Advance Mechanism for Endorsing City Tourism: An Augmented Reality Mobile Game Application with Geolocation Elements

John Ray L. Francisco
Computer Studies Program
Father Saturnino Urios University

Jeremiah B. Perez
Computer Studies Program
Father Saturnino Urios University

Lamberto C. Boligor, MBA, MSIT
lcboligor@urios.edu.ph
Computer Studies Program
Father Saturnino Urios University

Melquizedek G. Borbon, MSCS
mgborbon@urios.edu.ph
Computer Studies Program
Father Saturnino Urios University

Mark Francis Y. Omac
Computer Studies Program
Father Saturnino Urios University

Abstract

The tourism industry in the city requires new and engaging ways that are also innovative in the local industry. This study aims to do that by developing a game application that uses Augmented Reality (AR) and Geolocation to boost tourism in the city and to spark interest among visitors that could encourage them to visit local tourist spots. The game is quest-based with augmented reality environments made with ARCore and geolocation made with Mapbox that encourages users to travel. The Technology Acceptance Model was implemented to determine the Behavioral Intention to Use for the system, with positive results. The application itself was developed with the Unity Engine using the Evolutionary Prototyping Development Model with feedback from project advisors and intended users as well as the company intended for deployment. Upon total completion, it will then be uploaded to the Google Play Store and will be available for download by Android users. Further, results show that most domestic tourists are willing to utilize the augmented reality mobile based application for endorsing city tourism.

Keywords: Augmented Reality, Game, Geolocation, Tourism

1. Introduction

The city of Butuan has had a rich history and culture (Hontiveros, 2004), with many tourist sites that denote historical and cultural importance such as the Balangay Shrine and Magellan's Anchorage (Cayron, 2017). There are also man-made landmarks that contribute to city tourism like the Delta Discovery Park and the Butuan National Museum. Agusan del Norte shares the same percentage as Surigao del Norte in terms of tourism contribution to the region which is 35% to economy (Abello-Camarin, 2017), and the greater bulk of the province's tourist arrivals can be attributed to Butuan City. The presence of the Bancasi Airport that service flights from Manila and Cebu are contributory to the arrivals. The city, which is also Caraga's regional center, sits strategically in the province. It has major gateways such as the previously mentioned Bancasi Airport, as well as Nasipit Port and Land Terminal that provides most of the tourists who come to the region (Abello-Camarin, 2017). It is in a central position travel-wise and points to other destinations in Caraga. This provides ample opportunity to attract tourists with a new way of multi-sensory interactive tourist engagement. With this research, users will be encouraged into visiting these locations featured in the application.

This research will promote tourism in the city of Butuan by featuring its various tourist spots and historical sites as hotspots or "points of interest" in a geo-location-based augmented reality game. The game would use augmented reality elements to improve user immersion, if it gives the user a quality and memorable experience using the technical quality of an augmented reality environment (Molnár & Szűts, 2019); (Shin, 2017), which could generate visiting interests (Berger, et al., 2007).

The app will focus around designating the tourist spots as points of interest upon which several game content interactions may occur. The players will be incentivized into traveling to these tourist spots by the game mechanics that connect the points of interest using a quest system and then providing players upon arrival with an augmented reality environment through which the game content will be presented.

With the growth of technology and various media platforms over the past decades, more and more ways to spread information to the masses emerged more than ever before. One of these ways is the modern trend in mobile applications. According to statistics from Sensor Tower and App Annie, as of 2018, 105 billion apps were downloaded from the Apple App Store and Google Play by 2.9 billion smartphone users, 33% of these apps being games (Iqbal, 2019). With billions of downloads, apps published in app store platforms like the Google Play Store and the Apple App Store have the potential to be an effective tool for tourism promotion. This is because of these platforms' wide reach, which covers key customer demographics (Islam, Islam, & Mazumder, 2010). A potentially better way to achieve this is through applications that are intended for gaming. There have been past studies (Malone, 1981); (Thomas & Macredie, 1994); (Xu, Buhalis, & Weber, 2017), the empirical evidence showed that video games capture attention and encourage retention through their game mechanics that appeal to a user's intrinsic curiosity and sense of fantasy and challenge.

