

Development of Android Based Smart Tourism Application Based on Tourism Bigdata Analytics

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Abstract: Smart tourism provides various tour and tourism services based on Internet of Things (IoT), communication system, bigdata and Artificial Intelligence (AI) of the key technologies of the 4th industrial revolution. In this study, we develop the android based smart tourism application for individual tourists based on the tourism bigdata analytics. The tourism bigdata platform provides tourists information on tourism destinations and festivals by data analysis of Call Data Records (CDRs) of mobile communication network and access logs of WiFiAPs and Beacons. The bigdata platform also provides tourist's creditcard usage patterns with bigdata analytics. The Android based smart tourism App. consists of recommended travel products, my travel products, tourist destinations and tourist information such as lodgments and restaurants. The recommended travel products consist of personalized tourist attractions, lodgments and restaurants based on the number of tourists and creditcard usage at tourist attractions. The recommended travel products and tourist attractions are provided based on tourism bigdata analytics. Tourists can select and modify recommended travel products to create the personalized travel products and saved as my travel products. The smart tourism App. allows tourists to register my travel products as recommended travel products after their trips.

Key words: Smart tourism, Android based tourism App., recommended travel product, tourism bigdata analytics, context awareness, lodgments

INTRODUCTION

Smart tourism is the application of the concept of the 4th industrial revolution to tourism and is part of smart city. Smart tourism is based on Internet of Things (IoT), wireless and mobile communication systems, cloud computing, big data and Artificial Intelligence (AI) of the key technologies of the 4th industrial revolution (Gretzel *et al.*, 2015; Sun *et al.*, 2016; Lamsfus *et al.*, 2015; D'Aniello *et al.*, 2017). We define smart tourism to support tourist activities before, during and after the trip using the key technologies of the 4th industrial revolution. In before the trip, tourists can select travel products offered by travel agencies or use recommended travel services offered online about sightseeing spots, restaurants and hotels in e-Tourism. In smart tourism, tourists can choose routes and geotagged tourist contents such as story telling, curation, guidance, etc. which are provided in conjunction with location information, sensors, beacons installed at tourism destinations to provide smart tour guide services at tourism attractions (Jwa, 2016; Jeong-Woo, 2016). We develop android based smart

tourism App. to provide tourists smart tour guide services using my travel products that is selected or created in before their trips.

Tourism bigdata can be composed of tourist's access logs collected by sensors, beacons, WiFi Apps. installed in tourist destinations, location information data of mobile communication subscribers and CDRs of mobile communication network. Jeju special self-governing province provides the Beacon SDK (Tamra SDK) to develop smart tourism webs and Apps. using beacons installed in major places such as Jeju international airport, Jungmun tourism complex and Dongmun market (Anonymous, 2017). The Jeju special self-governing province also has established the tourism bigdata platform for analyzing not only beacons but also access logs of WiFi Apps., bigdata collected from public and private sectors and provides Jeju provincial tourism bigdata analysis information (Anonymous, 2017).

The recommendation system filters the information and provides tourists personalized tourist products. The recommendation systems can be classified as item-based and user-based Collaborative Filtering (CF),

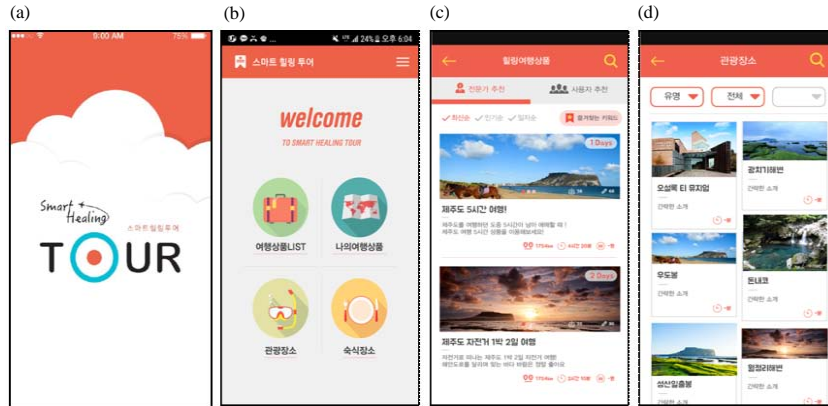


Fig. 1: Android based smart tourism App.: a) Intro; b) Main menu; c) Recommend travel products and d) Tourist attractions

