Multilingual Information Service Based on Combination of Smartphone and Digital Signage

Tetsuro Ogi[1(✉)], Kenichiro Ito[1], and Seiichiro Ukegawa[2]

[1] Graduate School of System Design and Management, Keio University, 4-1-1 Hiyoshi, Kouhoku-Ku, Yokohama, Japan
{ogi,kenichiro.ito}@sdm.keio.ac.jp
[2] EMBARK JAPAN, 1000-1 Kitamachi, Nagaoka, Niigata, Japan
Ukegara.japan@gmail.com

Abstract. Recently, a lot of people often visit foreign countries due to the progress of globalization in the world, and Japan also aims to become a tourism oriented nation. However, various languages are used in the world, and it has become a bottleneck for the people to visit other countries. In this research, by combining the smartphone and the digital signage based on iBeacon technology, multilingual information service system was developed. This system was implemented into the information service in Shirakawa-go that is one of the UNESCO world heritage site, and the evaluation experiment was conducted. In the experiment, several foreign tourists were asked to use the multilingual information service system and the effectiveness of this system was evaluated.

1 Introduction

In recent years, with the progress of globalization, many people visit foreign countries more often. Even in Japan, building tourism-oriented country has been promoted in accordance with holding the Tokyo Olympic Games in 2020. On the other hand, in the today's information society, people are living their lives while getting a lot of information every day. However, when visiting foreign countries, it is difficult for many people to obtain information in the same way as they are in their home countries due to the difference of languages, which makes inconvenience and obstacle to staying in the foreign countries.

At the Tokyo Olympic Games held in 1964, pictogram that indicates signs such as toilet and emergency exit was created as a method of providing information to the foreigners. The pictogram has been spread into many countries together with the following Olympic Games, and currently, it is used in all over the world [1]. However, there is a large difference in the amount of information provided in everyday life between today and at that time. Therefore, in the information society, the effective method of providing large amount of information instead of the pictogram is required.

In this study, in order to solve such problems, multilingual information service was developed based on the advanced information communication technologies. In this system, we focus on the combination technology between smartphone and digital

signage as information providing tool that can be used instead of the pictogram [2]. In particular, short-range communication technology of iBeacon was used as a trigger of combining both devices [3]. By using this method, it is expected that people visiting foreign countries obtain necessary information naturally in the same way as they are in their home countries. This paper describes the required functions, system configuration of the prototype system developed in this study, and the evaluation experiment being conducted in Shirakawa-go area.

2   Required Function in Multilingual Information Service

In order to provide information effectively to the tourists, it is necessary to provide necessary information to the tourists using their mother tongue without requiring special actions. Namely, the information system in which the tourists can obtain necessary information at the necessary place by just walking for sightseeing should be constructed. Though we can obtain some information from the surrounding buildings or billboards in our home country, it is difficult for us to understand it in the foreign countries. Therefore, in this study, we considered three kinds of information provision functions shown in Fig. 1 by combining smartphone and digital signage.
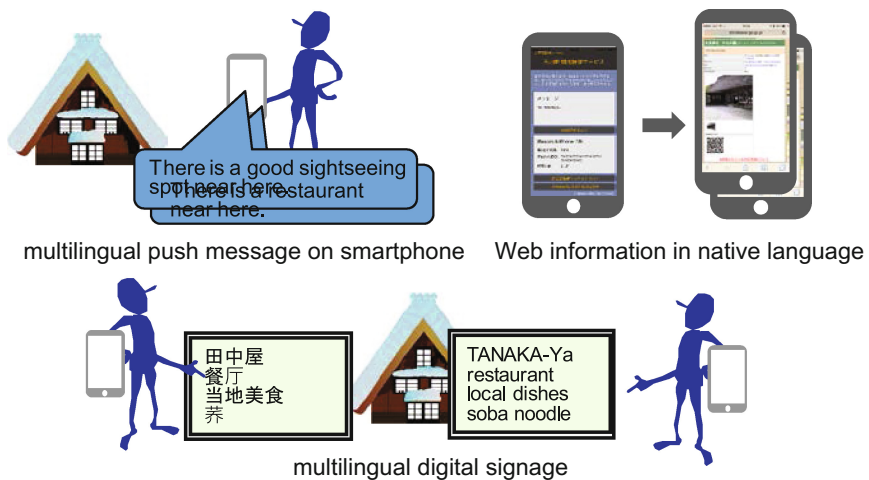

Fig. 1.   Information provision functions using smartphone and digital signage

2.1   Multilingual Push Message on Smartphone

Smartphone is an information device that most people own in these days. In general, in the Web information retrieval using the smartphone, users have to search information actively by themselves in order to obtain necessary information. On the other hand, as a method of providing information to the passive users using the smartphone, the function of push notification can be used. The push notification includes a local push notification that generates information inside the smartphone and a remote push notification that transmits

information through the Internet. In both methods, it is possible to notify the information at the necessary time by using sound and visual display with a trigger of time or location.

