FACULTY OF ENGINEERING

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SECP1513 – TECHNOLOGY INFORMATION SYSTEM

SECTION 02

PROJECT - PHASE 1 (PROJECT PROPOSAL)

[AUGMENTED REALITY IN EDUCATION]

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PROBLEM BACKGROUND

1.1 Overview of Project

We are working on creating an application that will assist physical learning progress during the COVID-19 outbreak. During this COVID-19 pandemic, some of the classes can only be done physically such as lab experiments as specific tools are needed for the experiment to be conducted. This application will help our potential clients (the students and teachers) to conduct experiments without any tools as the experiments can be done through the internet. Our application will run with Augmented Reality(AR) and cloud computing as its main system. The application will enable students to conduct experiments through AR by scanning the QR code in their textbook. Students will also be able to conduct their own experiments and all the results of the simulation experiments will be based on the previous research on the web. Teachers on the other hand will be able to track their students' progress through this application. Therefore, we believe that our application will smoothen and enhance students' learning experience during this pandemic period.

1.2 Problem Statement

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) and cloud computing into the solution.

1.3 Proposed Solutions

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.

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.

1.4 Objectives

There are some objectives that we want to highlight about the implementation of Augmented Reality (AR) in education sectors. The objectives are:

1. To produce quality students with practical experience.

   Augmented reality gives opportunities to students to make more involvement in practical learning such as experiments in the laboratory. In this case, we can achieve an equality for each student in understanding the practical learning process. As a result, we can produce more quality students that understand both theoretical and practical topics.

2. To boost student's understanding during the learning process.

   The incorporation of augmented reality into a class can help students to have a better understanding about a topic. All teachers must be concerned about the resources or materials that they bring to the class whether it can boost the understanding of one's student or not. However, the AR technology enables teachers to create immersive educational experiences on their own to help ensure their students understand the learning content.

3. To reduce the cost of education materials.

   Augmented reality does not require any specific complex tools and devices to operate. It only needs an application and a smartphone with an internet connection. In contrast, the normal learning process commonly needs to spend a lot of money to buy school equipment like textbooks, stationeries, laboratory tools and others. Otherwise, most people in current time own a smartphone and our particular potential client is aged 13 and above.

PROJECT PLAN

2.1 Selection of 4th IR Technology

Augmented reality

Augmented reality (AR) is a real time view of a physical real-world environment with added virtual computer graphics. AR combines 3D virtual objects as well as real objects and makes them interactive. AR is also one of nine (9) main components in IR4.0 digital technologies which consist of big data and analytics, autonomous robots, cloud technologies, cybersecurity, system integration, industrial internet of things, simulation and additive manufacturing.

Following the COVID-19 outbreak in Malaysia has led the government to enact the Movement Control Order (MCO) to contain the pandemic. Traditional method of face-to-face learning has been replaced with Open distance learning (ODL) where students learn through online classes. However, some topics do require lab sessions. But, due to the MCO, the lab was being held online and most teachers only gave a video regarding the experiments.

This is when a virtual lab, powered by AR comes into play. With the AR application students can perform the experiment online with 3D material apparatus which the students can have better understanding. With the AR application, instead of doing the experiments which are pre-programmed by the textbook QR code, students can also conduct experiments which are out of learning scope and by using the result from previous research from the web. Other than that, the learning process has become easier compared to the traditional lab sessions where some schools have insufficient material and apparatus to conduct the experiment. Plus, it is much safer with the AR app because some experiments are using dangerous materials and chemicals.

Cloud Computing

Cloud computing is the on-demand delivery of computing resources such as data storage and computing power without management from the user directly. Simply said , cloud computing is offering faster innovation, flexible resources, and economies of scale by delivering computing services such as storage, databases, networking, software, analytics and intelligence over the Internet.

