Available online at www.gieas.org
Gl Engineering, Technology Applied Sciences Forum

FULL PAPER PROCEEDING
Multidisciplinary Studies
Engineering and Technology Studies

Full Paper Proceeding ETITR-2022, Vol. 4, 1-9

ISBN: 978-969-695-070-7

ETITR 2022

Evaluation of a Non-Linguistic Tourism Information System in Mountainous Areas

Shinya ABE[1], Kayoko YAMAMOTO[2]*

[1] Tokyo Metropolitan Industrial Technology Research Institute
[2] Graduate School of Informatics and Engineering, The University of Electro-Communications

Abstract

Despite continuing efforts to translate information systems as part of preparations for hosting foreign visitors in Japan, the language barrier cannot be completely overcome by translation alone because it is not possible to convey important information in a sufficient number of languages. To address this issue, we developed a system that provides only non-linguistic tourism information. The defining characteristic of our system is its user interface comprising only public information symbols, images, and Arabic numerals. In this paper, we discuss field tests conducted to evaluate the system in mountainous areas and demonstrate that the system's response performances are about the same as our related works.

Keywords: Non-Linguistic Information, Tourism Information System, User Interface, Response Performance

Introduction

Beyond the Tokyo Olympic and Paralympic Games, tourism information systems should be developed that are straightforward and convenient for international visitors as well as Japanese people. Several existing systems have been tailored to international visitors, but the language barrier remains problematic as an increasingly diverse range of people visiting Japan [1].

Recently, there have been efforts to translate such systems in order to overcome the language barrier. For example, a study revealed that translation is a part of most academic endeavors to promote inbound tourism and prepare Japan to host foreign visitors [2, 3]. Ongoing initiatives to develop systems for hosting inbound tourists have roots in academia; however, the Japanese government has not unveiled specific tourism policies involving anything other than translation [4, 5]. Additionally, although the Japan Tourism Agency has released 16 application forms for foreign tourists as of October 25, 2021, none of them goes beyond translation into another language [6].

Unfortunately, the language barrier cannot be completely overcome by translation alone because it is not possible to convey important information in a sufficiently large number of languages. To address this issue, and in recognition of the limits of language in conveying information, we have proposed a tourism information system based on only non-linguistic information [7, 8, 9].

In this paper, we discuss our system and its characteristics as well as tests we conducted to evaluate the system in mountainous areas, and demonstrate that the system's response performance is sufficient for practical use.

II. NON-LINGUISTIC TOURISM INFORMATION SYSTEM

In this section, we describe the non-linguistic tourism information system we developed. The user interface of our system comprises only public information symbols, Arabic numerals, images, geographic information, and other forms of non-linguistic information. A screenshot from the system is shown in Fig. 1. Our system uses the standard set of public information symbols from Japanese Industrial Standards to show users different tourist attractions and modes of transportation [10]. To make the travel times, fees, and other information presented in Fig. 1 universally understandable, our system uses only Arabic numerals to display them. Images and geographic information show users how to reach tourist attractions.

The tourist attraction retrieval interface is similarly non-linguistic [11, 12, 13]. It comprises selectable buttons with tourist attractions and modes of transportation rendered as public information symbols, and drop-down lists with travel times and fees rendered in Arabic numerals (Fig. 2).

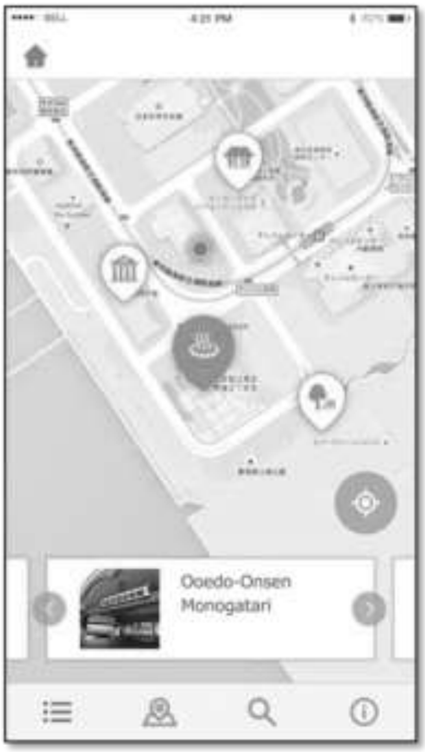

Figure. 1. Non-linguistic tourism information system (Maps © 2021 Google LLC)