In the tourist information service, by using the push notification function, it becomes possible to provide necessary information to the tourist even if he or she does not take any special action. For example, when the user comes near a sightseeing spot or a souvenir shop, it can inform necessary information by presenting a message on the user's smartphone such as "There is a good sightseeing spot near here" or "There is a souvenir shop near here". In particular, since it is difficult for the foreign tourist to obtain information from the surrounding environment, the function of push notification would be effective.

2.2 Web Information in Native Language

In general, though the smartphone is often used to retrieve Web information, in this case the user must search the target site using the search engine. In particular, as for the oversea information, we usually do not know whether there is any information written in the user's native language or not. Nowadays, it is possible to refer to the information written in foreign language while translating it into the user's native language by using the automatic translation function. However, it is difficult for the foreign tourists to retrieve the target Web site written in foreign language, because they cannot use the keywords of foreign language.

Therefore, it is desirable that the user can easily access the target Web site without performing any operation such as searching the site written in the user's native language or translating the retrieved site into the user's native language. For example, it is desired to construct a function in which when the traveler comes near a sightseeing spot or a souvenir shop, the URL of the target Web site written in his or her native language is automatically displayed on the user's smartphone and the user can access to the necessary information with one touch operation.

2.3 Multilingual Digital Signage

While the smartphone is a portable information device, the digital signage is an information device that is placed in a public space. Since the digital signage is connected to the Internet, the displayed contents can be changed easily. Whereas the smartphone needs the user's active operation of information retrieval, the digital signage can provide information to the user's eye when the user comes near it passively without performing any special action.

In this study, we considered developing a multilingual digital signage that always displays information using the user's native language when the user comes near to the digital signage. As for the digital signage that provides multilingual information, several techniques such as the method of displaying information written in several languages in cyclic order, the method of displaying multilingual information simultaneously, and the method of switching display language using touch buttons, have been used [4]. However, these methods have some problems such as the waiting time for the cyclic

display, the limitation of the amount of displayed information, and the requirement for user's touch operation, respectively.

Therefore, it is desired to realize the method of identifying the user's native language and switching the display language on the digital signage automatically when the user comes near to it. We designed the multilingual digital signage that detects the setting language of the user's smartphone and switches the display language according to it when the user comes near to it.

This study aims at realizing the multilingual information service that provides information using the user's native language by integrating the functions of push notification of the smartphone, Web information access in native language, and multilingual digital signage. In addition, iBeacon technology was used as a trigger of executing these three functions in cooperation.

3   System Construction

In this study, a prototype of multilingual information service system was constructed based on the functional requirements. Figure 2 shows the system configuration. This system uses iBeacon as a trigger for activation. iBeacon is a short-range communication technology using BLE (Bluetooth Low Energy), which distributes ID information of the iBeacon device such as proximity UUID (Universal Unique IDentifier), major and minor values. Proximity UUID is the ID number identified as the multilingual information service system, major is the number allocated for each sightseeing area, and minor is the individual number allocated for each device of the iBeacon. This system provides information to the user according to the distributed ID values of the iBeacon.
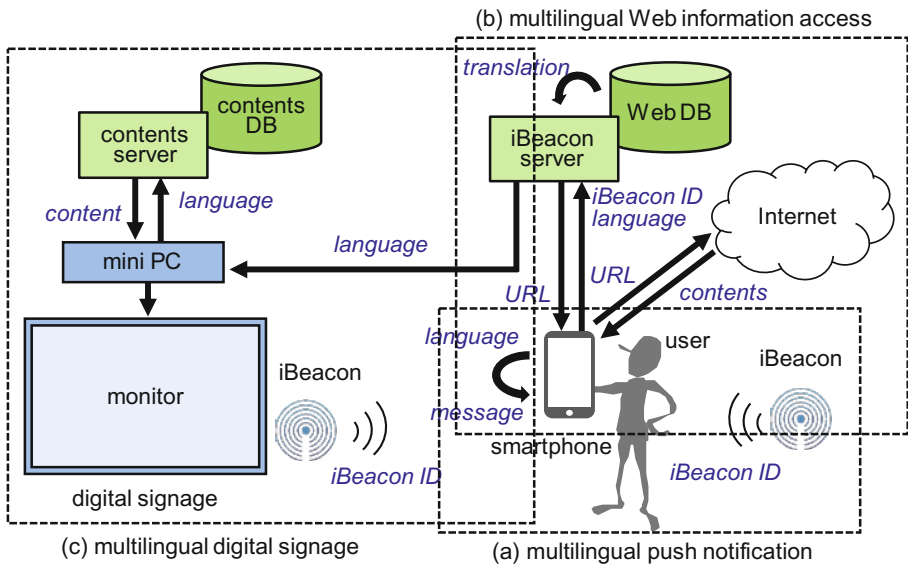

