















Figure 4. Developed web pages regional information added

Operating web page of bus location system

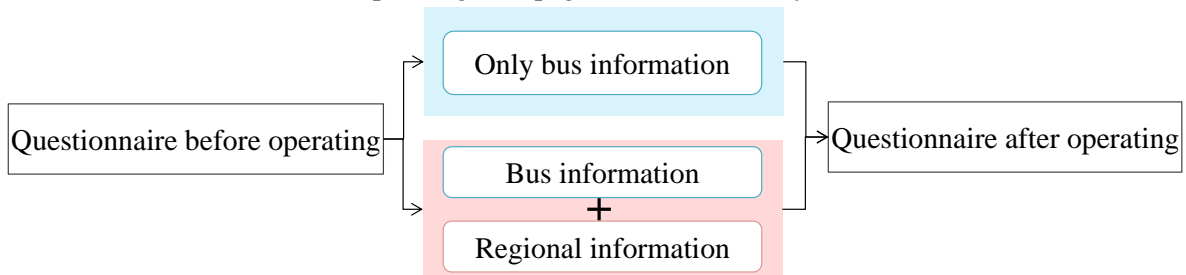


Figure 5. Survey flow of subjects' consciousness

## 5. QUESTIONNAIRE SURVEY

In order to grasp passengers' consciousness on the information provided by the developed bus information system, we conducted a questionnaire survey at Chita city on December 10, 2011.

### 5.1 Method of Questionnaire Survey

For this survey, we brought some PCs which could communicate to the Internet to the Chita Civic Gymnasium where we conducted the survey. Two web pages were provided to subjects by Google Maps in order to grasp an effect of providing regional information in addition to the bus information on promotion of bus usage and regional vitalization. One page provided only static and real-time bus information and another page provided regional information in addition to the bus information. When a bus stop icon on the map is clicked, bus stop name, timetable of the bus stop and facility information around the bus stop are displayed (the left of Figure 4). When a facility icon on the map is clicked, facility name, address, telephone number, a picture of the facility and business hours are popped up (the right of Figure 4).

Figure 5 shows a survey flow of subjects' consciousness. First, we asked subjects' attributes and their consciousness on a bus before operating the bus information system. Next, we separated the subjects into two groups in which the numbers of subjects were equal. Each subject operated one of two pages, in which "Only bus information" page provided "real-time bus location", "bus route" and "location of a bus stop" and "Regional information added" page provided regional information in addition to the bus information. The regional

Table 4. Ratio of subjects' attribute

	male over 64	male under 65	female over 64	female under 65
Only bus information	57.1%	14.3%	23.8%	4.8%
Regional information added	52.2%	17.4%	26.1%	4.3%

Table 5. Evaluation terms of bus information

Evaluation term	Abbreviation
Routes are understandable	Route
Bus stops are understandable	Bus stop
Timetables are understandable	Timetable
Bus passages are understandable	Passing
Delays are understandable	Delay
Transfer information is understandable	Transfer

information was obtained from the Chita chamber of commerce and Industry. After operating the Web page of the bus information system freely, the subjects evaluated the developed system and their consciousness about going out by bus.

## 5.2 Results of Questionnaire Survey

Fifty five subjects participated in the survey. Among them, 27 subjects operated "Only bus information" page. The other 28 subjects operated "Regional information added" page. Since the subjects operate the web page actually and personal computers we could prepare to be operated by the subjects are limited, it is difficult to obtain many samples. Accordingly, the survey results of each question are assessed by the statistical significance using the Cronbach's alpha.

Table 4 shows the subjects' attributes. An elderly male/female is defined as 65 years old and over. More than half of subjects are a male. The elderly occupies about 60% to 70% of subjects.

First, the questionnaire before operating the web page is analyzed here. Table 5 shows the evaluation terms on bus information and the abbreviation of each evaluation term. Table 6 indicates the level of satisfaction to the bus information. The value of Cronbach's alpha using evaluation terms of bus information is 0.827, which means the survey results are reliable. The most difficult term among the bus information in Table 5 for subjects is "Delay", "Passing" or "Transfer", in which 60% of subjects feel difficult to understand. Because "Delay" and "Passing" are able to be provided by the real-time bus information, the subjects cannot obtain such information without the bus location system. Similarly, because transfer information was not provided at that time, the subjects had to check a transfer ways by gathering all information of transportation modes such as a timetable, routes and fares. Therefore, the subjects feel delay information, pass information through a bus stop and transfer information as hard to understand. Conversely, it's easy for the subjects to understand "Route", "Bus stop" and "timetable" information because a route map and a timetable can be obtained on the Internet and also available by a printed one. However, about 50% of the subjects think such bus information as hard to understand overall. Thus, it is shown that the bus information is not provided enough to passengers of Aiai-bus.