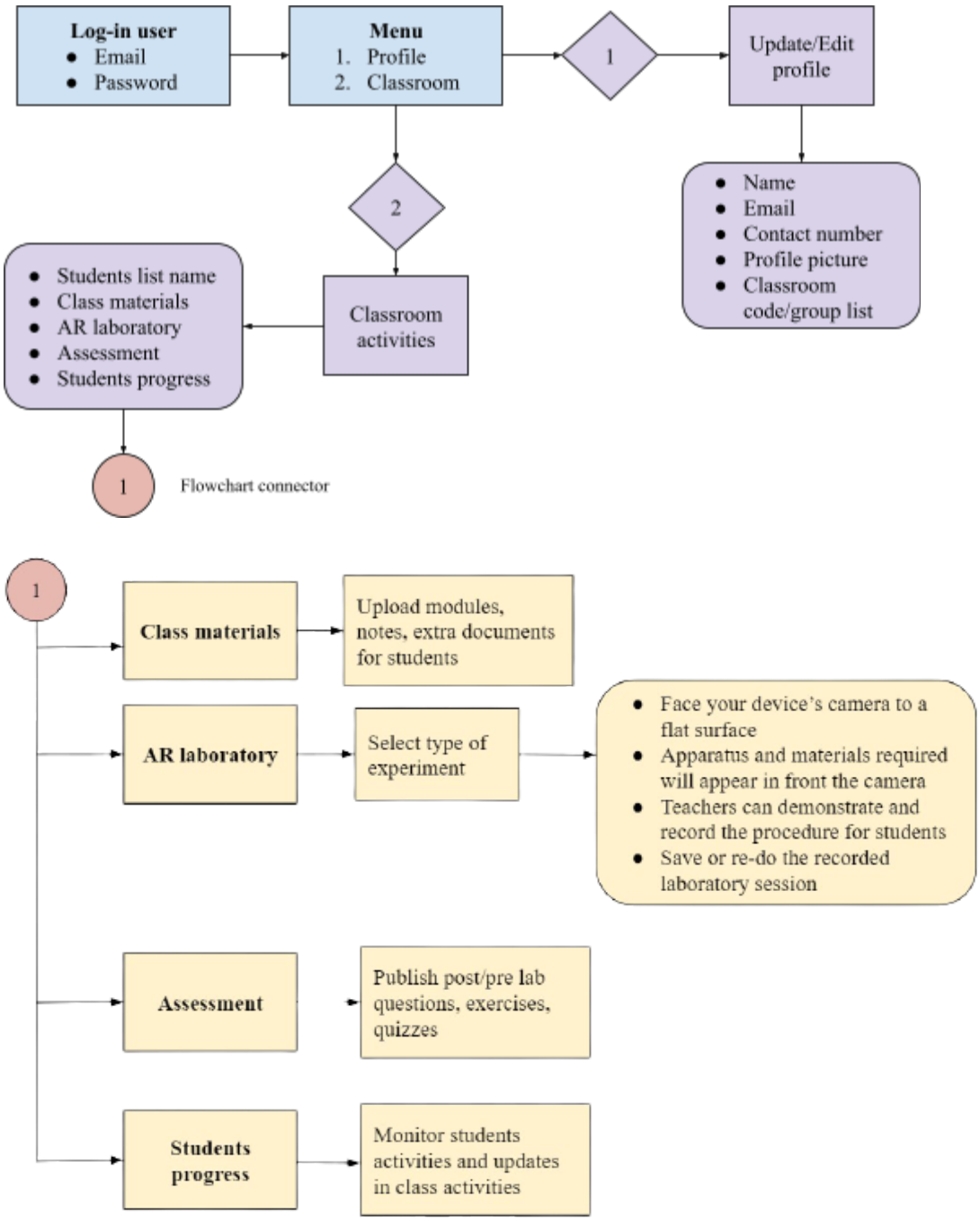
The implementation of cloud computing in augmented reality is to store and organize the information of the physical world and transfer it in real time and in a visual way through any device like mobile phones, glasses or AR helmet. In this case, the AR application can be accessed by someone from anywhere as long as they are connected to the Internet.

In this study, the implementation of AR cloud into education is possible to create a new way of learning environment. Learning with AR clouds will introduce the student and also the teacher to learn visually from anywhere. There is no need for students and teachers to bring or keep physical learning resources such as textbooks, calculators, laboratory equipment and others because all the resources are stored into cloud storage which can be accessed by them at any moment.