Fig. 2. System configuration of multilingual information service

3.1   Multilingual Push Notification Subsystem

The multilingual information service system consists of three subsystems according to the required functions. The first subsystem is a multilingual push notification subsystem. In this subsystem, when the user's smartphone receives a signal of iBeacon installed in the sightseeing area, a message of local push notification is displayed on the smartphone. Figure 3 shows examples of the screen images in which the notification message is displayed. These messages are displayed on the user's smartphone using the user's native language.

Fig. 3.   Screen images of push notification

In this system, the local push notification is used so that even the foreign travelers who do not have Internet connection can receive the messages. Therefore, the kinds of the displayed messages are limited, and the notification message was divided into some categories such as "There is good sightseeing spot near here", "There is a souvenir shop near here", and "There is a public toilet near here" according to the minor number. In this case, the messages in several languages such as Japanese, English, Chinese, Korean, etc. were prepared beforehand. As for the users whose language is not prepared, English is used as a default language.

Figure 2(a) shows the process flow of this subsystem. When the user's smartphone enters the iBeacon area and receives the BLE signal, the setting language information that means what kind of language is used on the smartphone is checked. According to the setting language and the minor number of the iBeacon, the message is selected and it is displayed as a local push notification. In the case of the iPhone, it can receive the BLE signal when the application program is running in the background or even when it is not running since the function of receiving iBeacon signal is included in the iOS. Therefore, the notification message can be displayed at any time when the user just comes near the iBeacon location.

3.2   Multilingual Web Information Access Subsystem

The next subsystem is a multilingual Web information access subsystem. This subsystem provides a function in which the link to the Web site written in the user's native language is automatically displayed on the user's smartphone, so that the user

can access the webpage written in the mother tongue with one click. In this system, the database that stores the URL information of the webpages for each site and in each language was constructed. By using the database, the button linked to the webpage written in the user's native language can be displayed on the user's smartphone.

In the database constructed on the iBeacon server, minor number of the iBeacon, language type, and URL of the webpage are registerd. If the webpage written in corresponding language already exists, the URL of that page is registered, but if the webpage written in corresponding language does not exist, the URL using Google Cloud Translation API is registered. In this method, the webpage is translated to the corresponding language automatically using Google translation function when it is displayed on the user's smartphone. For the language that is not supported by Google Translation function, it is translated to English as the default language. Figure 4 shows the example of the screen image in which the webpage written in the user's native language is displayed.

Fig. 4. Screen image of Web information access

Figure 2(b) shows the process flow of this subsystem. When the smartphone receives the iBeacon signal, the corresponding URL is retrieved from the database using the minor number and setting language as keywords, and the button linked to the webpage is displayed on the smartphone. In the case of the URL using the Google Translation API, the display language is translated to the setting language of the smartphone when it is displayed on it. By using this method, it would be possible to present the webpage written in the user's native language even if the corresponding page does not exist.

3.3   Multilingual Digital Signage Subsystem

The third subsystem is a multilingual digital signage subsystem. In this subsystem, when the user just comes near to the digital signage, the display language is automatically switched to the user's mother tongue. Though it is difficult to identify the user's mother tongue from the captured image of the user's face or the recorded conversation [5, 6], it can easily be identified by detecting the setting language of the user's smartphone because most people own the smartphone. In this system, the user's native language is identified by sending the setting language information from the user's smartphone to the digital signage according to the trigger of the iBeacon signal [7, 8].