Advancements in technology have given these mechanics more appeal to consumers, shown by the growing number of users showing interest in emerging technologies like Augmented Reality (AR). The innovative aspects of AR add a certain 'edge' to a game, which would make prospective players want to play it (Nilsen, Linton, & Looser, 2004). These features also add immersion by melding the virtual world in the device's screen with the reality of the player holding it, providing a new method of interaction with game content. In a gaming context, such an exploration of interaction is often motivation enough (Nilsen, Linton, & Looser, 2004).

2. Review of Related Literature

2.1. Promoting Tourism with Augmented Reality

According to (Weber, 2014), the location-based mobile Augmented Reality Games are an innovative way to attract tourists into challenges and interactive gameplay while they are exploring an urban

destination or cultural heritage site. AR games provide more engagement with the locations by gamifying an educational experience, making it more entertaining or "fun" using location-focused storytelling, with features and social interactions that feel personalized. The player's location and the game's context are important factors in creating rewarding location-based gameplay. The younger generation born into an abundance of digital media demands new forms of media applications for creating engaging experiences. With modern smartphones and tablets, there can now be a ubiquitous link between real and virtual environments (Mortara, et al., 2013) which enable mobile and location-based games to become pervasive and, and to be played in any situation of life. The learning aspect of an AR tourism application might be a reason for traveling as it broadens the horizon and enhances the understanding of cultures and history. It has also been a neglected area in tourism research (Falk, Ballantyne, Packer, & Benckendorff, 2012).

2.2. Existing AR Applications that Promote Tourism

An example of an augmented reality application promoting tourism would be Florence Travel Guide by Daniel Juarez Garcia, which utilizes augmented reality as well as geolocation to make traveling around the city of Florence, Italy more convenient and engaging. Another example is the Skin & Bones app by the Smithsonian Institution which makes visiting the Smithsonian's Natural History Museum in Washington, DC more immersive by bringing the skeletons to life in augmented reality. There have also been augmented reality games that boost tourism as a side-effect, most notably Pokemon GO (Zach & Tussyadiah, 2017). It combines augmented reality and geolocation to provide players with an exploration and location-focused game experience. Based on a series of regression analyses by (Zach & Tussyadiah, 2017), Pokemon GO increases travel and visitation to other geographic areas. Findings also contend that in terms of spending, increasing motivation to win battles and enjoyment are associated with increased probability to spend money on goods (at shops), on food and beverages (at food establishments such as restaurants), and travel. Visitors can also be guided to locations already within the destination, thus allowing control of the flow of a location's visitors. The combination

of these experiences will have provided educational information and created memorable experiences.

2.3. Games as Promotional Tools

Previous studies of (Falk, Ballantyne, Packer, & Benckendorff, 2012); (Garretson & Burton, 2005) (Garretson & Niedrich, 2004), suggest that the presentation of an advertisement largely determines how well consumers receive the message. According to (Glass, 2007), video games have many elements that make them ideal platforms for advertisements. For the study 'The Effectiveness of Product Placement in Video Games' (Glass, 2007), participants played a video game that featured branded products, then took an implicit associations test to determine whether they "had more positive attitudes toward the brands in the game than toward a set of equivalently rated brands". All three hypotheses were supported by the results. Finally, they took significantly longer to categorize the in-game brands as bad than they took to do the same for their out-of-game counterparts. The same results can be anticipated for promotions regarding tourism.

2.4. Augmented Reality Entertainment Value

An appealing feature of outdoor AR games is the user's movement in the game reflects physical movement (Thomas, Krul, Close, & Piekarski, 2003). This gameplay mechanic must be integrated properly and seamlessly in a game. An issue that might arise is the fact that people walk slower compared to a game character's more pronounced movement in most video games. Therefore, the games are required to be designed to be accommodating. Users of a geolocation game will want the physical game device and hardware to be lightweight so as not to overly tire the user and unobtrusive to allow a great range of movement, such as the movements required in a pretend battle. To maximize entertainment value, developers should address the issues that affect the usability and playability of augmented reality games. There has been some testing for a game called ARQuake (Thomas, Krul, Close, & Piekarski, 2003) that found several issues in constructing virtual worlds. Poorly optimized field of view (FOV) settings caused depth perception problems. AR is more immersive and responsive in a well-lit

environment. In the Augmented Virtuality and Augmented Reality modes, very dark and black colors (unless used for occlusion purposes) should be avoided.