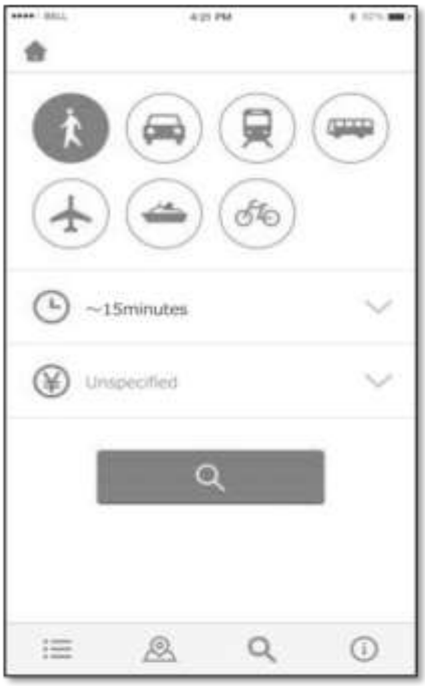

Figure 2. Non-linguistic information retrieval interface

Non-linguistic information retrieval interfaces do not give users as much freedom to enter search terms as their linguistic counterparts, and thus might not return results as closely aligned to users' intent. In this paper, we include a tourist attraction recommendation function and an interactive search function to counter these disadvantages. Fig. 3 shows the recommendation function. Here, the function recommends four attractions, which are shown at the bottom of the Fig. 3. If a search fails to return the desired result, users can try the recommended attractions to obtain the information they seek. Users can also filter recommended attractions from the information retrieval interface (Fig. 2).

Next, we discuss how the system makes recommendations. In advance, it assigns values to the correlations between tourist attractions. The data are structured in a network with the attractions as nodes and the correlations as links. When the user selects an attraction, the system displays all directly correlated attractions—that is, all attractions that have a direct link to the selected attraction. When the user applies a filter, the system displays linked attractions that meet the filter criteria.

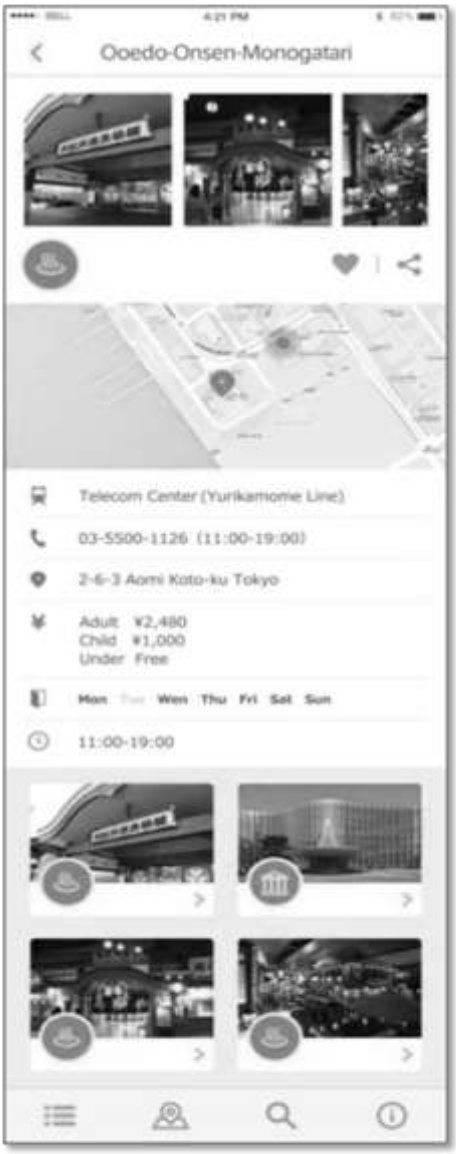

Figure 3. Tourist attraction recommendation function (Maps © 2021 Google LLC)

