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Improving tourism experience in open data environment with mobile augmented reality: needs and challenges

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Abstract. Tourism industry plays a significant role in the economic growth of every country. It is one of the fastest growing sectors that provides continuous growth and deepening diversification that leads to socio-economic progress. This study gives an overview of the needs and challenges of incorporating Mobile Augmented Reality in an open data environment to improve tourism experience. The use of open data in tourism and mobile augmented reality was presented to have an overview of its impact on tourism. Mobile Augmented Reality applications are one of the best suitable applications to boost tourism activities. However, there are still existing needs and challenges that need to be addressed, these are a. technical requirement of the application, b. acceptability of users to utilize MAR, c. availability of data specifically on the tourism site.

1. Introduction

Tourism industry plays a significant role in the economic growth of every country. It is one of the fastest growing sectors that provides continuous growth and deepening diversification that leads to socio-economic progress. The global state of tourism has produced economic and employment benefits in many related sectors. In 2015, the international arrival of tourists grew by 4.65 % which is roughly equivalent to 1,184 million and has generated 1.5 trillion US \$ in export earnings and UNWTO is predicting that by 2030, arrivals of international tourist will reach 1.8 billion [1]. The importance of tourism activities is evident in the numerous numbers of tourism applications available for Android users such as Trip Advisor, Explore Macau and various map portals. Also, in its IOS counterpart which, tourism related applications are evident examples of which are MetroAr, Waalkz, Layar, and Wikitude. The tourism industry thrives on information [2] and a vast number of data repositories contributed by tourists thru reviews, ratings and social media posts and comments provides researchers and policymakers the data needed in decision making.

The principles of open data [3] provide the capability of free access to relevant data. Reusability [4] of these data promotes public engagement and efficient use of public data resources. [5] argues that it is possible for businesses in all industries to find and utilize open data to improve their products and services. In the tourism sector, the presence of open data is deemed necessary specifically in locating tourist destinations and their exact landmarks, providing information on transportation, accommodations, food, and business establishments. New technologies such as Geographic Information



Systems (GIS), Mapping, Virtual Reality (VR) and Augmented Reality (AR) are significant in the delivery of timely and improved tourist experience. Utilization of both open data and AR offers holistic tourism environment.

Concurrently, new consumer-level media platforms like virtual and augmented reality are evolving rapidly and show promise of mass adoption [6]. A visual AR System [7] enhances the visual environment of the user in par with the real-world environment. The integration of AR improves tourism experience [8], the presence of Mobile Augmented Reality (MAR) delivers an interesting way of accessing relevant information at the same time have an on-hand visual grasp on that specific tourist destination. The utilization of MAR is an avenue of reaching wider scope and different types of audience as it delivers an increased level of interest throughout the process, also, it enables citizen participation and contribution to touristic public data. These new technologies may inspire increased citizen engagement with public data and affairs and may even encourage citizens to empower themselves by developing their own media based on publicly available data.

Tourist, sightseers or travelers usually don't want to utilize multiple applications, compare result and interconnect various information from different domains. Majority of data could not be found in one specific domain [9], a minimal number of applications cater to just one domain. From navigation tools for transport and travel, booking an accommodation and locating a specific tourist destination exist in separate applications. The problem in accessing multiple applications is time-consuming and oftentimes produce incomplete or irrelevant data. Also, the heterogeneity of data [10] plays a significant problem in the integration of data from multiple sources.

This study determines the existing needs and challenges of incorporating open data and MAR in improving tourism experience. In the following sections, the use of open data in tourism and the use of mobile augmented reality for tourism was discussed to specifically determine the need for and challenges in tourism.

2. Open Data in Tourism

Open government data typically comes in three sources: authorized statistical data, sensor-based data, and user-generated content [11]. Authorized statistical data includes population, the existence of businesses, employment, crimes, and health, etc., and can also come in geo-mapping formats such as Shapefiles or Geo-json. Sensor-based data can include real-time data from sensors such as street lighting, humidity, temperature, air pressure, traffic etc. User-generated content can often include GPS-based data from mobile devices or user-interactions such as text input. Open government data can thus include static content as well as real-time feeds [8].