Figure 2(c) shows the process flow of this system. When the user comes near to the digital signage and the user's smartphone receives the signal of the iBeacon attached to the digital signage, the setting language of the smartphone and the minor number of the detected iBeacon are sent to the digital signage server. Each digital signage constantly monitors the language information sent to the server, and when the language information for the concerned digital signage is changed, the digital signage switches the display contents to the corresponding language.

The display program of the digital signage is constructed in the form of a Web application. This application reads the list of display contents registered in the contents database and displays the content sequentially at the constant time intervals. Therefore, by registering the display contents corresponding to various languages in the contents database, it becomes possible to switch the display content according to the user's native language. Also in this case, if the contents corresponding to the user's native language is not registered in the database, the content written in English is displayed as the default language content. Figure 5 shows the example of the screen images in which the display content is switched.

Fig. 5. Screen images of multilingual digital signage

4   Evaluation Experiment

In order to evaluate the effectiveness of the proposed system, evaluation experiment was conducted by installing the iBeacons and the digital signage in actual tourist area. As a place of the evaluation experiment, Shirakawa-go in Gifu prefecture was selected. Shirakawa-go is a village where traditional wooden houses named Gassho-zukuri have existed from the Edo period, and it is registered as a UNESCO World Heritage (cultural heritage), so that it is a famous sightseeing area where a lot of foreign tourists visit every year.

In the experiment, we installed a total of 25 iBeacon devices at some sightseeing spots, restaurants, souvenir shops, photo shops, etc. in Shirakawa-go. Since Shirakawa-go is designated as a World Heritage Site, it is not allowed to place the signboards on the roadside. Therefore, even if the foreign tourists look at the house from the outside, it is difficult for them to understand whether it is a restaurant or a souvenir shop. By using this system, the tourists can obtain necessary information in their native languages when they enter each iBeacon area while walking in Shirakawa-go.

Figure 6 shows the locations where iBeacon devices were installed in Shirakawa-go. As iBeacon devices, MyBeacon of Aplix Corporation was used. There are three kinds of MyBeacon devices: iBeacon for long range use (less than about 30 m), iBeacon for short range use (less than about 2 m), and waterproofing iBeacon for outdoor use, and these devices were used properly according to the installation locations. Each iBeacon device was installed keeping a sufficient distance from each other so that the tourist walking on the road can receive the iBeacon signal certainly and the signals from several iBeacons do not mix with each other. In addition, the digital signage was placed in the tourist information center as shown in Fig. 7.
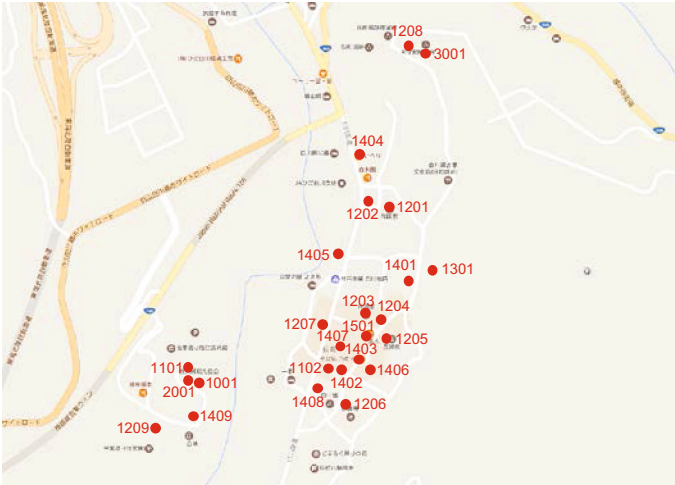

Fig. 6. Locations of iBeacon installation in Shirakawa-go

Fig. 7. Multilingual digital signage placed in Shirakawa-go

In Shirakawa-go area, there are some access points of free Wi-Fi. But, in order to use this system constantly, it is necessary that the smartphone of the foreign tourist is connected to the Internet by using a mobile router or roaming service while he or she is

walking in Shirakawa-go. In addition, it is necessary that the application program is installed in the tourist's smartphone. When the tourists visit Shirakawa-go using public transportation, they must get on a bus for more than one hour from the nearest stations such as Takayama, Toyama or Kanazawa. Therefore, we handed out a leaflet about this service to the travelers at the bus center and the tourist information center so that many tourists install the application program into their smartphones.

