the most huge advantages of working as a team is that the work is distributed among all members of the group. When work is shared, each member is assigned an equal number of tasks. As a result, no one should feel overburdened by the task at hand. In order to make this project a success, all tasks and assignments were divided into many sections to achieve our goals and purposes of the project. Throughout the process of completing this project, we communicated and comprehended each other's ideas and thoughts.

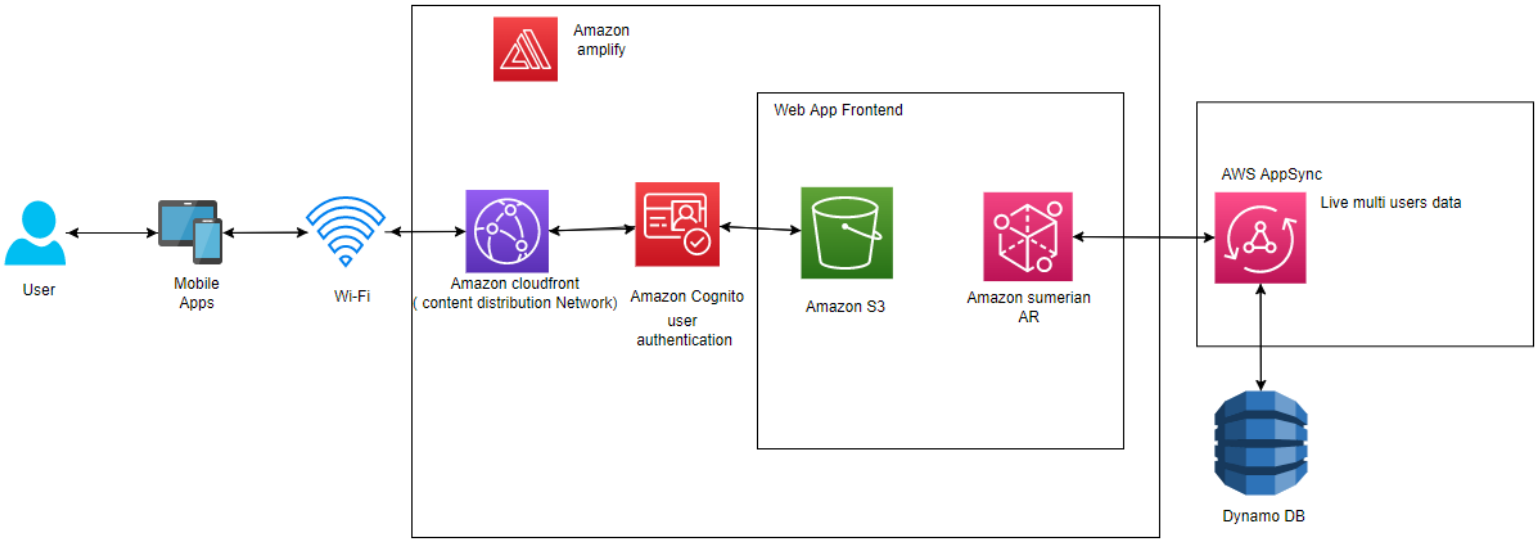
In the making of Phase I, many studies and opinions were thoroughly put to give the best outcome possible. During our first discussion, we brainstormed and exchanged ideas in order to develop an efficient and effective system. The process of searching the targeted industry was contributed from each member to ensure we build a compulsive and adaptable product. After a few suggestions and discussions, we agreed to focus on our education system because it is a crucial time for the education community during this pandemic as we are experiencing it first-hand as students. As the situation is close to our life, finding a client was not a problem. Collaboration from each member has made this project a smooth process. We approached our school teachers to get a problem scenario for us to create a solution. Later on, we allocated and divided the tasks to each member which includes selecting suitable IR4.0 technologies, designing cloud architecture and designing the flow of the program (major user views). Every documentation was done on Google Docs to allow synchronous engagement and discussions were done through Google Meet(s) and on WhatsApp application.

The journey of completing Phase II was not as challenging as Phase I because the ideas and concepts have been processed during Phase I. In Phase II, we discussed our report content and allocated tasks to each member of the group. Before assigning tasks to each member, we worked and discussed together to ensure everyone was on the same page to proceed with the reporting, video making and presentation preparation. When designing our low-fidelity prototype, everyone gave their creative thoughts and opinions to create an easy-to-use and appealing user interface. We also discussed the cloud architecture design for our system to make sure it is robust and efficient

for our client to implement in the future. Finally, everyone completed each task in their own free time.

Overall, each member contributed equally and gave their best to complete the project within the timeline given. The commitment and cooperation from each and every one of us has made this project a success. Everyone is always ready and set to help or assist one another if any problem arises in completing each part of the project. We managed to achieve our main goal to create a system where we can ease the learning and teaching in the education sector.

AWS Architecture Design



User

Users consist of teachers and students that use the application for educational purposes.

Mobile App

Mobile apps need to be installed into users' mobile devices like smartphones or tablets to run the AR application.

Wifi

Internet connection such as Wifi or mobile data is fundamental in order to run the AR application. The user could experience better performance of AR applications if they have higher Internet bandwidth.

Amazon Amplify

AWS Amplify is a collection of purpose-built tools and capabilities that allow frontend web and mobile developers to rapidly and simply build full-stack apps on AWS, with the flexibility to access the entire range of AWS services as use cases change. It can simply establish a web or

mobile app backend, connect the app in minutes, graphically construct a web frontend UI, and manage app content outside of the AWS console using Amplify.

Amazon CloudFront

Amazon CloudFront is a web service that allows you to distribute static and dynamic online material to your visitors more quickly, such as.html,.css,.js, and picture files. CloudFront distributes your content via a global network of edge sites, which are data centres located all over the world. When a user requests material from CloudFront, the request is routed to the edge location with the lowest latency (time delay), ensuring that the content is delivered as quickly as feasible. With CloudFront, users can receive the desired content at higher speed.

Amazon Cognito

Amazon Cognito provides authentication, authorization, and user management for your web and mobile apps. Your users can log in directly with a username and password, or through a third party such as Facebook, Amazon, Google or Apple. The service saves and synchronizes end-user data. Amazon Cognito collects a user's profile into directories called user pools that a mobile app or web app uses to configure limited access to AWS resources. An identity pool combines end-user information, client access platforms, devices and operating systems to organize identity groups. As a result, Cognito can secure the account of students or teachers because the users need to login using their own username and password or third party authentication.

Amazon S3

Amazon Simple Storage Service is a service offered by Amazon Web Services that provides object storage through a web service interface. It also enables users to store and retrieve any amount of data at any time or place. It gives the developers access to highly scalable, reliable, fast, and inexpensive data storage . Plus, it has easy management features to organize data for websites, mobile applications, backup and restore. In this case, Amazon S3 facilitates the students or teachers to store or retrieve any data at any time or place.

Amazon Sumerian

Amazon Sumerian is a browser-based authoring tool you can use to easily create and publish augmented reality, virtual reality, and immersive applications and experiences. Amazon Sumerian is used to create engaging 3D front-end experiences and is integrated with AWS services to provide easy access to machine learning, code execution and more. In other words, Amazon Sumerian helps developers to easily create the augmented reality applications for clients which in our case is for students and teachers.

