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# Stay Fit During COVID-19, a Study using Interactive Jogging Application (JOGA)

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## ABSTRACT

Fitness and keeping a balanced lifestyle are an important aspect in our daily lives. Being healthy will allow us to conduct our daily activities in a more productive manner. However, it is sidelined by the fact the people now a days are mostly busy with their work and other things, added the fact of the lack of motivation to conduct the physical activities, lead to people not having a balanced life. For that reason, the aim of the developed application is to provide users with an immersive and interactive jogging application which will help in motivating the user into wanting to conduct fitness activities. The interactivity is provided by implementing Geofencing technique, which is by generating a parameter around certain coordinates which when entered by a device will create certain events such as sending notification or directing to a different page. While the immersiveness aspect is implemented using Augmented Reality, which is where a 3D model is anchored into a certain plane which can be seen by using the mobile phones rear camera. The Rapid Development Life Cycle (RDLC) have been chosen as the methodology for the development of the application because it allows developer to iteratively change the system requirements during the development and presentation phase. Functionality testing have been conducted to the developed application.

**Key words:** Augmented Reality, Geofencing, Pedometer, Rapid Development Life Cycle.

## 1.0 INTRODUCTION

There are many form of exercise for people to conduct in that they could use to keep healthy and active, and jogging or running is one of the more popular form of exercise, but one of the most hardest things about running is keeping oneself motivated and engage so they can accomplish their fitness goals[1]. With the advent of the smartphone technology and all its features, it has been a great tool in keeping one motivated. The mobile device is perfect for keeping track of your running, distance, frequency, and in some cases, even heart rate[2]. Applications installed on the smartphones uses this feature to enhance the jogging experience.

Geo-fencing or geo-fence is a technique where a virtually generated perimeter is covering a real world geographic area, which allows the covered area to generates enter and exit events when a device crosses the border[3]. Geo-fence is mainly used to assist in detecting mobile communication devices that are within the area and will trigger events only when the device crosses its border instead of periodically determining the precise location of the device, which can consume a large amount of power consumption[4]. Geo-fencing can be applied to many type of applications including media recommendation, advertisements, family monitoring, anti-theft installations, geo-caching, recreational activities, and ethnographic studieswhich would be useful to be applied to an application such as an interactive jogging[5].

Augmented reality or AR is a concept where a virtual information is integrated into a person's physical surrounding which allows the person perceive that information as existing in their surroundings [6]. The term augmented reality was first introduced by a researcher named Tom Caudell, who was tasked to improve the expensive diagrams and making devices that would be used to guide workers on factory floor. Researchers proposed that the characteristics of augmented reality are systems that combines real and virtual, interactive in real time and is registered. The definition aims to allow multiple technologies such as mobile devices to implement augmented reality components. AR systems are built upon on three major buildings blocks: tracking and registration, display technology and real time rendering. Which fits perfectly when implemented to an interactive jogging application which will track the user's movements and display virtual data to the user.

Additionally, the pedometer feature that will be implemented into the application will hopefully attract people who were once might not be interested in engaging in outdoor activities and exercises by providing them with a way to set the goals which they would want to achieve. This can help in motivating the user into wanting to accomplish and finishing the set goals.

Jogging Augmented or "JOGA" is a mobile application that will implement the techniques that have been described above and the many features equipped on a smartphone to create an interactive jogging experience. It

will be divided into 2 main functions. The 1st function will be used to track users jogging session. While the 2nd function, will implement gamification features which will allow for interactivity with the environment and where users can set high scores according to the extent, they complete the objectives

## 2.0 RELATED WORKS

### 2.1 COVID 19 In Malaysia

A pedometer is a device that is small in its size, which is used to count the number of steps the wearer or holder of the device have taken. Another way of calling it is a step counter [7]. The pedometer operates depending on its type which there are two of the first is a spring-levered type, which uses a horizontal arm that would move up and down in response to the user's movement as they are wearing or holding the device, as they walk or run. A step is registered for every opened and closed electrical circuits. Another way is by piezoelectric,

### 2.2 Pedometer

A pedometer is a device that is small in its size, which is used to count the number of steps the wearer or holder of the device have taken. Another way of calling it is a step counter [7]. The pedometer operates depending on its type which there are two of the first is a spring-levered type, which uses a horizontal arm that would move up and down in response to the user's movement as they are wearing or holding the device, as they walk or run. A step is registered for every opened and closed electrical circuits. Another way is by piezoelectric, which is a material that generates an electrical charge as it deformed mechanically. It uses the weight that compresses a piezoelectric crystal when acceleration is detected, which will generate voltage which is proportional to the acceleration and oscillation that is used to record a step. Continuing on, the pedometer can be used during activities such as dancing, walking (outdoors or treadmill) and jogging. While activities such as biking, swimming, rowing or skiing would not work with the pedometer [8].

