Aiming to Realize Ubiquitous Services: Participation in Verification Experiments of Ubiquitous Services for Kobe Airport

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Introduction

As a supporting member Oki Electric has been participating in the Free Mobility Project (Chairperson: Professor Ken Sakamura at the University of Tokyo), which has been promoted by the Ministry of Land, Infrastructure and Transport, from the time the project was first inaugurated in March 2004 .

This paper introduces the vefification experiments along with the results, undertaken as a part of the project, using ZigBee®*1) at a museum within the City of Kobe, as well as at Kobe Airport, which had been recently opened at the time.

Free Mobility Project

The Free Mobility Project Promotion Committee (currently referred to as the "Free Mobility Project") has been working towards realizing a "Universal Society" that is built through the mutual support of all people by fully utilizing their capabilities, along with the provision of information in multiple languages in order to support foreign nationals visiting Japan, as a part of the Visit Japan Campaign being promoted under the "Basic Policies for Economic and Fiscal Policy Management and Structural Reform 2002" as decided by the cabinet of Japan on June 25, 2002. Committee members of the Free Mobility Project, as well as their supporters and local government supporters, brought forth ideas with people from other areas of expertise to promote various experiments with an outlook that reaches ten years into the future in order to create an environment wherein information relating to "traveling routes", "transportation methods" and "destinations" necessary for