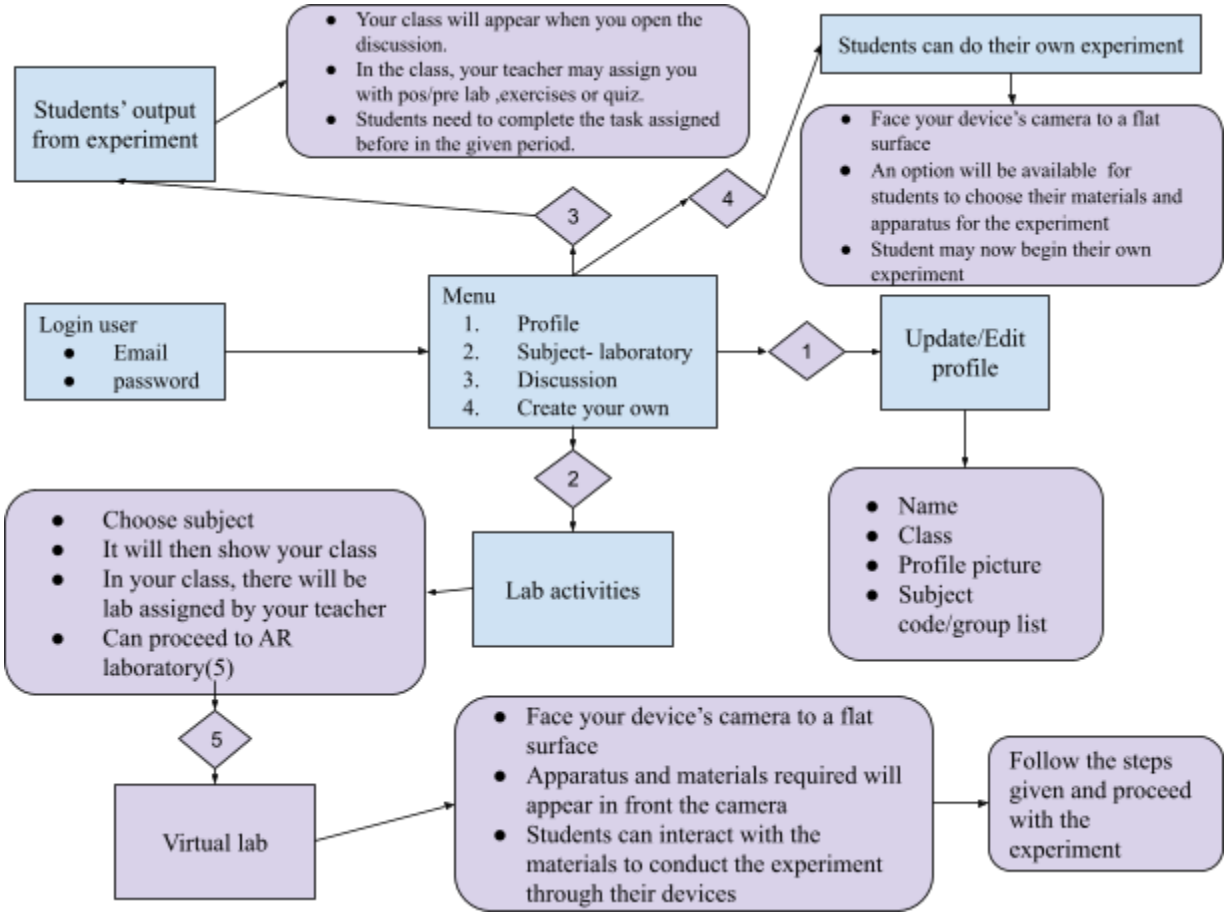
ARCHITECTURE PLANNING AND DESIGN

3.1 Major User Views

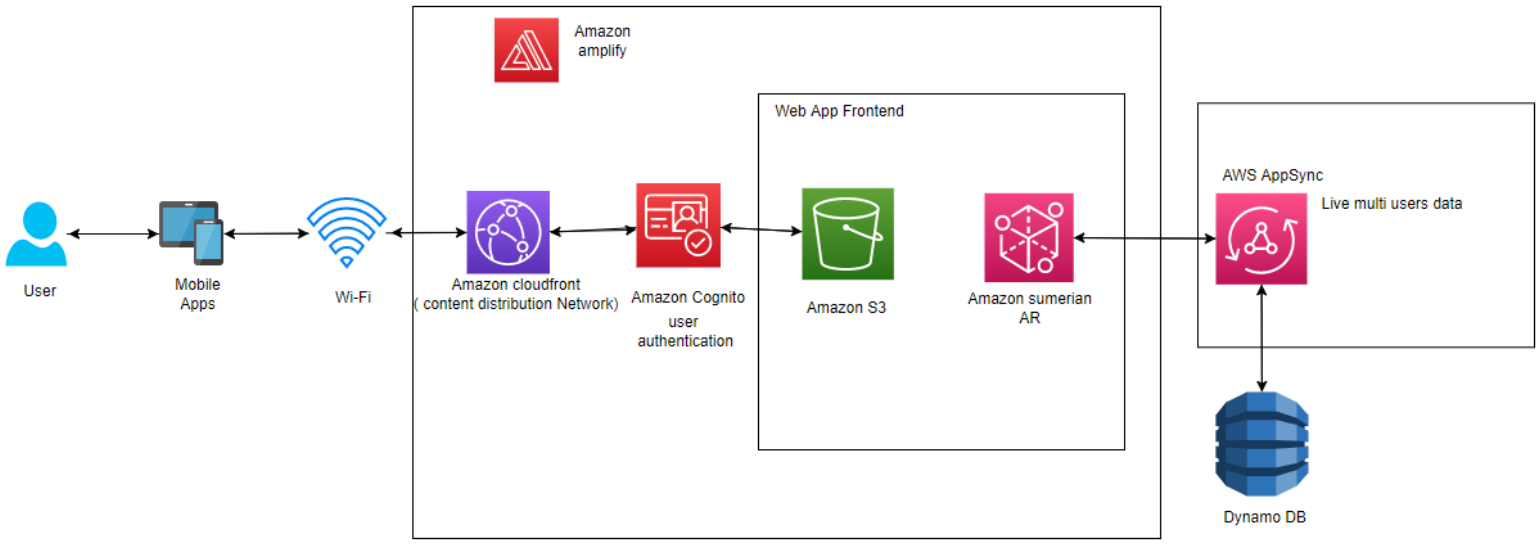
3.1.1 Teacher-view



3.1.2 Student-view



3.2 Cloud Architecture



User

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

Mobile App

Mobile apps need to be installed into user's 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.

Amazon Cognito

Amazon Cognito provides authentication, authorization, and user management for your web and mobile apps. Your users can login 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.

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.

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.

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.

CONCLUSION

4.1 Benefit(s)

- Accessible learning materials

  Education learning process will become portable and always on the move. Augmented reality allows students and teachers to access their learning materials anytime and anywhere at the tip of their fingers. This will replace physical textbooks, models and printed materials where everything will exist in a single place.

- No special equipment is required

  The only equipment that they need is a smartphone or a tablet to access every feature that has been provided. The difference between AR and VR is that AR does not require expensive and specialized hardware. According to Statista, 87.61% of Malaysians use smartphones in their daily lives (Müller, 2021) and this AR can be immediately used for the majority of our clients.

- Higher student engagement and interest

  Learning through gamified AR can increase their interest by engaging with their own hands and experience. As a result, the process of learning is more exciting and effortless which gives a significant positive impact on students. Education system will be a faster and more effective learning process as practical learning is one of the best ways to understand better.

- Improved collaboration capabilities

  Direct interaction between students and teachers provide a wide range of options for diversifying and ramping up ordinary classes. Teamwork skills among students can be developed and improved through interactive lessons because all students participate in the learning process at the same time.

- Safe and efficient classroom

  Augmented reality is able to conduct a hands-on classroom without exposing everyone else in danger or risks huge amounts of money if something turns out the opposite. In a way, this will reduce the cost consumption to provide special equipment and a workspace for students and teachers to do practical work.

4.2 Limitation(s)

- A lack of necessary training

