SECP1513-10 TECHNOLOGY AND INFORMATION SYSTEM

LOW FIDELITY PROTOTYPE - PROJECT 1

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Introduction

On 7 November 2021, we sent a lot of emails to our potential customers to promote our service of developing a new system that suits their company's operation. As an outcome, we managed to receive a reply from one of them, which is the LYLN Home Decor Company. This company was established in the year 2020. From their reply, we know that they wish to have an enhancement on their existing online business platform. There are three weaknesses in their current platform which are unable to handle a massive amount of data, low level of platform security, and lastly, it does not provide on-demand service. Furthermore, due to the COVID-19 pandemic, the turnover of this company's physical store is affected critically, so they expect to concentrate their business via an online platform. To address these issues, we suggest a few of the fourth industrial revolution technologies, such as the Internet of Things (IoT).

Case Study

LYLN Home Decor Company is a growing Malaysian company that has 10 million customers, RM200 Million annual revenue. Due to the COVID-19 pandemic, the company met some challenges, which are reduced passenger flow and management on their on-premises data centre. This is because on-premises data centre upfront charge necessary for additions and modifications, plus the time required to install, and physical space restrictions that can cap growth. The company has responsibility for provisioning, troubleshooting, and managing data centre infrastructure would consume a lot of operational costs and time. To overcome those challenges, we decided to provide solutions to the company, such as using the Cloud Computing service provided by AWS to provide an on-demand service hence reducing the operational cost, improving the security of the system, staff management, automatic software update and so on. Examples of Cloud services such as analysing data, storage, backup, and data retrieval, creating and testing apps, and delivering software on demand. To adapt to the change of the business due to COVID-19 and satisfy the demand of the company, we built an application that implements some kinds of 4th IR technologies: Artificial Intelligence, Augmented Reality, Cloud Computing,5G, and Internet of Things. With the application we build, the customers can know the information of the furniture by pointing their mobile devices to scan the product. The information of the furniture including the brand, the feature, and other things will pop up in the specific coordination of the furniture so that the customer can know more clearly about the function of the furniture. With this, shopping in the store without accompanying the staff could be achieved in real-life. This reduces the need to task more staff to provide guidance and information to the customers because the application will help the staff to execute most of this task. This will build up an environment to reduce the physical contact between the customers and the staff and obey the SOP procedures which are announced by the government. For the use of the company, the management staff can upload the information of the furniture by using the app. The information could

be registered more efficiently. The application will be built up based on the cloud computing architecture. We found that AWS service could be a good solution to replace their on-premises data centre to overcome the previous weaknesses. AWS could offer highly dependable databases, large-scale cloud storage, and many centres around the globe. The information of the furniture could be stored up more securely and handled easily and does not need to recruit related professionals to handle the flow and the process in the databases. Most of the infrastructure is managed by AWS service providers. Besides that, by using AWS services, the company can collect user feedback in different aspects of user experiences. The data collected could be analysed and visualised in a way that the company could easily understand. They can gain this data through the digital portal.

Selection of 4IR Technology

1. Augmented Reality (AR)

Augmented reality is one of the fourth industrial revolution technologies that is chosen to develop the application. This technology superimposes a virtual image onto the user's view of the real world and enhances it from every aspect. One of the useful functions of augmented reality is to highlight the specific features of physical objects and increase the users' understanding of those features. When the user taps on the object, the information about the object will show up on the screen. There are several key technologies of augmented reality that help to ensure the function and sustainability of augmented reality devices.

One of the key technologies is 3D real-time tracking and registration. 3D Real-Time Tracking and Registration of virtual information and real environments are required to perform a better combination of virtual information and real scenes. This 3D real-time tracking technology starts to run when the camera of a mobile device corresponds to the object in the real scene. The process of 3D real-time tracking and registration is divided into two parts. Firstly, the 3D real-time tracking technology detects the features and figures of the object that is scanned by the user through a mobile device. Next, the technology finds corresponding data from storage and displays coordinate information of the features of the object on the screen. In this case, when the user scans the furniture through a smartphone, the information about the features of the furniture is displayed on the screen and the user can find out the desired information easily.

