Designing Mobile Application to Motivate Young People to Visit Cultural Heritage Sites

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Abstract—This paper presents a mobile phone application developed for sightseeing in Nikko, one of the cultural world heritages in Japan, using the BLE (Bluetooth Low Energy) beacon. Based on our pre-research, we decided to design our application for young people who walk around the area actively, but know little about the tradition and culture of Nikko. One solution is to construct many information boards to explain; however, it is difficult to construct new guide plates in cultural world heritage sites. The smartphone is a good solution to send such information to such visitors. This application was designed using a combination of the smartphone and beacons, set in the area, so that when a tourist passes near a beacon, the application displays information about the area including a map, historical or cultural information about the temples and shrines, and local shops nearby as well as a bus timetable. It is useful for foreigners, too. In addition, we developed quizzes relating to the culture and tradition of Nikko to provide information based on the Zeigarnik effect, a psychological effect. According to the results of our trials, tourists positively evaluated the basic information and young people who used the quiz function were able to learn the historical and cultural points. This application helped young visitors at Nikko to understand the cultural elements of the site. In addition, this application has a function to send notifications. This function is designed to provide information about the local community such as shops, local transportation companies and information office. The application hopes to also encourage people living in the area, and such cooperation from the local people will make this application vivid and inspire young visitors to feel that the cultural heritage site is still alive today. This is a gateway for young people to learn about a traditional place and understand the gravity of preserving such areas.

Keywords—BLE beacon, smartphone application, Zeigarnik effect, world heritage site, school trip.

I. INTRODUCTION

MORE than 50,000,000 tourists visited cultural world heritage sites in Japan in 2011 [1], and the numbers of visitors have been increasing. However, there are two main concerns on cultural world heritage sites, one is the strong restriction on cultural world heritage and another is the negative feeling about cultural heritages of young people [2].

After designation as a world cultural heritage site, the area has been tied to the stereotyped idea where only one object or one place is highlighted. It is the important obligation of the world heritage culture sites to preserve the areas as they were; however, the more architecture that is well preserved, the greater likelihood of these areas attracting the interest of young people. However, they tend to be content to view the famous architecture, while knowing little about the background or other areas around these world heritage sites. Culture is not only in the tangible architecture, it also includes the customs and lives of the people who once resided there. This problem is highlighted even more for foreign tourists, as it is difficult to understand different or past cultures. As tourists, we all tend to look at the famous architecture and be satisfied while knowing little about the background or some other area around the world heritage sites. To solve this problem, the authors decided to develop a new smartphone application that works with BLE beacons, since many young people carry a smartphone. In Japan, for example, some 94.1% of 20 year olds use smartphones, according to a survey by Ministry of Internal Affairs and Communications [3]. By using this application, new signboards are not needed, since the beacons will automatically invoke the display information when a tourist enters the area of a BLE beacon. A smartphone is useful for connecting to cultural places, and the application will create an entrance to world cultural heritage sites as new and interesting places, as well as provide more general information about the local area.

The second problem emerges with school trips. In Japan, 2~3 day school trips are a compulsory as part of the curriculum, and many young students living in the Kanto area in Japan visit cultural world heritage sites in Nikko. As part of the school trip, they visit cultural world heritage sites by bus, walk-around the area at a quick pace, and then get back on the bus and go to the next destination. Often, they do not know the correct etiquette for visiting a shrine, and seldom have a chance to talk with the people living there.

In our survey about Nikko, many such students do not wish to visit there again [2]. The results of the questionnaires showed that the students had already visited the site as part of their school trip and few had good impressions about the area. The visits are too short for these young students to feel some special impression there. We have to consider the psychology of such young students, what kind of things they are interested in and how to show them the characteristic points of the area. It is very important for cultural world heritages to educate such young people. If they do not recognize and value the important significance of the area, Japanese traditional culture will be on the decline.