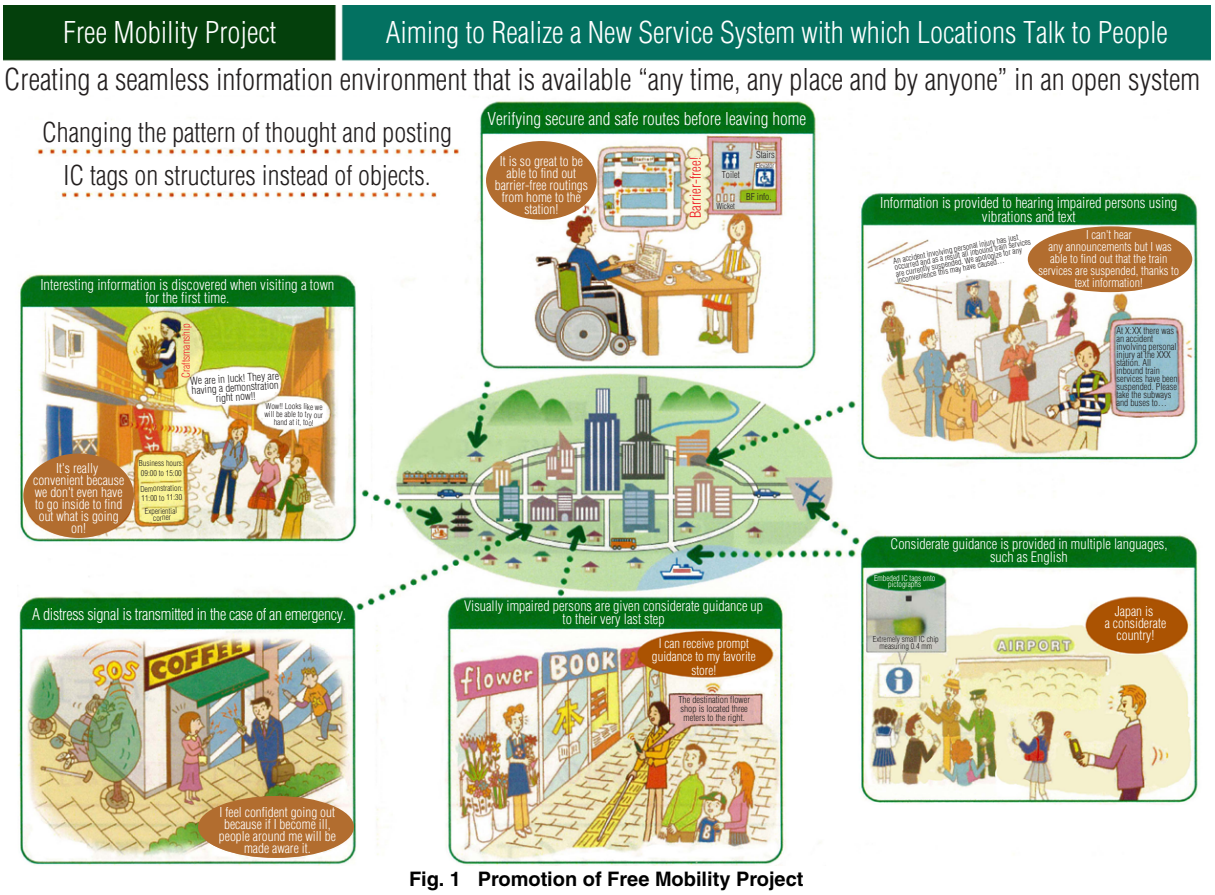

Fig. 1 Promotion of Free Mobility Project

Source: Excerpt from "Promotion of Free Mobility Project" of the Ministry of Land, Infrastructure and Transport by the Free Mobility Project Promotion Committee

*1) ZigBee is a registered trademark of Koninklijke Philips Electronics N.V.

social participation and for gaining employment, can be accessed “any time, any place and by anyone” (**Fig. 1**).

The City of Kobe, which is the seat of the Committee, is not only a strategic location for land, sea and air transport but it is also a tourist destination visited by many people from overseas. The city indicated agreement with the Project early on and they have been participating in the Project since it began. Furthermore, the City held the “International Conference of Challenged Japan Forum (CJF) in Kobe” and has also been a proactive provider of venues for experiments, such as the Kobe City Hall, Kobe City Museum, Nankinmachi and Kobe Airport, while promoting the implementation of their own experiments as well.

Verification Experiments in which Oki Electric Participated

Verification experiments were held at venues situated at a variety of locations. Of all the experiments, Oki Electric participated in the experiments implemented in the City of Kobe under the guidance of the YRP Ubiquitous Networking Laboratory. More specifically the locations were the Kobe Maritime Museum, Kobe International Exhibition Hall, Kobe Fashion Mart (venue of the international conference for CJF), Kobe City Hall, Kobe City Museum and Kobe Airport (**Table 1**).

The largest experiment in which Oki Electric participated in the Kobe District was the “Kobe Airport Ubiquitous Verification Experiment” held at Kobe Airport in March 2006. The concept of the experiment involved the use of the context awareness*2) and universal design using uID (ubiquitous ID), which is a technology intended for assigning unique numbers to various “objects” and “locations” in the real world in a way that is easy for computers to read. Furthermore, this enables all persons, whether physically challenged or physically unimpaired, to receive services that are appropriate for particular situations of the time and according to their attributes. Oki Electric conducted experiments, including the experiment at Kobe Airport that involved a total of 550 participants, ranging from senior citizens to grammar school students, who represented visually impaired persons, hearing impaired persons, foreign nationals, as well as physically unimpaired citizens of the City of Kobe and Hyogo Prefecture at six test locations during approximately eight months between August 2005 and March 2006.

Descriptions of the attempts made in the experiments in which Oki Electric participated are provided below, with references made to the experiment held at Kobe Airport.

Ubiquitous Verification Experiment Using uID Technology at Kobe Airport

Personal attributes (existence and type of impairment, as well as flight number) were collected from recruited monitors for the experiment and the information was registered on the information management server. Services were then provided and the usefulness of providing various services was investigated through evaluations given by monitors.

