JR East has many information provision systems such as train departure information displays and service disruption information displays to provide information to customers in stations. Those systems provide services using so-called fixed terminals such as LED and LCD displays, which cannot be moved to places where many customers gather when situations such as train service disruptions occur. Furthermore, information is provided separately from individual systems such as Shinkansen and conventional line train departure display systems and the service disruption information display system. Accordingly, it is for the most part impossible to switch to display information from multiple systems via a station common network. And we report the results of this system's development and operation tests in Tokyo Station.

Keywords: Provision of information in stations, Movable display system, Information centralization, Station common network, Wi-Fi

1 Introduction

JR East has many information provision systems such as train departure information displays and service disruption information displays to provide information to customers in stations. Those systems provide services using so-called fixed terminals such as LED and LCD displays, which cannot be moved to places where many customers gather when situations such as train service disruptions occur. Furthermore, information is provided separately from individual systems such as Shinkansen and conventional line train departure display systems and the service disruption information display system. Accordingly, it is for the most part impossible to switch to display information from a single system from different systems.

On the other hand, the new “station common network” for information services began to be installed at Tokyo Station at the end of fiscal 2013. This is a base platform upon which systems utilizing various networks can be built, and it can also flexibly handle addition of and change to the networks on it. In this way, an in-station environment that facilitates construction of new information services and systems is emerging.

In light of this situation, we developed an information system utilizing the station common network, for which information provided and the location where it is provided can be changed according to the situation and at the discretion of station personnel. More specifically, we developed a battery-powered movable display system with a Wi-Fi function. We further conducted field tests at Tokyo Station to evaluate effectiveness of the system and find issues that need to be dealt with ahead of practical use.

2 Study on System Specifications

2.1 Existing Information Systems in Stations

There are diverse information systems in stations, including digital signage for ads. The systems that provide operational information include the Shinkansen train departure information display system, that for conventional lines, and the service disruption information display system. In addition, Tokyo Station has its own unique system where station personnel can input text information to be shown on displays (hereinafter, the “text information display system”).

Where to place those systems is decided on in coordination between the station as system operator and the sections in charge of individual systems, and the systems are placed in locations where they are necessary. However, it is difficult for the systems to cover large-scale stations such as Tokyo Station, as the number of the individual systems installed and the area where the displays can be seen are limited. Furthermore, those are stand-alone means of information provision, which cannot provide information from other systems. For these reasons, the systems cannot sufficiently provide the information needed in cases of train service disruption where passengers gather at ticket gates and Shinkansen transfer gates for information, and thus they currently cannot adequately support station personnel. In light of this situation, demand has arisen for a new information system that can switch over to display information from other systems and can be moved where it is needed.
requires connection and coordination between networks and software of the existing systems, making the system configuration more complex and requiring more modification. It also requires development of a new program to centralize information and generate images because existing software cannot meet the requirements of the method.

Based on the results of examining those two methods, we decided to adopt method No. 1, which can be completed in a relatively short time. This was done because the main goal of this research was evaluation of the effectiveness of the movable display system. For the information to be acquired, we selected the content of the Shinkansen train departure information display system, the service disruption information display system, and the text information display system, where information is provided on LCD displays. The reason for this selection was that, with method No. 1, the new movable system can acquire only image information that is directly shown on LCD displays and the like.

2.3 Study on Movable Display System Structure

For the appearance of the movable display system, we adopted a design where a display is placed at a high position of 1,700 mm to secure good visibility even in a congested station (Fig. 4). However, there is a risk that the system might run into guide signs and the like, resulting in damage, if moved with the display at a high position. We thus chose specifications where the display can be raised and lowered. For the space under the display, a whiteboard of A1 size (594 x 841 mm) on which posters can be placed with magnets and information can be handwritten was attached.

To allow flexible placement, we adopted Wi-Fi communications where there is no need for cables for external communication and built-in large-capacity lithium-ion batteries for operation.
without external power supply such as an electric outlet.

To prevent the system from falling over, those batteries and built-in components are located at the bottom of the movable display system to lower the center of gravity. We also designed casters that allow the display to be moved straight only when pushed from the side and turn by applying pressure from the front. This was because pushing from the front or the rear of the display could easily cause the system to fall over.

2.4 System Configuration
Fig. 5 shows an overview of the system configuration for acquiring information by images described in 2.2. Image information is acquired from branch cables attached to the Shinkansen train departure information display system, the service disruption information display, and the text information display system, and it is converted with encoders for transmission over an IP network. The information is centralized in a server over the station common network and delivered to the movable display system via Wi-Fi.

Station personnel can switch the images to be shown using a tablet. The images chosen are transmitted to the display via a server. Images can also be seen on the tablet, allowing the station personnel to show passengers the images for guidance purposes and to check the information displayed.