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The aim of this paper is to introduce research to develop a mobile phone application that works with a BLE beacon for young people and describe the results of experiments from 2012 to 2016 in Nikko [4], one of the cultural world heritages in Japan.

The remaining part of this paper is structured as follows. Section II examines related works. Sections III and IV explain the system and results of testing the application in 2015. Finally, the paper concludes with a discussion of new and traditional information for the cultural sites and futue plans.

II. BACKGROUND

We will discuss a sightseeing support system from two sides. One is the tourists or users of the application, and the other is people living the area, especially the shops owners who use and maintain the system, where they can promote their shops and goods, as well as present their traditional ways of live.

First, we will look at the users. Many smartphone applications for sightseeing exist in Japan, through which tourists can obtain information about restaurants, souvenir shops, the weather, and maps. We had 666 applications of local information in 2015. The number of applications does not reflect the validity of such contents. It showed us there was no successful content yet, as 91% of them were downloaded less than 10,000 times [5]. The developments are proceeding day by day. However, few users support them.

There are several reasons why users seldom use some local applications for sightseeing. One problem is too many applications. Each application has an original interface and their characteristic operations. What does the application's originality mean for tourists? It does not mean usability. People use navigation applications in their everyday lives, which shows them a map, shops, foods, etc. They may feel it is enough to have such usual application when they are on the trip, too. In addition, it is important for them to look at the physical landscapes or beautiful objects when they are on the trip.

From the viewpoint of the resort; shop owners and residents living in the area, local government or tourism associations sometimes assist in creating such a community information application for local development. Those applications have to publish information related to each facility in the same manner, since those applications were developed using public money and should be treated impartially. However, it is not necessary for tourists to know every detail about the area; they want to be advised of specific information based on their interests or needs, or to be notified of areas of interest near the main shrine.

It is necessary to create an application which connects both the local people in the area and tourists. We have to consider both sides.

III. RELATED WORKS

A. Information Technology for Tourism

Recent smart phones have many sensors. In Table I, functions, devices and relation and related tourist information are described. Many devices can be used to get information and find the location of a tourist destination. Using such functions, there are a lot of trials of applications such as location-based services with AR, games, urgent information alert systems etc. [6].

In the EU, The TAG CLOUD (Technologies lead to Adaptability & lifelong enGagement with culture throughout the CLOUD) project is a remarkable system using smartphone technology to provide information about traditional cultural sites [7]. This project by the Community Research and Development Information Service was launched to investigate ways of enabling cultural engagement using cloud-based technologies to show cultural heritage content to tourists. The TAG CLOUD is a cloud service, which means that tourists to have Internet access. On the other hand, our application is designed to work without the cloud, as Internet access is sometimes limited in rural areas.

TABLE I
FUNCTIONS AND DEVICES IN THE SMARTPHONE

Functions	Devices in the smartphone	Relation to the tourist
	3G/LTE	Download
Communication	Wi-Fi	Download/Find Location(Indoor)
	BT	Find Location(Indoor)
Location	GPS	Find Location(Outdoor)
Near Field Communication	NFC	
	RFID	Get small Information
	BLE	
	Accelerometer	Detect Stress
Motion Sensor	Gyro	Detect Movement
	Compass	Detect Direction
Picture	Camera	Get Picture/Get Small Information/ Though 2D Barcode

B. Psychology for Tourism

For the Zeigarnik effect, which we apply in this paper, a study made by Greist-Bousquet and Schiffman in 1992 [8] provided evidence. The Zeigarnik effect carries the name of Bluma Zeigarnik, a Lithuanian-born psychologist. This effect explains that completed tasks are less recalled than uncompleted tasks.

There are several related works about environmental psychology and tourism. Pearce and Stringer [9] studied from the viewpoint of physiology, cognition and individual variation etc., Fridgen [10], van Raaij [11], Sasaki also studied about this field. Especially, Sasaki mentioned that we can segment a tour into three scenes: before the trip, during the trip, and after the trip [12]. We researched these three scenes in our trials.

