ANDROID BASED AUGMENTED REALITY FOR DIGITAL VISUAL NAVIGATION

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A B S T R A C T

Augmented Reality (AR) used in online business not merely to give new perspective of customer experience to product. AR is also used in operational such as in logistic to deliver product to the customer. The online map service such as Google Map, sometime fails to bring real visualization to user, especially when they are in unfamiliar places.

AR may provide visualization of certain location's coordinate. This digital visual navigation will help the user to choose which direction they should go, especially when Google Maps do not give accurate information related to the user's surrounding.

This papper provide solution to create Android application that can generate Augmented Reality navigation while user is using Google Map to travel. This papper is aimed to support the navigation for logistic management system especially for online business companies.

In spite of the result of this reasearch, some findings and issues need to be discussed in the future. There was delay to generate the AR objects especially when user moves the device around fast. A simple 2D AR object is suggested for future work in order to decrease the delay.

Keywords—Augmented Reality, navigation, Android, Google Map.

I.   Background

The demand to implement the Augmented Reality (AR) in modern digital business has significantly increased nowadays. The online business companies innovated their advertising and brought new perspective for their customer to experience products and services [1]. The needs for AR is growing from customer relationship management to other operational sectors. The online business especially in retail business is depended on logistic. To deliver product to the customer on time has always been the main issue. The AR is suggested to be one of the solutions to answer this challenge.

To navigate the direction, especially when delivering products to customers, users found many problems to reach to customer location. Those problems are related with unaccurate map information. A popular digital map, such as Google Map, is featured with limited animated direction option. Google Map or other digital map

sometime fail to provide accurate direction in a real situation when users are on the road, especially when they are on smaller roads, alleys, and such unpopular public road. In this case, digital navigation using AR will give a better visual direction to reach a certain location.

However, on the other hand, to present a digital navigation sign using AR is also limited to some accurate road condition and direction. In fact, the AR will create a digital navigation that ignored all the things surrounding such as building, river, mountains, cars, etc. Therefore, in this article, the combination of digital navigation using AR and digital map, such as Google Map, was proposed as the solution for better navigation system. The Google Map will provide direction based on a real map, while the AR will provide more visualized direction when users get lost especially when they are in a less common roads. This papper introduces how to develop an Android application prototype that enable user to generate AR direction while navigating using Google Map.

II. Literature Review

A. Augmented Reality

The Augmented Reality abreviated as AR, in some other pappers is described as a new technology that mixes the real and computer generated object. The AR adds a layer of graphics enhancements in user real visual perspective [2].

The common methods used in Augmented Reality basically grouped as Marker Augmented Reality and Marker-less Augmented Reality. The Marker based Augmented Reality augments an object by using a special marker to create a digital visualized object. For example, an AR application create a 3D animation at the time when a sensor, mostly a camera, recognize a certain marker. It seems that a digital 3D object is augmented on the marker or on the real world.

On the other hand, the Marker-less Augmented Reality does not require a special marker. Instead using a specific marker, it uses

any specific information to augment the object. For example, a 3D object will be created when an AR application received a specific information such as coordinate of an object.

AR is also used to generate better visualization for Simultaneous Localization and Mapping (SLAM). SLAM is an approach to solve complex AR simulation. It simultaneously localizes sensors with respect to their surroundings. At the same time, the sytem will generate the visual structure of the environment [6].

AR recognition sensor such as camera, is used to identify visual markers or objects, such as a QR/2D code or natural feature tracking (NFT) markers. The camera will capture the pattern then the application will display an overlay only when the marker is sensed by the device. Marker-based AR technology depends upon device camera to distinguish a marker from other real-world objects. Not only the marker image but the position and orientation can also be calculated. Once recognized the marker on screen is replaced with a virtual 3D version of the corresponding object. This is done to permit the user to observe the object in more detail and from various angles. Rotating the marker would rotate the virtual replication as well.

In contrary to recognition based, location-based AR relies on a GPS, digital compass, velocity meter, or accelerometer to provide data about the location and the augmented reality visualizations are activated based on these inputs. It is also known as marker-less augmented reality. The location detection features in smartphones make it easy to leverage this type of augmented reality technology, making it quite popular. Some common uses of location-based AR include mapping directions, finding nearby services, and other location-centric mobile apps.

B. Related AR and Navigation Research

A survey of Augmented Reality in 2015 suggested that almost 50 years, started from 1960's to 2010's, AR has developed in

accordance with the device technology developments [4]. The future of the AR technology as suggested by this survey will related to mobile technology with advanced sensors devices.

Most mobile devices that are equiped with GPS tracker will enable users to receive information related with location or a coordinate. The information of coordinate from the GPS is considered the most accurate information for AR application development, especially for navigation system. Given some points of coordinates, the application could do some spatial operations such as measuring the distance between two points or more [7].

Nowadays, Android has become popular mobile platform. Google Map service in Android is considered to be one of the most user friendly digital map service. A research that combining Google Map and AR has proven to be more effective in creating digital navigation system [3].

A research in developing Android based navigation system used some sensors to deliver a digital map to guide user to destination location. The sensors used to measure speed, range, and the movement of the device such as the turn and move of the mobile device [5].