Content-Based Filtering (CBF) and hybrid technologies (Thai and Pishva, 2015). The recommended tourist products based on user-based collaborative filtering can be developed by analyzing the number of tourists and the amount of creditcard usage for tourist attractions, accommodation and restaurants. We can also develop recommended tourist products for repeat visitors with item-based collaborative filtering. The smart phones provide tour and tourism services such as tour guide and storytelling services with GPS and beacons. We develop an android based smart tourism App. to provide recommended personalized travel products. In the App., tourists can make personalized tour schedules by modifying tourist attractions, accommodations, restaurants, etc. from the selected recommended travel product. In the tourist destination, the location-based tour guide is very useful for tourists, enhancing self-guided tours and enhancing the tourist's travel experience. We developed the location-based multilingual audio tour guide system using the server-based TTS engine (Kang *et al.*, 2017). The audio tour guide system provides tourist information optimized for tourists using tourist context information such as language, age, gender, preferences and local information such as date, time, location information and weather on tourist spots. The smart tourism App. allows tourists to register the personalized tour products as the recommended travel products after their trips.

In this study, we develop android based tourism App. to provide tourists smart tour services in Jeju. In the smart tourism App., we use the tourism bigdata platform to create recommended tour products and to select major tour attractions. We also use the bigdata platform to select restaurants and lodgment in the recommended tour products.

Smart tourism App. based on bigdata analytics

Android based smart tourism App.: We develop android based tourism App. that can be used before, during and after the trip in smart tourism as shown in Fig. 1. The smart tourism App. consists of the main menu of recommended travel products, my travel products, tourism destinations and tourist information as shown in Fig. 1b. The recommended travel products are developed to provide tourists smart tour guide services in their travel destinations. Figure 1c and d show examples of the recommended travel products and the tourist information, respectively. The schedule of smart travel product includes travel information of restaurants and accommodations at tourist destinations to be visited during the trip. The travel information at tourist destinations includes routes and voice guidance contents for tour guide services. The pedestrian networks for smart tour guidance are developed and updated using GPS trajectory data using GPS-enabled devices (Jwa, 2016; Jeong-Woo, 2016). The voice guidance contents are geotagged and activated by tourist's selection (Kang *et al.*, 2017). The recommended travel products are developed by local specialists such as expert commentators and village representative as well as travel professionals to produce new travel products that utilize differentiated tourist contents. In before the trip, the smart tourism App. allows tourists to select recommended travel products shown in Fig. 1c and modify their travel schedule such as the preferred tourist attractions, accommodations and restaurants and then save them as my travel products. The tourists can select the preferred tourist destinations, restaurants and accommodations in the menu of tourism destinations and tourist information as shown in Fig. 1d. In this study, we use tourism bigdata analytics to provide popular tourist attractions, accommodations and restaurants in Jeju.

Table 1: Top 5 tourist attractions for the number of tourists in Jeju and Seogwipo cities

Classification	Number of tourists	Amount of card usage	Lodgment	Food	Leisure	Tourism
Jeju City						
DuMaeong-I alley	4,634,773	8,230,831	1,333,229	6,878,134	19,468	0
Hyeopjae Beach	3,688,591	8,621,023	1,481,681	7,067,291	72,051	0
Seokmulwon	3,151,646	3,606,496	209,400	3,312,066	85,030	0
Biyangdo Island	2,772,857	5,516,502	104,280	5,412,222	0	0
Gwakji Gwamul Beach	2,457,173	2,397,276	224,113	2,173,163	0	0
Seogwipo City						
Lee Jung Seop Street	8,323,739	44,939,694	5,552,902	38,125,308	1,261,484	0
Seongsan Ilchulbong	4,644,660	9,788,919	301,886	9,479,298	7,735	0
Oedolgae Rock	3,862,175	2,050,221	115,949	1,934,272	0	0
Shinyang Village	3,529,241	21,872,569	17,878,556	3,994,013	0	0
Aqua Planet Jeju	3,128,813	19,330,737	17,866,381	1,464,356	0	0

Table 2: Top 5 tourist attractions for creditcard usage amount in Jeju and Seogwipo cities

Classification	Amount of card usage	Lodgment	Food	Leisure	Tourism	Number of tourists
Jeju City						
Chong Mul Orum	47,610,095	215,046	3,183,992	44,211,057	0	671,873
Geum Orum	37,267,392	0	274,128	36,993,264	0	899,584
Sebyul Orum	37,204,930	0	0	37,204,930	0	267,935
Health and Longevity	33,302,719	1,760	0	33,300,959	0	200,778
Theme park						
Yongduam	32,264,922	91,198	11,385,645	0	20,788,079	1,844,984
Seogwipo City						
Jungmun tourist complex	189,469,568	166,582,266	11,485,711	11,401,591	0	3,611,329
Jungmun Saekdal Beach	185,246,990	169,927,734	3,985,164	11,334,092	0	2,526,171
Wangime	54,057,624	52,376	334,246	53,671,002	0	331,318
Mulyeongari Orum	54,036,836	37,056	102,326	53,897,454	0	432,240
Dongbaektown	52,226,673	0	28,432	52,198,241	0	38,225

During the tour, the smart tourism App. provides the tourist the tour guide service according to the schedule of my travel product. The tourist can change tourist destinations, restaurants, accommodations and geotagged contents in my travel product during the trip and can register that as a recommended travel product after his trip using the App. The tourist can use location-based multilingual audio tour guide services using speech synthesis provided by the server-based Text-To-Speech (TTS) engine. After the trip, tourists can register my travel products as recommended travel products through the App. Tourists also can recommend my travel products to acquaintances which can increase the visit rate of individual tourists.