C. Our Previous Works

Junior high school and high school students go on several school-sponsored day trips to learn about history and nature in a proactive way in Japan. Students study history and the value of the objects before visiting the area in the classroom for several hours. However, students cannot fully grasp the artistic or cultural value in the classroom. In addition, when they visit

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the area, they seldom look at their notebooks, which they have worked on in the classroom. To make their learning more deeply, we developed a new learning model for outdoor study [13]-[15].

We, human beings, do not recognize all the things that we see; we notice only some characteristic points or certain images. For example, it is sometimes difficult to find some different points in two similar photos or pictures in the game of photo hunt. However, once finding the different points, we cannot help seeing them. By using the quizzes, we draw students' attention to particular points on the trip.

IV. OUR BEACON SYSTEM

We created our application in order to connect people in the Nikko area and young tourists. At first, we configured the basic information; navigation to temples and shrines, bus schedules, and local store information. Then we created a function of walk rally to enjoy quizzes during walking from the Nikko station to the main shrine. All of them could incarnate by BLE beacons.

The BLE beacon is a recent technology for local communication. Many trials have been conducted for location-specific information, shopping information in shops and some indoor places [16]-[18]. However, cases using the BLE beacon for outdoor use have rarely been discussed in the literature. This system uses the BLE beacons outside for the following reasons:

1) Using GPS reduces battery life; however, it is important for tourists to use smartphone to contact someone or somewhere, especially for young people who are habitual smartphone users. The BLE beacon uses less battery power, and therefore, extends the battery life beyond that for the GPS use.

2) We would like to present the local information to create a sense of interest and curiosity when users are in Nikko area. This information is suitable to use in near field communication.

There are other interesting locations and objects in that area. Unfortunately, tourists usually are unaware of the unseen or hidden parts, and seldom take the time to notice them.

Japanese shrines, including Toshogu at Nikko, are located far from train stations, which is inconvenient for many travelers. However, traditionally, travelling on the long route to the shrine is the central feature. There are wells en route to the main shrine, where visitors purify themselves by washing their hands. If they do not know the tradition, they would not be aware of the meaning of the long walking route and may not sense one of the important cultures and traditions of the world heritage site. Currently, there are no explanations about such customs along the way, and also, it is difficult to find such information online and only locals or elderly Japanese are aware of such methods and accept them as common practice. There are no signboards, and, it is difficult to set up new signboards at world heritage sites.

We planned to use BLE beacons to create a new traditional route to the main shrine, Toshogu at Nikko. In addition, we tried to the display messages that were created by local residence on a smartphone.

Fig. 1 Beacon map at Nikko

The beacons were set on lampposts 100 m apart, as shown in Fig. 1. Fig. 2 shows our original beacons. The bigger square

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ones are for shops (indoor use) and the smaller round ones are for the poles (outdoor use) on the way to the main shrine, which are set 100m apart. Table III explains the two kinds of beacons. The round beacons are set on the small signboard on the poles, which are made of steel, and which make it possible to send out the radio waves in one direction. In addition, one of our staff wore a beacon at the trial of walk rally with quizzes. He was a moving beacon. He walked around the area, and if participants found him, they got a bonus point. There are a lot of ways to make use of the beacon and we tried several.

Fig. 3 shows some of the screen shots. Users can choose a language from Japanese, English, Chinese or Thai (Fig. 3 (a)). Fig. 3 (b) shows the seasonal information sent by using the push notification service. The third screen shows the locations of the temples and shrines together with brief explanations. The right screen is the beacon collection. Each function has more detailed content. For example, Fig. 4 shows the bus function, where a user can see the timetables for a selected bus stop.