2.5. Geolocation Gaming

Location-based mobile games utilize physical space as the game environment, enhancing players' experience of the physical world through 'the linking of information to places, and players to each other via location awareness', with 'the game (taking) place primarily in the physical space and on the cell phone screen, as players can see each other and/or virtual game elements on their mobile screen' (Silva & Hjorth, 2009). An example is Ingress by Niantic. Ingress does more than just motivate players to recognize significant sites in their immediate surroundings (Stark, 2016). However, In-game achievements and collaboration within the community result in modifications to player mobility, including where people go, how they behave while they are there – for instance, driving four or more laps of a route while 'farming' for equipment; how they move, including walking instead of driving or catching public transport; and encouraging participation in the curation and experience of cultural heritage (via portal submissions and mission design).

2.6. Simulations in Conceptualizing History

According to (Kapell & Elliott, 2013), simulations not only present users with challenges similar to those faced by historical actors in their appropriate context but also model the concepts necessary to assemble historical facts into historical representations. Concepts such as an autocratic government, mercantile economics, or war tactics are all exercises in the organization of systems. Concepts allow us to infer patterns observed from certain events. For example, without formally learning about siege warfare, a player may unwittingly develop an understanding of it by playing a game that features it. Complex relationships between concepts can be better understood through the unique subjectivity offered by simulations, as well as the inherent active participation in a simulated scenario. Rather than a “what-if simulation with a known case study as a referent”, nonspecific simulations “provoke

a wider range of interrogations, encouraging the more abstract, theoretical engagement of historical processes" (Uricchio, 2005).

3. Methodology

The game will then be developed using the Unity Editor and coded in c# using Visual Studio 2017, using the Evolutionary Prototyping Model. External assets to be used in the game will be imported and utilized in the development environment. Saved files will be stored using binary formatting serialization, and player preferences will be stored using Unity's PlayerPrefs utility. The project itself will be backed up to Unity Cloud Storage for collaborative development throughout the prototyping process.

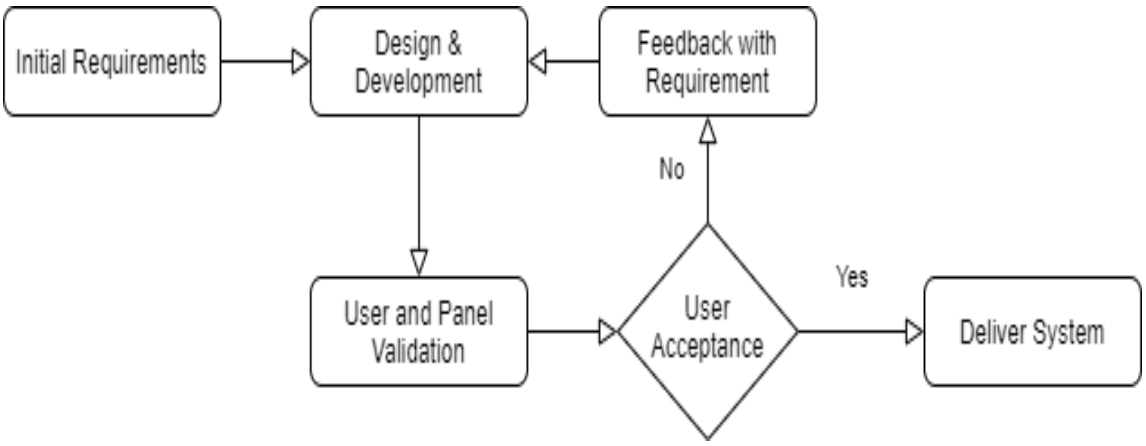

Figure 1: Evolutionary Prototyping Model Diagram

The initial phase of development focused on background research of the locations. The user interface (UI) and geolocation elements were then coded. Afterwards, the structure and game flow were formalized as the foundation for the AR module of the application was built. Quest content, dialog, the registering of coordinates, and design then followed before the final bouts of testing were conducted.