Next, the other key technologies of augmented reality are display technologies. Various technologies and devices now have been developed and applied to augmented reality, such as the head-mounted display, which is widely used to enhance users' visual immersion. According to the specific realisation principle, it can be divided into two categories, which are Optical See-through HMD and Video See-through HMD. Optical See-through HMD Augmented Reality system has advantages of simplicity, high resolution, and no visual deviation, but it also has problems such as high positioning accuracy, difficult delay matching, relatively narrow field of view, and high price. In this case, when the user scans a piece of

furniture, the virtual furniture displayed in their electronic device will be of high picture quality and less chromatic aberration. Thus, they will be able to see the details or the precise colour of the chosen furniture and as a result, they do not need to worry about the furniture being unsuitable.

The third key technology used in AR is intelligent interaction technology. Unlike in real life, augmented reality is the presentation of virtual objects in reality, and interaction is to prepare for the better presentation of virtual objects in reality. Therefore, Interaction technology is one of the most important technologies to have a better AR experience. Interfaced is, the program responds to a user's intention and actions in an intelligent manner. An intelligent user interface allows computers to be interacted with in a way that is minimally invasive, intuitive, and efficient, minimising cognitive and perceptual load. To provide an intelligent interface, a program must be able to accurately identify the will of the user and satisfy their needs with the least amount of input. As the final aim, it is to create an interface that is functionally invisible to the user and makes interacting with virtual objects as natural as interacting with physical objects, removing the separation between the two worlds, which are physical and virtual. In this case, when users scan a piece of furniture, the furniture will be displayed on their electronic device. Then, the intelligent interaction technology will allow users to interact with the virtual furniture. For example, users scan a cupboard, and they are not sure whether it is suitable for their room size or not. Hence, they could use intelligent interaction technology and try to move around the cupboard in their room.

The goal of augmented reality is to combine virtual information with real scenes. To have a stable and better AR experience, Four elements are necessary and indispensable which are geometric consistency, model reality, lighting consistency, and colour tone. Lack of any one of the elements will lead to the instability of the AR effect, hence affecting the AR experience.

2. 5G

5G is the fifth generation technological standard for broadband cellular networks, which cellular phone operators began building globally in 2019, and is the expected replacement to the 4G networks that link most existing cell phones.5G networks, like their predecessors, are cellular networks with service regions separated into tiny geographic units called cells. Radio waves connect all 5G wireless devices in a cell to the Internet and telephone network via a local antenna in the cell. The major benefit of the new network will be increased capacity, allowing for faster download rates of up to 10 gigabits per second(Gbit/s). In addition to being quicker than existing networks, 5G can link more devices, and even in congested locations, the servers will be more unified, enhancing Internet service quality. Because of the increased bandwidth, it enables new applications in the Internet-of-Things(IoT) and cloud computing. In this case, with less latency, users request info from the database quicker. Even though users are in the edge location, AWS cloud computing provides

a service that supports a 5G network that has a wider coverage and lets the user to have a low latency connection and a better experience.

