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User Evaluation of GPS-based Travel Information System for Bus Passengers

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Synopsis

A Travel Information System for Bus Passengers was experimentally developed using GPS and Web-based information system. The objective of providing information is to improve time-reliability for passengers. To provide information in efficient way, the system is designed as passengers can receive operational real-time information by using their mobile phone or PC according to their requests. A further investigation about information contents or provision methods is needed to make it more effective. This paper reports on the effect of the system from the viewpoint of user requirements based on the 3-month demonstration results.

KEYWORDS: *Travel Information, Public Transport, GPS, Time-Reliability*

1. Introduction

Bus transport service often experiences a delay because of unexpected road congestion or road accidents. To improve passengers' time-reliability, many types of travel information system have been developed in Japan. Although these systems reduce passengers' anxiety in waiting at bus stop, but similar systems has not been introduced in wider area because of two reasons. One is that the system requires a vast initial cost to install the road-to-vehicle communication system and electronic bulletin board at each bus stop. Another is that provided information may not satisfy potential demand of passengers because pre-trip information which assists mode choice based on estimated arrival time for destination doesn't include.

Under these situations, GPS-based bus location systems which can provide real-time information have spread over nationwide with the advance of technology. The system integrated with fleet management system has some advantages compared with an ordinary information system. In the system, travelers can access information by using their mobile phone or PC whenever and wherever they request it. In addition, the system can obtain global positioning data at relatively low cost.

To realize precise and customized information system which is suitable for travelers' activities, wider variety of providing methods and information contents are required. Therefore not only web and e-mail solution for providing information, but also information cart system, which is like an shopping cart system, were introduced in our study. The information cart system enables users to select the method and/or content

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and the users add information contents freely into a virtual cart after customizing schedule or timing corresponding to the optional needs. Customized operation is required in case of enabling an event-driven alert function, and users can receive an alert message automatically only when an event would happen. In addition, as the contents of each cart are stored in databases located on the servers, users can always access their suitable information and the information contents are refreshed automatically when they access to it. By using these functions, the information system called Personalized Bus Location System (PBLS) can offer active and direct information especially for people who require time-reliability in their activities. However, further investigation about information contents or provision methods is needed to make it more effective based on those characteristics. This paper reports on some user evaluation results focusing the PBLS service based on an experimental demonstration.

2.1 Outline of demonstration

3-month demonstration project was conducted at Kizu-minami district in Kyoto Prefecture, Japan from October in 2002. The area has approximately 1200 households and 3600 population. According to the result of preliminary survey conducted in January of 2002, 95% of households had owned vehicles, and 53% of residents had used car for commute. Although, 30% of residents had an intention of changing their travel mode, it depended on an introduction of newly convenient bus routes. Then, additional bus service between the area and Takanohara railway station (Kyoto Line of KINKI NIPPON RAILWAY CO., LTD) was designed, which consisted of 12 bus stops and it took about 21 minutes between 8.3km for one way. The time-headway of bus was 30 minutes during peak hours and 60 minutes during off-peak hours, and the number of weekday round trip was 23. With the experimental operation, GPS-equipped three vehicles were introduced to demonstrate the PBLS supported financially by Kinki Regional Development Bureau, Ministry of Land, Infrastructure and Transport.

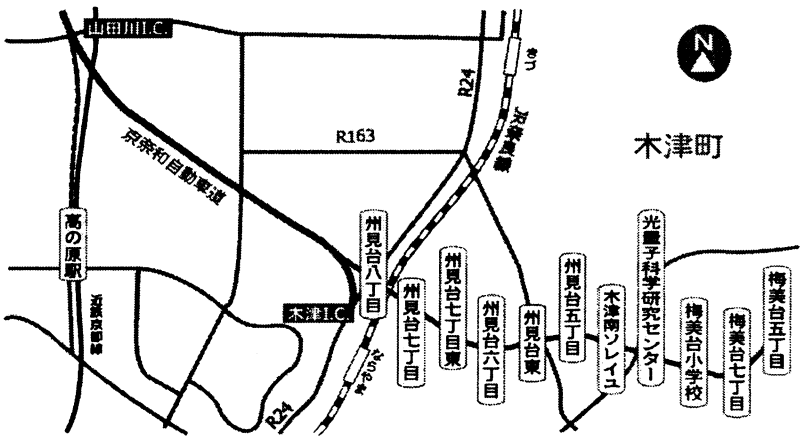

Figure-1 Location of newly introduced bus service

2.2 Outline of Surveys

During the demonstration, a series of surveys was continuously conducted to observe responses to the service according to respondents' type shown in **Table-1**. Because the number of passengers during the demonstration was between 80 and 120 per day, the number of respondents resulted in relatively small.