Fig. 2 Beacons (a) two kinds of beacons (b) a beacon on the pole

TABLE II
TWO KINDS OF BEACONS

Installation location		Battery	Battery life	Contents	Notes
Indoor	In the shops	dry cell	2 years	Shop information	
Outdoor	On the poles	micro cell	1/2 ～ 1 year	Short information, Bus timetable, Cultural Navigation, Quiz	water proof
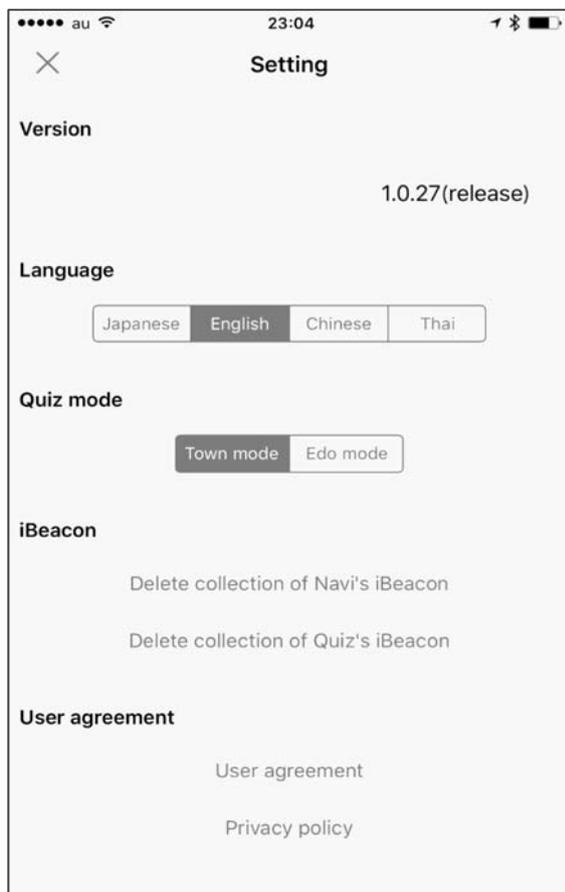
| (a) | (b) |

Fig. 1 Screenshots of our application (a) setting page (b) seasonal information

Almost of all the functions are administered by the developer now; however, the seasonal information is provided by local shop owners, who can easily input relevant seasonal information using a PC (see Fig. 5). The screen shot in Fig. 3

(b) shows a sample of the seasonal information.

After speaking to shop owners who maintain their traditional ways, it was clear that they would like to have the opportunity to tell their cultural or seasonal information to all

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visitors. However, there are few chances to speak with young students who visit Nikko of school trips or with foreign visitors; many shop owners do not speak English well. We,

therefore, planned to implement the function for the residents and shop owners in Nikko in order to maintain this system in the area.
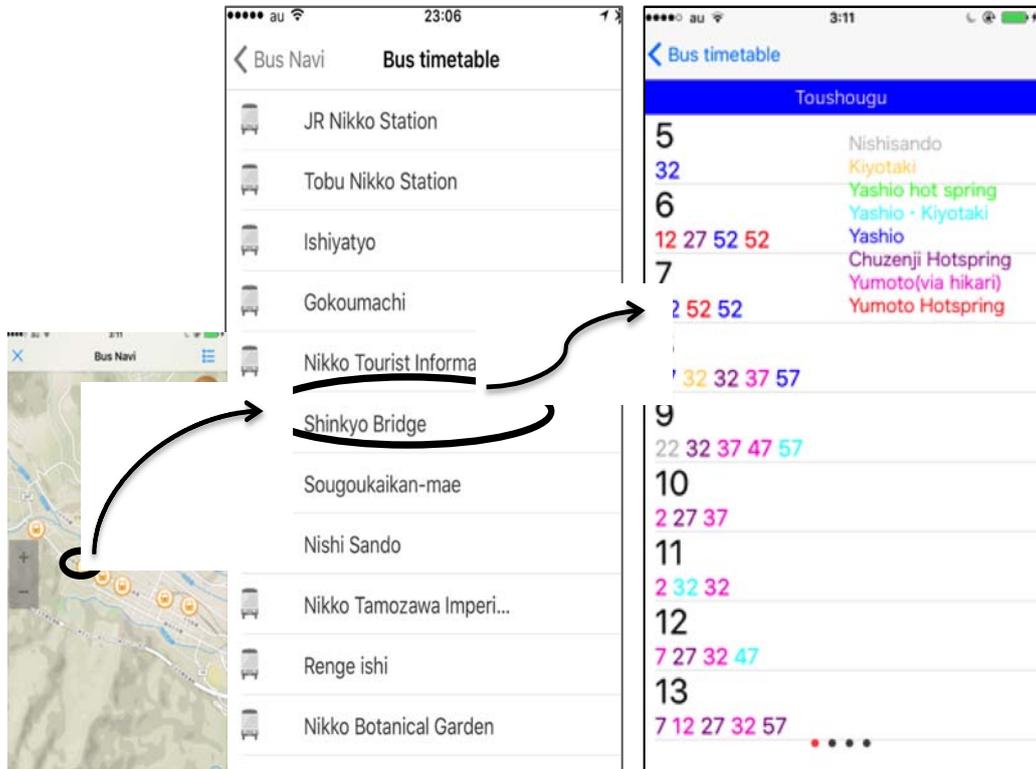
Fig. 4 Bus time tables