3. Artificial Intelligence

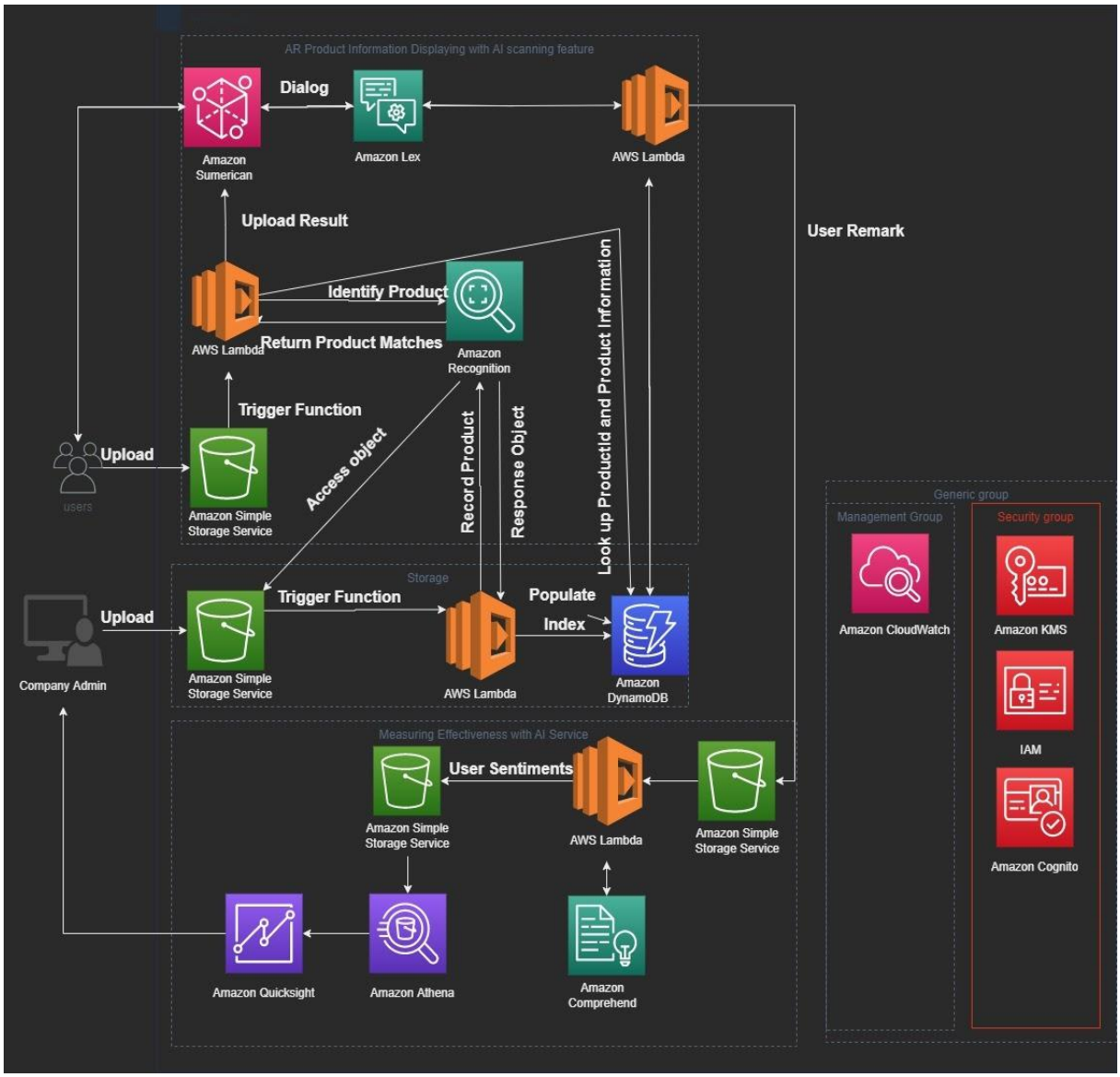
Artificial Intelligence (AI) is the imitation of human intelligence that is processed by a machine's system. The AI system works by acquiring large amounts of different data, analysing the pattern and category of data, and using the analysing results to make predictions. By comparing the data and the user's input, AI algorithms can help to discover data trends that can be used to develop more effective cross-selling strategies. This can help to make other relevant recommendations to the customer when the customer is searching for a specific item. Hence, with the aid of an AI system, the user can search for the desired items easily, and be able to make comparisons between similar items. In this case, when a user scans an object through a camera or scanner in our app, the AI system will recognise the object by referring to the database and categorise the object, hence displaying the information to the user. AI also could suggest the furniture to the user by referring to the interest of the user. For example, if the user scans a table, the AI system will recognise the similar table referring to the database and then display the object that is retrieved from the database.

4. Internet of Things(IoT)

The internet of things, a.k.a. IoT, is a network of interconnected computing devices, mechanical and digital machinery, items, animals, or people having unique identities(UIDs) and the capacity to transfer data without needing human-to-human or human-to-computer contact. An IoT ecosystem is made up of web-enabled smart devices that gather, send and act on data from their surroundings using embedded systems such as CPUs, sensors, and communication hardware. By connecting to an IoT gateway or other edge device, IoT devices may exchange sensor data that is either routed to the cloud for analysis or examined locally. These gadgets may occasionally interact with one another and act on the information they receive. Although individuals may engage with the devices to set them up, give them instructions, or retrieve data, the gadgets conduct the majority of the work without human participation. In this case, the mobile devices of the customer will be IoT devices to exchange the data like customers' remarks to the service and customers' feedback to the furniture to the cloud for storing and analysing. It is used to measure the commercial value of the furniture and the effectiveness of the service.