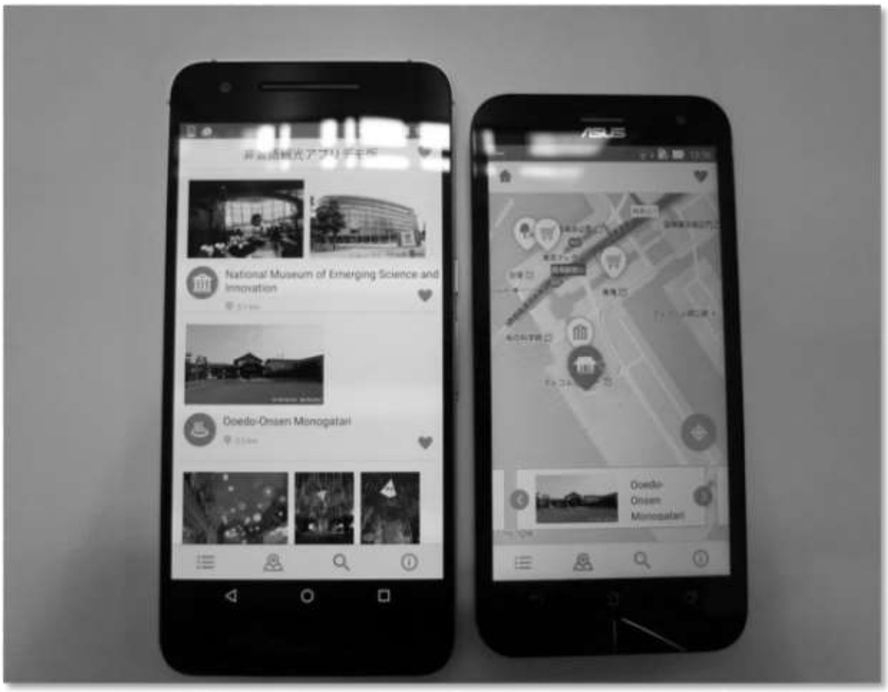

Figure.4. Prototypes (Maps ©2021 Google LLC)

III. EVALUATION OF RESPONSE PERFORMANCES IN TAMA AREA

Non-linguistic tourism information systems provide directions to nearby tourist attractions by superimposing public information symbols, images, and other non-linguistic information on maps and updating as required by the situation. Accordingly, data acquisition time impacts the systems' response performance. The impact is pronounced when the interactive search function is activated. Additionally, non-linguistic information generally involves larger amounts of data than linguistic information. Therefore, we would expect a non-linguistic tourism information system to have worse response performance than a linguistic tourism information system.

In this paper, we present our evaluation of the response performance of the non-linguistic tourism information system we developed. Fig. 4 shows an image of the prototypes we used to conduct the tests. We installed our non-linguistic tourism information system onto the prototypes as Android applications. We conducted the tests in Tama area. At each station, we measured the acquisition time for three-dimensional positional information (longitude, latitude, elevation) of nearby tourist attractions as well as three-dimensional routing information (directions, slopes) from the stations to the tourist attractions. We performed each measurement 10 times and used the slowest time as our measured value, that is same as our related works [14, 15, 16, 17]. It is worth noting that no suspected outliers were observed during the tests.

TABLE 1 shows the results of tests at stations on JR Ome Line Tachikawa to Ome. We conducted the tests on November 12, 2021. The longest acquisition times for three-dimensional positional and routing information were 1.99 s and 2.78 s, respectively.

TABLE 2 shows the results of tests at stations on JR Ome Line Miyanohira to Oku-Tama. We conducted the tests on November 29, 2021. The longest acquisition times for three-dimensional positional and routing information were 2.49 s and 3.42 s, respectively.

TABLE 3 shows the results of tests at stations on Keio Takao Line. We conducted the tests on December 7, 2021. The longest acquisition times for three-dimensional positional and routing information were 2.18 s and 2.99 s, respectively.

TABLE 1
ACQUISITION TIMES ON JR OME LINE
(TACHIKAWA TO OME)

Station	Positional information (s)	Routing information (s)
Tachikawa	1.74	2.56
Nishi-Tachikawa	1.68	2.49
Higashi-Nakagami	1.66	2.47
Nakagami	1.65	2.62
Akishima	1.67	2.46
Haijima	1.66	2.40
Ushihama	1.72	2.47
Fussa	1.71	2.50
Hamura	1.71	2.55
Ozaku	1.80	2.66
Kabe	1.91	2.78
Higashi-Ome	1.99	2.69
Ome	1.97	2.56

TABLE 2
ACQUISITION TIMES ON JR OME LINE
(MIYANOHIRA TO OKU-TAMA)

Station	Positional information (s)	Routing information (s)
Miyanohira	1.99	2.59
Hinatawada	2.01	2.65
Ishigamimae	1.87	2.65
Futamatao	1.97	3.14
Ikusabata	2.08	3.26
Sawai	2.34	3.16
Mitake	2.03	3.24
Kawai	2.47	3.36
Kori	2.49	3.39
Hatonosu	2.22	3.15

Shiromaru	2.32	3.42
Oku-Tama	2.27	3.37

TABLE 3
ACQUISITION TIMES ON KEIO TAKAO LINE

Station	Positional information (s)	Routing information (s)
Kitano	1.90	2.57
Keio-katakura	1.97	2.63
Yamada	1.91	2.54
Mejirodai	1.92	2.68
Hazama	1.98	2.58
Takao	1.96	2.74
Takaosanguchi	2.18	2.99

IV. EVALUATION OF RESPONSE PERFORMANCES IN HAKONE AREA

Next, we discuss the evaluation tests we conducted at Hakone area. The methodology and evaluation items were the same as our related works [14, 15, 16, 17].

