Providing appropriate information services at stations is an important issue for railway operators. However, immediate improvement of information provision at stations has become an urgent issue with the diversification of rail lines and with increased complexity of station structures due to development of in-station businesses. We also must improve information provision services for the increasing numbers of visitors from abroad. Research and development on improvement of information-providing services for stations was thus carried out.

2.1 Survey on the Needs of Visitors from Abroad
To identify what information visitors from abroad require when using railways, we conducted a questionnaire survey. Target responders were from four locations where the majority of visitors to Japan from abroad come from: the USA, China, Korea and Europe. We surveyed what information they require before getting on the train and what information concerning railway use they want more of. We obtained the results shown in Fig. 1.

The survey showed high needs for route information such as transfer guidance and travel time. Based on the results, we developed a terminal that can provide highly needed information centering on route searching.

2.2 Development of a Transfer Information Terminal
2.2.1 Development of the Housing
We designed the housing of the information terminal based on the three concept points shown below:
1) Having presence in the station while being in harmony with the station environment
2) Being safely installed
3) Having a printing function

Fig. 2 shows the appearance of the developed housing.

2.2.2 Overview of the System
This information terminal uses the service provided by ekitan & Co., Ltd. (former Ekimae Tanken Club) via the Internet to obtain transfer information. Fig. 3 shows the system configuration.
2.3 Field Test

2.3.1 Overview of the Field Test

To verify the usefulness of the developed terminal, we set up terminals at Tokyo station and Akihabara station and checked how they were used. Table 1 and 2 show an overview of the field test, and Fig. 10 and 11 show the installed terminals.

<table>
<thead>
<tr>
<th>Table 1 Overview of the Field Test at Tokyo Station</th>
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</thead>
<tbody>
<tr>
<td><strong>Period</strong></td>
</tr>
<tr>
<td><strong>Operation time</strong></td>
</tr>
<tr>
<td><strong>Number of terminals</strong></td>
</tr>
<tr>
<td><strong>Place installed</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2 Overview of the Field Test at Akihabara Station</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Period</strong></td>
</tr>
<tr>
<td><strong>Operation time</strong></td>
</tr>
<tr>
<td><strong>Number of terminals</strong></td>
</tr>
<tr>
<td><strong>Place installed</strong></td>
</tr>
</tbody>
</table>

2.3.2 Field Test Results

We tabulated the number of times terminals were used based on their operation logs. Fig. 12 and 13 show the daily results. Number of uses was counted by number of searches made. In the figures, weekdays and weekends/holidays are differentiated by color.

At Tokyo station, the three terminals were used approx. 150 times on weekdays and approx. 300 on weekends/holidays. The number at Akihabara station was approx. 320 on weekdays and approx. 430 on weekends/holidays. It is apparent that the terminals were used more often on weekends/holidays than on weekdays at both stations. The number of times terminals were used did not differ much by location where they were installed at each station, but the total number at Akihabara station was larger than that of Tokyo station.

As for the number of uses by language, searches in English accounted for 30% of total use at both stations. Usage was concentrated in the time between 9 am and 4 pm at Tokyo station and between 11 am and 6 pm at Akihabara station.

In 40% of searches made, users printed out the search results, demonstrating a high need for users to take information with them. We also found by observation that some users simply checked the route map on the terminal without searching.
2.3.3 Operation of Terminals in the Field Test

In the field test, we tried to make the field test could be carried out without the station staff having to be involved with operation. For example, we added a manual startup and shutdown function along with a function to report to the maintenance company errors and the built-in printers running out of paper, allowing maintenance such as paper replenishment to be conducted without the station staff being bothered.

2.4 Considerations and Future Issues

The field test results showed that terminals were used more often on weekends/holidays than on weekdays. We presume this is because of the difference of station users on those days. On holidays, many station users visit first- and one-time destinations and need transfer information, while business people and other users who are accustomed to traveling to their destinations account for a large part of station users on weekdays. The large difference in the number of uses between Tokyo station and Akihabara station could have been caused by the difference in the location where terminals were installed. At Akihabara station, the information terminals were placed in sight of the flow of foot traffic, catching the eye of station users and raising recognition of their presence. Use by visitors from abroad, the target users of the terminal, accounted for 30% of the total use. Considering the rate of overseas visitors among total railway users, we can see that many visitors from abroad used the terminals.