The Technology Acceptance Model (TAM) by (Davis, Bagozzi, & Warshaw, 1992) will be used to determine user acceptance of the technology about Perceived Usefulness, Perceived Ease of Use, and Behavioral Intention of Use. There will be 105 respondents.

(a)

(b)

(c)

Figure 2: Screenshots of the application. (a) The title screen. (b) The map screen showing the player near a point of interest. (c) AR scenes, which can be seen when the player enters different points of interest.

4. Results

This chapter presents the analyses and interpretation of the data gathered for the study. Specifically, the presentations were according to the specific scale that this study aims at revealing: the acceptability,

effectiveness, efficiency, and overall Ease of Use of the Augmented Reality Game Application. Behavioral Intention to use is the dependent variable. Performance Usefulness, Perceived Ease of Use, are independent variables. Age, Sex, and Experience using augmented reality applications are the moderating variables.

4.1. User Acceptance using Technology Acceptance Model (TAM)

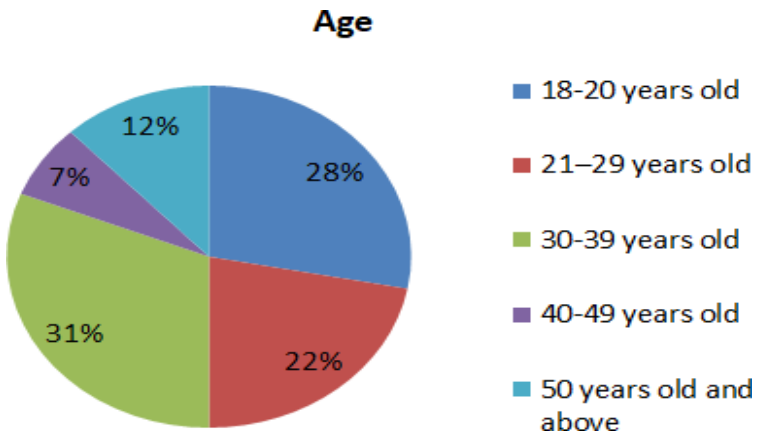

Figure 3: Profiles of the Respondents According to Age

Figure 3 indicates that the respondents of the study are mostly 30-39 years old which comprised 31%, followed by 18-20 years old which is 28%, next is the 21-29 years old, or 22%, and then the 50 years old and above or 12%, and the 40-49 years old, the 7% of the respondents. This also assumes that there is diverse representation included as data for the different age groups in the people of Butuan City.

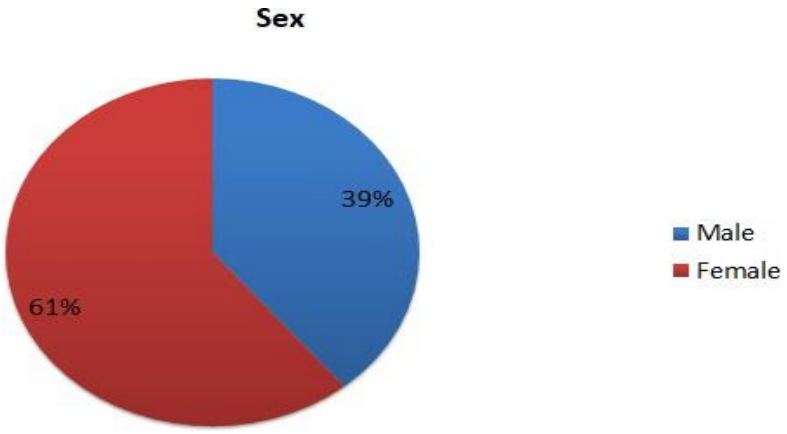

Figure 4: Profiles of the Respondents According to Sex

The chart in Figure 4 shows that there are 41 identified as males comprising 39% of the total samples, 64 individuals were recognized as females comprising 61%. In total there were 105 people in Butuan City who served as respondents for the TAM survey.