As an evaluation experiment, we asked tourists coming from various countries to use this system and to answer the questionnaire. About 70 tourists from China, Taiwan, Hong-Kong, Thailand, etc. used this system, and 14 users answered the questionnaire. Figure 8 shows the results of the questionnaire. In the questionnaire, we asked the users to evaluate the effectiveness and interest for each function of the multilingual information service using five-grade evaluation from 1 to 5. From these results, we obtained generally favorable opinions for each service. In particular, evaluation for the push notification and the digital signage was high. Based on the evaluation experiment, we can conclude that the proposed system can be used effectively as information service for the foreign tourists.
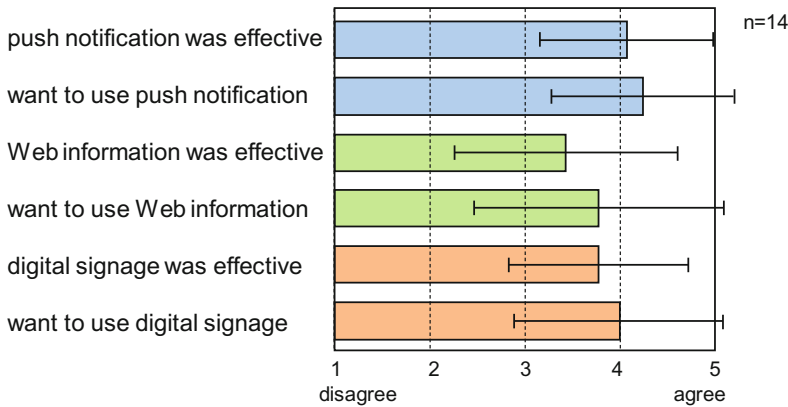

Fig. 8. Results of questionnaire in evaluation experiment

5   Conclusions

In this study, in order to provide the information to the foreign tourist using the user's native language, the multilingual information service system was developed by combining the smartphone and the digital signage based on the iBeacon technology. This system consists of three functions such as displaying the multilingual push notification, accessing to the multilingual Web information, and switching the multilingual digital signage. By using the developed prototype system, evaluation experiment was conducted in the sightseeing area of Shirakawa-go, and the favorable evaluation was obtained from the users.

In the future, we are planning to increase the number and the nationalities of subjects in the evaluation experiment as well as to improve the functions of the prototype system.

In addition, we would like to expand this service to various sightseeing areas as a generalized multilingual information service. Though this system was constructed as a service for the foreign tourists coming to Japan, it can also be applied effectively to the Japanese tourists going to the foreign countries conversely. In the future, it is expected that this function is installed into the OS of the smartphone, so that it can be used as a universal information service in which anyone can acquire necessary information anywhere using the native language.

References

1. Kim, S.: Trends in olympic pictograph design: a comparative study using olympic games' sports symbols. Parsons J. Inf. Mapp. **IV**(4) (2012)
2. Liang, Z., Ogim, T.: The UHD navigation signage system: multi-to-multi interaction approach with smartphone. In: 2016 Asian Conference on Design & Digital Engineering (ACDDE 2016), Jeju, Korea (2016)
3. Kouhne, M., Sieck, J.: Location-based services with iBeacon technology. In: 2nd International Conference on Artificial Intelligence, Modelling and Simulation, pp. 315–321 (2014)
4. Görlitz, G., Schmidt, A.: Digital signage: informal learning in animal parks and zoos. In: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2008, pp. 841-846 (2008)
5. Alt, F., Schneegass, S., Girgis, M., Schmidt, A.: Cognitive effects of interactive public display applications. In: 2nd ACM International Symposium on Pervasive Displays (2013)
6. Diez, H.V., Barbadillo, J., García, S., del Puy Carretero, M., Álvarez, A., Sánchez, J.R., Oyarzun, D.: Interactive Multimodal Platform for Digital Signage, Articulated Motion and Deformable Objects. Lecture Notes in Computer Science, vol. 8563, pp. 128–137 (2014)
7. Ogi, T., Tateyama, Y., Matsuda, Y.: Push type digital signage system that displays personalized information. In: 2014 International Conference on Network-Based Information Systems (NBiS 2014)/INVITE 2014, pp. 411–415, Salerno, Italy (2014)
8. Ogi, T., Ito, K., Konita, S.: Multilingual digital signage using iBeacon communication. In: 19th International Conference on Network-Based Information Systems (NBiS 2016)/INVITE 2016, pp. 387–392, Ostrava, Czech Republic (2016)