  Technology is growing rapidly and not every person can adapt to new technologies. Several educators might find it difficult to implement these new technologies since their prior lessons lack the necessary skills. We need forward-thinking teachers and schools willing to use augmented reality applications in classrooms.

- Dependence on hardware

  In order to use augmented reality, students need a precise set of resources. Augmented reality requires students to use smartphones as their medium or hardware to access the application. This disadvantage is highly concerned towards underprivileged students or smartphones that are not capable of running AR applications.

- Content portability issues

  The AR application we create must operate across all devices and platforms equally and effectively. Nevertheless, providing the same level of AR content on each platform is almost hard.

- Internet connectivity

  To get a smooth experience while using the AR application, students and teachers need a high speed internet connection and network with low latency. This will help the engagement between two parties are parallel and provide the best learning experience. However, not every household has a great internet connection.

4.3 Summary of Proposed System

COVID-19 has urged Malaysians to implement new technology drastically and the education world is one of the many that is affected during this pandemic. All physical classrooms have turned online and virtual to communicate and learn with one another. As a solution to enhanced classroom experience, augmented reality (AR) technology is a part of the solution to produce quality students with real-life experiences. This application system utilizes the 4IR technology, cloud computing, with its architecture and design to provide a better and mobile user experience. Our objectives are to build up students' understanding, reduce cost of education and provide accessible learning materials. These objectives will benefit students with a better learning environment in open distance learning. The combination of two worlds (real and virtual) is an advantage to help students' learning process; easy access to materials, no special equipment needed, increase students' interactions and interests, boost collaboration capabilities and provide safe and efficient learning. Nevertheless, the cons of AR are it is lack of necessary training, the platform of AR is dependent on hardware (ie. smartphones and tablets), content portability issues with different devices and platforms and the need of high speed internet connectivity for better real-time experience.

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