Augmented Reality (AR) for Promoting Public Participation in Urban Planning

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ABSTRACT

Public participation plays a vital role for the developer and local government as this ensures the acceptance of the general public to the proposed project. However, the general public participation rate in the planning process in Malaysia is still at a low level. Hence, this study was conducted to study the use of augmented reality (AR) as a tool in promoting public participation in the planning process. In the study that was conducted, 77 respondents were selected from the general public to evaluate the effectiveness of AR. During this evaluation process, 37 of them were given AR material, and another 40 of them were given classic plan material. By using feedbacks from the public, statistical analysis was done to study the effect of AR and conventional plan material on the willingness for public participation process. The statistical test shows that the participant is more willing to participate in the public participation process when AR material is being used.

INTRODUCTION

In the current era, public participation in urban planning becomes a big challenge for the general community as there are many challenges that all party faces. The most certain problem that definitely can be seen is the connection between the general public with the developer as the developer tries to reach out to the general public. The general public, on the other hand, is clueless as to how the developer tries to reach out, or worse, they do not even know a developer is trying to reach out to them. This situation gets even worse as the general public does not even know how they might benefit out of the participation can, thus ignoring the developer completely. Therefore, by using AR mobile applications, the developer could benefit from a better engagement as the general public can obtain information about the development project easily.

Another problem that needs to be addressed is how to provide a very clear explanation of the project to ensure that there is no misunderstanding in the information delivery. Either the government agency or private sector may provide visual animation on the transformation before and after the planned development. The illustration will only be seen for those who have access to it. The internet has the capability to pull the audience, and with the aid of advertisement, this method can reach more audience from all walks of life. Another method is to create a mobile application and post its QR code on the site. Upon installation in their mobile, the surrounding public is better informed of the development plan, and this is a more effective way to advertise.

METHODOLOGY

Study Area

Figure 1 shows the urban planning project area where it covers 1.29 hectares. The location is situated in Majlis Perbandaran Iskandar Puteri, Skudai, Johor, Malaysia with the latitude of 1°31'34.99" North and longitude of 103°40'8.00" East. With National Digital Cadastral Database (NDCDB) as a reference, the area was selected to ensure it does not encroach into other plots of land.

Source: (Google map, 2019)
Figure 1. Area of Study

Material

There are two (2) sets of different materials that were used in this study. The first set consists of a planning permission layout plan (PP), topographic plan, unmanned autonomous vehicle (UAV), survey plan, and architecture plan. Meanwhile, the second set consists of AR mobile application.

Plans

In order to create a planning permission layout plan, data was collected from JUPEM (Jabatan Ukur dan Pemetaan Malaysia) in the form of a certified plan. Then, by using the certified plan, information on lots within and the surrounding of the selected area were extracted. Among the information extracted are bearing, distance, coordinate (location), *mukim*, district and lots number. Based on the land lots information, the boundary for the proposed develop area was selected, and a planning permission layout plan was generated based on the format used by the local authority of Johor. Other plans that were attached with the planning permission layout plan including topographic plan, UAV survey plan, pre-computation plan and architect plan. Meanwhile, UAV survey plan consists of an orthophoto of the area overlayed with a lot's information. In order to create the orthophoto, a flight plan was designed for the UAV drones. Then, DJI Phantom 3 Standard drone was flown according to the flight plan. Then, the picture taken from the UAV was processed using Agisoft PhotoScan professional software to produce an orthophoto. Then, using the orthophoto, fixtures such as road, building and fencing was digitized to produce a topographic plan.

Augmented Reality

There are several components needed to be added to the mobile phone in order for AR applications to function correctly and stably (see Figure 2). There are various methods to develop the AR mobile application. In this research, the AR+GPS Location unity package was used due to its ability in providing all the source code and elements that are needed.

Figure 2. The component in AR mobile application

Distribution of questionnaire

Figure 3 shows how the two-sample test was conducted. The purpose is to test a direct comparison between the two materials; planning permission and AR. The respondent was presented with one of the two materials. They will be asked to answer the questionnaire to get their feedback based on the material presented to them. The respondent presented with planning permission was labelled as group A, and those presented with AR as group B. Using their feedback, comparison analysis was conducted to examine the participants' understanding of the project, interest in the material and likelihood to participate in public participation process when the material was presented to them.
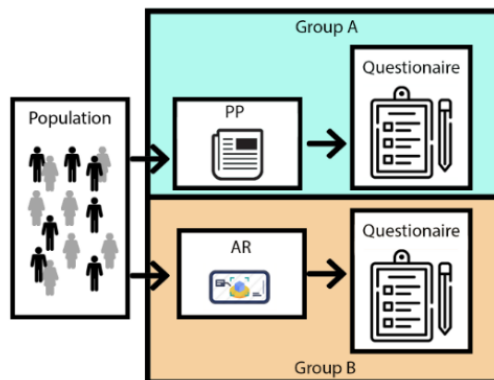

Figure 3. The two-sample test

RESULT AND ANALYSIS

The study was conducted by employing two-sample tests to study user acceptance on plan and AR. During this evaluation process, 77 respondents were selected from the public. 40 of them were given classic plan material and labelled as group A, while the other 37 were given AR and were labelled as group B.