There are several benefits to using the pedometer while conducting activities which requires movement. The first is that by telling the user how many steps they have taken, it can help motivate them to walk more. Next, the pedometer can help the user in setting specific goals to be achieved while walking. For an example, user can set the number of walking steps they would want to take in a single day, which can be tracked and adjusted. Lastly, the pedometer can be used to remind the user to walk more. The pedometer might make it more interesting to add more steps by checking how much more steps is needed to meet the daily goals [8].

Although the pedometer is a convenient device, there are limiting factors to it. Firstly, a study was done which discovered that the pedometers tend to be more accurately count steps at speeds greater than 3 mph, than at lower speed [8]. Table 1 shows the drop in accuracy when there is a drop in speed.

**Table 1:** Pedometer test results on the decreasing on speed.

| Speed | Accuracy |
|---|---|
| More than 3 mph | 96% |
| 2 – 3 mph | 74%- 91% |
| Less than 2 mph | 60%-71% |

### 2.3 Augmented Reality

Augmented Reality (AR) is a concept where a virtual information is integrated into a person's physical surrounding which allows the person perceive that information as existing in their surroundings [6]. AR implements the use of special passive marker in form of QR code [22]. AR is a an indirect or direct view of a live, physical, real-world environment which are enhanced with computer-generated input such as sound, video, graphics or Global Positioning System (GPS) data[9]. The term augmented reality was first introduced by a researcher named Tom Caudell, who was tasked to improve the expensive diagrams and making devices that would be used to guide workers on factory floor. Researchers proposed that the characteristics of augmented reality are systems that combines real and virtual, interactive in real time and is registered in. The definition aims to allow multiple technologies such as mobile devices to implement augmented reality components. AR systems are built upon on three major buildings blocks: tracking and registration, display technology and real time rendering. The process of how camera and virtual objects are blended together is simplified in the figure 1.

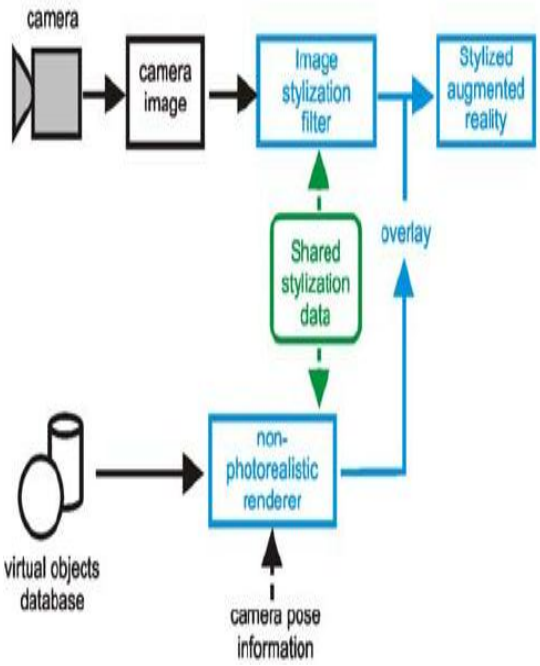


**Figure 1:** Augmented Reality Process

### 2.4 Pokemon Go

Pokémon Go is a multiplayer location-based mobile application that was developed by Niantic for the iOS and Android mobile devices, and was released on July 2016, which to this day have attracted worldwide interest and

attention [10]. Pokémon Go is a truly mobile application where player is tasked to physically roam an area by utilizing a mobile devices capabilities[11]. The reason which made it so appealing or special is that, Pokémon Go utilizes an innovative, award-wining gameplay mechanics that uses Augmented Reality (AR) technology, it superimpose computer-generated information over your physical surrounding and put virtual creature at a real-world location[12]. In Pokémon Go, players would walk around a real world environment which uses the GPS on the smartphone to track the players real time location, to find creatures called "Pokémon" and interact with special digitally created object that is placed at a real-world landmark [13].