TABLE 4 shows the results of tests at stations on Hakone Tozan Railway. We conducted the tests on June 11, 2021. The longest acquisition times for three-dimensional positional and routing information were 2.13 s and 3.89 s, respectively.

TABLE 5 shows the results of tests at stations on Hakone Tozan Cablecar. We conducted the tests on June 18, 2021. The longest acquisition times for three-dimensional positional and routing information were 2.12 s and 4.02 s, respectively.

TABLE 6 shows the results of tests at stations on Hakone Ropeway. We conducted the tests on July 2, 2021. The longest acquisition times for three-dimensional positional and routing information were 1.82 s and 4.13 s, respectively.

TABLE 4
ACQUISITION TIMES ON HAKONE TOZAN RAILWAY

Station	Positional information (s)	Routing information (s)
Odawara	1.56	2.89
Hakone-Itabashi	1.53	2.83
Kazamatsuri	1.67	2.92
Iriuda	1.72	2.89
Hakone-Yumoto	1.90	2.81
Tonosawa	1.99	2.83
Ohiradai	2.13	3.50

Miyanoshita	2.10	3.68
Kowakidani	2.06	3.73
Chokokunomori	2.04	3.84
Gora	2.02	3.89

TABLE 5
ACQUISITION TIMES ON HAKONE TOZAN CABLECAR

Station	Positional information (s)	Routing information (s)
Gora	2.12	3.78
Koen-Shimo	2.00	3.96
Koen-Kami	1.99	3.78
Naka-Gora	2.02	4.02
Kami-Gora	2.05	3.84
Sounzan	1.96	3.91

TABLE 6
ACQUISITION TIMES ON HAKONE ROPEWAY

Station	Positional information (s)	Routing information (s)
Sounzan	1.82	3.96
Owakudani	1.79	4.07
Ubako	1.77	4.13
Togendai	1.34	3.40

V. EVALUATION OF RESPONSE PERFORMANCES IN NIKKO-KINUGAWA AREA

Next, we discuss the evaluation tests we conducted at Nikko-Kinugawa area. The methodology and evaluation items were the same as our related works [14, 15, 16, 17].

TABLE 7 shows the results of tests at stations on JR Nikko Line. We conducted the tests on August 3, 2021. The longest acquisition times for three-dimensional positional and routing information were 2.25 s and 3.57 s, respectively.

TABLE 8 shows the results of tests at stations on Tobu Kinugawa Line. We conducted the tests on August 20, 2021. The longest acquisition times for three-dimensional positional and routing information were 2.08 s and 3.46 s, respectively.

TABLE 7
ACQUISITION TIMES ON JR NIKKO LINE

Station	Positional information (s)	Routing information (s)
Utsunomiya	1.85	2.86

Tsuruta	1.54	2.38
Kanuma	1.67	2.97
Fubasami	1.46	3.15
Shimotsuke-Osawa	1.79	3.57
Imaichi	2.25	3.36
Nikko	1.95	2.28

TABLE 8
ACQUISITION TIMES ON TOBU KINUGAWA LINE

Station	Positional information (s)	Routing information (s)
Shimo-imaichi	2.08	3.46
Daiyamuko	2.06	3.27
Okuwa	1.66	2.76
Shin-takatoku	1.82	2.75
Kosagoe	1.69	2.89
TOBU WORLD SQUARE	1.85	2.94
Kinugawa-onsen	1.78	2.93
Kinugawa-koen	1.56	2.84
Shin-fujiwara	1.80	2.91

VI. CONCLUSION

In this paper, we presented an evaluation of our non-linguistic tourism information system. We conducted tests to evaluate response performance Tama area, Hakone area and Nikko-Kinugawa area. The results were about the same as our related works.

We will continue evaluating performance from the perspective of non-Japanese users by conducting tests along railways in Central Tokyo area.