Fig. 5 The screen which shop owner input seasonal information

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Fig. 6 explains the software components of this application. BLE scanning function always waiting the advertising message. When the operating system (OS) receives an advertising message, it is forwarded to the application. In the case of the Core Location framework of iOS (7 or later), it provides three properties of proximity UUID, major and minor.
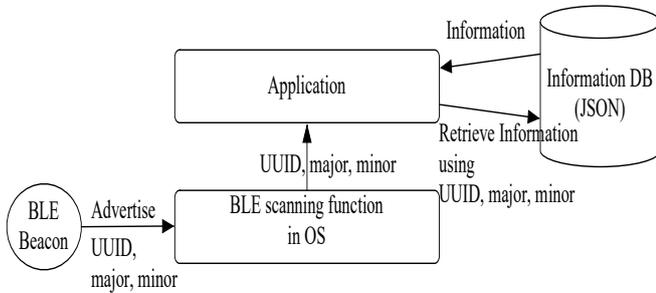

Fig. 6 The software components

V. RESULT OF THE RESEARCH FOR TOURISTS

A. Basic Information

Useful information and maps relating to the temples and shrines, local shops, and bus timetables at Nikko, are available in the proposed application. We installed a button to answer the questionnaire at the top left part of the home screen of our application.

We asked tourists to install the proposed application at Tobu Nikko Train Station during 29th-30th August, 26th-27th September and 8th November 2015. Some users responded to an online questionnaire voluntarily after using this application.

The total number of respondents was 57: English speakers (Foreigners) 15 and Japanese 42. Users tended to rate our application as convenient, interesting and helpful. However, a larger percentage of foreigners selected these words than the Japanese participants. Less than half of the Japanese tourists (47.62% - 20 persons) responded that this application was "Convenient", while 73.33% (11 persons) of the foreigner respondents described it as such. Fig. 7 shows an evaluation of the operation of the proposed application. Evaluation by foreigners was higher than the Japanese respondents for operation, too. Foreigners have little information available en route to the main shrine now, and therefore, they are more likely to find this application useful for them.
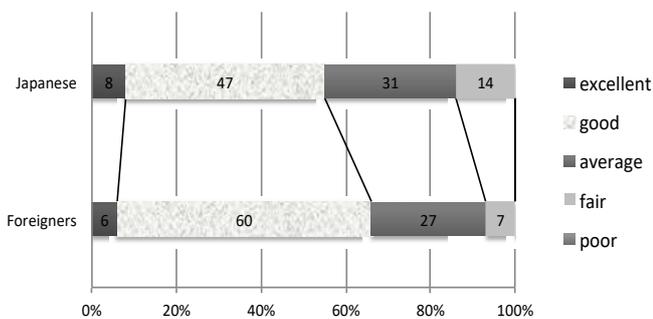

Fig. 7 Evaluation of the operation (%)

B. Quiz Function

The same beacons were used for the source of the quizzes along the journey. This new quiz application was tested on 26th-27th September, 2015.