III.   Methodology

The prototype is design as Android application that run in Anroid version 8.0. It works using the Google Map API to get the destination point and a GPS to get the user current location. Some Google Map features used in this application are:

- generating markers for location destination
- camera and view to give ease for map interaction
- generate current place of user

The GPS API used to support some of the application features, such as:

- GPS status

- Location Manager

The Augmented Reality part will generate the navigation to locate the direction to the destination point. Information related with the distance or range between the user and the destination will be generated using spatial operation to measure between points.
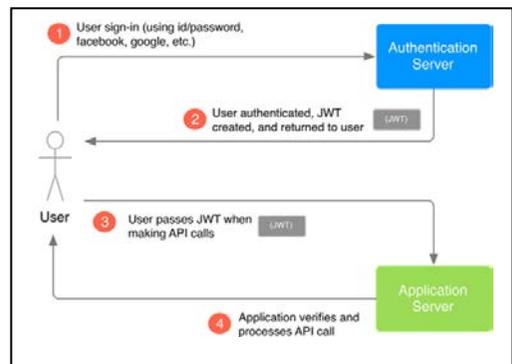

Figure 1. Application Design

IV.   Discussion

The application is developed using Android Studio version 3.4 with Android version 8.0. The ARCore is used to develop the Augmented Reality navigation.

A database, MySql version 5.6 is used to record the destination location and the coordinate. The application will generate a marker on Google Map and get the location's coordinate. The coordinate of the location then will be stored in database.

The AR navigation will generate a point to direct user to the destination point. The user will use the camera to find the AR object.

Figure 2. AR Object using Camera view

The information of the distance is generated using simple spatial operation to calculate two points. The distance of two points (A and B) will be measured using spatial operation that implement a Pythagoras formula.

$$a^2 = b^2 + c^2$$

a = distance
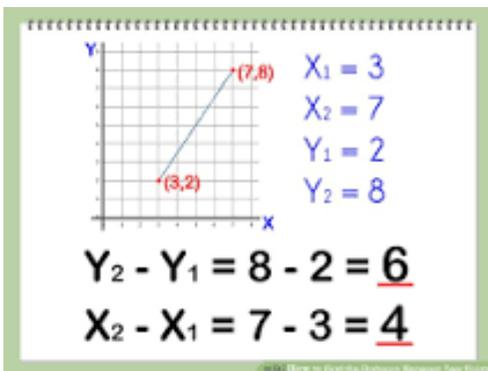*b = point 1 (x1, y1)*
c = point 2 (x2, y2)

Figure 3. Measuring distance between two points

The implementation progress involves different forms of technology ranged from front-end to back-end. With the help of team project management tools like git, this also becomes a good practice of software engineering.

V.   Conclussion

The result of the application testing shows that the AR object can be created in ease on user mobile device through the camera. However some problems occurs when the users moving the device around to find the AR object. The delay occurs when generating the object especially when user moving the device fast. This has become significant issue that must be solved in the future, especially how to generate AR object using low hardware specification device. A simple 2D object is supposed to be easier to render rather than a 3d one. However, this should be experimented and tested for the future work.

This application also has several limitations to be improved in the future. To find the AR object, user needs move the mobile device around or 360 degree. This will bring user friendly issue especially when user is driving a car or motorcyle. It is suggested to stop the car or motorcycle in order to find the AR object. A suggestion to solve this issue is using voice notification telling the user that the object is on a certain degree point.

Other problem is that the distance measurement ignores the route of the road. It basicaly measure the distance of two points. This, of course, will not provide real distance on the road. In order to solve this problem, in the future, the distance also considering the road wise as given by the Google Map.

The other future work for this application also suggest a real case testing in a logistic company.

This papper is also an appreciation to President Univesity especially to:

- Center for Reseach Institute and Community Service
- Faculty of Computing
- Faculty of Engineering

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References

[1] J. Scholz and A. N. Smith, "Augmented Reality: Designing Immersive Experiences that Maximize Consumer Engagement", *Business Horizons, Volume 59, Issue 2, 2016.*

[2] M. Agarwal, A. Kulkarni, S. Joshi, and N. Tiku, "Augmented Reality", *International Journal of Advanced Research in Computer Science and Management Studies, Vol 3, Issue 2, 2015*.

[3] McMahon, D. D., Smith, C. C., Cihak, D. F., Wright, R., & Gibbons, M. M., "Effects of Digital Navigation Aids on Adults With Intellectual Disabilities: Comparison of Paper Map, Google Maps, and Augmented Reality", *Journal of Special Education Technology*, *30(3), 157–165, 2015*.

[4] M. Billinghurst, A. Clark and G. Lee, "A Survey of Augmented Reality", *Foundations and Trends in Human–Computer Interaction*: Vol. 8: No. 2-3, pp 73-272, 2015.

[5] Chee Oh Chung, Yilun He, and Hoe Kyung Jung, "Augmented Reality Navigation System on Android", *International Journal of Electrical and Computer Engineering, Vol. 6, No 1, pp 406-412, 2016*.

[6] F.P. Jorge, R.A. Jose, R. Mancha, and J. Manuel, "Visual Simultaneous Localization and Mapping: A Survey", *Artificial Intelligence Review, Vol. 4, Issue 1, pp 55-81, 2015*.

[7] M. Graham, M. Zook, and A. Boulton, "Augmented Reality in Urban Places: Contested Content and The Duplicity of Code", *Transaction of The Institute of British Geographers, Vol. 38, Issue 3, 2012*.