Utilization of Mobile Phones in Information System on Trains for Private Customers

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Abstract

East Japan Railway Company (JR East) and Mitsubishi Electric Corporation are undertaking research and development on a method for easy-to-understand information provision to railway users. This article will introduce InfoPic, an information system we developed with the aim of providing information to individual passengers on trains, particularly individuals using mobile phones. We have continuously worked on providing information to individual passengers onboard since the development of a demonstration system in FY 2006, and in FY 2009 we installed the system on the MUE-Train test train and connected it to the actual train control system. System operation tests demonstrated that this system could obtain data from the actual train control system without problem and continually update and deliver data to mobile phones while running. Service evaluation by test subjects also proved the high level of acceptability for provided content.

1. Introduction

Many train lines are spread in Tokyo metropolitan area in Japan and these lines are usually operated on time. Therefore, frequent passengers need traffic information; for example, which line is delayed or suspended and why the lines are not on time. On the other hand, basic information such as stops and the destination on the train is also required by infrequent passengers including foreign tourists.

Though flat panel displays have already been installed on trains on several lines and provided traffic information, it is impossible for those monitors to show all data at the same time which each customer wants to obtain. In order to solve the issue, JR East and Mitsubishi Electric have developed InfoPic (Information Providing System for Individual Customers) an information system which can realize communication between onboard information servers and mobile phones which passengers are using on trains. This development device makes it possible for users to receive latest information on demand from trains themselves. That data can be contained not only traffic information but also commercial contents like coupons for shops at stations along the line on which passengers are. A device for commuter trains is only focused on in this paper.

2. Concept of the Research

Fig. 1 illustrates the concept of this research.

In general, we can say that passengers on trains are restrained in time and space. The flow on the left side of Fig. 1 shows things we aimed for in improving convenience by providing information on operation and transfers in such a restrained situation and for reducing stress due to lack of information in operation disruptions.

In contrast, the flow on the right side of Fig. 1 is based on a perspective that such a situation can be a business chance. Specifically, cabins can become beneficial information spaces by providing
information on the area along the line and entertainment information. What is new about this system is that it provides information from the train to mobile phones of individuals according to the location, time and travel direction of the train.

Fig. 2 shows the history of development in this research. Development started in FY 2006. In FY 2007, the demonstration system was presented in a conference of the Research and Development Center of JR East Group and the CEATEC JAPAN comprehensive exhibition cutting-edge IT and electronics. Through those presentations, we were able to confirm how great the need is for services we were aiming for in this development (Fig. 3). Accordingly, we launched in FY 2008 full-scale development of a system to be installed to actual trains. The system was installed to the MUE-Train test train in FY 2009, and we checked operation and details of services.

Figure 2: History of Development in the Research

3. Development History

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4. Overview of InfoPic

4.1 System Configuration

Fig. 4 shows the configuration of the system installed on the MUE-Train. InfoPic is the name of the system for providing to mobile phones via the onboard IT server and train information controllers information obtained from the train control system. The main feature of this system is that it uses a FeliCa IC chip reader/writer (R/W) or Wi-Fi access points on the train to provide information to mobile phones of passengers.

When we introduced this development project in Summer 2008 issue of JR East Technical Review (Japanese version only), we assumed that we would use infrared communication as a means of wireless communication. But smartphones exemplified by iPhone have recently been gaining popularity. The infrastructure for Wi-Fi is thus rapidly increasing since those devices are equipped with a Wi-Fi function. In light of that situation, we have decided to use Wi-Fi instead of infrared communication.

As for the method of obtaining information with a reader/writer, we used ToruCa, a function built into NTT DOCOMO mobile phones.

We developed in this research the part of the system within the dotted line in Fig. 4. The core of the system is the onboard IT server. The server collects from the train information controller (MON8 for the MUE-Train) data such as the schedule of the train and passenger load factor that can be used for information services for passengers as well as operation information from our data center and
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ATOS (Autonomous decentralized Transport Operation control System) data. The IT server then has the job of processing that data into easy-to-understand screens for passengers. The processed screens are transmitted through onboard information control terminals to VIS (Visual Information System) already used on the Yamanote line and other lines, Wi-Fi access points and FeliCa control terminals.

4.2 Information to be Provided to Mobile Phones

This section will cover the type of information that the InfoPic system can provide to individual passengers. Sample screens for mobile phones (mobile phones with IC chips and smartphones with Wi-Fi functions) are also shown. Fig. 5 shows the initial screens to be displayed when the mobile phones obtain information.