With its abilities to influence and attract people through its gameplay mechanics and features, the game could also have a broader impact on society through its potential health benefits. There are ways the game is good for you. The first is, by walking outside (during daytime) to catch Pokémon's or complete objectives players are exposed to sunlight, which is required to make vitamin D, a hormone needed for absorbing molecules vital to your diet, like the calcium in bones. Vitamin D deficiency raises the risk of cardiovascular disease, cancer and others. Another benefit is, Pokémon Go offers numerous incentives that encourages exercise. through the gamification feature of Pokémon Go, it is able to gamify physical activities by offering achievement and other rewards[12].

### 2.5 Geo-Fencing

Geo-fence is mainly used to assist in detecting mobile communication devices that are within the area and will trigger events only when the device crosses its border instead of periodically determining the precise location of the device, which can consume a large amount of power consumption[4]. Depending upon how the geofence is designed it can incite pop-up messages, trigger messages or alerts, distribute target commercials via web-based networking media, permit following of moving vehicles, limit the use of a device or convey area based promoting information [14]. Nowadays, Geo-fencing can be use for tracking and speed monitoring [23]. Geo-fencing can be applied to many type of applications including media recommendation, advertisements, family monitoring, anti-theft installations, geo-caching, recreational activities, and ethnographic studies [5]. As an example, it can be used to share information or advertisements that are location based, to mobile computing users [15]. Geofencing is applied by first establishing a virtual boundary around a specified location in Global Positioning System (GPS). The virtual boundaries can be set or drawn around a location on Google Maps, by using APIs when developing a mobile app. There are many advantages to geofencing, some of them are. In term of advertisements, customers can be notified of sales or offers, which can interest them to buy a product from the business. Geofencing is also effective in remotely monitoring workforce movement and activities at a given location. There are also limitations to which are only a few of. The first is, activation of geofencing requires approval from the user, which when not turned on it will not produce any result. Also, applications that utilizes geofencing tends to use too much battery life which can make users want to turn off the feature [14].

### 2.6 Zombie,Run

Zombies run, is a smartphone application which fused exercise with video games, and provide an example of a hybrid game that bring together elements of labour and leisure [16]. It is a game where the player will be taken into a post-apocalyptic world that have been overrun by zombies. The player's task is to go out on runs into zombie territory to retrieve supplies and rescue stranded survivors.

The basics of the game are. As the main character in the story. The user would select an episode or mission they would want to play out and go for a run. An audio clip of zombie sounds and mission related audio will be played throughout the mission. The players main objectives are to go on missions, interact with others and collect supplies [17].

The application works by using the GPS tracker on the mobile device, to track the players speed and distance. The user will be told of the missions as they run through an audio-clip that will be played during and after the mission. It can be used outside or indoors while using treadmills, as it utilizes the accelerometer in smartphone devices. There is little to no onscreen elements, as the user would need to focus their attention on running instead of relying on visual realism [16].

## 3.0 METHODLOGY

It is essential to lay out the developmental process and give a walkthrough in developing the JOGA. For the project, the model that will be implemented is the Rapid Application Development (RAD) model. As such the steps taken are as listed. (a) Requirement Planning, (b) User Design, (c) construction, (d) Cutover.

### 3.1 Rapid Application Development

The Rapid Application Development (RAD) model is a software development methodology that rather than using rapid prototyping, would use minimal planning instead. It is the development of a working model of a computational product that is used in a project to assist in analysis, design, development, and evaluation of development process [18]. Rapid model is seen as a type of evaluation that can be used repeatedly throughout a project and one that involves changes in the traditional approach to software development. It is designed to give a much quicker development and higher-quality result than ones that were achieved with the traditional lifecycle, which is designed to take the maximum advantage of more powerful development software [19]. Because of RAD's ability to allow for changes in a much smaller cost than using traditional method, it is mainly used for projects which have a tight schedule and budget. RAD focuses on compiling the projects requirements and doing early testing of prototypes by the customer using the iterative concept, recycling of the components of existing prototypes, and continuous integration and rapid delivery. Analysis, design, development and testing phases are broken up into an iterative short development cycle.

