Smart Tourism Information System using Location-based Technology

Hyu-Chan Kim\(^1\) and Young-Sang Kim\(^2\)

\(^1\)Dept. of Digital Contents, Cheju Halla University, South Korea
\(^2\)Dept. of Digital Contents, Cheju Halla University, South Korea
khc@chu.ac.kr, yskim@chu.ac.kr

Abstract

With the broader application of 5-day work week scheme and expanding wellbeing trend of South Korea, increasing number of people are looking for tourism leisure activities. And the demand for tourism information has surged as well. In this situation, the internet, SNS, broadcasting and many other medial channels have been providing exponentially growing number of tourism information.

In this study, smart tourism information system was produced by applying the location-based service (LBS) to provide customized information in line with user characteristics and push function on open platform with a view to activate information, culture and transactional exchanges between local entities and tourists.

The system proposed herein enabled tourists to gain the information on their surroundings through a smart phone in major tour destinations and local commercial districts. The system provided more sophisticated customized smart tourism guide service via hybrid BLS method combining GPS location determination method and beacon-using micro location determination method.

With the application of IoT technologies, tourism and culture contents have become utilized to the maximum extent, enabling smart tourism service. And with smart devices, tourists are expected gain great help in searching information or making decisions on destination and surrounding places, etc.

Keywords: LBS (location-based service), smart tourism, beacon, IoT, POI

1. Introduction

In step with ICT development, knowledge and information-based society is shifting toward smart society. Smart society refers to the society of hyper-connectivity based on cutting-edge network ensuring data access without a temporal limitation. IoT (Internet of things) \([1]\) is what enables such a society. IoT generally refers to the kind of technologies creating future services such as smart grid, smart home, healthcare and smart car service based on the fusion and convergence between IT and other diverse industries \([1]\).

The technology is expected to help change future industrial paradigm thanks to telecommunication network advancement including WiFi and LTE as well as remarkable miniaturization and performance upgrade of mobile devices.

Smart phones are the most fundamental case of IoT, bringing about changes already in diverse aspects of our lives. IoT-based smart meter can help save unnecessary energy consumption to improve energy efficiency. Combined with agricultural and livestock product, it has allowed their smart and automated management.

In step with the recent broader application of 5 day work week scheme and increasing wellbeing trend in South Korea, more people are looking for tourism and leisure activities, pushing up the demand for tourism information. In this situation, the internet, SNS, broadcasting and diverse medial channels are providing exponentially growing number of tourism information.
Smart tourism provides tourism service in a mobile form. Traveling tourists can receive real-time customized tourism information via mobile devices with full-time access to diverse forms of information including webs or apps.

As of 2014, the number of social media users in the world was 1.79 billion people and the number is expected to increase by about 50% by 2016. In 2014, the number of South Korean smart phone users exceeded 40 million, representing the explosive increase in smart device-based contents consumption [3].

![Figure 1. No. of Global SNS Users and Growth Trend](image)

Accordingly, the world is experiencing fiercer smart marketing efforts by using smart phones and smart device-based tourism services are rapidly expanded. Especially as more and more people acquire information for themselves, smart tourism has emerged as the most notable issue in the tourism industry.

Tourists are analyzed to obtain tourism information through more diversified channels in step with the rising number of tourists. The number of people using the internet and mobile devices jumped by 60% in particular. The internet and mobile are also found to account for over 50% of tourists’ travel information acquisition channels in each country.

Presently, South Korea experiences continued growth in the number of tourists to major destinations thanks to broader application of 5 day work week system and rising desire for leisure time activities. The number is deemed to grow continuously in the future as well. Also, in order to satisfy tourist needs growing more sophisticated, diversified and specified, differentiated tourist destinations have been developed in reflection of local characteristics [4].

Amid the rising number of domestic and overseas phone users and smart phone market growth, smart services with maximum contents application has been activated. Tourists also want to acquire information with the web and smart phones. This study seeks to establish a tourism information system by adopting IoT-based LBS in line with this change in tourist patterns.