AWS AppSync

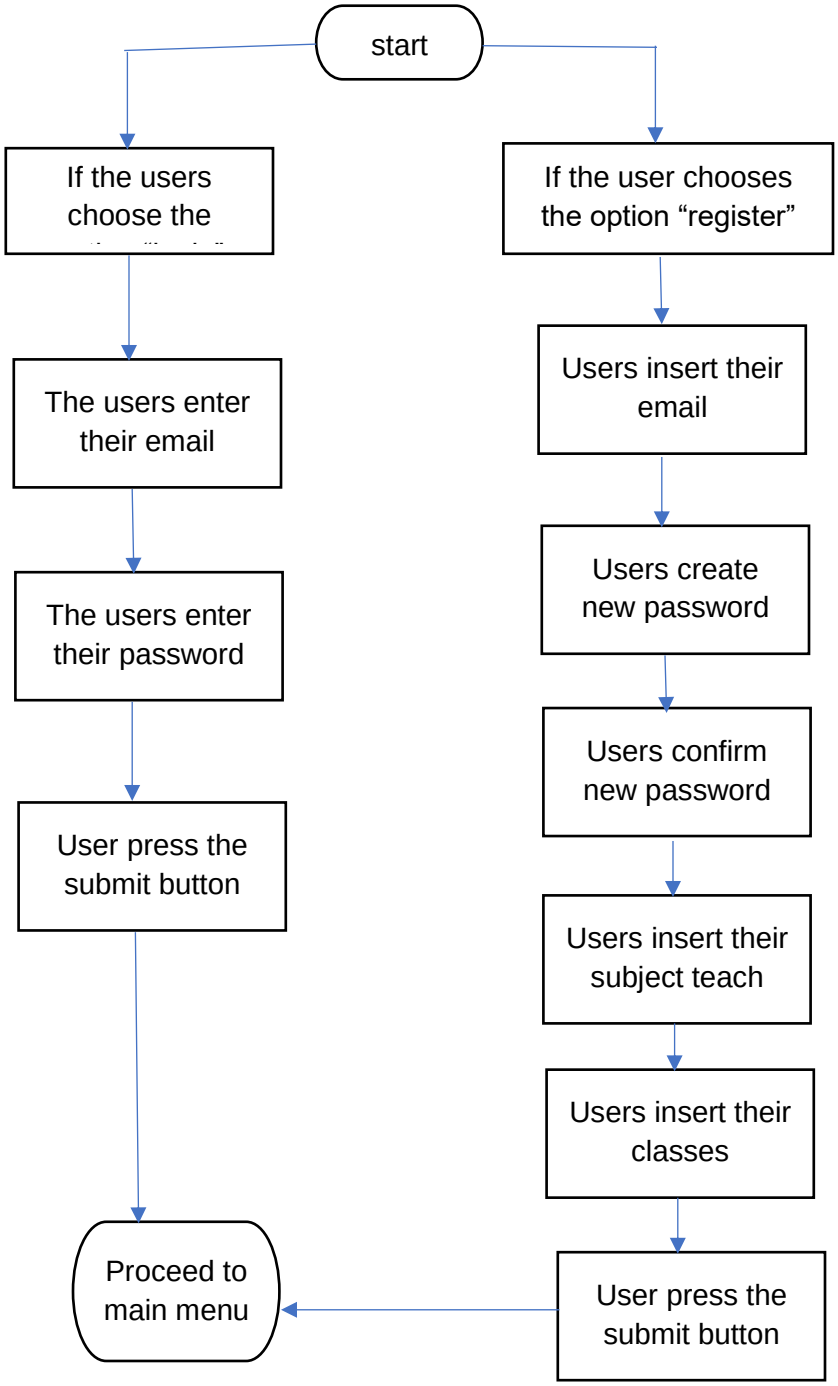
AWS AppSync is a fully managed service that simplifies the development of GraphQL APIs by taking care of the heavy lifting of securely linking to data sources such as AWS DynamoDB, Lambda, and others. Organizations select GraphQL to construct APIs because it allows front-end developers to access different data structures, microservices, and APIs with a single GraphQL interface, allowing them to design apps quicker. In AppSync, adding caches is to gain better performance, subscriptions to support real-time changes, and easy to keep off-line clients in sync with data that stores on client-side.

Amazon DynamoDB

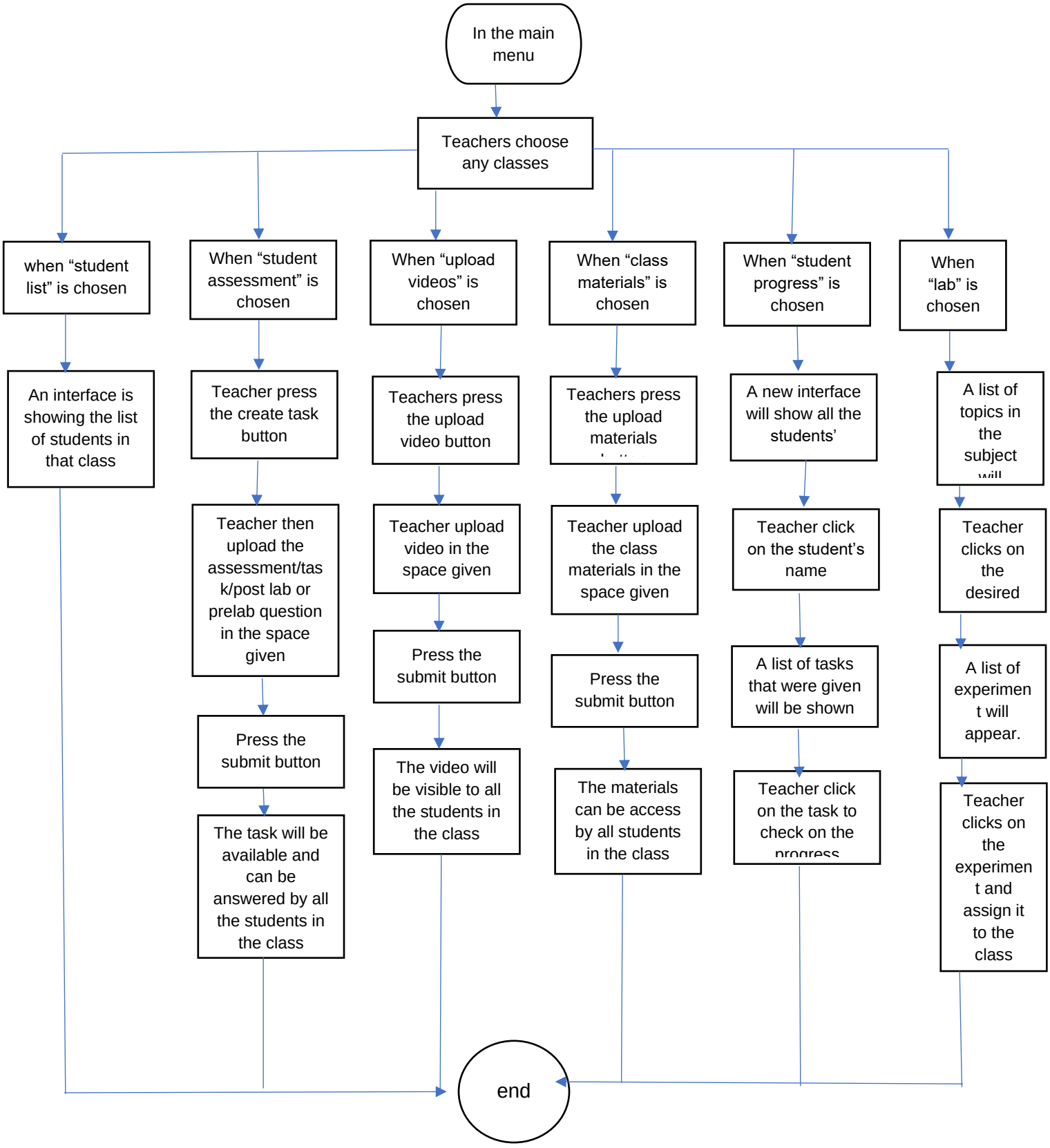
Amazon DynamoDB is a fully managed, serverless, key-value NoSQL database designed to run high-performance applications at any scale. DynamoDB offers built-in security, continuous backups, automated multi-region replication, in-memory caching, and data export tools.