But we have discovered the following two issues that need to be taken into consideration in the future. The first is enhancement of information. We only provided transfer information in two languages in this field test, but we need to expand the service to Chinese and Korean languages and add other information such as in- and around-station guidance for destination stations. The second issue is providing transfer information in accordance with actual train operation status. An information service that can make route searches based on the actual status in case of operation disruption would be even more useful. Although we could not achieve those services this time because they require a more powerful search engine system and linkage to other systems, we have brought them up as issues for the future.

3.1 Development of a Touch Panel Information Terminal

3.1.1 Background of the Development

JR East is currently working to make signage more substantial and to set up information centers in stations to provide information for areas around stations where large-scale redevelopment constantly changes the cityscape. The busiest information centers receive approx. 2,000 inquiries from passengers daily, of which inquiries on information for areas around stations and station layout account for the majority. In this R&D, we developed an information terminal that can provide such information based on actual inquiries made to information centers.

Setting Shinagawa station as the model station, we developed content for in and around the station.

3.1.2 System Component Specs

We used the following devices as system components.
- Display: 46-inch LCD
- Touch panel: Infrared touch panel for 46-inch display
- PC: Pentium M 1.8GHz CPU, 256 MB memory, Windows XP operating system

As we will explain in detail later, one of the features of this development was that we employed a 46-inch large-sized display which allows the display to function as a sign too. We chose an infrared touch panel and customized it to cover its inherent weakness to light. The customized touch panel can withstand light of up to 4,000 lux. Fig. 14 shows an overview of the system installation.

3.1.3 Development of the System’s Application

We developed the application based on the following four design concepts.
(1) Easy to use (intuitive interface)
(2) Easy to understand (combined guidance using figures and pictures)
(3) Maintainability (easily changed tools)
(4) Learning function (provides information that passengers want with higher priority)

In an information system using a touch panel, it is important for users to be able to intuitively recognize that the system uses a touch panel. Providing content in a variety of forms in addition to text and maps could also help make the guidance easy to understand. Furthermore, old information and long waits to acquire the required information impair the function as an information terminal. Taking those into account, we developed the application to allow the terminal to handle such issues.

3.1.4 Information Content

We configured the in- and around-station information in the following three-layer structure.

(1) First level (start screen)
The first page of the start screen shows guidance information for six locations and one column to select the language from Japanese, English, Chinese (Mandarin) and Korean. We designed a layout similar to that of fixed signs. In that layout, the start screen also functions as a fixed sign, so simply having it display is meaningful. We also used a layout that incorporates moving images to make it easier to recognize that the screen is a touch panel. The second and subsequent pages show guidance information for 12 locations. Fig. 15 shows sample pages.

(2) Second level (in- and around-station map)
This page displays by touching the destination in the first page, and it includes an in-station (or around-station) map and a free column. The destination is indicated by a flag in the map, and guidance to the destination is noted in text in the free column (Fig. 16).

(3) Third level (individual guidance)
We also prepared other diagrams for destinations that cannot be shown on an in- or around-station map. Those include the shop location map for ecute and platform information by line. Fig. 17 shows sample screens for those.

3.1.5 Learning Function

It is important for such an information service to provide the required information as quickly as possible. Accordingly, we gave the developed terminals a learning function where the system compiles a search log once a day and shows the results of the items searched for the most in 30 days in a ranking format on the terminal. This is based on the concept for web searches where a website displays the items searched for higher up in the results. We also classified the ranking into four patterns under the assumption that required information varies depending on weekdays or weekends/holidays and on Japanese users and visitors from abroad. Fig. 18 illustrates an overview of the system.

3.2 Field Test of the Touch Panel Information Terminal

3.2.1 Overview of the Field Test

We set up the developed terminal at Shinagawa station to verify how it is used. An overview of the field test is shown in Table 3 and the actual terminal in Fig. 19. When deciding the height to set up the terminal, we took into consideration the viewing height of a standing person being 1,560 mm and that of a person in a wheelchair being 1,175 mm.
3.2.2 Field Test Results

Fig. 20 shows the daily total numbers uses (in 61 days from March 26 to May 25, 2007). The terminals were used approx. 500 times on weekdays and approx. 1,000 times on weekends/holidays. The results show that the terminals were used more often on weekends/holidays than on weekdays. Looking at the use history of services in Japanese and in foreign languages, we found that use in foreign languages showed almost no difference between weekdays and weekends/holidays, while use in Japanese differed largely between weekdays and weekends/holidays.