In this study, Chapter 2 deals with relevant studies and technologies; Chapter 3, case study; Chapter 4, composition and design of the proposed system; and Chapter 5, the study conclusion and suggestions for future study.

2. Relevant Trend Analysis

2.1. Change in Korean People’s Tourism Pattern

With the 5 day work week system in place and rising demand for leisure activities, the number of tourists has continuously increased in major destinations of the country. The number is expected to keep increasing in the future as well. In order to meet the ever-
diversifying and sophisticated tourists’ needs, differentiated tour destinations have been developed in reflection of local uniqueness [4].

As the idea of fair tour or good tour spreads widely, tour patterns are changing towards as follows;

- Tour where everyone is happy including the tourists, local people living in tour destination, and tour service providing staff
- Tour helpful for local economy, local nature and local culture
- Tour with valuable experiences and exchanges with local people such as tour for experience, eco-tourism, cultural tourism and farming/fishing community tourism

<table>
<thead>
<tr>
<th>Year</th>
<th>Japan</th>
<th>China</th>
<th>USA</th>
<th>Taiwan</th>
<th>Hong Kong</th>
<th>Philippines</th>
<th>Russia</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>3,053</td>
<td>1,342</td>
<td>611</td>
<td>381</td>
<td>216</td>
<td>272</td>
<td>137</td>
</tr>
<tr>
<td>2010</td>
<td>3,023</td>
<td>1,875</td>
<td>653</td>
<td>406</td>
<td>229</td>
<td>297</td>
<td>151</td>
</tr>
<tr>
<td>2011</td>
<td>3,289</td>
<td>2,220</td>
<td>662</td>
<td>428</td>
<td>281</td>
<td>337</td>
<td>155</td>
</tr>
<tr>
<td>2012</td>
<td>3,519</td>
<td>2,837</td>
<td>698</td>
<td>548</td>
<td>360</td>
<td>331</td>
<td>167</td>
</tr>
<tr>
<td>2013</td>
<td>2,748</td>
<td>4,327</td>
<td>722</td>
<td>545</td>
<td>400</td>
<td>401</td>
<td>175</td>
</tr>
<tr>
<td>2014</td>
<td>2,280</td>
<td>6,127</td>
<td>770</td>
<td>644</td>
<td>558</td>
<td>435</td>
<td>214</td>
</tr>
<tr>
<td>2015.1</td>
<td>140</td>
<td>394</td>
<td>51</td>
<td>50</td>
<td>35</td>
<td>25</td>
<td>14</td>
</tr>
</tbody>
</table>

2.2. Status of Korean Smart Phone Use

According to the statistics on internet service released by the National Internet Development Agency of Korea in February 2016, the number of mobile communication subscribers in South Korea was 58,935,081 in 2015. The number of smart phone users exceeded 40 million in September 2014 and reached 40,386,543 as of end of November 2014. The number of mobile communication subscribers already exceeded the national total population by over 6.7 million [5].

- Java is employed in the mobile sector, which is widely used in the Internet and open source areas, in order for many Java-using developers to easily develop Android applications.
Of them, the number of smart phone subscribers accounted for 78% of the total at the end of November 2014, indicating the dawn of the era of one smart phone for one person, if special groups are excluded such as younger children and the very elderly.

Delivery apps for food, etc. on mobile devices have grown rapidly since 2010 to reach about KRW 10 trillion in its market size as of now. And they are expected to grow continuously (Korea Economic Daily, 2015).

The daily frequency of using mobile internet terminals in South Korea was 12.3 times in 2013 for 1 hour and 34 minutes. Also, 95% of the mobile internet users were found to have a smart phone. 95.9%, the largest part of them were found to use mobile internet service for the purpose of data and information acquisition. [6] (investigation in June 2013; mobile internet status investigation by the National Internet Development Agency of Korea).

These statistics show that mobile devices have already become a very common and individual means of information acquisition and commerce.