Business Process Flow Diagram

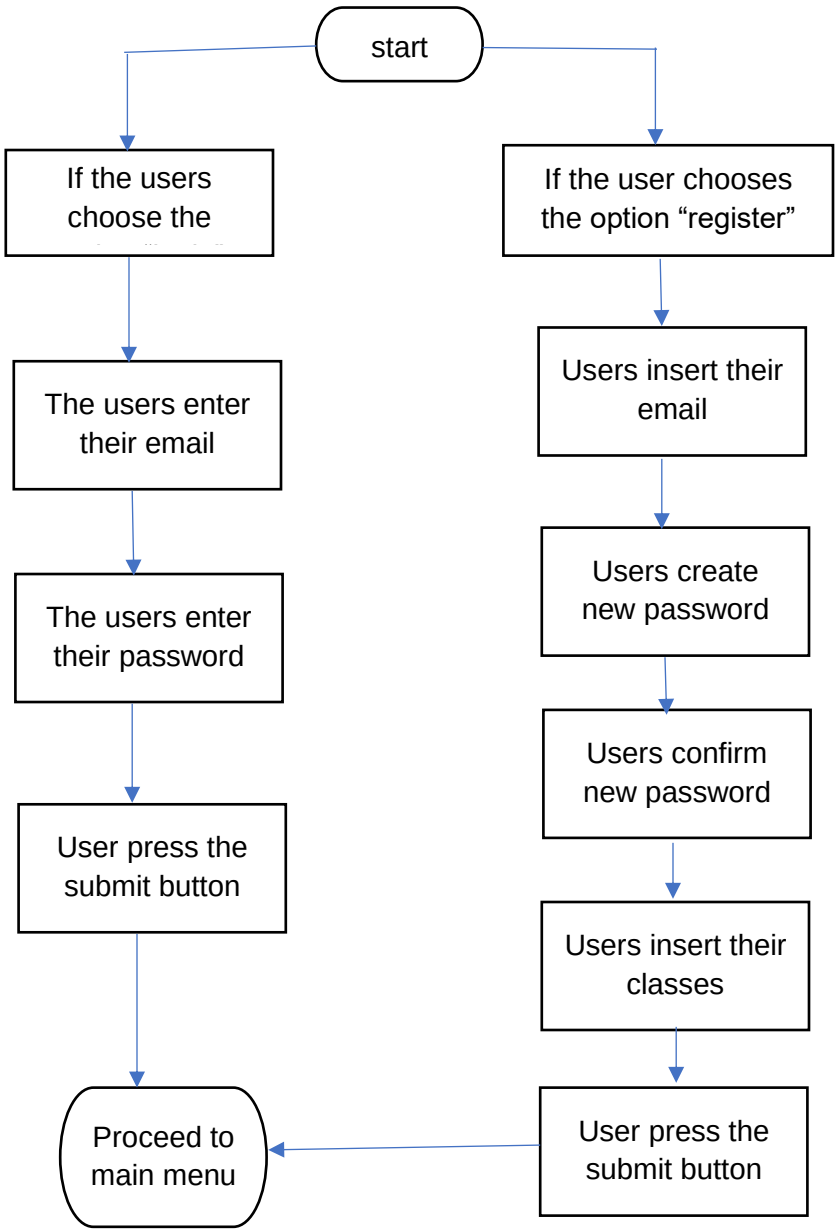
Login/ register process teacher interface



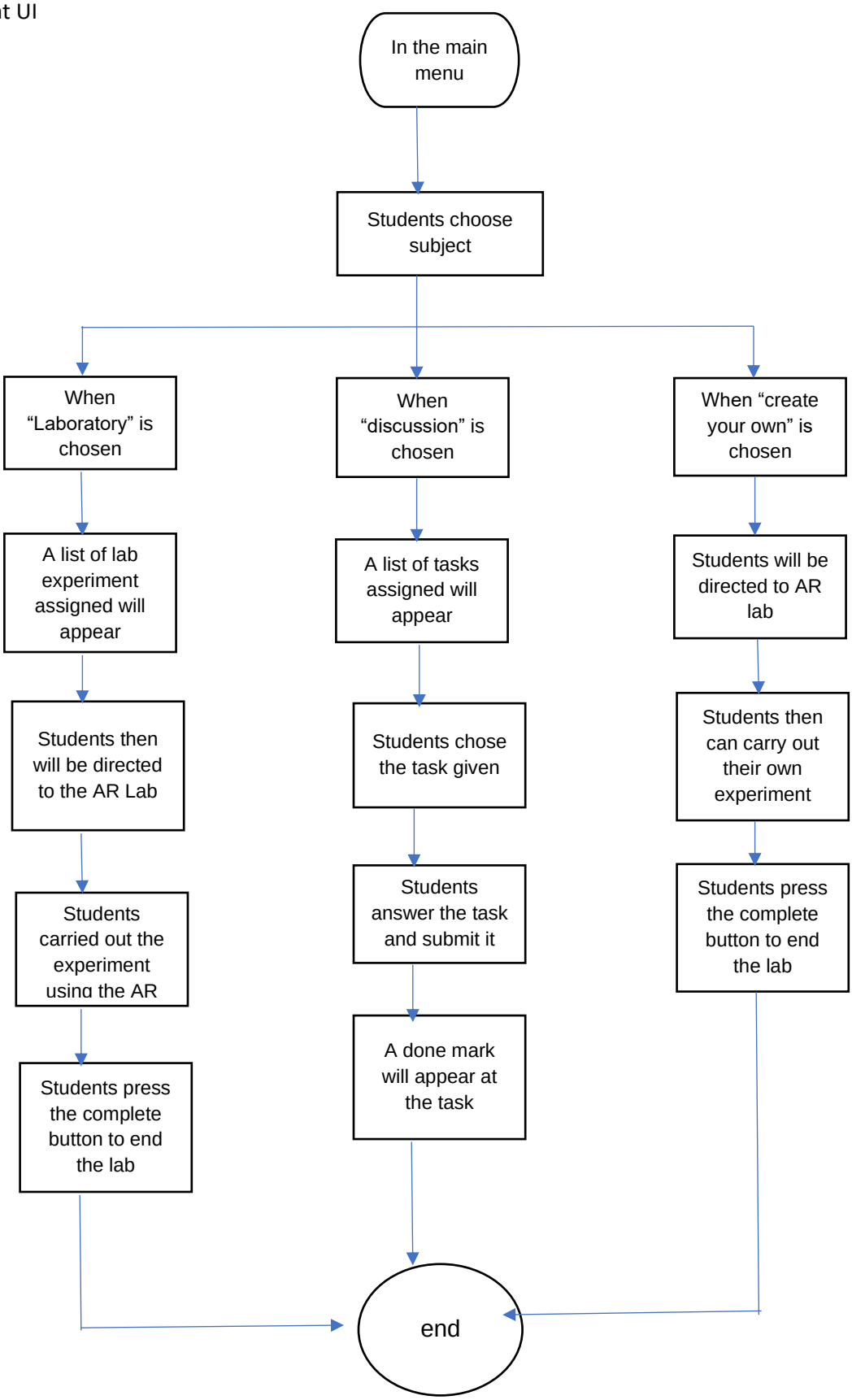
Teacher UI


In the main menu
Teachers choose any classes
when “student list” is chosen
When “student assessment” is chosen
When “upload videos” is chosen
When “class materials” is chosen
When “student progress” is chosen
When “lab” is chosen
An interface is showing the list of students in that class
Teacher press the create task button
Teachers press the upload video button
Teachers press the upload materials
A new interface will show all the students’
A list of topics in the subject
Teacher then upload the assessment/task/post lab or prelab question in the space given
Teacher upload video in the space given
Teacher upload the class materials in the space given
Teacher click on the student’s name
Teacher clicks on the desired
Press the submit button
Press the submit button
Press the submit button
A list of tasks that were given will be shown
A list of experiment will appear.
The task will be available and can be answered by all the students in the class
The video will be visible to all the students in the class
The materials can be access by all students in the class
Teacher click on the task to check on the progress
Teacher clicks on the experiment and assign it to the class
end