Tourism bigdata analytics: In order to develop popular customized travel products, tourist information such as tourist attractions, restaurants and lodgings should be recommended through tourism bigdata analysis. In this study, we use bigdata analytics of KT BigSight™ (Anonymous, 2016) which provides insight into policy and business by utilizing bigdata obtained from various data sources such as tourist logs of communication networks and usage of BC card. The TriP (Travel Intelligence Platform) of KT tourism analysis solution provides tourist information on major tourist attractions and festivals through bigdata analysis of Call Data Records (CDRs) of mobile communication network and

access logs of WiFi Apps. and Beacons in Jeju. The bigdata platform also provides tourist consumption information through BC card usage analysis. We use the number of tourists, creditcard usage analysis and the distribution of tourists on GIS map provided by the bigdata platform for the development of recommended travel products. Table 1 shows the top 5 out of 208 tourist destinations for the number of tourists for 13 months until October 2017 in Jeju and Seogwipo cities. Table 2 also shows the top 5 tourist attractions for the amount of creditcard usage in the year. The amount of creditcard usage is classified into lodgment, food, leisure and tourism. The bigdata platform provides the number of tourists and the amount of creditcard usage for each tourist destination by hour, month and age. The bigdata platform also shows the distribution of tourists on the GIS map in weekly and monthly.

Table 1 shows the DuMaeong-I alley which is the 1st of the number of the tourists is not the most popular tourist attraction in Jeju city. To find out why, we analyze the creditcard usage amount, the number of tourists by time of day and the distribution of tourists on the GIS map. Figure 2 shows the distribution of the number of tourists around DuMaeong-I alley and Yongduam and Jeju international airport on the GIS map. The red color shows high density of tourists. In DuMaeong-I alley, tourists are concentrated not only in DuMaeong-I alley but also in the famous restaurant and market areas as

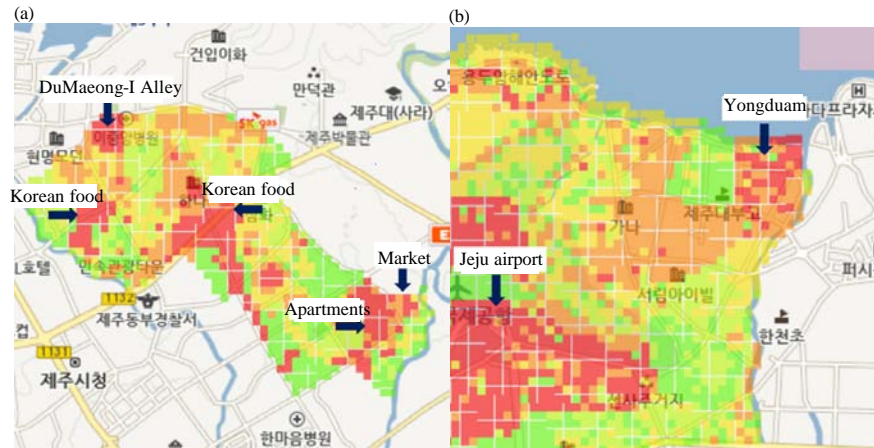


Fig. 2: The distribution of the number of tourists on the GIS map (red color is high density): a) DuMaeong-I alley and b) Yongduam and Jeju International Airport

shown in Fig. 2a. In Table 1, we can see that the amount of creditcard usage is relatively high at the restaurants. Seongsan Ilchulbong and Hyeopjae Beach are the most famous tourist attractions in Jeju. Lee Jung Seop Street in Seogwipo City is a famous sight seeing spot but the number of tourists is high because of the famous restaurants around there. The creditcard usage at Lee Jung Seop Street is relatively high at the food as shown in Table 1.