Table 1 Verification Experiments conducted by Oki Electric

Experiment site	Experiment monitor	Main experiment subjects
Kobe Maritime Museum	Physically unimpaired persons and foreign nationals	· Guidance for museums using free mobility system and description of exhibited items, etc.
Kobe International Exhibition Hall	Visually impaired persons	· Demonstration of guidance services intended for visually impaired persons who use free mobility system.
Kobe Fashion Mart	Visually impaired persons Hearing impaired persons Persons who use a wheel chair	· Direction and guidance at event hall venues for physically impaired persons who use free mobility system. · Demonstration of ubiquitous functions at multi-purpose toilets (ubiquitous toilets).
Kobe City Hall	Visually impaired persons	· Direction for visually impaired persons inside a building where floor-installed directing Braille blocks are not available.
Kobe City Museum	Visually impaired persons	· Guidance for inside a building and descriptions of exhibited items using a free mobility system for the enjoyment of visually impaired persons.
Kobe Airport Terminal Building	Physically unimpaired persons and foreign nationals	· Provision of information intended for the convenience of passengers, information on transfer routes, as well as information about the facilities and tourist destinations.
	Visually impaired persons	· Same as above. Direction and guidance, however, are provided audibly.
	Hearing impaired persons	· Same as above. Direction and guidance, however, are provided with sign language message and text screen displays.
	Airlines	· Positional tracking of passengers who have not boarded an aircraft.

1. Provision of services for visually impaired persons

Individual airlines offer various services intended for visually impaired passengers, however, most of these services are provided once the passengers have been checked in. For this reason, it is essential that guidance be provided from the public transportation system and not just inside the airport terminal.

Directing guidance from the Portliner arrival platform at Kobe Airport Station to the check-in counters of individual airlines located inside the Kobe Airport Terminal building, as well as inside the holding rooms (security areas) were provided for the experiment (**Photo 1**), with the aim of fusing the existing guidance services that are already being provided by individual airlines, which guide passengers from the check-in counters to holding rooms (security areas) via the baggage inspection areas.

Photo 1 A scene in front of the Japan Air Lines check-in counters of a experiment for visually impaired persons

*2) Context awareness services provide services optimally suited for the context (conditions relating to attributes and situations).

These directing guidance services were provided using white walking sticks incorporating an RFID reader, as well as directional sensors and a ubiquitous communicator[*3]. A white walking stick is specially equipped with an RFID reader at the tip, which is a device capable of providing directing guidance information along the walking route by reading and comparing the ucode[*4] information, stored in RFID tags (hereinafter referred to as the "tag for directing visually impaired persons") installed beneath the tactile tiles, with directional information received from directional sensors.

Tactile tiles with protruding bumps cannot be easily installed in some indoor locations, unlike pedestrian walk and other outdoor facilities. For example, tiled carpet made of a rubber material covers the floor surface inside the Kobe Airport Terminal building. It is difficult to determine the bumpy sensation by feeling the floor with the feet when walking inside the terminal building. For this reason directing tags that have the same characteristics as the tags for directing visually impaired persons (hereinafter referred to as the "RFID tags for under floor installation") were installed whenever possible so that visually impaired persons can arrive at their intended destinations with audio guidance alone. Furthermore, these "RFID tags for under floor installation" were installed along the walking routes so that when a person veers off the walking route of their intended destination an attention drawing message is emitted to prompt the correction of directional angle along which the person is walking (**Fig. 2**).

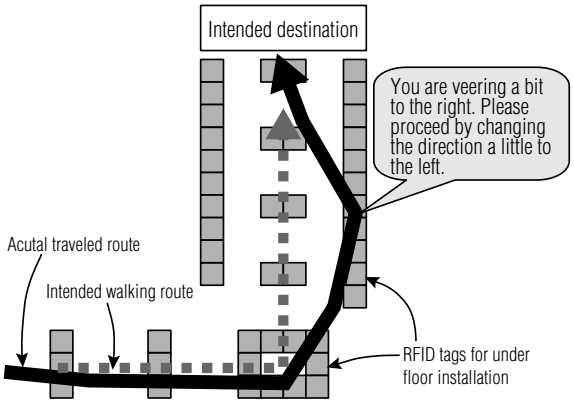

Fig. 2 Guidance provided when "direction shifts" take place

Screen displays of a ubiquitous communicator were devised to ensure that they offer some assistance in providing guidance information to visually impaired persons. It is sometimes possible for individuals with weak eyesight to read messages displayed on a screen when a strong contrast exists between the background color and the colors of text characters. For this reason text characters were displayed in black and white reversed displays. Furthermore, in order to offer some assistance to physically unimpaired persons or care providers in the vicinity by providing guidance information to visually impaired persons, the experiment was conducted with the present location displayed on the screen (**Fig. 3**).