Student login/ register process

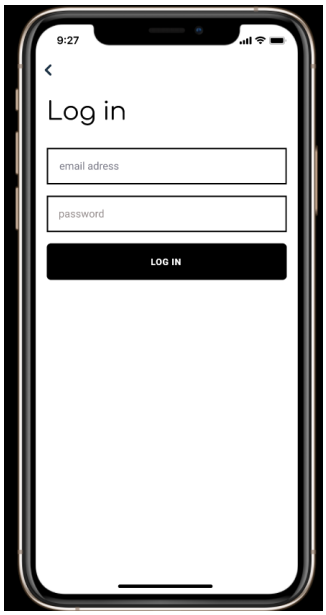


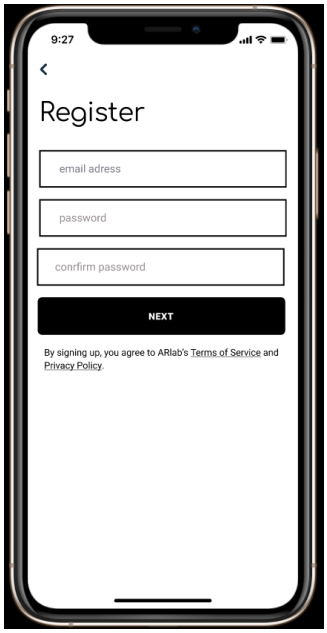
Student UI


In the main menu
Students choose subject
When "Laboratory" is chosen
When "discussion" is chosen
When "create your own" is chosen
A list of lab experiment assigned will appear
A list of tasks assigned will appear
Students will be directed to AR lab
Students then will be directed to the AR Lab
Students chose the task given
Students then can carry out their own experiment
Students carried out the experiment using the AR
Students answer the task and submit it
Students press the complete button to end the lab
Students press the complete button to end the lab
A done mark will appear at the task
end

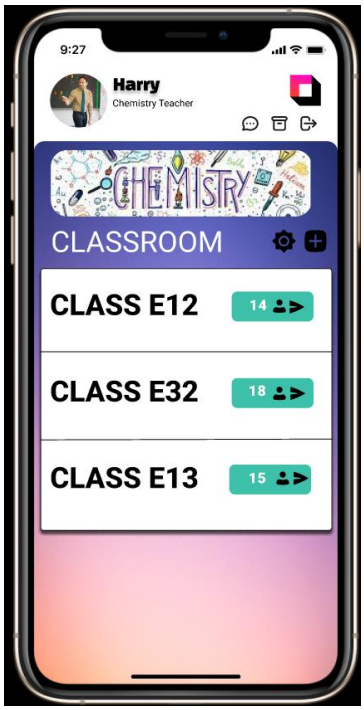
Low-fidelity Mock-ups

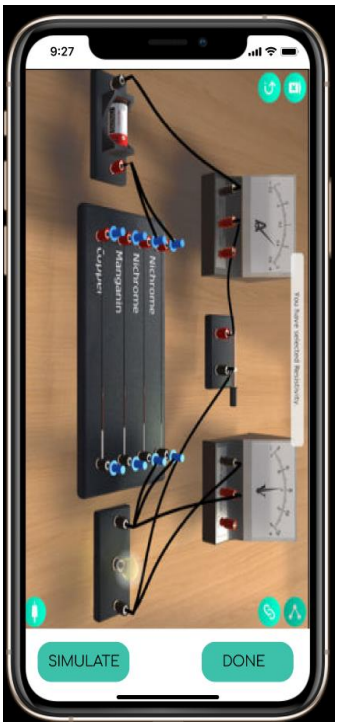
LOGIN / REGISTER PAGE



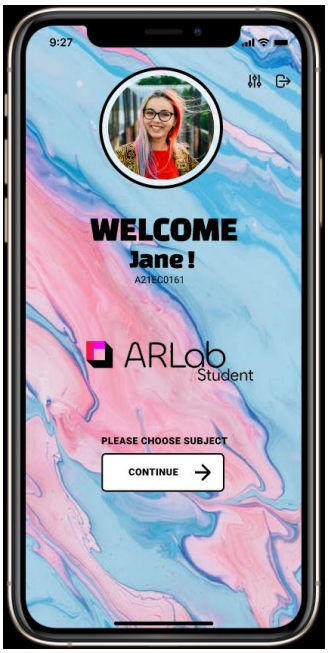


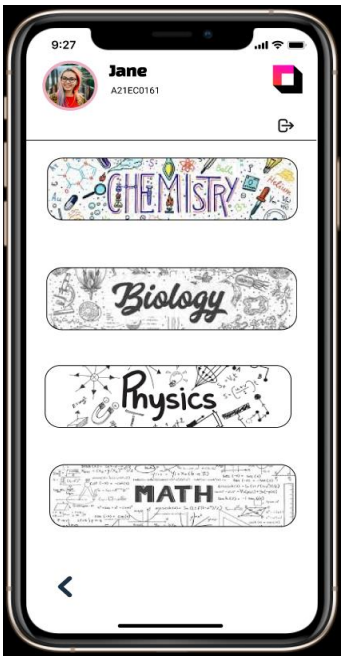
TEACHER'S PAGE

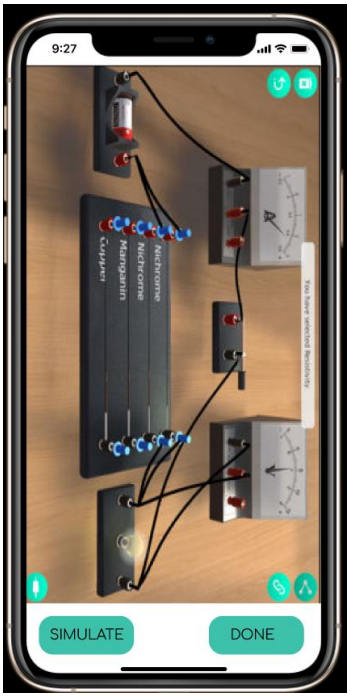




STUDENT'S PAGE







Reflection

Through this project we have learnt the advantages of AR technology and how it can be used to shape the future starting with education. The pandemic made us learn that technological advancement is inevitable and to overcome future crises we must be prepared, which in this context is online learning. We also learnt that the technology infrastructure needs to be developed alongside other technologies so that it can grow substantially. For example, the use of cloud computing in the AR application. Other than that, we are very lucky to have supportive team members that motivates one-another. Beside that, the project itself is our main motivation to create an initiative that will help a lot of students.