Table-1 Summary of Surveys

Survey name	Method	Date / period	Respondents	Contents				Num. of respondents / response rate
				Attribute	Bus usage	Travel activity	PBLS service	
Survey in bus part I	Deliver by hand & return by post	Nov. 2002 1 week	Bus passengers	G	I		G	161 63.1%
Interview survey	Interview	Dec. 2002 2 days	participants for Demonstration	G			I	108 -
Follow-up survey I	Deliver by hand & return by post	Dec. 2002 -	Local residents	G	G		G	209 16.2%
Survey in bus part II	Deliver by hand & return by post	Jan. 2003 2 days	Bus passengers	G	I		G	67 58.8%
Follow-up survey II	Posting & return by post	Jan. 2003 -	Local residents	G	G	I		160 11.6%
On-line survey	On the website	During demo. -	Local residents	G	G	I	I	16 11.6%

I: In-depth contents, G: General contents

3. Analysis of User Evaluation

3.1 Needs for Information

In the interview survey, respondents were asked about mainly three contents after being explained the PBLS; experience of delay in the past, needs for information, and interests of the PBLS. Nearly half of respondents had experienced a delay, and they regarded the main cause of the delay as road congestion. From the result shown in **Figure-2,** nearly 80% of respondents required delay information. Furthermore, people who experienced a delay have a tendency to request the information. These findings suggest that travelers are seemed to expect estimated operational information in advance.

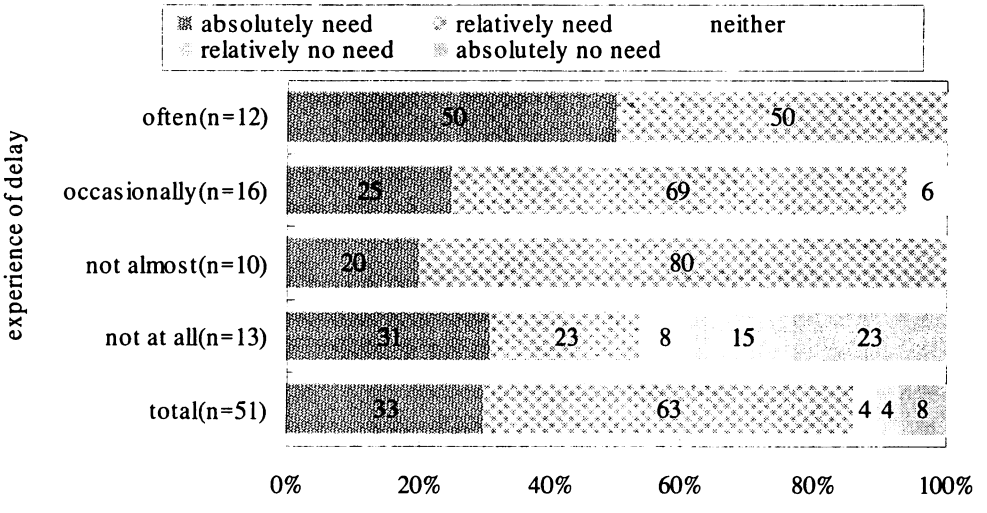

Figure-2 Needs of Information according to the Experience of Delay

With regard to interests in the service provided for PC or cellular phone, **figure-3** shows that more than 80% of respondents revealed to be useful. In addition, some interesting suggestions for further improvements were shown from the results that the contents for cellular phone had higher interests than the contents for PC, and that non-bus-user had not a few concerns about the service.

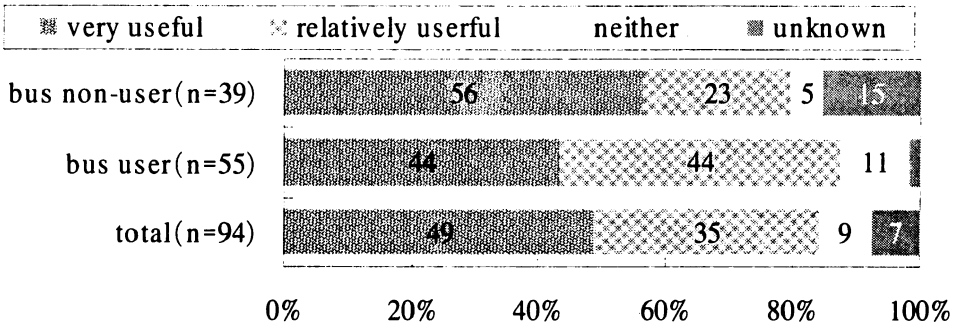

Figure-3 User Interests for Providing Information (Information for PC)

3.2 Purpose and Value of Use

Figure-4 shows that respondents have an intention to use the service for the purpose of checking current operation, timetable, and expected time. From the viewpoint of user intention, this result suggests that there are needs for support decision-making about mode choice related to their travel activity. Besides, as travelers didn't know the timetable exactly when they were going to home, providing such information to their mobile phone is considered to be convenient.

On the other hand, about 40% of users had an intention to use the service even in case of being charged, and it is also considered that introducing such an information service has a higher value on congested routes.