Perceived Usefulness	Weighted Mean	Standard Deviation	Interpretation
1. Using the system would make …	4.5	0.50	Strongly Agree
2. Using the system would help …	4.47	0.56	Agree
3. Using the system would increase …	4.37	0.49	Agree
4. Using the system would improve …	4.06	0.49	Agree
5. I would find the system useful in …	4.09	0.42	Agree
Average weighted mean	**4.30**	**0.49**	**Agree**

Table 1: TAM Perceived Usefulness

In the statistical analysis of the TAM survey, the results for the Perceived Usefulness indicated that respondents strongly agreed that the system would make them more interested in Butuan City and agreed that the system would help them learn more about the city, would increase their interest in visiting its tourist spots, would improve their experience when visiting these tourist spots, and would be useful in improving tourism in Butuan City. These findings agree with those of (Weber, 2014) which stated that location-based mobile Augmented Reality Games can be a way to attract tourists into exploring an urban destination or cultural heritage site. Thus, the researchers have the basis for the creation of this system as it helps the promotion of tourism in Butuan City.

Perceived Ease of Use	Weighted Mean	SD	Interpretation
Learning to operate the system would be easy for me	4.30	0.52	Agree
I would find it easy to get the system to do what I want it to do	3.49	0.68	Unsure
It would be easy for me to become skillful in the use of the system	4.02	0.46	Agree
I would find the system easy to use	3.30	0.58	Unsure
Average weighted mean	**3.70**	**0.56**	**Agree**

Table 2: TAM Perceived Ease of Use

The results for the Perceived Ease of Use revealed that respondents agreed that operating the application would be easy for them and that it would be easy for them to become skillful in the use of it. But they are not sure if they will find it easy to do what they want to do and find it easy to use. Thus, researchers must provide guidelines in using the system (Andersen, et al., 2012) and information for the people about the places included in the system for them to be able to access the said places as well as the mechanics on how to use the application.

Behavioral Intention to Use	Weighted Mean	SD	Interpretation
1. I presently intend to use the system when travelling to tourist spots in Butuan City	4.45	0.55	Agree
2. I presently intend to use the system as a way to learn more about Butuan City	4.54	0.55	Strongly Agree
Average weighted mean	**4.50**	**0.55**	**Agree**

Table 3: TAM Behavioral Intention to Use

The results for the Behavioral Intention to Use makes it known that respondents agreed and have the intent to use the system when traveling to tourist spots in Butuan City and intend to use the system as a way to learn more about the city. Respondents showed interest, which is supported by (Camilleri, 2019) stating that AR can play a vital role in generating curiosity and interest on travel destinations.