The first phase is Requirement Planning, which is where the project business model are designed based of flow of information and through the distribution of information

from multiple source. Next is User design phase, which would review and analyses information gathered in business modelling phase and forming sets of data object to be utilized for the project. This is also where the data objects are to be converted to form a business information flow that is vital in achieving the project objectives. The next phase is Construction phase, where the coding would be done using automation tools and the actual system is built. Lastly is the cutover phase, this is where data flow and the interfaces between all the components are to be thoroughly tested with complete test coverage. Since most of the components have already been independently tested during every iteration, it would result in reduced testing time and reduced risk of major issues occurring. The figure 2 shows the RAD model.

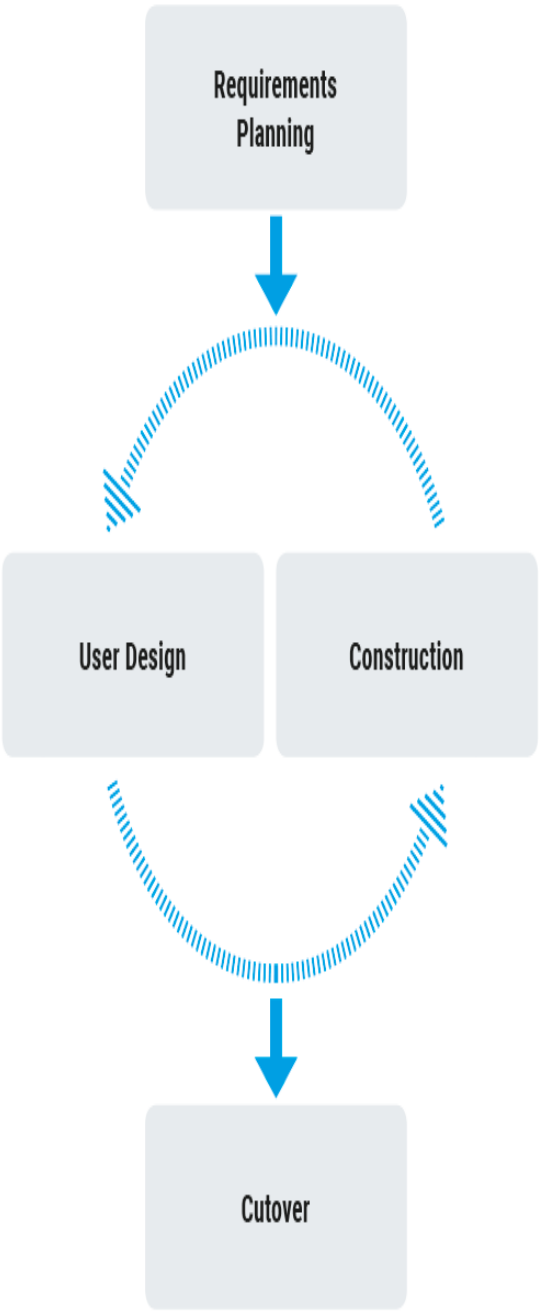


**Figure 2:** RAD model

### 3.1.1 Requirement Analysis

For the requirement gathering for the JOGA application. A survey has been conducted by using Google form. This is to determine the likelihood of a person using a jogging application to keep track of their jogging session. Also, to find out if the person is continually using the application, and if not the reason why they decided to stop using the application. A sample of the result is provided in the Appendix: Interactive Jogging Application Survey. Based on several sources such as surveys and researches from websites and journal articles. I have managed to identify the problem statement, objectives and significance of the project.

To ensure that a good understanding of the functional aspect of each module that exist in the application. A literature review for the Interactive Jogging application had been done and based on it, have provided the necessary information including techniques and software that would be useful in the development of the application. A comparison is made between several existing applications that utilizes either augmented reality or geofencing in its application.

Additionally, it is important to assess the correct hardware requirement needed for designing and developing a mobile application is crucial. This is to ensure that the developers' minimum hardware requirement is met as to not lead to any error when it comes to producing the application. Table 2 shows the hardware requirement for both laptop and smartphone.