There were a few challenges that have become a major setback to complete this project such as communication problems. Some of us have connection problems which makes it hard for us to have proper discussion. However, we managed to have discussions as those who have connection problems went to the local library where the connection is significantly stronger. Other than that, we are also struggling to catch up with the due date as we have other assignments piling up. Nevertheless, we managed to finish the project as we carefully planned our time management. After that, one of the major problems is designing and creating AWS cloud architecture which at that time we had zero knowledge of. In Spite of that, we still managed to create as we completed the AWS module and got some assistance from videos explaining about cloud architecture. Last but not least, to create mock-ups using software like Figma. It took some time for our team members to learn how to use, design and create the mock-ups. In addition, we also learn a lot of things by overcoming challenges as we learn how to spend time wisely, building cloud architecture, and designing mock-ups using software.

Upon completing the assignment, we realised that we have a long way to go and a lot to learn in order to broaden our knowledge in technology as technology is always evolving. We all decided to venture more in the world of technology and try to gain even more knowledge so that we can find solutions to any problems that occur in order to change the world to a better place for mankind.

In this competitive industry where many tech companies are battling against each other to have their hands on the latest or cutting-edge technology first. They often scout for the best

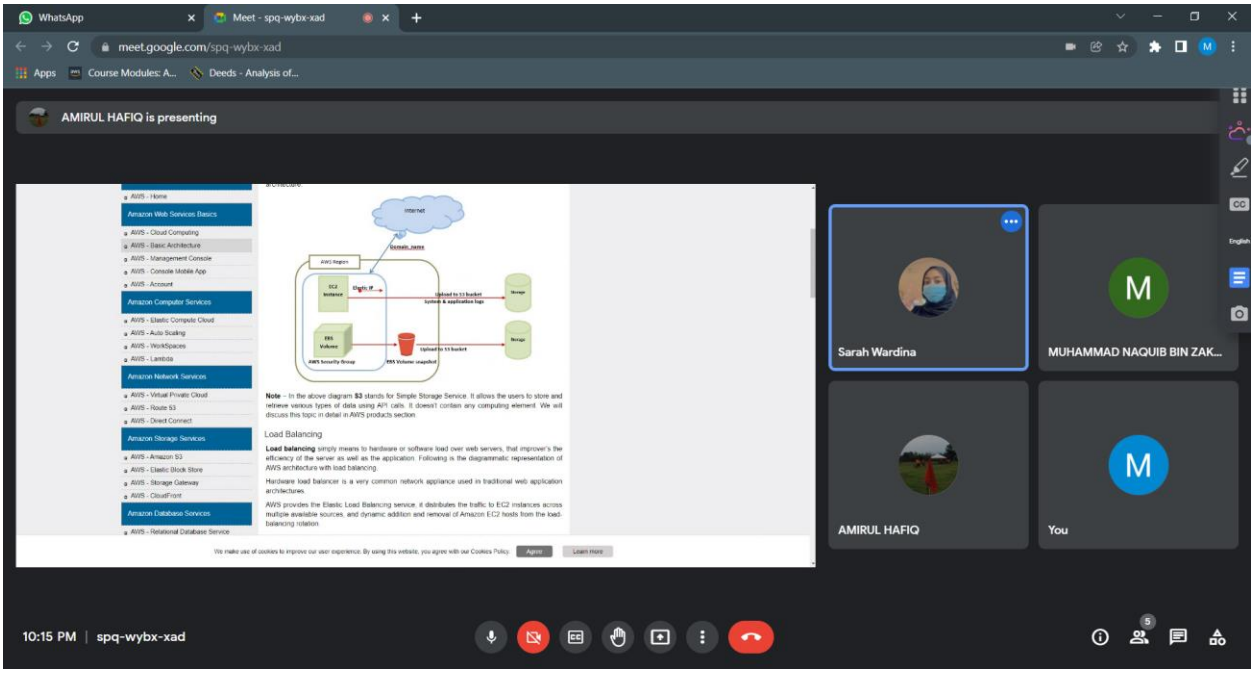
employee that can help them achieve their target. Therefore, we must prepare ourselves by mastering what we learn during this course as it is crucial for us to compete with other people in the industry.

Video Documentation

1. Video Journey - https://youtu.be/i302dI8SyJ4
2. Video Presentation -https://youtu.be/4gnyYavgzHA

Appendices

Appendix 1



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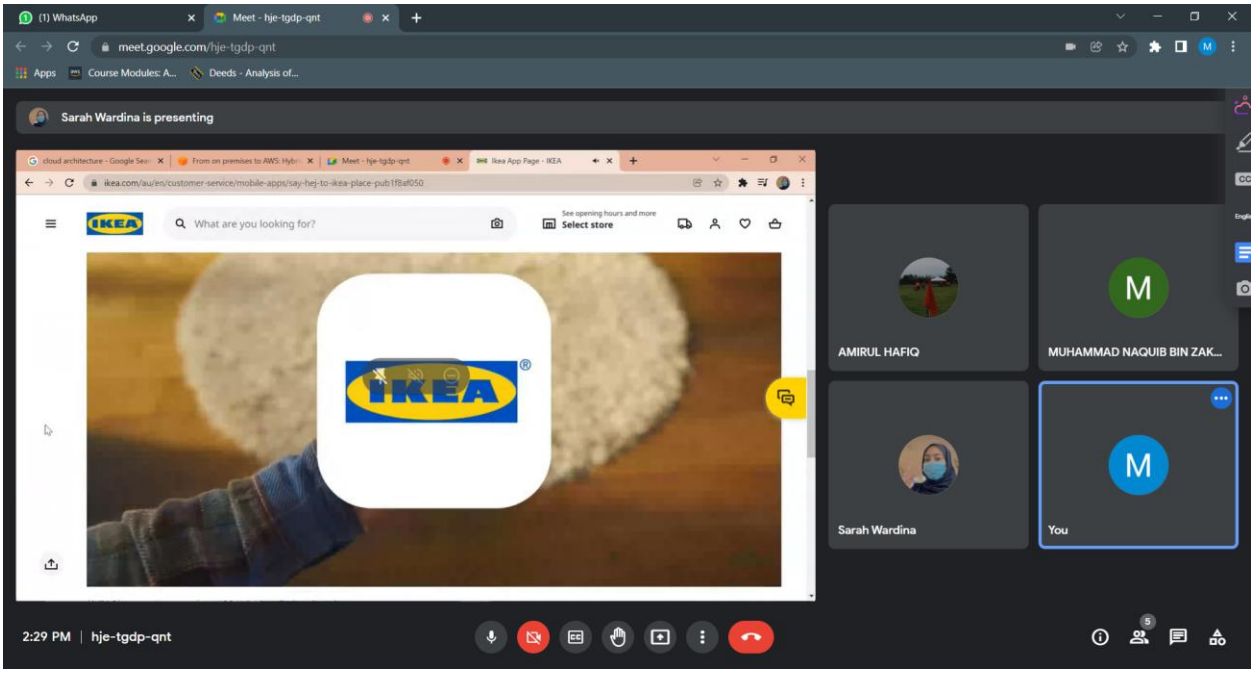