After operating one of two web pages, the subjects evaluated changes of their consciousness and rated their intentions to use the bus location system. Table 7 shows the result of the intention to use the bus location system. The upper of the graph shows the result by the operating "Only bus information" page and the lower part is the result by operating



Table 6. Evaluation of each bus information

	Strongly agree	somewhat agree	neither	somewhat disagree	strongly disagree
Route	25.5%	19.6%	27.5%	19.6%	7.8%
Bus stop	18.4%	26.5%	20.4%	24.5%	10.2%
Timetable	18.0%	22.0%	34.0%	14.0%	12.0%
Passing	32.7%	28.6%	28.6%	6.1%	4.1%
Delay	42.9%	28.6%	20.4%	8.2%	0.0%
Transfer	34.7%	24.5%	22.4%	10.2%	8.2%

Table 7. Intention to use bus location system

	Want to use	Sometime use	Won't use	Never use
Only bus information	40%	45%	10%	5%
Regional information added	56%	36%	8%	0%

Table 8. Evaluation terms of using the system

Evaluation term	Abbreviation
Not irritated by waiting bus	Waiting
Easy to find out the way to reach destination	Finding way
Want to use bus	Using bus
Intend to use bus when going out	Going out
Want to visit shop around bus stop	Visiting
Want to know more about regional information	Information

“Regional information added” page. The subjects who want to use the bus location system are about 40% for “Only bus information” page and about 60% for “Regional information added” page. It’s obvious that adding the regional information on the bus location information impresses all the users as a useful system. About 90% of the subjects evaluated positive for the bus location system with the regional information.

Changes of their consciousness after operating the system were evaluated by 5 ranks. The 6 evaluation terms on using the system are shown in Table 8. The result of the evaluation is illustrated in Table 9. The value of Cronbach's alpha using evaluation terms of using the system is 0.887, which means the survey results are reliable. The ratios of positive evaluation for “Regional information added” page are more than those for “Only bus information” page and are all over 60%. Especially, there are large differences in the evaluations for “Visiting” and “Information” between “Only bus information” page and “Regional information added” page. The evaluations of “Regional information added” page for “Waiting” and “Using bus”, which have no relation with the providing regional information, are rated higher. This means there is possibility of providing regional information added on real-time bus information to promote bus usage. However, the ratios of negative answers of “Finding way” and “Information” for “Regional information added” page are higher than those for “Only bus information” page. It’s conceivable that the pages with the added regional information provide too much information for some subjects, which affected the page operation by the subject.

### 5.3 Evaluation of developed bus location system

The developed bus location system was evaluated by the subjects. Table 10 shows the evaluation terms of the developed bus location system and the abbreviation of each evaluation

Table 9. Consciousness on using the system

		Strongly agree	Somewhat agree	Neither	Somewhat disagree	Strongly disagree
Waiting	Only bus information	10%	45%	25%	20%	0%
	Regional information added	32%	40%	16%	8%	4%
Finding way	Only bus information	0%	40%	40%	20%	0%
	Regional information added	36%	20%	20%	24%	0%
Using bus	Only bus information	5%	35%	40%	20%	0%
	Regional information added	28%	36%	20%	12%	4%
Going out	Only bus information	15%	45%	25%	15%	0%
	Regional information added	32%	32%	32%	4%	0%
Visiting	Only bus information	25%	30%	35%	10%	0%
	Regional information added	68%	28%	0%	4%	0%
Information	Only bus information	25%	40%	30%	5%	0%
	Regional information added	54%	21%	13%	13%	0%

Table 10. Evaluation terms of developed bus location system

Evaluation term	Abbreviation
Understandability of bus position	Understandability
Update interval of bus position	Update interval
Easy to use	Usability
Information of surrounding facilities	Surrounding information

term. Table 11 shows the result of evaluating the developed bus location system. The evaluation of “Understandability” and “Update interval” are about 70 % positive. “Usability” is evaluated as about 50% positive from both of the web pages. Because the both web pages use Google Map, there are few differences of the evaluation between two pages. In terms of “Surrounding information”, the ratio of the positive evaluation for “Regional information added” page is twice larger than that for “Only bus information” page. However, the ratio of positive evaluation of "Understandability" for “Regional information added” is lower than that for “Only bus information”. This is considered the map becomes too complex for subjects to understand easily when the regional information is added on the page of the bus information.