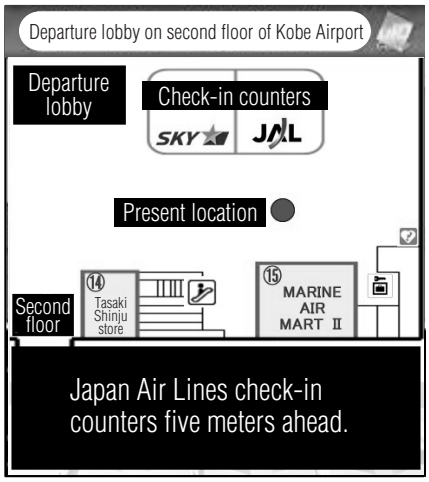

Fig. 3 Screen display of ubiquitous communicator

2. Provision of services for hearing impaired persons

Along with the provision of services for physically unimpaired persons and foreign nationals described later on in this paper, emergency guidance announcement information using sign language image synthesis technology was also provided in the experiment.

Sign language image synthesis is a technology that takes in photographed images of persons using sign language and connects such image fragments to express messages thereby synthesizing expressive sentences (**Fig. 4**).

Fig. 4 Sign language image synthesis

These services feature a clearer conveyance of information for hearing impaired persons with the display of actual images with subtle facial expressions and the movement of lips, difficult to express using computer graphics. The task of providing details of a sign language image synthesis technology is handed over to the article, "Application of Sign Language Image Synthesis Technology in Free Mobility Project" in this issue (pages 58 to 61).

3. Services provided to physically unimpaired persons and foreign nationals

Services were provided with the objective of catering to air travelers, as well as customers using the airport terminal for dining and sightseeing purposes.

(1) Services for air travelers

Services for air travelers were provided for boarding

*3) The ubiquitous communicator is a mobile information terminal developed by the YRP Ubiquitous Networking Laboratory.
*4) Ucode is an identifier for assigning numbers unique in the entire world to various "objects" and "locations".

passengers through the registration of flights on the information management server.

Details of these services are provided below (**Fig. 5**):

a. Change information guidance service

A service that provides changes relating to departure times and the boarding gate of flights (also providing guidance for the time required to reach the boarding gate from the current location).

b. Boarding delay prevention service

A service providing guidance to prompt passengers to board their aircraft 30 minutes and 20 minutes before departure time.

c. Escape directing service

The escape directing service guides people to escape from their current location through an optimum escape route when a disaster occurs.

These three services were provided through the connection of ZigBee wireless markers with ZigBee SD cards built in ubiquitous communicator units online. The following are three features of these services that provided information through a push-type delivery (**Photos 2, 3 and 4**).

First of all, services were provided for foreign nationals in their native tongue, based on personal attributes registered in advance. Phonetic symbols were implemented to provide guidance to children at the Kobe Maritime Museum. Furthermore, guidance was provided audibly for visually impaired persons, whereas guidance was provided using sign language or text for hearing impaired persons.

Secondly, information relating to changes at boarding gates or delayed departure times were provided based on boarding flight information registered in advance.

Thirdly, the current location was tracked using ZigBee and the transfer time to the destination was calculated to provide guidance to prompt movement suitable for the boarding time of individuals. Furthermore, fire disasters were also demonstrated with an escape directing service that provides guidance for escaping through optimum escape routes, based on locations where fire disasters occurred and the current location of the person.