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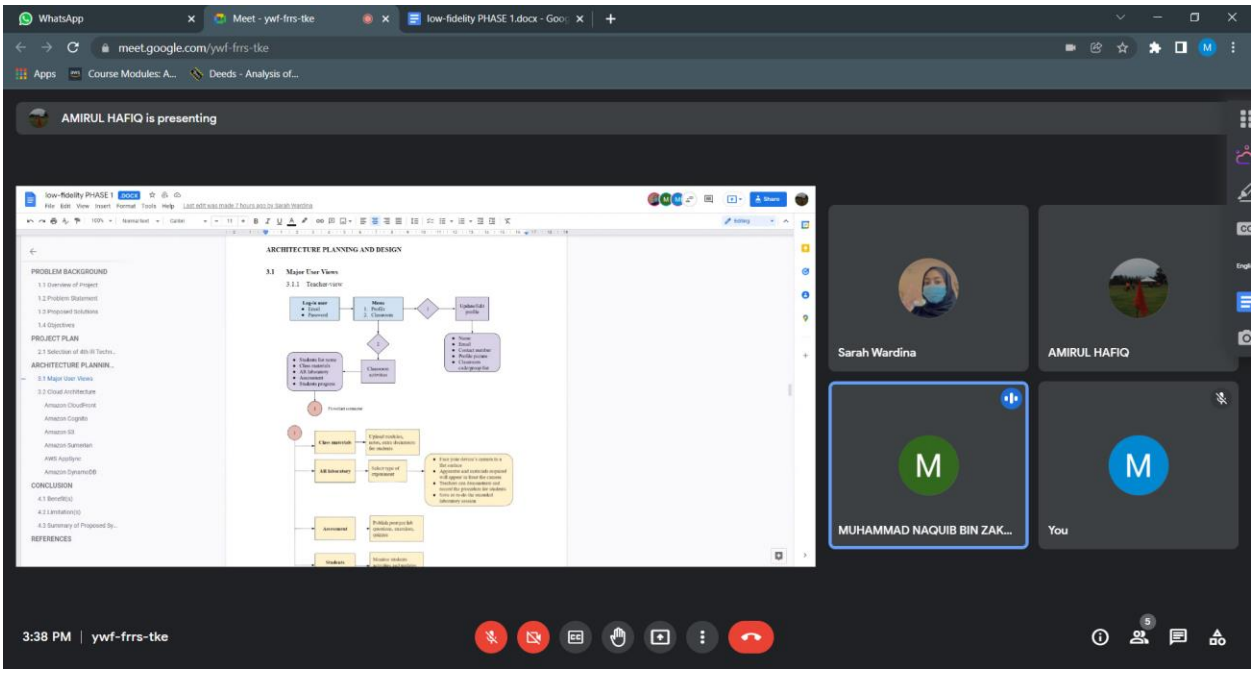
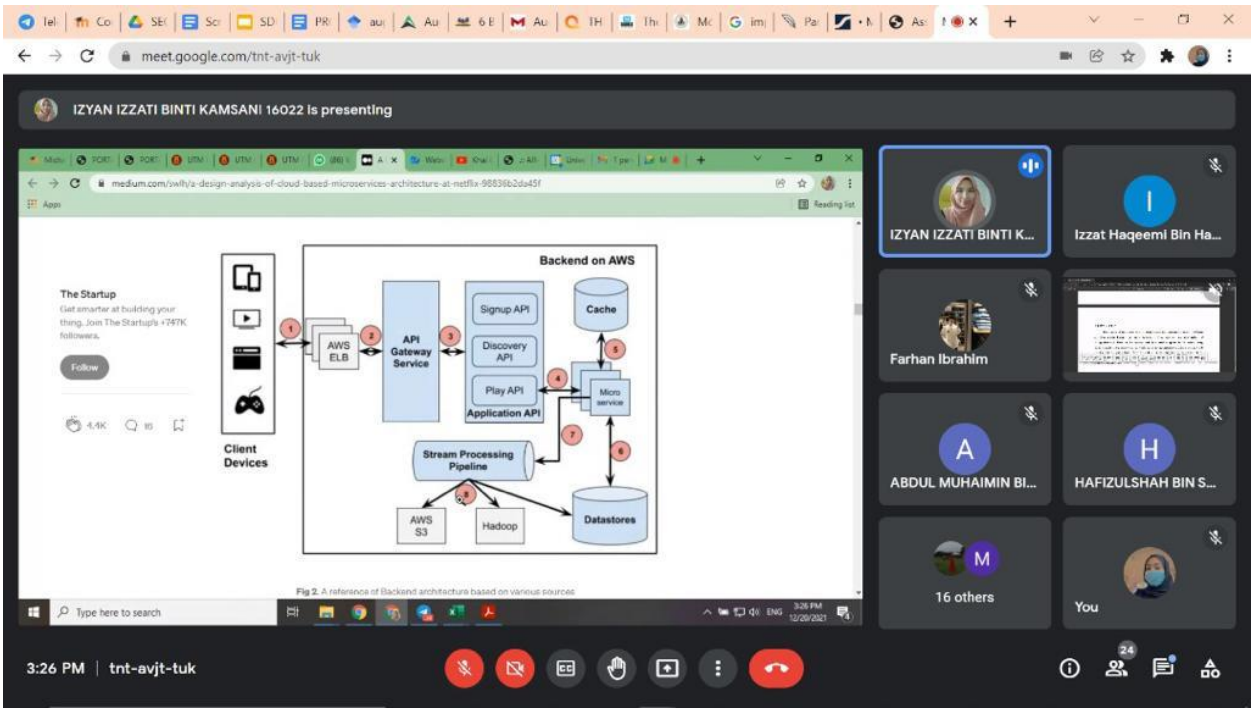


Appendix 4



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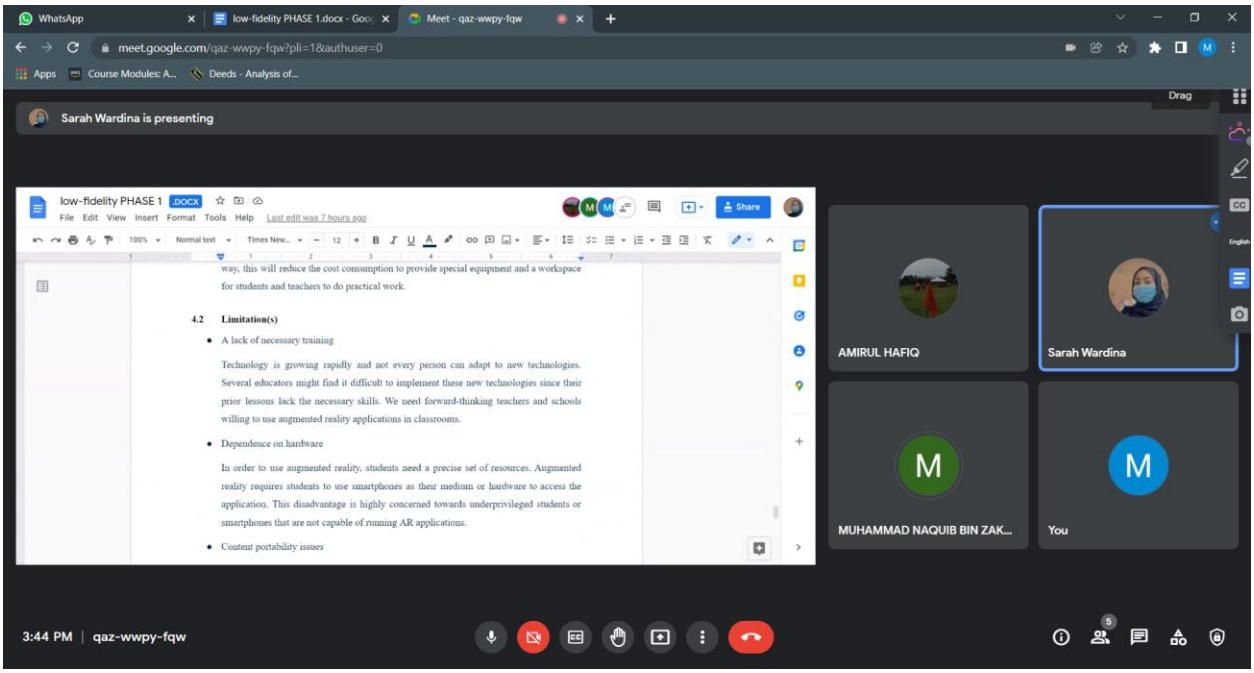