#### 5.4 Analysis of Web Component by Hayashi’s Quantification Theory Type II

As a result of the evaluation mentioned above, it is found that the regional information added on the bus information obviously effect the motivation of going out. We therefore analyze the components of the bus location contributing for regional vitalization.

In order to analyse the relation between the evaluation of “Visiting” in Table 8 and the evaluation of the developed bus location system, we use the HAYASHI’s quantification theory type II. Hayashi’s quantitative theory type II (Hayashi 1954) is a method of multivariate discrimination analysis to manipulate qualitative data as predictor variables. A criterion variable is “Visiting” and independent variables are the evaluations of the system. As a result, the correlation ratio of this analysis is 0.414. The standardized category scores and item ranges are shown in Table 12. A category score represents the weight on a criterion variable of each category. Item range is difference between the maximum and the minimum of the category scores, represents the influence on the criterion variable which of each item. It represents the influence on the criterion variable of each item.

The positive value of the category score shows the corresponding category will promote

Table 11. Evaluation of developed bus location system

		Only bus information	Regional information added
Understandability	Good	78.9%	68.0%
	Average	21.1%	32.0%
Update interval	Good	73.7%	68.0%
	Short	26.3%	32.0%
Usability	Good	52.6%	52.0%
	Average	47.4%	48.0%
Surrounding information	Good	21.1%	44.0%
	Average	68.4%	40.0%
	Bad	10.5%	16.0%

Table 12. Category score and item range for “Visiting”

Item	Item range of predictor variable								
	Understandability		Update interval		Usability		Surrounding information		
Category	Good	Average	Good	Average	Good	Average	Good	Average	Bad
Category Score	-0.15	0.39	0.22	-0.53	0.90	-0.99	0.51	-0.14	-0.73
Item Range	0.534		0.753		1.892		1.239		

the intention of the subjects to visit the shops around a bus stop. From the figure, we find that the item ranges decrease with the following order; “Usability”, “Surrounding information”, “Update interval” and “Understandability”, in which their values are 1.892, 1.239, 0.753 and 0.534, respectively. The contribution of “Usability” and “Surrounding information” are larger than other item categories. Therefore, in order to improve “Visiting”, we should enhance “Usability” and “Surrounding information” in our web page.

From Table 11, it can be seen that less than half of the subjects are satisfied to “Usability” and “Surrounding information” of the web page. We should make some changes to improve these evaluations to promote bus usage and regional vitalization.

## 6. CONCLUSIONS

Many local governments in Japan have introduced a community-bus and support it financially for the purposes of ensuring residents’ mobility, reducing the area without public transportation services and so on. Although the bus location system is demanded for improvement of the level of bus service, it is practically difficult for a local government to introduce the system because of the expense to introduce and operate the system continuously. According to our survey of needs for bus information, it is found that static bus information is desired at home and real-time bus information is necessary outside home by passengers of a community bus operated by Nisshin city. We therefore developed a simple bus location system using a smartphone available commercially and constructed a web page to provide real-time bus information. The operational test using real buses by the developed bus location system was conducted for 4 weeks, in Chita city and we confirmed that the system worked correctly and accurately.

In order to grasp passengers’ consciousness on the information provided by the developed bus information system, we conducted a questionnaire survey at Chita city. We prepared two web pages, one is the page providing only bus information such as a route, a timetable and a real-time bus location and another is the page providing regional information

added on the bus information. After operating one of two web pages, the subjects evaluated changes of their consciousness and rated their intentions to use the bus location system. As a result, it revealed that many subjects intended to use this system and wanted to go out by bus. In addition, more subjects wanted to know regional information by providing the regional information added on the bus information. These results show that the provision of regional information can improve not only intention to go out but also promotion of bus usage.

We then analysed the components of the bus location system contributing the regional vitalization by the HAYASHI's quantification theory II. As a result, it can be seen that the terms of the usability of the page and the information of surrounding area have influences more than others. However, these terms should be improved in the current system.

Analysis based on attributes of subjects is expected by getting more subjects to use this bus location system. Furthermore, behavior changes and consciousness of passengers who actually use this bus location system are needed to be observed in the future work.

It is possible to introduce this bus location system for other provincial city if an android smartphone is available and also used with inexpensive cost. In addition, it can be expected to promote bus usage and vitalize the region by providing information of attractive facilities around the bus stops added on the bus location information because attractive regional information stimulates the intension of residents to go out by this study.

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