2.3. Status of Overseas Smart Phone Use and OS-specific Status

The number of global smart phone users is expected to reach 2.5 billion in 2015 and continue to grow by 150% for the next 7 years (Strategy Analytics (SA); 2014.07. 2014.04. world population of 7.25 billion

Gartner stated that Google Android accounted for 38.5% of the global market as of April 2011, the no. 1 position, and anticipated it to take up 48.8% in 2015, almost half of the total. It estimated that iOS would form 17.2% of the entire market.

China, one of the main targeted countries in this R&D project, announced it had 1.2 billion 86 million smart phone users as of December 2014. Given the estimated Chinese population ranging from 1.4 up to 1.7 billion, China is deemed to enter the era of one mobile phone for one person [7].

Table 2. 2013 World’s Smart Phone OS Users (Strategy Analytics. 2014.01)

<table>
<thead>
<tr>
<th>Country</th>
<th>Android</th>
<th>IOS</th>
<th>Blackberry</th>
<th>Windows</th>
<th>Symbian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea</td>
<td>93.4%</td>
<td>5.1%</td>
<td>0.1%</td>
<td>0.9%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Argentina</td>
<td>82.0%</td>
<td>4.0%</td>
<td>5.9%</td>
<td>3.8%</td>
<td>3.5%</td>
</tr>
<tr>
<td>China</td>
<td>81.8%</td>
<td>8.6%</td>
<td>0.1%</td>
<td>1.9%</td>
<td>6.7%</td>
</tr>
<tr>
<td>India</td>
<td>78.4%</td>
<td>4.3%</td>
<td>3.3%</td>
<td>3.8%</td>
<td>9.0%</td>
</tr>
<tr>
<td>Iraq</td>
<td>77.9%</td>
<td>4.3%</td>
<td>1.9%</td>
<td>2.6%</td>
<td>12.1%</td>
</tr>
<tr>
<td>USA</td>
<td>56.0%</td>
<td>36.8%</td>
<td>3.8%</td>
<td>3.2%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Singapore</td>
<td>54.2%</td>
<td>35.4%</td>
<td>3.5%</td>
<td>3.7%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Australia</td>
<td>53.0%</td>
<td>34.9%</td>
<td>1.4%</td>
<td>4.1%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Canada</td>
<td>48.0%</td>
<td>32.2%</td>
<td>15.0%</td>
<td>3.7%</td>
<td>0.8%</td>
</tr>
<tr>
<td>HongKong</td>
<td>60.3%</td>
<td>31.2%</td>
<td>1.9%</td>
<td>3.5%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Japan</td>
<td>59.0%</td>
<td>21.6%</td>
<td>0.4%</td>
<td>0.9%</td>
<td>12.4%</td>
</tr>
<tr>
<td>Finland</td>
<td>39.2%</td>
<td>19.2%</td>
<td>2.6%</td>
<td>24.5%</td>
<td>13.8%</td>
</tr>
</tbody>
</table>
2.4. IoT

Internet of Things (IoT) means a material space network involving three kinds of diffuse environmental factors - human, thing and service - to form intelligent relationships such as sensing, networking and data processing in a mutually cooperative manner without explicit human intervention. Not only diverse objects and products but even animals, plants and locations are connected to the internet [8].

The idea of IoT was advanced from the previous ideas of USN (Ubiquitous Sensor Network), and M2M (Machine to Machine). It is now expanded into intelligent communication of things, or internet of everything (IoE). Recently, the term, the era of IoT, is much talked about, generally referring to the point where the number of internet-connected things or entities exceeds the number of internet-connected humans. Specifically, this means that, in a new dimensional environment where everything is connected without any limitation on time, space and entity, everything is assigned with an internet address and each of their information is shared and communicated via mobile devices through the internet. That very moment and environment is what this idea refers to [9].

IoT is similar to ubiquitous in putting human at the center. Ubiquitous means the kind of environment where users can access network freely anytime anywhere without being conscience of network or computer. It is more similar to the era of internet of everything (IoE) which is further beyond the world defined by IoT.