Twenty-eight students from Utsunomiya University and Chuo University participated in the trial, of which, 23 of them answered 10 quizzes on the route to the main shrine. 5 students walked without the application for comparison. Meanwhile, 23 students took part in quizzes just before arriving at some traditional objects. They answered questions and then went on to verifiy the responses at the actual sites. This study is based on the Zeigarnik effect discussed earlier.

After the test, the students were asked to answer several questions, including their evaluation of the area in Nikko. We analysed their answers regarding the proposed application. The results of the cluster analysis are shown in Table III. Using Ward's method, the data were then classified into three clusters. Cluster 1 tended to evaluate the tangible factors of the application. Cluster 2 tended to provide a general impression. Cluster 3 evaluated the content (the quizzes) and the map that was being used for the quiz rally. Each coloured article reflected the highest numerical value in the three clusters. Participants answered the same questionnaires about the evaluation of Nikko twice: before the visit and two months later.

After visiting the site, the evaluation of "History/Culture" was higher than before for all clusters. Table III shows the change of their evaluation. Each coloured article is the highest numerical value of the three clusters. There are remarkable features in cluster 3; they evaluated six factors higher after the trip than prior. In the other two clusters, only two or three factors were evaluated higher. In cluster 3, particularly, they evaluated 'History/Culture' high; the numerical value increased by 1.5 points after the trip, in the five-point Likert scale. However, they evaluated 'interaction with local people' lower than in the other two clusters.

After two months, the impressions of the application and the evaluation of the user interface had faded from the minds of users in cluster 1. However, according to the answers from those in cluster 3, the quiz content helped to make the area more attractive-than before.

We researched not only the evaluation of the proposed application, but also the memories that it created in the minds of participants and their understanding of the cultural site and motivation for repeating to visit Nikko. Two months after their visit, participants were also asked to draw a map of the walk from the station to the main shrine.

Fig. 8 shows the hand-drawn map of one participant, who was able to recall and write 21 Japanese words in a map, of which, nine related to the location; shrine, train station, steps, bus stop, ticket box, tourist information center, river, gate and red bridge; while seven were the names of food items sold at the local shops. For example, the participant wrote Yuba Manju (sweets) and Tamarizuke (pickles), which are traditional foods from Nikko. The remaining four words recalled were; convenience store, souvenir, rent-a-car, and fortune slip. Most of his words were unrelated to the quizzes;

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however, he looked at these objects or locations when he stopped at beacon points.

Application users wrote 9.18 objects on average in their maps. Non-applications users wrote down 5.80 objects on average. Students who used our application tended to remember the shops around the beacons.

TABLE III
EVALUATIONS ABOUT FACTORS FOR THE TRAVEL OF THREE CLUSTERS
(BEFORE AND AFTER THE TRIP/ 5 POINTS' LIKERT SCALE)