**Table 2:** Hardware requirement

| Hardware List | Specification |
|---|---|
| Laptop | Model: HP-Pavillion ce0082TX<br>Processor: Intel® Core™ i5-8250U @ 1.60GHz 1.80 GHz<br>RAM: 8 GB<br>OS: Windows 10 Home Single Language<br>System Type:64-bit Operating System |
| Smartphone | Model: Google Pixel 2<br>Android version: Android 10<br>RAM: 4 GB<br>Storage: 64 GB |

### 3.1.2 User Design

User design will explain more about the flow of the application which will include the activity diagram and detail class diagram. Activity diagram is essential for the project as it ensure that the application follows the flow accordingly. Also, will be included is the user interface, to provide more detail on the expected outcome for the application.

#### 3.1.2.1 Use Case

The use case in figure 3, will summaries all the module that is involved in the system and analyses the relationship between the user and the application. There is only one type of user for the application.

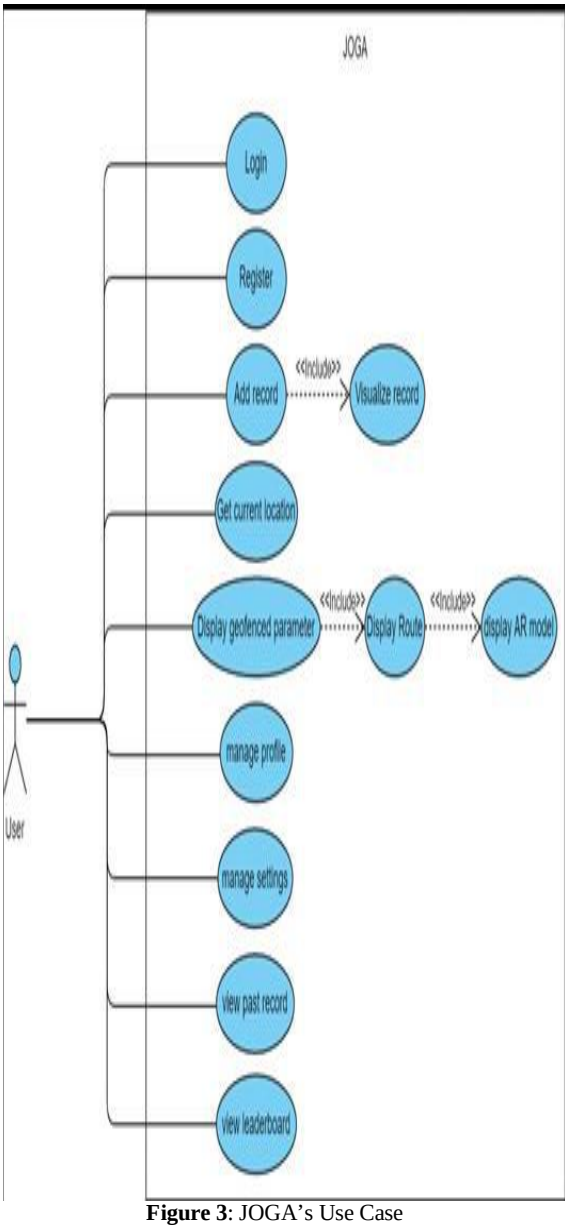


**Figure 3**: JOGA's Use Case

### 3.1.3 Construction

The construction phase focuses on the development of the Interactive Jogging Application. This is to ensure that the application will run properly and also serve its purposes.

Augmented Reality (AR) is used in this project as a mechanic to implement gamification features to the application. As shown in figure 4, which shows the process in which to anchor a 3D model to a plane.

In this project, AR will be implemented by using the mobile phones rear and front camera and also the available sensors, where the virtual information will be projected on the smartphone screen.

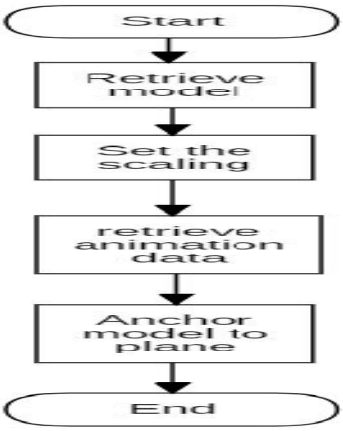


**Figure 4:** JOGA's AR process

The AR aspect is implemented by using Unity software which is shown as in figure 5.