Architecture planning and design

We are planning to provide Augmented Reality technology to the client. Augmented reality is a technology that allows the virtual world on the display screen to interact and combine with the real world scene through actuarial calculation of the position and angle of the camera and combined with image analysis technology. What AR shows is the combination of real scenes and virtual scenes, which is more suitable for simulating the coordination between commodities and existing furniture and styles in consumers' homes.



<u>Cloud Computing Architecture</u>
Service Used:
<u>Storage</u>

Amazon S3 is a scalability,data availability,security,and performance object storage service.The data related to the websites,mobile apps,backup and restore,archiving,enterprise applications,Internet of Things(IoT) devices,and big data analytics can be stored and protected in Amazon S3.Persistent storage,in which each file is turned into an object that can be retrieved from anywhere via a Uniform Resource Locator(URL)

AWS Lambda used to run code without provisioning or managing servers. Users can upload code to AWS Lambda and run only when it's triggered. It pays only for the compute time that you use. AWS Lambda supports multiple programming languages such as C#, Java, Python, and others. Lambda runs the Lambda function by assuming a role that you specified when you created the Lambda function.

AWS DynamoDB is a fully managed cloud database that supports both document and key-value stores to maintain a reference of the ProductId returned from Amazon Rekognition, the full name, and the information of the product. AWS DynamoDB adds multiple references for a single person to the image collection because adding multiple reference images per person greatly enhances the potential match rate for a person. It provides additional matching logic to further enhance the results.

Amazon Rekognition is a service that allows you to easily integrate picture and video analysis into your app.It just sends photos or videos to the Rekognition API,which recognises a variety of goods.For the submitted photographs and videos,Amazon Rekognition can also deliver the most accurate product analysis and recognition.It does not save copies of the photos that have been analysed.Product feature vectors are the mathematical representation of a product in Amazon Rekognition's collection.This is also known as a thumprint or a faceprint.

AR Product Information Displaying with AI scanning feature

Amazon Sumerian is a service provided by AWS to execute augmented reality and 3D applications, without any professional skills in 3D graphics. Developers can use Sumerian to create highly immersive and interactive scenes and run them on common hardware such as IOS mobile devices. At the same time, Sumerians support multiple languages and gestures, making the interaction more realistic and friendly.

Amazon Lex is a service for building conversational interfaces with voice and text. It provides the ability to have interactive conversations with the user, understand its areas of interest, and deliver appropriate information.

AWS Lambda, Amazon Rekognition, and AWS DynamoDB as explained above will also apply in this area.

Measuring Effectiveness with AI Service

Amazon Simple Storage Service(Amazon S3) is used to store information and provides a data retrieval for AI service and AWS Lambda execute the code when there is demand.

Amazon Comprehend is a natural language processing service that utilise AI to extract meaning from text and assesses insights or sentiments in text.

Amazon Athena is an interactive query service that uses normal SQL to evaluate data in S3.

Amazon Quicksight enables business intelligence accessible to everyone and integrates analytics into the app,allowing you to execute complicated analyses using machine learning insights.

Security Service

Amazon Cognito is a service that makes integrating user sign-up and authentication into you app a to become a simple thing.