2.5. Beacon

Beacon service refers to smart phone –based local area communication service supporting functions such as text sending and mobile payment by locating a user within a close range. Beacon allows diverse services such as object & context awareness, contents ignorance, indoor locating, auto-check in, and GeoFence. Also, if a user reaches a beacon-attached terminal within a few meters, a pre-determined signal is received and beacon locates the user based on the signal [10].

The communication distance of BLE beacon device is from 5 ~ 50 m. Data transmission is possible without a separate action of recognition (tagging). It can provide more precise location information than GPS scheme. In addition, it adopted low energy technology to sustain battery for 1~2 without charging.

The beacon technology providing diverse information and services based on local area locating and communication technologies emerges as a future key technology that will enable online-offline service convergence [11].

![Figure 3. Beacon Service Concept](image-url)
2.6. LBS(Location Based Service)

Location Based Service (LBS) provides appropriate information or entertainment according to users’ locations based on the location data sent from communication network or PGS, etc. Necessary information and diverse entertainment services can be developed by using mobile devices embedded with geographical location data.

With smart phones, users can gain various information in real time such as traffic, weather, stores, and convenient facilities for their current locations. Main LBS examples include finding friends, guide in driving, find a nearest gas station, and missing child finding. LBS is related with geographical information system (GIS) or intelligent transportation system (ITS). Starting from a WiFi-based LBS, it receives limelight as a promising service in the mobile era. Gartner selected LBS as one of the most noteworthy smart phone applications in 2012 [12].

2.7. Smart Tourism

With the recent increase in smart phone related issues, discussion has begun on the idea of smart both internally and externally. But studies have been less than sufficient in this regard. JeongHee Lee, TaekKyun Ahn and HongMin Kim (2012) defined that smart tourism was to provide real-time customized service to domestic and foreign tourists based on LBS information and real-time communication by introducing cutting-edge ICT to tourism. They said it is to add value by improving the contents environment and industrial structure.

Smart tourism service can be provided to tourists through diverse technologies. Augmented reality, IoT, tagging and many diverse services are being developed to expand tourists’ pleasure and tourism efficiency [14].

3. Case Study

3.1. Overseas Cases

3.1.1. Apple: Apple shows one of the most active movements regarding beacon. Apple disclosed iBeacon together with IOS7 at the WWDC in June 2013, elevating industrial interest in beacon technology. Since then, the company has introduced iBeacon-applied services in cooperation with various companies including US Major League and Macy’s, a US department store chain[14].

![Figure 4. Apple Store iBeacon Service](image)

3.1.2. Qualcomm: Qualcomm demonstrated the Proximity Beacon service based on its own context-awareness platform, Gimbal at the UPLINQ 2013, a Qualcomm-hosted mobile conference. In the demonstration, if a visitor with a name tag reached a specific spot, the person received diverse information, coupons, etc. as well as certification of event attendance. Qualcomm is also providing location-based service centering on relatively narrower spaces or micro-locations such as inside buildings, etc. The company completed technology test in the American football stadium at the end of 2013 [14].

3.1.3. PayPal: Online payment system company, PayPal, developed PayPal Beacon, a receiver/transmitter for store use to be inserted into a PC USB port or power outlet.
PayPal Beacon exchanges information with PayPal mobile app installed in customers’ mobile phones through Bluetooth. If a customer with a smart phone installed with PayPal mobile app walks into a shop, PayPal Beacon provides the customer with discount information or shop information or the customer can pay via the PayPal app [14].

3.2. Beacon Applications Case

3.2.1. Traditional Market in Suyu, Seoul: Beacon device was employed to establish and provide services for traditional market activation such as incentive to visit traditional market, loyalty point granting upon visit, discount sales and events. After logging in, users can check their current location and ways. But events such as coupon have not been successfully utilized.