2 Tablet for Switching Images Displayed
Fig. 7 shows a screen we developed for display on a tablet. For easy operation even by those not familiar with use of such information devices, we made the screen design simple. Images to be shown can be selected from those of the service disruption information display system, Shinkansen train departure information display system, and text information display system. Pressing a button switches the image shown on the LCD of the movable display system.

The images chosen are shown on the part above the buttons on the screen of the tablet, so station personnel can also provide passengers with information using the tablet.

3 Production of a Prototype
3.1 Structure of the Movable Display System
Fig. 6 shows the actual structure of the prototype movable display system that was produced for the field tests based on the aforementioned study on specifications. A photograph of the front of the system with the LCD raised is shown on the left, and a picture of the rear with the LCD lowered is shown on the right.

Two levers are employed to raise and lower the LCD, and a gas damper on the rear allows that to be done without large force. Batteries are built in at the bottom of the display for operation without external power supply. We were able to confirm by measurements that the movable display system operated continuously for about five and a half hours when the batteries were fully charged.

4 Field Tests
4.1 Overview and Conditions of the Tests
To verify the effectiveness of the developed prototype, we carried out field tests in the ticketed area on the first floor of Tokyo Station. To make the conditions equivalent to those of actual use, station personnel operated the prototype and decided themselves on the placement and movement of the prototype.

The tests were conducted from December 13, 2013 to January 31, 2014 so as to check the flexibility of operation in different environments such as in normal operation, disruptions, and busy periods.
4.2 Test Results

In order to evaluate the test results, we collected comments from station personnel who actually operated the prototype. With those, we reviewed the system’s effectiveness and issues to be handled in the future.

4.2.1 Evaluation of Effectiveness

Many of the comments indicated that the movable display system was useful particularly at times of heavy railway usage. Those include early morning, morning, and night as time slots and the middle of December to the beginning of January as the period. Some indicated that it was useful in normal situations too. We could also confirm that the movable display system with flexibility in placement was well received for the very reason that it increases the means by which information is provided.

In terms of images that could be shown, image information from the Shinkansen train departure information display system was appreciated, particularly in the year-end and New Year holidays when many people use the Shinkansen.

The tablet to switch images was also highly appreciated, not only because of ease of use, but also because of the feature for showing image information in a stand-alone manner. It was also highly portable, so we received many requests for increasing the number of that tablets and for implementing the system to existing tablets.

4.2.2 Operational Issues

As opinions on operational issues, there were many comments that the weight of the prototype movable display system caused problems with moving it. Reducing the weight was difficult this time because the prototype included heavy components such as the structure, the LCD display, and the batteries. The weight of the prototype, however, actually became a factor inhibiting its frequent movement. The prototype could be moved easily on flat floors, but there are many slopes in the station. It also made much noise when moving on braille blocks.

Some also pointed out that the battery time was insufficient.

When initially studying the specifications, we assumed operation where the movable display system would be used as a fixed display using external power supply in normal situations. It would be moved where needed upon switching to battery power in disruptions, and then returned to the usual place when the situation is resolved. We thus decided on a battery capacity of about five and a half hours. It actually proved very difficult for station personnel to often check the remaining battery capacity and return the display to its original location for charging. In addition to the poor mobility due to the weight as mentioned above, the problem of battery time caused situations where the display had run out of power before station personnel noticed. Improvement in mobility and battery time is thus an issue that needs to be overcome in the future.

Furthermore, with the Wi-Fi function we adopted as the communications method to acquire image information, signal interference occurred and caused disturbance of images because there are many Wi-Fi signals being transmitted in the station, including those of mobile routers of passengers. We thus need to further consider a communications method that is stable even in such an unstable communications environment. One possible alternative can be by acquiring internal database information as covered in 2.2.

5 Consideration and Conclusion

With an aim of providing information to passengers in stations in a timely manner, we conducted development of and effectiveness evaluation by field tests for a movable information system. With this system, station personnel could switch at their own discretion the information being provided and change the location where it is provided based on the actual situation. As a result of the tests, we received comments that the display and the system’s tablet were useful, demonstrating high need for an information device for providing information flexibly in stations.

In contrast, we also received many comments on specification issues. Future issues to overcome include reducing the weight of the movable display system for better mobility, improving battery time, and providing more stable display of images. As lighter weight and longer battery time are mutually exclusive, it might be more practical to focus on areas other than simply increasing battery operation time and reducing weight. Rather, as a short-term target, we may need to pick out and achieve functions that will prove useful. For example, we could make the system to be semi-fixed and operate using external power supply only (without batteries for better mobility) and provide information by multiple tablets. We will further discuss with stations and other sites involved with operations and continue development of an information system that will be of help to customers.