There is already a considerable number of actors providing open data in the field of tourism. Majority of the data is from governments and cities. the open tourism data has been seen as a data source for mobile applications and websites. Already there are many successful and well-documented examples of the efficient use of open data in various fields [12]. However, when for example the idea of Smart Tourism Cities develops and data is utilized as a part of the whole ecosystem, then the real benefits of open data can be utilized [13], the classification of open data are shown in Table 1. Business level data is not as openly available as government data. Tourism businesses should at least provide the information that is available on their websites in a machine-readable format. This content could include among others GPS-coordinates, opening hours and products descriptions. Opening such data could provide a possibility for innovative tourist services and mobile applications [14]. Especially destination management organizations are in a crucial role in collecting and opening data from their region for innovation purposes. If a destination wants to open its data suitable resources have to be allocated and openness should be included in the destination management strategy. Table 2 provides an example of the different applications and websites that utilize open data.

Classification of Open data in tourism presented in Table 1 provides an overview on the existing applications and websites that utilize the concept of open data, the majority of this applications are collaborative information from different individuals, organizations and government agencies. Table 2

shows some sample applications and websites that apply the open data concept that becomes relevant to the tourism industry.

Table 1. Classification of Open Data in Tourism

Open Data Type	Description	Where data has been used
Geographic Data	GPS-Location	Mobile App, websites
Event Data	Description of events, bands playing, timetables, event types	Mobile App, websites
Visitor statistics	Number of overnights	Mobile App, websites
Supply statistics	Number of businesses, types of business, number and information on attractions and museums	Mobile App, websites
Survey data	Data from survey studies	Mobile App, websites, academic, and business research
Supply information	Information about travel, destinations, attractions, restaurant, and happenings	Mobile App, websites, academic, and business research
Transit Data	timetables	Mobile App, websites
Governmental Data	Tax distribution and collection	Mobile App, websites, academic, and business research
All of the above		Smart Tourism City, Augmented Reality Applications, services that combine data from several sources

3. Mobile – Augmented Reality in Tourism

Mobile tourism applications [15] provides the capability of providing information to users while navigating at a certain place. Applications such as location-based services [16], social networking sites as mobile guides [17] and navigation maps contain information to help users navigate via thru data from different users, places and any point of interest (POI). This information is integrated into digital maps that are on par with the real-world environment which is suitable for travelers while they are on the move and this application is termed as Mobile Augmented Reality (MAR). The integration of MAR [18] in tourism offers an opportunity for tourism agencies, government entities and tourism sites to deliver relevant information in an interactive form rather than visiting a specific website. The existence of MAR helps boosts the marketing strategies of the different tourism destinations at the same time improving tourism experience of travelers without moving away from their current location and be able to have an overview on the place they intend to visit.

3.1. Mobile Augmented Reality Tourism Applications

Numerous MAR applications have been developed for tourism, applications such as Google Translate, Apple Maps: AR flyover, HolloMaps, and Hudway are just some of the AR apps that are useful in traveling. However, there are also MAR applications that are designed for the specific city, such application is Tuscany+ [6] an iOs based AR application that is used as a digital tourist guide in the Tuscany region. Another is the Basel AR [7] an AR tourist guide that is dedicated to the contents of the Basel city, it can run thru the Layar AR browser, it contains information on tourist sites, accommodation and food establishments in the city of Basel.

Table 2. Sample applications and websites that utilize Open Data in Tourism

Open Data Type	Sample Application	Mobile Platform	Sample Website	URL
Geographic Data	Google Trips	Android and IOS	Czech Tourism	www.czechtourism.com
Event Data	Tourist: New Guide Around Me App GoOut	Android Android and IOS Android and IOS	Geneva Tourism	https://www.geneve.com/
Visitor statistics	Sense-T	Android and IOS	gov.wales the visitor journey	https://gov.wales/statistics-and-research/great-britain-tourist-survey/?lang=en https://www.visitscotland.org/research-insights/about-our-visitors/visitor-journey
Supply statistics	Klook	Android	The Faroe islands World Tourism Organization	https://visitfaroeislands.com/ http://www2.unwto.org/
Survey data	-	-	Business Victoria	http://www.business.vic.gov.au/tourism-industry-resources/research/tourist-accommodation
Supply information	Klook, Tourist: Travel Lovers,	Android Android	Booking.com	https://www.booking.com/
Transit Data	Walks and Trails App Waze Rome2Rio Transit	Android and IOS Android and IOS Android and IOS Android and IOS	TRAVIC	https://tracker.geops.ch
Governmental Data			World Tourism Organization Open Data of Singapore	http://www2.unwto.org/ data.gov.sg
All of the above	Smart Tourism app Smart Tourist Guide	Android Android	Center Smart Tourism European Capital of Smart Tourism	www.centersmarttourism.com http://smarttourismcapital.eu/

These Mobile Augmented Reality applications provides an interactive form of navigating a certain place. It has the capability to display relevant information about the place and explore around the area in an interactive and dynamic manner.