In Table 2, we can see that leisure item of the amount of creditcard usage is much higher at Orums. There are more than 30 golf courses in Jeju and most of them are concentrated in the middle mountain region. In Table 2, tourist attractions such as Orums and park with high creditcard usage in the leisure item are tourist sites with nearby golf courses and most of creditcard usage is done at the golf courses. There are many accommodations near Jungmun Saekdal Beach in the Jungmun tourism complex and therefore, Jungmun Saekdal Beach has relatively high creditcard usage in the lodgment item. Yongduam near Jeju International Airport has relatively high creditcard usage in the tourism item as rental car companies are concentrated near the airport. We select popular tourist attractions, restaurants and lodgings through the analysis of the number of tourists, the GIS map distribution and the creditcard usage amount. We provide popular tourist attractions based on tourist context information such as age and gender. In this study, we classify tourists as 20 or 30, 40 or 50 sec, over 60 males or females, families and students on school trips.

Development of recommended travel products using bigdata analytics: We develop recommended travel products using popular tourist attractions, restaurants

and lodgings chosen from tourism bigdata analysis. In this study, we develop the itinerary of recommended travel products which consist of famous tourist attractions, starting from Jeju City with the international airport and port. We make recommended travel products by the following procedure: choose an area for tourists to be moved during the trip considering tourist context information, select tourist attractions and geotagged audio guide and storytelling contents and routes in tourist attractions considering transportation choose, restaurants and accommodations considering travel time, decide on the price and time of travel. In the recommended travel product design process, we consider tourist context information such as age, gender and local information such as date, time, location information and weather on tourist spots.

In this study, we select sightseeing spots in descending order of the number of tourists in the area and select restaurants and accommodation considering the amount of creditcard usage in the selected area. For example, we make a 2 night and 3 days recommended travel product for 20 or 30 sec during the summer vacation season in Jeju as shown in Fig. 3.

We choose a route to Jeju City, Hallim-eup and Seogwipo City to return to Jeju City. The first day departs from Jeju international airport and moves to Hanlim-eupas shown in blue in Fig. 3. In Hanlim-eup, we choose Hyeopjae Beach of the most popular tourist destination in Jeju as shown in Table 1. we choose Biyangdo, Seokmulwon in Hanlim-eup. In the first day, tourists may change Biyangdo to Hallim Park in recommended travel products while creating my travel products. We chose the Dreaming Pig restaurant near Hyeopjae Beach on the first day for lunch as the food portion in the amount of



Fig. 3: The 2 nights and 3 days recommended travel product for 20 or 30 sec during the summer vacation season in Jeju

creditcard usage is the highest at the beach. We chose the Hyeopjae guest house in the lodgment dense area within a 1 km of the beach so that tourists can easily change accommodation in the process of making my travel product. In day 2, we choose Jungmun Saekdal Beach, Camellia Hill and Lee Jung Seop Street as shown in yellow in Fig. 3. Although, the food portion in Jungmun Saekdal Beach was high as shown in Table 1, we chose the Yong's restaurant and the Jenny's home guest house near Lee Jung Seop Street considering the travel route at the day 2. In day 3, we choose Soesokkak, Jeju Jeolmul Natural Forest Resort and Yongduamas shown in green in Fig. 3. In day 3, we chose the Aseowon restaurant located near Soesokkak considering the route and lunch time. In day 2 and 3, tourists may stay at Jungmun tourism complex and can select tourist destinations such as Cheonjeyeon Falls and Yeomiji botanical garden, restaurants and accommodations while creating my travel products.

DISCUSSION

Smart tourism can support tourist activities before, during and after trips and provides tourists smart tour guide services based on the key technologies of the 4th industrial revolution during their trips. In this study, we develop android based smart tourism App. and provide tourists recommended travel products, restaurants and accommodations based on tourism bigdata analytics. In this study, we use tourism bigdata analysis of CDRs of mobile communication network and access logs of WiFi Apps. and beacons and creditcard usage amount about tourism attractions in Jeju. To support tourist activities before the trip, we develop a smart tourism App. that

allows tourists to make personalized tour schedules by modifying recommended travel products. In during the trip, we develop the location-based multilingual audio tour guide system to support tourist activities using the server-based TTS engine. The smart tourism App. allows tourists to register the personalized tour products as the recommended travel products after their trips. In this study, we develop recommended travel products in smart tourism App. for individual tourists using tourism bigdata analysis. we use tourist context information such as age, gender, preferences and local information such as date, time on tourist attractions to develop recommended travel products. Jeju special self-governing province has installed free WiFi Apps. and beacons at major tourist sites and is conducting analysis of tourism bigdata. we will develop recommended travel products considering tourist's movement on Jeju Province tourism bigdata.

CONCLUSION

So far, we have shown the process of developing a recommended travel product for 20 sec based on tourism bigdata analytics. We develop recommendation tour products based on context awareness using tourism bigdata analysis and provide them to tourists through smart tourism App. to create the personalized tour product.

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