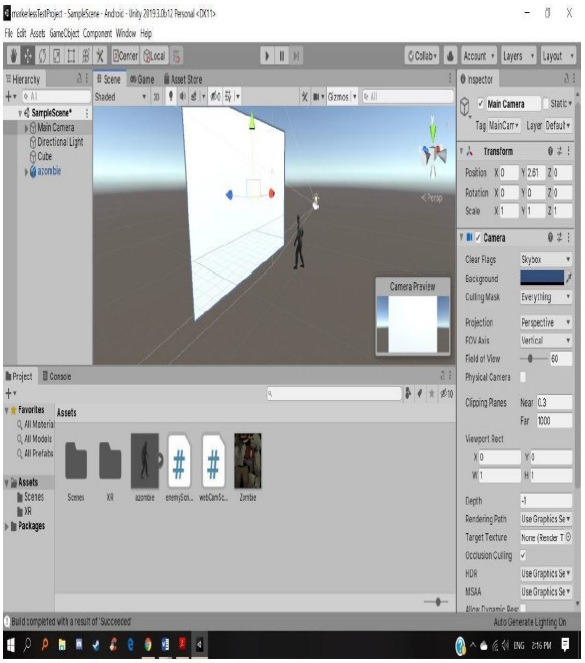

**Figure 5:** Unity software AR development

Geofencing is used in the project as a way to set an area of interest where the user would need to reach the covered area to open the AR page.

In this project,Geofire is used to track the user's current location at all time as long as the user is on the map page. Additionally, a Google Maps API Key would need to be obtained and by using android studio the geofence can be created. By defining the latitude, longitude and radius. A specific location can be covered which when entered can trigger a particular behaviour. Shown in figure 6, which shows the process in which to fetch a coordinate and creating a parameter around the coordinate.

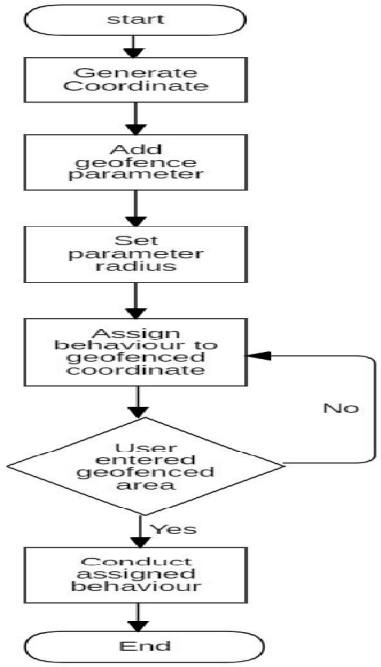


**Figure 6:** JOGA's geofencing process

### 3.1.4 Cut Over

The Cut Over phase is the most important phase in the system development. It is a set of activities that is conducted with the intent of finding errors in a software product [20].This is because the feasibility of the system will be tested as a whole, to find if any error can be discovered and corrected.

#### 3.1.4.1 Functionality Testing

It is a software testing where the application will be tested to see if it meets the functional requirements or specification. The functions will be tested by providing input and examining the output. This testing is to ensure that all the application requirements are satisfied properly. It is also referred to as black box testing.

The Blackbox testing is not concern with the internal mechanism of a system. This is because the focus of the test is solely on the generated outputs the is in response to selected inputs and execution conditions. The only information that is available to the tester is that of the input to the Blackbox, which the system will give a response to. Continuing on, the test case that is chosen for the test is according to the requirement of the software entity that is being tested on [21].

The benefit of the Blackbox testing is that it aids in the overall functionality validation of the system. Also, any incomplete requirements can be easily identified and address as the test is done based on the requirements set by the customer. Lastly, Blackbox testing is able to handle both valid and invalid inputs from the customer's perspective.

## 4.0 DESIGN AND DEVELOPMENT

The design stage for a mobile application that implements geo fencing and augmented reality elements requires a great amount of time and combination of multiple software and components. For the creation of the application, a lot of consideration and decision making were made in choosing the right platform for implementing the augmented reality and on what item or elements are needed for the creation of the application. Also considered are the correct way of implementing geofences live geographic location.