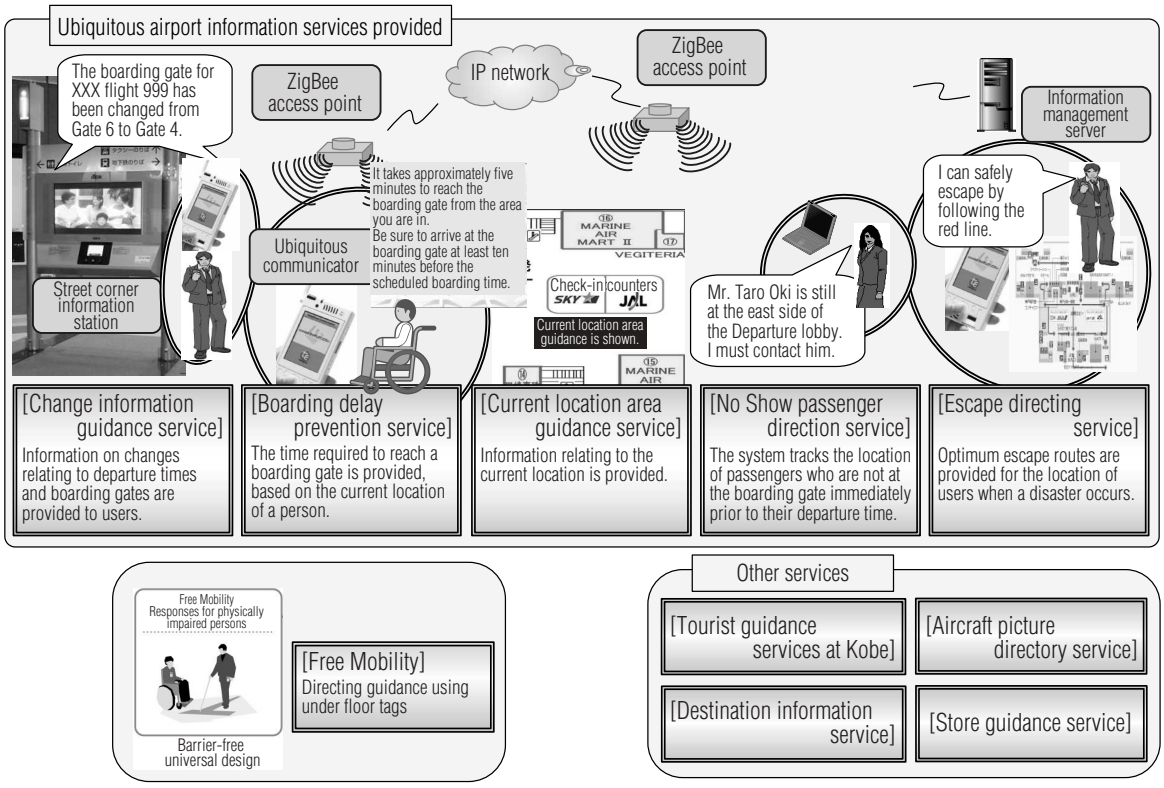

Fig. 5 Ubiquitous airport information provision services

Photo 2 ZigBee wireless marker

Photo 3 Ubiquitous communicator

Photo 4 ZigBee SD card

(2) Services for customers using airport terminals for dining and sightseeing purposes

Guidance providing information on facilities was the primary services intended for customers using airport terminals for dining and sightseeing purposes.

These services were also provided to monitors boarding aircraft, details of which are described below:

a. Current location area guidance service

This service provides information about the surrounding area of a location, as well as guidance relating to information for routing from one location to a destination.

b. Tourist guidance service at Kobe

A service that provides sightseeing guidance matching the direction viewed by the user, through the reading of RFID tags installed on a rooftop observatory in the direction of tourist destinations (**Photo 5**).

Photo 5 Outdoor installed-type RFID tag

c. Aircraft picture directory service

A service providing an introduction to all types of aircraft taking off from Kobe Airport.

d. Destination information service

A service that provides guidance with information relating to access to the airport at the destination.

e. Store guidance service

This service introduces the products and menus offered by individual merchants within the terminal. Two methods for providing information were adopted for this service, one involving the acquisition of information through the operation of the touch panel on the ubiquitous communicator and the other involving the acquisition of information by pointing the ubiquitous communicator to the RFID tags (**Photo 6**).

Photo 6 Indoor (store) installed-type RFID tag

These five services provide information acquired autonomously by monitors and are considered pull-types of information.

4. Services provided to airlines

A service that tracks the location of passengers who have already been checked in but have not boarded their aircraft (hereinafter referred to as “No show passengers”) using IT technologies, which support various services described thus far, primarily ZigBee.