(1) Guide to Stops and Transfers
Information on stops ahead of the present location is shown on the screen with scheduled arrival time for each of those (Fig. 6). This utilizes data of the schedule for rolling stock usage intended for drivers. For transfer stations, users can also check information on connecting trains including any delay information (Fig. 7). Such a service is possible by utilizing onboard ATOS information intended for conductors.
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(2) Operation Information and Proof of Train Delay
We enabled train operation information displayed on VIS screens to be shown on the mobile phones (Fig. 8). Locations of trains before and after the present train are also shown along with operation information for the train and line the passenger is currently using. While still just an idea, we are also considering allowing proof of train delays to be issued onboard (Fig. 9).

(3) Cabin Information
Information on items fluctuating in real time such as the passenger load factor and room temperature transmitted from the train information controller is shown along with fixed information such as the location of the ladies-only car and mildly cooled car (Fig. 10).

(4) Information on Locations along the Line
One idea for content taking into consideration the flow of the system concept on the right side of Fig. 1 (new business) is showing information on shops along the line and coupons on mobile phone (Fig. 11, virtual information). The method for distribution of the information of this type is still under consideration.

5. System Operation Check on MUE-Train, Evaluation and Verification of Service
We equipped a MUE-Train with the developed InfoPic system and implemented system operation checks for the four days of July 21 and October 19 to 21, 2009 in the section between Minami-Furuya
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Station and Osaki Station on the Saikyo line. We also evaluated and verified the service on the MUE-Train and with a mockup train laboratory.

(1) System Operation Check
We checked whether the system could properly work in the flow from obtaining information from the MON8 train information controller of MUE-Train, adding dummy operation information, ATOS information for conductors and advertisement and coupon information according to the current location, then delivering such information to mobile phones. We confirmed stable operation of the system while running with data for items fluctuating in real time such as the passenger load factor and room temperature that are sent to the IT server every second and static data such as the schedule for rolling stock usage that are sent at every update.

(2) Evaluation and Verification of Service
In the above-mentioned system operation check, 18 employees of JR East evaluated the details of the service. Fig. 12 is a photo of the system components on the MUE-Train and Fig. 13 is a photo of service evaluation by our staff members.

The evaluation method is as follows.
- Inform the test subjects of the test situation, assuming that they have taken a train at Musashi-Urawa Station on the Saikyo line and are going to Yokohama Station.
- Give tasks to each subject as the train travels and have them obtain information both with an IC mobile phone and a smartphone with Wi-Fi.
- Assign an interviewer for each subject and conduct interviews and ask questions between tasks.

Six tasks each were given for using a mobile phone with IC chip and smartphone with Wi-Fi function as follows.
- [Task 1] Obtain information.
- [Task 2] Check the travel time to Osaki Station.
- [Task 3] Something has happened. Check the onboard information display and obtain further related information using the mobile phone.
- [Task 4] You are nearing the transfer station. Check the departure train time on the line to transfer to.
- [Task 5] Check the level of congestion for the present train.
- [Task 6] Check for information on locations along the line.

Fig. 14 (a) shows the five-level rating results for each task performed by staff members. Positive values are positive responses and negative values are negative responses.

Wi-Fi received slightly greater support as method of information obtaining. Cabin information and information on locations along the line received somewhat low favor.

We also evaluated with 30 test subjects from the general population (six elderly people, housewives and students and 12 company employees; the same number of males and females except for housewives). While these test subjects did not perform evaluation riding on the MUE-Train, they evaluated in the mockup train laboratory equipped with a similar service environment. The evaluation results are shown in Fig. 14 (b).

Those test subjects gave balanced responses for each task over all, and they also showed slightly higher acceptance of Wi-Fi as a method of acquiring information. Information on locations along the line received somewhat low favor.
We omit diagrams per attribute because of space limitations, but here are some characteristic responses.

- Elderly people: High acceptance of operation and transfer information
- Housewives: High acceptance of schedule time information and cabin information
- Students: High acceptance of information in general, including information on locations along the line
- Company employees: Response tendency was similar to the total average.

6. Future Schedule

We will proceed with development from FY 2010 onward for the following two goals.

(1) Introduce the system to actual trains

We will develop a low-cost and expandable system with an aim of introducing the system to commuter trains in future. We are also considering field tests of the system on trains in commercial service in FY 2011.

(2) Expand rank and scope of service

The rank of service provided to passengers should be built on safety and security, followed by convenience, comfort and enjoyment (Fig. 15). We have developed service content mainly for the areas of safety and convenience so far, so we will consider deploying content to other service ranks. Also, we will use the Smart Station laboratory and the 209 series cars set up in that laboratory (called the Smart Train) to go forward with research and development to expand the scope of personal information provision to platforms and in-station spaces in addition to the train (Fig. 16).

Our final goal is to build an environment where we can offer personalized information services according to the location in our total business space such as on train, on the platform, in the station and in-station shops. Through that effort, we hope to make the system a tool to utilize the overall strengths of JR East Group.