### 4.1 Interface Design

The main page for this application. After a successful login, the user will be redirected to this page. The main page is divided into 2 section which is the bottom and top half. The top half shows the visualized graph that have been formed from the user's past activities. The data visualized are the number of steps the user have taken for the past 7 days. It will change colour to green to imply that the user has completed their goal for the following day. The visualized data will be updated daily to shows the current data. The bottom half will show the number of steps the user has taken for the day. Also included, are the overall steps the user has taken since installing the application and also the average steps taken per day by the user. The logo in the middle of the page, when tapped will redirect user to the interactive jogging. As shown in figure 7.


**Figure 7:** JOGA's homepage

Figure 8 shows the page that will be opened when the user tapped on the JOGA logo on the main page. The page will utilize google map which will cover the whole screen. Placed on the screen are the generated geofenced parameter from a random coordinate, which when entered by the user will create give a notification and also direct the user to the augmented reality page. The page will track the device current location at all time as the user walk around. Lastly, the page will draw a route between the

user's current coordinate and the destination coordinate, which the user can follow to the destination as to finish continue the mission.

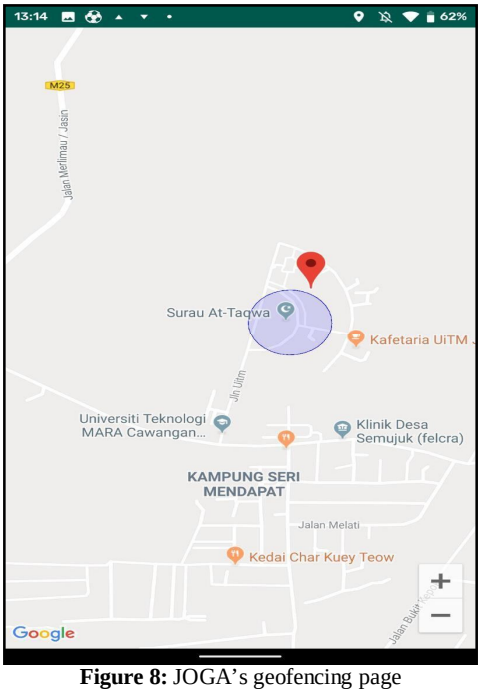


**Figure 8:** JOGA's geofencing page

Figure 9 shows the page that is opened when the user has entered the destination parameter. The device's rear camera will be opened automatically, and a model will be generated. The model will then be anchored into a random position which the user would have to search for. Once the model has been discovered, the user have to tap on the model and an effect will pop-up, signaling the end of the mission. The user will be redirected to the main page where they can either start a new game or stop.

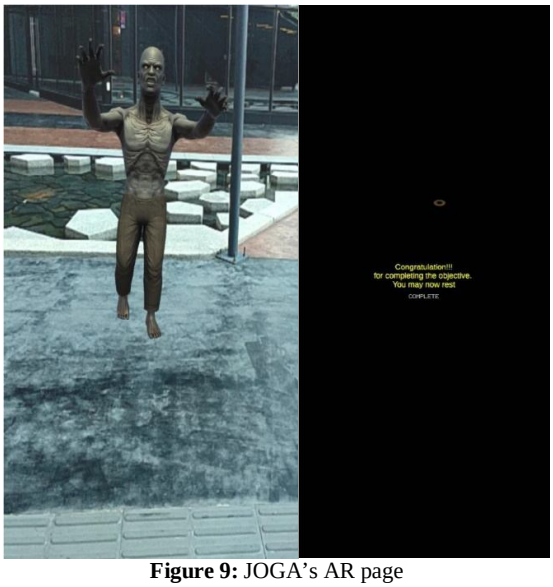


**Figure 9:** JOGA's AR page

## 5.0 CONCLUSION

Interactive Jogging Application or JOGA is an application that can be used as a way to record the users daily walking activities count, and also by letting them set their goals. Which might help in motivating the user to walk or run even more so that they would meet the goals. The application utilizes 2 main technique which are Augmented Reality and Geofencing. Geofencing is used to create a parameter around a desired coordinate, which when entered by device will create an event or activity. JOGA uses this technique as a way for users to have an interactive and immersive experience, as when the user have jogged or walked to the parameter, they will be greeted with an augmented reality page. The augmented reality is used as a way to generate a model into the user's live location. This is to make the experience more immersive as to make the user feel like the models are actually with them. The objectives which have been set have been met, which are by using the accelerometer on the phone it can keep track of the user's movement which will be recorded and also the added augmented reality feature which is done by using unity.

## ACKNOWLEDGEMENT

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