Table 1. Result of the willingness to participate in the questionnaire

Material	Mean score	T Test (P-value)
AR	4.432	0.042
Plan	4.125	

During the process of gathering the participant feedback, the participant was asked if they are willing to participate in an urban planning project in a one to five score where one is for strongly disagreeing and five is for strongly agree. From the 37 respondents that were shown AR, the participant's average score is 4.432 and the respondents with classic plan material recorded an average of 4.125 from 40 respondents, respectively. Since we only use a sample of the population, a statistical analysis needs to be done to determine whether the two different averages are significant or not. Hence, T tests were done to test if the two averages are significant. The P-value of the T test is 0.042 which is

less than the alpha value, 0.05, which means that there is a significant difference between the two averages. This value also gives a picture that if the same survey is done, there is a 95.8% probability that the average score from AR users will be higher as compared to the classic plan users.
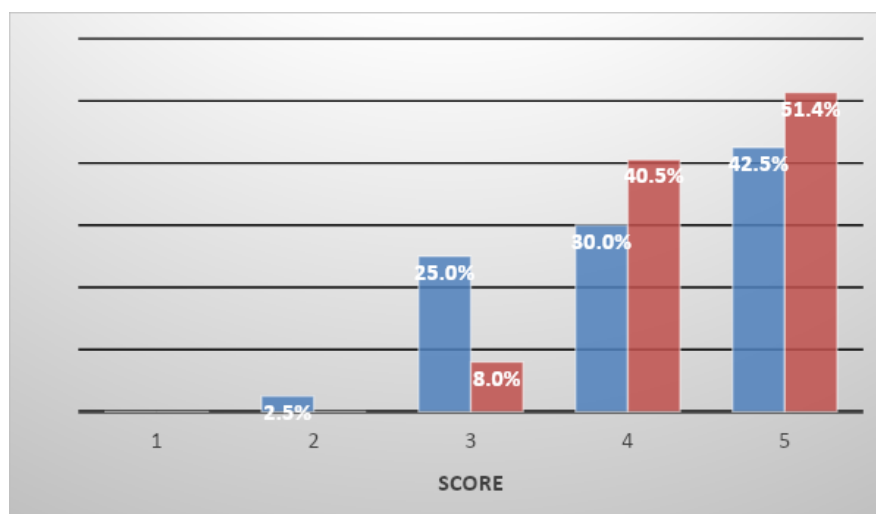

Figure 4. The distribution of answers in the questionnaire relating to the willingness to participate in the urban planning project

Figure 4 shows that more people will score 2 and 3 for plans with 2.5% and 25% of the participant, while AR got 0% and 8% of the participant, respectively. Moreover, for AR, more people score 4 and 5 with 40.5% and 51.4%, while plan respondents only received 30% and 42.5%. From the figure, it is shown that AR recorded a better distribution.

Table 2. Result of user preference on visualization

Question	Material	Preference from the participant (%)	T Test (P-value)	X^2 Test (X^2 calculated)	X^2 Test (X^2 value)
3D visualisation	Plan	60.0	0.0004	10.517	
	AR	91.9			
View of the environment	Plan	72.5	0.0040	6.686	
	AR	94.6			
View from a different angle	Plan	70.0	0.0005	10.02	5.991
	AR	97.3			
View from different places	Plan	67.5	0.0010	8.995	
	AR	94.5			
Final product	Plan	67.5	0.0002	11.471	
	AR	97.3			

During the questioning, the participants were asked their preference in viewing the material if they were to participate in an urban planning project; in 3D visualisation, the environment, from a different angle, from a different location, and the final product of the project. From all five of these questions, more people would like it better to use AR instead of plans with a significant margin. X^2 test and T test were done on all five questions and the result shows that AR stands on top for all five questions.

CONCLUSION

In conclusion, AR is a better material for promoting public participation in urban planning projects. The analysis shows clear evidence that the participant's willingness to participate is affected by different materials exposed to them, and AR provides a better medium for promoting public participation in urban planning projects. Furthermore, there is clear evidence showing that the public tends to like the use of AR more than plans in terms of 3D visualisation, environment visualisation, building

visualisation, and the final product of the project. AR also provides more advantages in public participation, such as easier to be distributed to the general public via Google Play Store and Apple Store, thus, reaching more people to participate with a lower cost. This shows that AR is a more effective and efficient way for the public participation process.

The study shows that the general public will be more interested in participating in urban development that is going to be done around them with the use of AR. This will aid the local authorities to inform the general public of their power in urban planning projects. Moreover, the point of participatory exercises is to have the general public to be included in the decision-making process. Be that as it may, the quantities of public participation are still low in Malaysia. As indicated by Lee (2012), the degree of participation from the overall population in Malaysia is very frustrating, assuming that most of the Malaysian citizens have limited access to the information relating to the planning procedure, its issues, and the guidelines overseeing the arranging procedure are dicey. Hence, the problem with the public participation process can be solved by AR which acts as a tool to attract more people to participate.

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