ACKNOWLEDGMENT

This work was supported by JSPS KAKENHI Grant Number JP19K20578

References

[1] Yoshihiro KAMEYAMA, Peng-na HOU: Inbound Growing and Information Transmission of Local Government, *Annals of the Association of Economic Geographers*, Vol. 62, No. 3, pp. 191-209, 2016.

[2] Reiko FUJITA: Tourism Informatics: 2. Role of ICT in Tourism Policy, *Journal of Information Processing*, Vol. 53, No. 11, pp. 1140-1145, 2012.

[3] Kiyotaka UCHIMOTO, Yutaka ASHIKARI, Hisashi KAWAI, Eiichiro SUMITA: Multilingual Speech Translation Technology, *Journal of Tourism and Information*, Vol. 13, No. 1, pp. 31-38, 2017.

[4] Japan Tourism Agency: Kankoken seibi jigyo no know-how ni kan suru kiso shiryo (Foundational Expertise on Tourism Area Development Projects), September 2, 2020. [online]. Available:

http://www.mlit.go.jp/common/000161119.pdf (Japanese)
[5] Japan Tourism Agency: Kanko rikkoku jitsugen ni muketa tagengo taio no kaizen/kyoka no tame no guideline (Guidelines for Improving and Enhancing Multilingual support for Realizing the National Commitment to Tourism), September 4, 2020. [online]. Available: *http://www.mlit.go.jp/common/001029742.pdf* (Japanese)
[6] Japan Tourism Agency: Smartphone app to no teikyo (Providing Smartphone Apps), September 11, 2020. [online]. Available: *http://www.mlit.go.jp/kankocho/shisaku/kokusai/appli.html* (Japanese)
[7] Shinya ABE, Daisuke MIKI, Kayoko YAMAMOTO: A Tourism Information System with Language-Barrier-Free Interfaces for Foreign Visitors, *Proceedings of International Conference on Marketing and Tourism*, pp. 58-66, 2017.
[8] Marzieh ALIABADI FARAHANI, Shinya ABE, Daisuke MIKI, Kayoko YAMAMOTO: MR Navigation System Using Non-Linguistic Information, *Proceedings of the Annual Conference on Engineering and Applied Science*, pp. 320-331, 2016.
[9] Shinya ABE, Daisuke MIKI, Kayoko YAMAMOTO: A Tourism Information System with Language-Barrier-Free Interfaces, *Proceedings of 80th National Convention of IPSJ*, 2018.
[10] Japanese Industrial Standards: *JIS Z 8210 Public Information Symbols*, 2017.
[11] Shinya ABE, Nagi YOSHITSUGU, Daisuke MIKI, Kayoko YAMAMOTO: An Information Retrieval System with Language-Barrier-Free Interfaces, *Journal of the Information Systems Society of Japan*, Vol. 14, No. 2, pp. 57-64, 2019.
[12] Shinya ABE, Kayoko YAMAMOTO, Daisuke MIKI, Marzieh ALIABADI FARAHANI: Information Retrieval Methods, Information Retrieval Programs, Terminals for Information Retrieval, and Information Retrieval Devices, Patent Application No. 2016-155123, 2016.
[13] Shinya ABE, Ryo SASAKI, Kayoko YAMAMOTO, Sightseeing Support System with Augmented Reality and No Language Barriers, *Urban Informatics for Future Cities*, pp.591-611, 2021.
[14] Shinya ABE, Ryo SASAKI, Kayoko YAMAMOTO, Evaluation of a Non-linguistic Tourism Information System in the Tama Area of Tokyo, *Proceedings of the International Conference on Engineering, Applied Sciences and Information Technology*, Vol. 3, pp. 8-18, 2021.
[15] Shinya ABE, Kayoko YAMAMOTO, Evaluation of a Non-linguistic Tourism Information System in the Haneda and Narita Areas, *Proceedings of Global Conference on Changing Paradigm in Engineering and Applied Sciences Research*, Vol. 4, No. 36, pp. 10-17, 2021.
[16] Shinya ABE, Kayoko YAMAMOTO, Evaluation of a Non-Linguistic Tourism Information System in the Metropolitan Area, *Proceedings of Emerging Trends in Information Technology, Robotics, Design, Engineering and Applied Science*, Vol.3, pp.1-9, 2021.
[17] Shinya ABE, Kayoko YAMAMOTO, Evaluation of a Non-Linguistic Tourism Information System along the Shinkansen Lines, *Proceedings of Process & Project Engineering, Information Technology, Applied Sciences*, Vol.3, pp.1-7, 2021.