| Cluster	1	2	3	1	2	3	1	2	3
Nature Landscape	5.0	5.0	3.8	4.4	4.8	4.5	-0.6	-0.2	0.8
History Culture	4.3	4.7	3.3	4.4	4.8	4.8	0.1	0.1	1.5
Street	4.4	4.3	4.5	4.0	3.8	4.0	-0.4	-0.5	-0.5
Hot Spring	4.1	3.7	3.5	3.6	3.5	3.3	-0.6	-0.2	-0.3
Traditional performing art/ Specialty	3.9	4.0	3.8	3.7	3.8	4.0	-0.1	-0.2	0.3
Food	4.7	4.4	4.3	3.7	3.8	4.8	-1.0	-0.6	0.5
Experience-based tour	3.4	3.6	2.5	3.0	2.8	3.8	-0.4	-0.7	1.3
Shopping	4.1	3.1	3.5	3.0	3.2	3.8	-1.1	0.0	0.3
Night Spot	3.7	3.0	4.5	3.0	2.7	3.0	-0.7	-0.3	-1.5
Relationship with people	2.8	3.3	3.0	3.7	3.3	3.0	0.9	0.0	0.0
Easy reservation	4.0	3.3	3.8	3.0	3.2	3.0	-1.0	-0.1	-0.8
Hotel charges	4.6	3.7	5.0	3.0	3.2	3.5	-1.6	-0.5	-1.5
Traffic convenience	4.7	4.4	4.5	3.3	3.5	1.8	-1.4	-0.9	-2.8
Commodity price	4.1	3.6	3.8	3.0	3.8	3.3	-1.1	0.3	-0.5
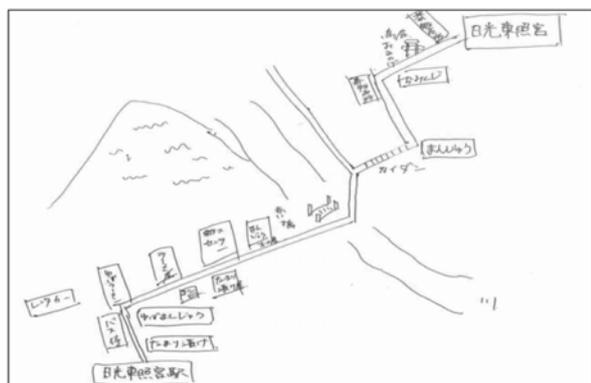
Fig. 8 A map after two months (from the station to the main shrine)

VI. CONCLUSION

We have developed a mobile application using a BLE beacon in Nikko in order to encourage young people to be more active and engaged in cultural sites. To analyze the performance of the proposed application, several tests were conducted with visitors to the chosen cultural site.

The results confirmed that young people received basic information relating to Nikko from the application and were interested in the history and culture of the area in our trials. They understood the historical and cultural value of Nikko and the importance of preservation of that area. The authors believe that if young people fail to appreciate customs or traditional ways of thinking, then it is possible the site would become a ruin.

How can we inform visitors about the attractions of a cultural heritage area? If the attractions were only architecture, then some tourists would not want to revisit. And if the cultural heritage only preserves the architecture, then it will be comparable to a theme park.

People are still living in and around cultural heritage sites and continuing traditional customs, and it is there locals that have unique information to offer tourists. Shop owners cooperated in the project, contributing vast traditional knowledge, as well as interacting with tourists.

We would like to support such seeds of hospitality to connect with tourists through the use of the proposed application. For example, in the discussion of the requirements of the application, locals recommended the introduction of the multilingual function to make it possible to communicate with the foreign visitors. The bus timetable in Nikko area was also provided for tourists. However, not only tourists, but also the Tourism Association staff use this function frequently to assist tourists. In addition, the results of our research showed good effects for the behavior of tourists. The walk to the main shrine from the train station takes about 10-15 minutes. For most foreign visitors, the final destination is the main shrine, and they tend to walk very fast. However, by using the application, the visitors were sometimes interrupted en route by a beacon and discovered not only the quiz content, but also shops and amenities located around the beacons (see Fig. 8).

In 2015, "Sites of Japan's Meiji Industrial Revolution: Iron and Steel, Shipbuilding and Coal mining" was selected as an industrial heritage sites [19], which is a collection of eight locations. One part of this heritage site is used still by a company today. Although it is not cultural heritage site, we have to consider how tourists can understand the site as a living place and what has been inherited in that area from the Meiji era.

We would like to continue this project for cultural interaction between people living in the area and people visiting. Trials of the application with beacons in Kagoshima, one of the locations of "Sites of Japan's Meiji Industrial Revolution: Iron and Steel, Shipbuilding and Coal mining", will be begin in autumn of 2016.

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