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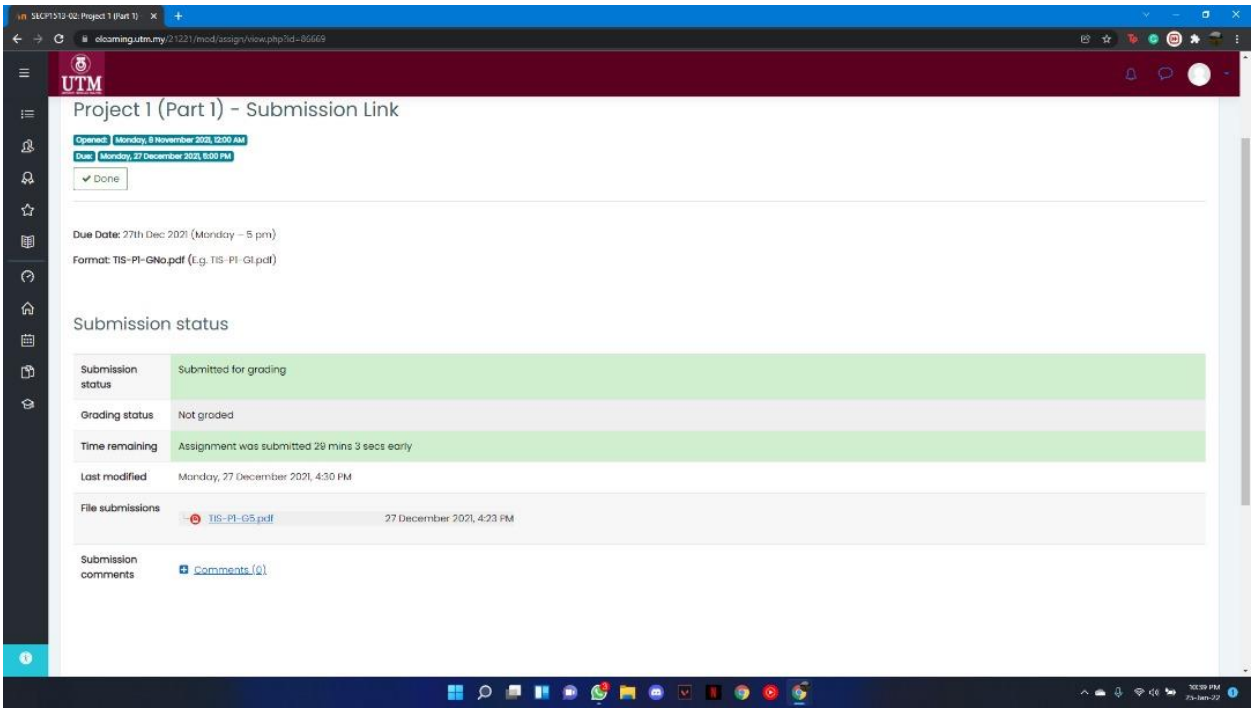

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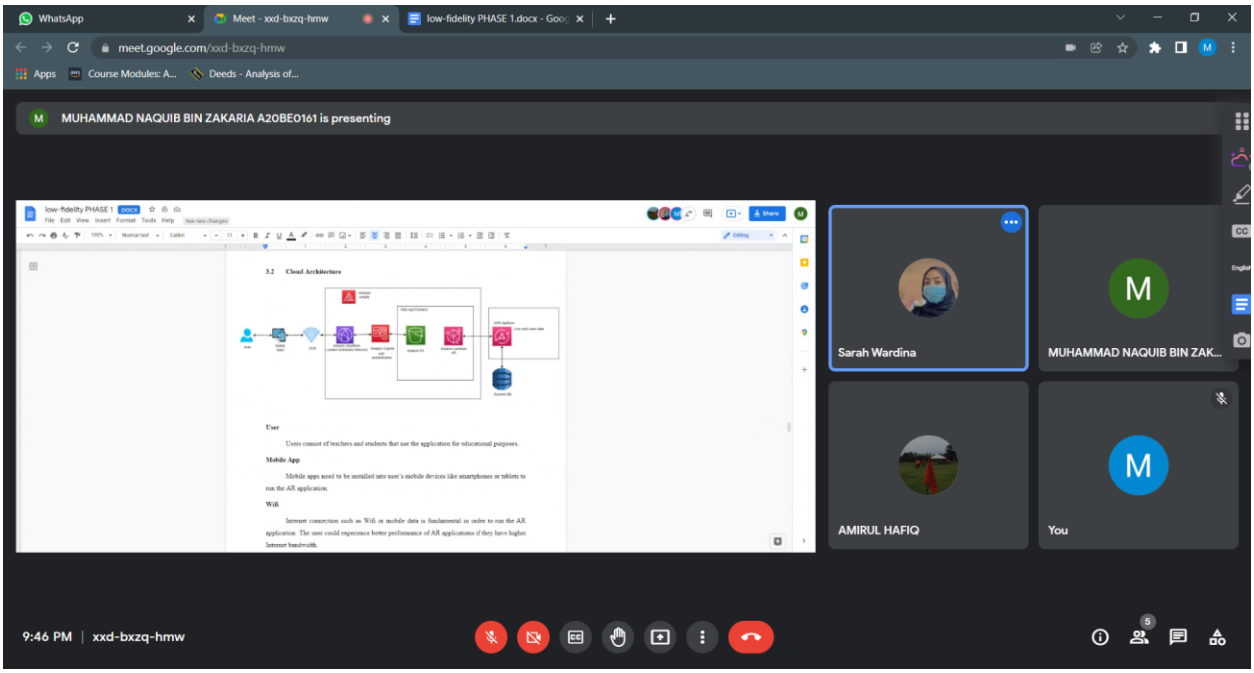
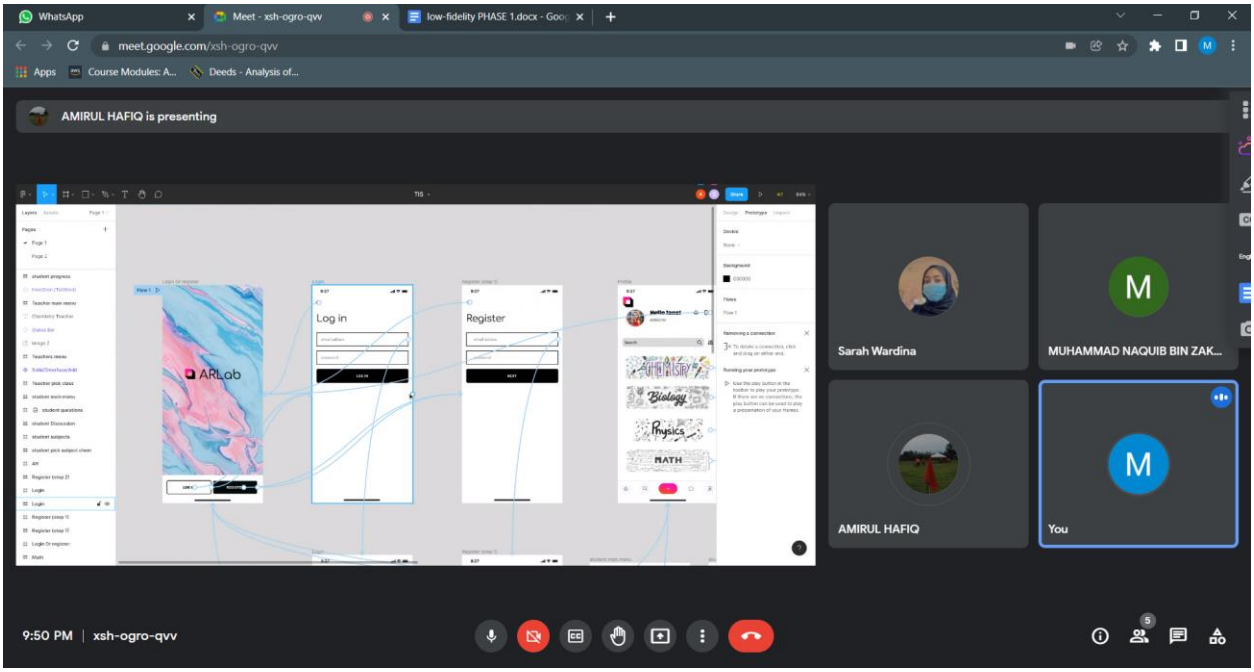
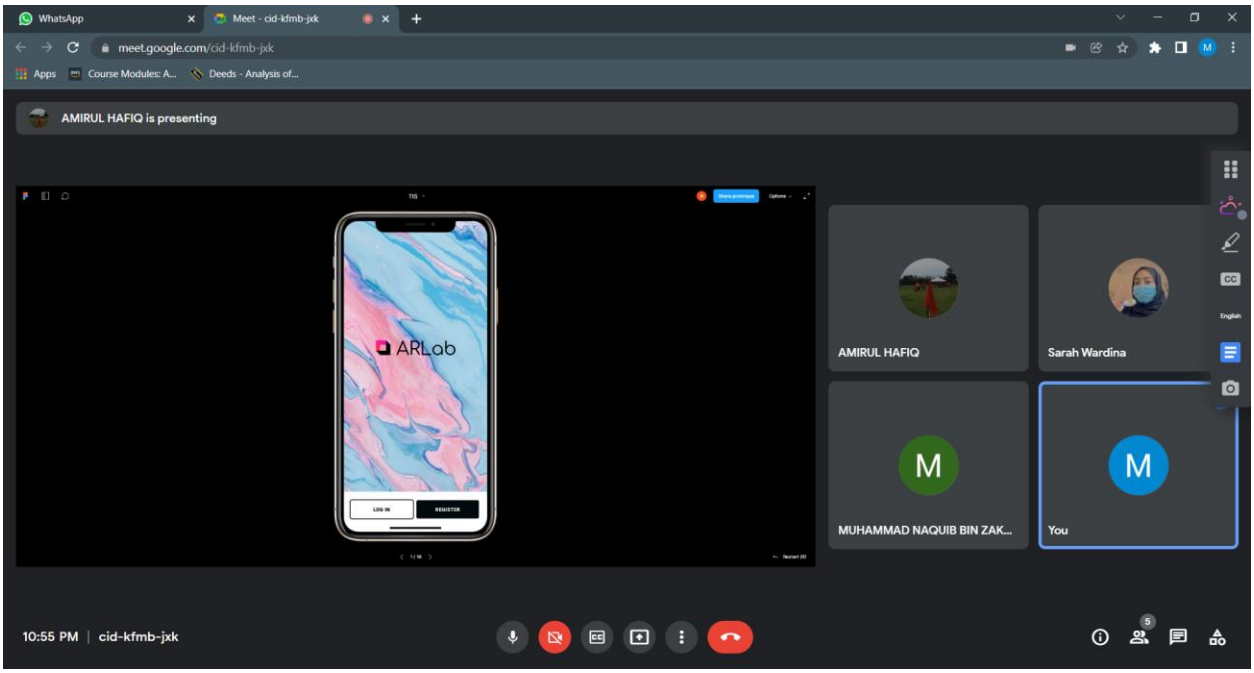