Fig. 21 shows the total numbers of uses per content item on weekends/holidays. These results show that information for around the station, amusement facilities in particular, is sought after on weekends/holidays, while information on the station is sought after on weekdays.

When we observed to identify how the terminals are used, we found that many users saved the around-station map screen in the search results using the camera function of their mobile phones.

3.3 Considerations and Future Issues

There had been many kinds of terminals from which users themselves could obtain information on specific facilities and the area around those. But, no matter how good the information content of such terminals might be, they did not perform very well if we look at how they were used. The causes for that could include that complicated operation is required to acquire the desired information and that the terminal itself does not stand out; thus, it is not noticed in the station environment. In the development of the new terminal, we paid attention to those issues so it would be highly useful and frequently used. As a result, we were able to bring to fruition ideas such as ranked information display through a learning function and guidance expression using moving images. When we installed the terminals in the field, we labeled them “Touch-screen Sign”. We believe this is an effective approach to making the terminals stand out and intuitively promoting that how they are used.

The search results for Shinagawa aquarium and EPSON aqua stadium suggest that there are many family visitors on weekends/holidays. Hotels and banks were searched for at a constant rate regardless of the day of the week. Those results showed us that railway users require railway operators to provide general in- and around-station information on top of information on station-specific facilities.

As for issues on the terminal, there are mechanical issues such as:
- Creation of installation standards to allow easy maintenance
- Countermeasures for direct sunlight on the touch panel and operational issues such as:
- Easy updating of information content.

Infrared touch panels have a weakness to light. In the field test, we observed that the terminal freezes when under direct sunlight. In the future, we must set up the terminals in places where they are not exposed to direct sunlight and think of other measures such as adding a shade to the infrared receiver.
4.1 Current State of Information Provision
With railway networks becoming more diversified and stations becoming large-scale facilities, railway spaces are not necessarily easy for users to understand. Appropriate provision of information to users is thus becoming a major issue. Recently, enhancement of in-station shopping malls called "ekinaka" has increased ad space in stations and other factors have made in-station information more complicated, and it is difficult to understand where required information is. We therefore reevaluated station space from the viewpoint of users and created a concept of a new information-providing service.

4.2 Rhythm of Space
Users need to be able to accurately recognize guidance displays in the station space where many kinds of information overflow chaotically. We suggested the concept of using "rhythm" of space as a method to accomplish that.

Rhythm of space is an approach to have users recognize the presence of guidance signs by placing signs of the same shape at equal intervals. That way, only the guidance signs give users the same visual stimulus in a set rhythm, regardless of surrounding information. We proposed two types of concept designs: a flag sign and a gate sign (Fig. 22).

As for the information to be displayed, we think that information should be classified based on its density. For example, brief information should be displayed in the upper space that users can see from relatively far away, and detailed information should be displayed on the wall or on the floor. Users can obtain detailed information on the wall and floor spaces that are integrated in a unit.

4.3 Temporary Appropriation of Information
We also suggested an approach where users can efficiently obtain just the information they personally require from out of a large amount of information.

Specifically, we suggested an interface that enables users to temporarily "appropriate" displays on the wall and other locations and make those show information such as the route and direction they should take by clicking or other simple action on a mobile phone or other device.

Since the displays that temporarily indicate one’s route and direction are shared with other users, users will of course see the information for other users. But, the user who takes the action such as pressing a key will recognize that the displayed information is the user’s own because the information is displayed only while taking that action (Fig. 23).

4.4 Development of the Demonstration System
Based on the proposed concept design of station space, we produced a 1/12-scale model and a 1/50-scale model of the sign unit for station space. Taking installation at stations into consideration, we made models on the concept design of the flag-type gate sign (Fig. 24 and 25).

We also developed an interactive demonstration system using mobile phones to demonstrate the ‘temporary appropriation of information’ concept. In this system, a navigation screen to the designation platform is displayed on the screen where ads and route maps are usually shown when the user sends destination data using the infrared transmitter of a mobile phone.

Allowing for every passenger to smoothly use railways is an important issue for railway operators. We must therefore further brush up this research so it may be of use in a solution for that issue.

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Fig. 22 Integrated Information Display on Ceiling, Wall and Floor Spaces
Flag-type sign and gate-type sign

Fig. 23 Temporary Appropriation of Information

Fig. 24 1/50-Scale Model of the Station Sign Unit

Fig. 25 1/12-Scale Model of the Station Sign Unit and the Developed Demonstration System

Fig. 26 1/12-Scale Model of the Station Sign Unit and the Developed Demonstration System