![Figure 5. Beacon-applied Suyu Traditional Market App](image)

3.2.2. Cultural Heritage Administration-Jongmyo Shrine/Bulguksa Temple IoT Cultural Heritage Tourism Information Service: Beacon device was used to locate users just by their movement without any separate tagging within the service area of Jongmyo Shrine and Bulguksa Temple and provide key cultural heritage information through smart phone in Active Tag.

![Figure 6. Jongmyo Shrine/Bulguksa Temple IoT Cultural Heritage Tourism Information Service](image)

3.2.3. Public Information Provision App: The Jeju Special Self-Governing Province offers a tour information app which displays information in simple lists. Based on GPS, it informs users of their nearby tour destinations. The app is viewed as a reduced version of PC website too complicated to be used by users.
3.2.4. Others Apps:

![Figure 8. Seoul Dulle-gil app and SK Syrup](image)

4. System Design and Materialization

4.1. System Construction

This study seeks to construct a smart tourism information system by applying location based technology to provide customized information according to user characteristics, push function and open platform with a view to activate information, culture and commercial exchanges between tourists and local communities.
4.2. App Development

Smartphone application interface was developed for Android SDK 2.2 and iOS 5.1.1 versions. The app allowed tourists to gain information on their surroundings through a smartphone in major established destinations and local commercial districts without any complicated search process.
The developed app herein employed a hybrid LBS method combining the GPS-based locating method and beacon-based micro-locating method to provide more sophisticated and customized smart tour guide service. Escaping from the existing form of tour information in text, photo, etc. via simple search, the app presented multimedia type fresh contents produced directly by staff at tour destinations or shops. Also, by matching the basic user disposition information with accumulated big data, the app follows a hybrid LBS method to provide personalized and customized information push in an intelligent manner without a special search process when users are at a specific location.
4.3. Beacon Platform CMS

A registration page was developed for the web application where staff at tour destinations or local commercial shops can input docent contents for each beacon POI directly. To realize a hybrid LBS, if the distance from POI (point of interest, equal to the beacon receiver/transmitter installation spot) was 30 m or farther, the input POI address was mapped with latitude/longitude GPS coordinate. And the web application supports real-time contents alteration to show instantly-updated contents to user applications.

5. Conclusions

This study investigated cases of IoT and LBS-using tour information system establishment. As increasing number of people enjoy tour and leisure activities, their demand for tourism information has soared. In this situation, the internet, SNS,
Broadcasting and diverse media channels are pouring in exponentially increasing amount of tour information.

In order to adjust tour information to the changing tourism pattern, a tourism information system was developed in this study by applying IoT-based LBS technology. As the IoT technology helps maximize the use of tourism and cultural contents, smart tourism service has been made possible. And broader smart device penetration is expected to be helpful for tourists’ decision making on matters such as data search, destination and surrounding environment choice.

Such smart tourism service is also changing as tourists utilize diverse price comparison service, real-time information service, etc. to get destination information, wayfinding service and consumption information. For further development of object recognition (augmented reality, virtual reality technology) and LBS (beacon)-based IoT in the future, it is necessary to work to apply IoT-based smart sensors to daily lives and enterprise activities in general while helping spread ICT-fused smart product services. It is needed to embed sensor, computer and internet into general things to develop smart sensor service with high added value of convergence; while improving industrial productivity and efficiency by fusing IoT smart sensors with industrial infrastructure including logistics, supply chain, sales and safety facility. Available useful services would include tour facility entrance/exit based on NFC in the field of tourism; diverse experience and information provision based on augmented reality in history and cultural spaces in museum, exhibition halls, etc.; interpretation via auto-interpretation function in international conference facilities; and tourism facility use pattern analysis based on big data [15].

References


Authors

Hyu-Chan, Kim, He received the B.S. and the M.S. from Jeju National University and the doctor course completion. He is currently a Professor in the Department of Digital Contents, Cheju Halla University. His research interests are in BigData, Social Media, Augmented Reality.
Young-Sang, Kim. He is currently a Professor in the Department of Digital Contents, Cheju Halla University. He received his PhD in Computer Engineering from the Kyungpook. His current research focuses on machine learning, virtual reality, smart media.