From the perspective of security it is necessary to unload the luggage of a no show passenger when the applicable passenger cannot be located, which is a problem that is directly linked to the delay of an operating schedule. Airlines only have a person's personal attributes, such as their name, age and sex and since airlines are not aware of a no show passenger's whereabouts, enormous resources are used to locate such passengers through announcements and through sending out personnel to run around and search for such passengers.

This service was provided by making it possible for airline personnel to locate no show passengers from personal computers installed on airline counters, making it possible to approach no show passengers from the nearest location.

5. Street corner information station

This operating terminal uses the street corner information station*5) of a large display board-type in this experiment (**Photo 7**).

Photo 7 Street corner information station

The pull-type mode of providing information was selected from among various services that have thus far been introduced in this paper for the street corner information station. The station automatically detected approaching users with a personnel sensor and provided services including guidance information using visual images and sound.

*5) The street corner information station is an intelligent information station providing directions for surrounding areas under ordinary circumstances and for providing various other information when a disaster occurs.

Our station attracted a lot of attention as it was installed in the departure lobby on the second floor of Kobe Airport Terminal and was freely available for use by all, including persons who were not our monitors.

6. Evaluation by monitors

(1) Visually impaired persons

Depending on individual differences many visually impaired monitors voiced their desire for the implementation of functions to make it possible to select the content and quantity of information, as well as the timing with which voice messages are provided. Furthermore, although many who indicated that the attention drawing guidance "diversion of direction" was a good feature, some voiced their desire for the implementation of more effective guidance by providing the direction in which the person should redirect the path in order to return to the intended walking route. While basic functions were accepted expectations were for more advanced features.

(2) Hearing impaired persons

Many hearing impaired persons who participated in the experiment as monitors, indicated that the information was conveyed more accurately with the use of sign language, rather than text subtitles.

Among the hearing impaired persons many considered sign language to be their first language of choice over text. Results of the survey indicated that many desired the provision of information with sign language and the inclusion of information relating to the causes of occurrences, as well as their current status. On the other hand, although basic functions had been accepted, expectations were for more advanced features providing selective functions based on personal attributes, such as the timing of providing information through sign language or text subtitles, as well as their content.

(3) Physically unimpaired persons and foreign nationals

The representative opinion of the monitors of physically unimpaired persons and foreign nationals was "the system makes it possible for first time visitors at an airport to move around without getting lost, particularly at larger airports, practical implementation of the system is desirable by all means". On the one hand more than 90% of monitors indicated on the survey that they would like to use such a system and even though the basic functions were accepted, like visually impaired persons and hearing impaired persons, their expectation was for even more advanced features, such as the real-time provision of information linked with personal attributes.

(4) Airlines

All monitors from the airlines, except for one person, provided a result indicating, "If this system can be realized, we would like to use it". The aforementioned person was opposed to the system on the grounds of privacy issues. Specifically, in the experiment toilets were excluded from the determination of the positional information of individuals, since it is logically possible to find out that a person is in the toilet in determining the positional information. For this reason it is essential to institute a design of the system capable of properly handling privacy issues when designing the system.

*6) e-Society is a registered trademark of Oki Electric Industry Co., Ltd.

Future outlook

The provision of information optimally suited to a particular location and conditions was conducted in these verification experiments, mainly with voice messages for visually impaired persons, whereas information was provided primarily with text and image created using synthesized sign language to hearing impaired persons, in the native language of foreign nationals and messages with phonetic symbols for children. We believe that providing information that is suitable for individuals in a secure, safe and comfortable manner by monitoring conditions and the location of such individuals while combining various IT technologies, is an effective means to realize the ubiquitous society.

At Oki Electric we intend to continue with our contributions to the Free Mobility Project in the future, with the intention of making a contribution toward the realization of the e-Society®*6), which is full of ubiquitous services "individualized" without discrimination.

Furthermore, even though the verification experiments at Kobe Airport were completed in March 2006, we are planning to implement a test by the end of this year at this airport, which is designated as the model airport for the entire nation, in order to seek out issues for practical implementation and strategies for improvements by providing services desired by customers using the airport, as well as a selection of content and quantity of information based on personal attributes along with the timing of voice messages.

References

1) Free Mobility Project Promotion Committee
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