3.2. Mobile Augmented Reality Applications in an Urban Open Data

Integration of open data in mobile augmented reality provides a visualization of useful information needed in exploring a specific destination. Accurate information on accommodation, tourist spots, restaurants, and such other information is very important in saving time, effort in money. Linked Open Data [19] integration was utilized to draw point of interest (POI) coming from several data sets and was displayed thru the MAR. Example of MAR application that utilizes linked open data is the LOD4AR [19] and MOBIAR [20].

Also, several applications that incorporates open data are as follows, a good example of this is the AR app Tunnel Vision [21] it is an AR application that helps commuters navigate the subway system of New York thru a physical map, it also provides statistical data on number of commuters in every substation thru the smart transit data feeds. Also, it allows commuters to explore the city via providing data on income levels, real – estate prices and etc. Another AR App is the Oculus Rift, it is an AR application that displays the virtual world of Canada. It allows tourists to have a view on the economic data of each province.

4. Needs and Challenges in Mobile Augmented Reality Tourism App

Mobile Augmented Reality applications are one of the best suitable applications to boost tourism activities. However, there are still existing needs and challenges that need to be addressed, these are a. technical requirement of the application, b. acceptability of users to utilize MAR, c. availability of data specifically on tourism sites.

4.1. Technical Requirement of the Application

The technical requirements in running MAR tourism applications vary in terms of the type of mobile platforms [22] the users currently have, the majority of AR applications are designed for iOS platforms and Apple mobile devices because of the capability of this devices to run AR applications without the need for additional hardware requirement. Another issue in terms of the technical requirement is the device capability and specifications since AR utilizes GPS and Internet Connectivity, one of the major drawbacks is the accuracy of GPS signal that is transmitted thru the device. Majority of GPS depends on the transmission of signal with the WIFI connectivity of the device. Based on experience conducted, the researcher utilized Pokemon Go as a testing application to test the accuracy of AR and GPS signal, it was found out that there are instances that the current location of the player and the location on the app differs, which concludes that the internet connection has a major impact on the GPS signal of the device thus it provides different display in the AR feature of the game. Thus, this technical requirement needs to be addressed in implementing the MAR for tourism to avoid wrong information in terms of location.

4.2. Acceptability of users to utilize MAR

Since the researcher currently conducts the study in the Province of La Union, based on an initial interview conducted, the citizens and some tourists utilize mobile applications related to tourism such as Google map, Waze and Pokemon Go. However, the majority of the respondents made mention that the utilization of the AR is challenging at some point because of problems in interconnectivity and mobile platform compatibility. Since the majority of mobile users interviewed utilize Android, the challenge in developing the MAR should be compatible with both Android and IOS devices. Though they intend to utilize the AR because of its interactivity features, the challenge on their device compatibility is one of the considerations they asked to be addressed.

4.3. Availability of Data

Majority of mobile-based tourism applications provides minimal data about a tourist destination; general information is only provided. One of the challenges that tourists experience is the accuracy of information provided by tourist applications. Information on transportation including fare is not updated, map navigation only displays main roads, accommodation, food establishments, and business establishments are non-existent. Also, tourist destinations are not updated as seen on the official website of the province of La Union as the target respondent of this study.

5. Conclusion and Future Direction of the Study

The concept of MAR provides an interactive medium for tourists to explore different destinations they want to visit because of its capability to provide a visual perspective. However, in terms of open data, it is clear through research on the use of open data in tourism is needed. Especially business and destination management perspectives are still in study and there is a considerable gap in research in studying the benefits of open data for tourism destinations and businesses. Also, there is a gap between benefits and adaptability of citizens to open data for tourism specifically in implementing AR also in consonance with the compatibility requirement of the different mobile platform.

Future research on the following needs and challenges should be conducted and addressed to better improve tourism experience. The integration of open data to MAR should be addressed so as with the technical requirements, user adaptability and availability of data.

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