IAM allows user to securely control access to AWS services and resources.The owner may create and manage AWS users and groups using IAM.The owner can utilise the IAM authorization to grant and prohibit access to AWS resources to users and groups.The user or role that runs the commands in AWS must have authority to offer a set of managed policies to help you get started quickly.IAM might apply minimal managed policies to a user or role through:

- AmazonDynamoDBFullAccess
- AmazonS3FullAccess
- IAMFullAccess
- AmazonSumericanFullAccess

The AWS Key Management Service(AWS KMS) allows you to produce and manage encryption keys,and regulate how encryption is utilised across AWS services and in the app. In Amazon S3 and DynamoDB,the AWS Key Management Service encrypts all data at rest

Workflow:

Storage

First, The company admin provides the collection of the images with the pieces of information of the product as bytes or makes them available to Amazon Rekognition inside an Amazon S3 bucket. After that, Amazon S3 detects the object-oriented event and publishes the object-created event to Lambda for invoking the Lambda function. Hence, Lambda runs the Lambda function to process the images that we uploaded to Amazon S3. The function of Amazon Rekognition is to detect the product images and record them as an index is

initiated, and create multiple entries within our Amazon DynamoDB key-value store for a mapping between the ProductID, the product's full name, the information of the product for later reference

Multiple references for a single product were added to the image collection because adding multiple reference images per person greatly enhances the potential match rate for a person. It also provides additional matching logic to further enhance the results

AR Product Displaying with AI scanning feature

Initially,customers submit videos or images to S3 Bucket using their phone app in order to store photos for analysis.The Amazon S3 sends the trigger to Amazon Lambda in performing its function to identify the product by using Rekognition API.At least two arguments must be provided when using the API:the name of the collection to query and the reference to the picture to analyse.The image's Amazon S3 bucket names and object key,as well as the image as a byte stream are delivered.Amazon Rekognition responds with a JSON object that contains the ProductIds of the matches.This object contains the product coordinates inside the photos as well as additional metadata and information as specified by AWS Lambda then transmits the result to Amazon Sumerican,and Amazon Lambda verifies user inputs and retrieves relevant content from Amazon DynamoDB.Finally,the Sumerican editor will show the AR interface on the user's mobile device as a response to user,and the content will be transmitted to Lex as a response to user queries.

Measuring Effectiveness with AI service

Amazon Lex takes user feedback and store it in Amazon Simple Storage Service(S3),which Amazon Comprehend analyses.Later,Amazon Comprehend deciphers text for meaning and insights/sentiments,and user feedback insights are stored in S3.Amazon Athena is used to analyse the insights gained from customer comments.Finally,Amazon QuickSight brings the information to be visualised

Conclusion

At the beginning of the project, our group faced a problem that does not know what exactly cloud computing is. After all of us finished the AWS module, we had some concepts about cloud computing but still not enough for us to progress the project. Therefore, we did a lot of research and collected a lot of information about cloud computing before we started our project. We know that with Amazon Web Services, we can deploy compute, storage, databases, analytics, networking, mobile, developer tools, management tools, IoT, security, and enterprise applications worldwide: on-demand, available in seconds, and priced based on usage. Next, we learn that cloud computing architecture is divided into 2 parts, which is the front end and the back end. The front end is controlled by users or clients, while the back end is controlled by service providers. Examples of components of cloud computing architecture are application, server, storage, security and so on. Each of these is necessary and indispensable in cloud computing architecture. Hence, with the combination and application of AWS service and cloud computing architecture, we manage to produce a complete project as well.

After proposing our project, we started to develop a new system for our client. In this new system, we manage to achieve some advantages that the old system of our client does not have succeeded. For example, by using AWS cloud computing, the client's company saved a lot of expenses on maintenance hardware, staff management and improving the security of the system. Instead of on-premises services, cloud computing is more cost-effective. Therefore, LYLN Home Decor company could focus more on their main goals because no worries about the system maintenance or shutdown, AWS cloud computing will handle these problems. Moreover, the system can help the client to get adapted to the situation, which is badly influenced by the COVID-19 pandemic. This is to ensure that the company can follow the SOP procedures and reduce the interaction between people in the store. The model of the business can be transformed into a digital operating model, which improves the efficiency of the business. For example, with the aid of the app, the customers can find the ideal furniture easily without further interaction with the staff. As a result, this system will definitely bring customers better shopping experiences by saving their time.

However, the project still faces some limitations in implementation at the moment. One of the limitations is the dependence of 5G network services in the interaction between user and cloud computing architecture. The next limitation is the immature AI and AR technology. These technologies are still in the process of innovation and development. Thus, we hope that in the near future, these technologies could be more mature and perfect so that Al and AR technologies are able to be popularised and benefit mankind.

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