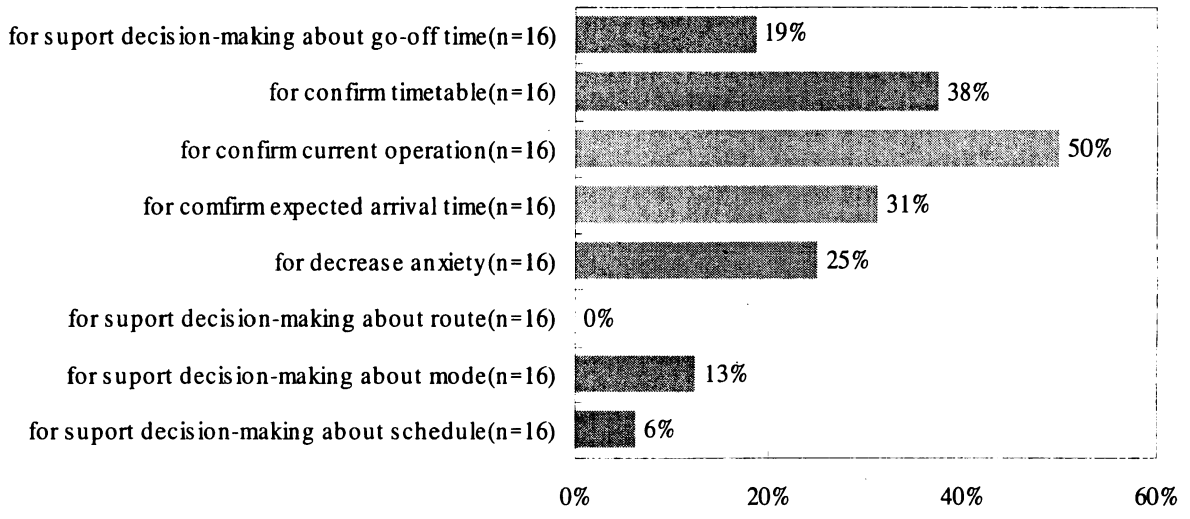

Figure-4 Purpose of Using Information

3.3 Subjective analysis of service usage

According to the results of Survey in Bus part I and II, The service provided during demonstration period was highly recognized among passengers because of publicity or promotion activities. During the period, the total number of information requests via PC was 3061 (33.3 per day) and 1380 (15.0 per day) was via mobile phone. To evaluate a characteristic of the actual use of real-time information subjectively, the number of access to the information server per day was analyzed using web-log data in Poisson regression method. Several types of variables were considered in this analysis. These included demonstration months, day of the week, hour, weather condition, and publicity effects. As all the variables in the analysis are dummy variables, the relative magnitudes of the coefficients represent an estimate of the important of the variables in influencing the probabilities of user requests. The output of the analysis in table-2 showed that almost every variable was significant effect and an adjusted R-square was sufficient to understand the effects. The result indicated that there were daily needs to request the information except during morning hours because a coefficient of weekday was relatively higher than weekend. With regard to month effect, the number of requests was decreased month by month. This tendency was for a reason of no delays in the bus operation during demonstration. The result also showed that higher requests were shown in case of bad weather conditions. This result is to be considered that providing real-time information was useful especially under environmental uncertainty conditions.

Table-2 Result of Poisson regression analysis

Variable		Coefficient	Standard variation	*t*-Statistic	Prob.
Month	November(D)	1.039	0.043	24.055	0.000 **
	December(D)	0.082	0.050	1.628	0.104
Day of the week	Weekday×Mon.(D)	0.360	0.060	5.951	0.000 **
	Weekday×Tue.(D)	0.317	0.052	6.098	0.000 **
	Weekday×Wed.(D)	0.296	0.052	5.738	0.000 **
	Weekday×Thu(D)	0.317	0.052	6.104	0.000 **
	Weekday×Fri.(D)	0.393	0.050	7.934	0.000 **
Hour	7	0.577	0.177	3.263	0.001 **
	8	1.275	0.160	7.973	0.000 **
	9	1.701	0.154	11.062	0.000 **
	10	1.585	0.155	10.211	0.000 **
	11	1.445	0.157	9.188	0.000 **
	12	1.593	0.155	10.271	0.000 **
	13	1.726	0.153	11.247	0.000 **
	14	1.556	0.156	9.999	0.000 **
	15	1.597	0.155	10.301	0.000 **
	16	1.522	0.156	9.748	0.000 **
	17	1.733	0.153	11.300	0.000 **
	18	1.637	0.155	10.591	0.000 **
	19	1.509	0.156	9.652	0.000 **
	20	1.548	0.156	9.937	0.000 **
	21	1.751	0.153	11.429	0.000 **
	22	1.649	0.154	10.676	0.000 **
Weather	Rainfall or snowfall	0.172	0.034	5.083	0.000 **
Publicity	Distributed day	0.341	0.039	8.824	0.000 **
	Constant	-1.504	0.149	-10.085	0.000 **
	R^2				0.329
	Adjusted R^2				0.318
	Num. of Observation				1564

4. Conclusions

This study reports on user evaluation of the PBLS based on 3-month demonstration results from a series of surveys. The demonstration and surveys were conducted to observe needs for providing bus information toward the realization of efficient information system. In spite of limited experiment and surveys, some fundamental findings about the effectiveness of the PBLS were obtained. Further improvements based on the results are required to make it more convenient for passengers. With regard to information contents, the results also suggested that the information supporting traveler's pre-activities was expected to realize further reliable activities through public transport system.

Acknowledgement

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