Appendix 8



Appendix 9


WhatsApp
Meet - cid-kfmb-jxk
meet.google.com/cid-kfmb-jxk
AMIRUL HAFIQ is presenting
ARLab
AMIRUL HAFIQ
Sarah Wardina
MUHAMMAD NAQUIB BIN ZAK...
You
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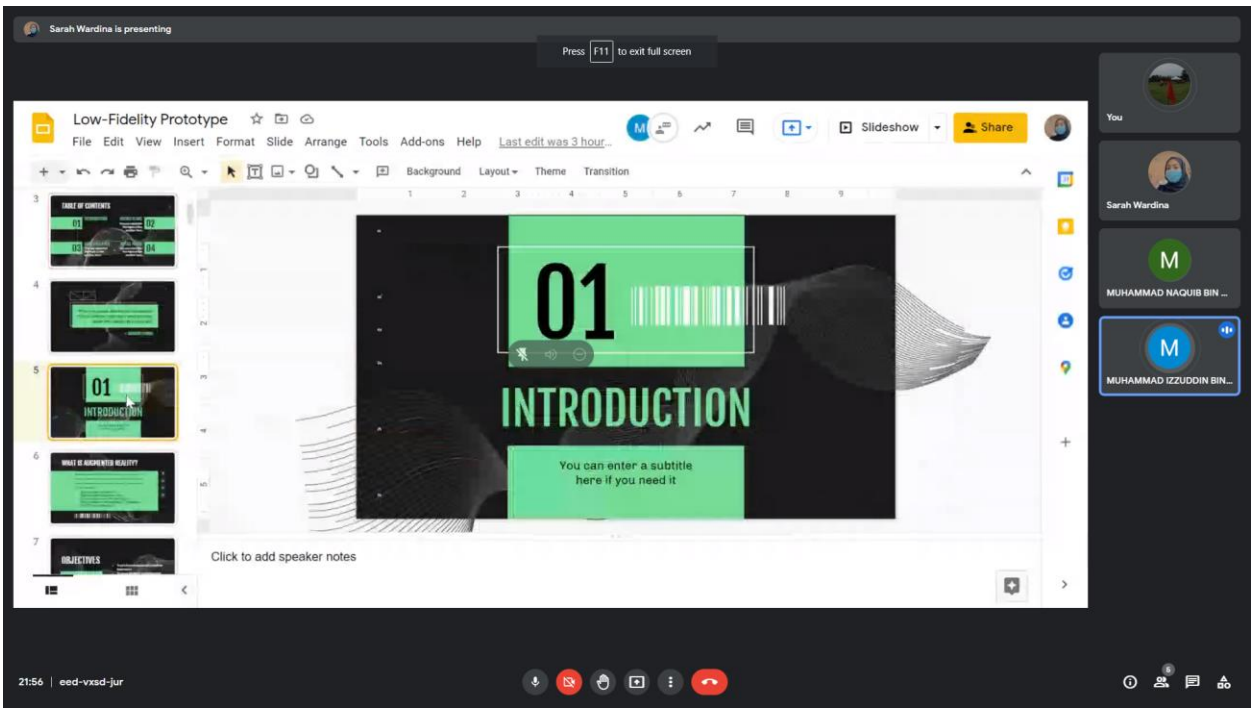
Appendix 10


Sarah Wardina is presenting
Press F11 to exit full screen
Low-Fidelity Prototype
Slideshow
Share
01
INTRODUCTION
You can enter a subtitle here if you need it
Click to add speaker notes
You
Sarah Wardina
MUHAMMAD NAQUIB BIN ...
MUHAMMAD IZZUDDIN BIN...
21:56 | eed-vxsd-jur

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