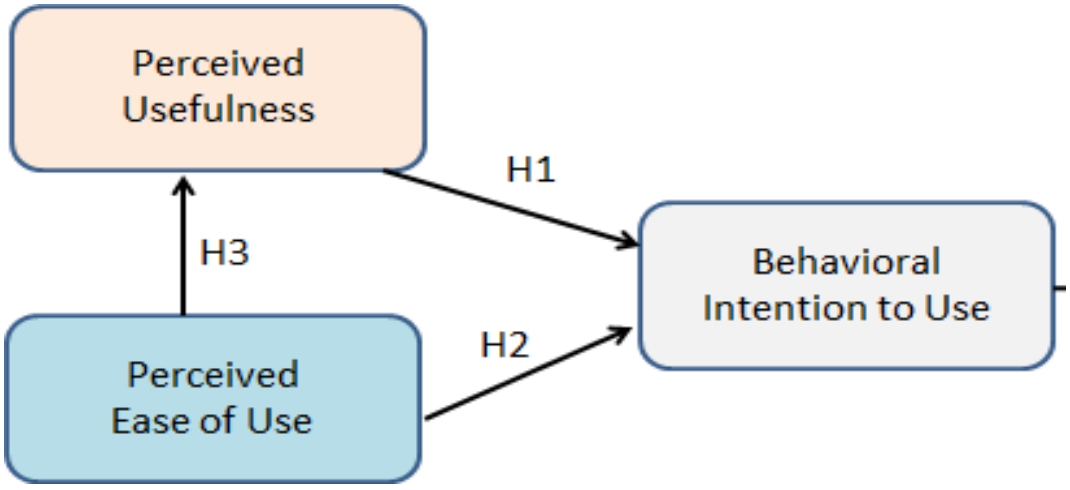

Figure 4: Conceptual Research Model used in the study

This study was tested using the following hypotheses:

H1: Perceived usefulness (PU) will have a significant effect on behavioral intention to use (BIU).

H2: Perceived ease of use (PEU) will have a significant effect on behavioral intention to use (BIU)

H3: Perceived ease of use (PEU) will have a significant effect on perceived usefulness (PU).

Hypothesis	R	R^2	P-value	5% Level of Significance H0 is	Conclusion
H1	0.405	0.164	0.000	Reject	Supported
H2	0.324	0.105	0.000	Reject	Supported
H3	0.408	0.166	0.000	Reject	Supported

Table 4: Summary Results of Hypotheses Test

Table 4 indicates that the Perceived Usefulness (PU) has an R-Square of 0.164, which shows a capability of explanation of 16.41% in relation to the proportion of the variance in the dependent variable Behavioral Intention to Use (BIU) that is explained by PU. The P-value of PU is 0.000, and this shows significance.

It also indicates that the Perceived Ease of Use has an R-Square of 0.105, which shows a capability of explanation of 10.54% in relation to the proportion of the variance in the dependent variable PU that is explained by PEU. It is less than the capability of explanation of PU of the BIU. The P-value of PEU is 0.000, and this shows significance.

On the other hand, it indicates that the Perceived Ease of Use has an R-Square of 0.166, which shows a capability of explanation of 16.65% in relation to the proportion of the variance in the dependent variable BIU that is explained by PEU. It is slightly more than the capability of

explanation of PU of the BIU. The P-value of PEU is 0.000, this also shows significance.

Lastly, the findings showed that the augmented reality application has a significant effect on tourism. However, additional features of the said application must be added to further improve the performance, and likelihood of acceptance from the users.

5. Conclusion and Future Work

Therefore, based on the statistical analyses of the Technology Acceptance Model (TAM), the researchers conclude that there is a basis to develop this system, as it would help improve tourism in the City of Butuan. Respondents reported that it would make them more interested in Butuan City and agreed that the system would help them learn more about the city's history. It would also improve their experience when visiting tourist spots in the city. However, surveys also indicated that respondents found the response time of the information display to be slightly late, and that there needs to be a short tutorial text when using the application for the first time. In addition, Perceived Ease of Use (PEU) had less significant effect on Perceived Usefulness (PU) when compared to the significance of PEU and PU on user's Behavioral Intention (BIU) to use the application. BIU also had a significant effect on user experience in actual system use. Overall, respondents indicated that they have the intent to use the system when traveling to tourist spots in Butuan City and they also intend to use the system to learn more about the Butuan. Their experience in using the system shows a significant relationship among the Intention to Use the System, Perceived Ease of Use of the System and their Perceived Usefulness of it.

For future papers, research, and projects regarding this topic, it should be mentioned that the GPS accuracy could still be improved, and more tourist spots could be added. An AR view of the locations and their distance from the user could also be added. In addition, the structure of the application has been developed in a way that it could also be used for other cities and locales for their own tourist spots. Image recognition

of tourist spots could also be implemented, that could identify a building or scenery using reference images. One could also implement online functionality, such as a leaderboard, multiplayer aspects, factions, item trading, and synchronous multiplayer gameplay. More 3D models customized for each location could also be added, such as a 3D recreation of the Balangay Boat or a possible 3D recreation of the Banza church ruins at its prime. A social media aspect could also be integrated into the gameplay. A customizable player avatar is another recommended feature, which could be customized using items unlocked in-game.

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