

# Voice Guide System for Foreign Laborers by Cell Phones

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## Summary

In recent years, labors from abroad have been increasing. They do not always understand Japanese. Until they acquire ability to understand Japanese, instructions to them have to be done in their mother language. In addition, many of foreign labors have a high-function cell phone of Japanese make.

After a document for instruction was translated into English and Chinese, the translated text was converted and compressed into voice data. Then it was placed on the Web server. The authors made a prototype system that labors could listen to the instruction through their cell phones after they received an e-mail with the URL. This paper shows the usefulness of the system based on a questionnaire survey

### **Key words:**

Web, cell phone, translation, mail

## 1. Introduction

### 1.1 Background of Research

Foreign labors to Japan have been increasing due to the appreciation of the yen since 1985 Plaza Accord. GNP per capita in Japan is quite higher than other Asian countries. Many foreigners have come to Japan because they think they can live a rich life in Japan.

The biggest reason of a serious social problem in acceptance of foreign labors is the lack of education at the beginning of acceptance.

Employers make foreign labors work for a production line immediately though they do not understand instructions fully. In the result, the fusion of their companies and communities can not work in right direction.

Meanwhile, cell phone subscriptions are increasing year by year. According to the statistical data by the Ministry of Internal Affairs and Communications, the number of contracts has doubled in six years, between 1999 and 2005,

and it is more than 87 million. Internet-capable cell phones account for 80% of subscriptions in 2005. Cell phones are changing from just a tool of conversation to a tool of Internet connection.

For the reason above-mentioned, this paper provides a voice guide system with a cell phone for foreign labors as a means of their contributions to companies and communities.

### 1.2 Purpose of Research

This paper unified the translation engine, the Web server and the voice compression technique, and then a system was built on trial. A questionnaire was carried out to research the usefulness of the prototype system and we studied the issues for it by the result of survey.

The carriers surveyed on making a prototype system are NTT Docomo, Ezweb and Vodafone. In Japan, the network of cell phones is formed by these three carriers [1] mostly.

## 2. Transition of Foreign Labors and Cell Phone Market

This chapter describes a consideration of the necessity for the prototype system based on a statistical data about the transition of foreign labors and the cell phone market.

### 2.1 Transition of Foreign Labors

The number of foreign residents in Japan that was about 740 thousand people in 1972 has been increasing year by year and it reached 1.78 million people in 2001. The number is equivalent to 1.4% of total population. The growth rate was only a few percent over the previous year until the mid-1980s but it showed large increase during the "bubble years." The major reason was the sharp increase of Japanese ancestry to Japan where labor power was

lacking because of immigration regulation which was enacted in 1989 and enforced in June 1990. Then the growth rate declined for a while, however, it has continued to increase again in recent years.

By countries where foreign residents are from, South Korea and Korea have the highest percentage and then China, Brazil and the Philippines in the order. Among these countries, China has the largest growth rate. Figure 1 shows the transition of foreign labors.

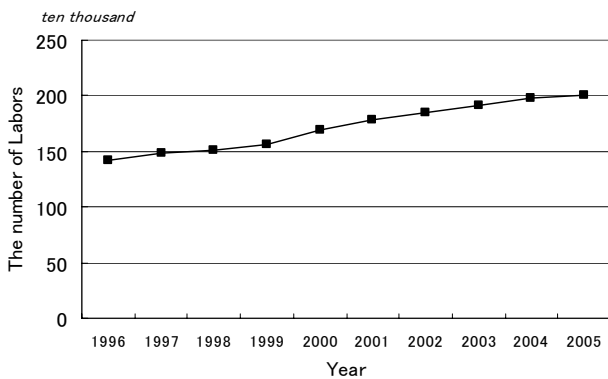


Figure 1: Transition of Foreign Labors

A data in 2006 from the Immigration Bureau of the Ministry of Justice

### 2.2 Cell Phone Users

The history of cell phones dates to a car telephone service which was developed by Dendenkosha of the time in 1979. In 1985, shoulder phones were released with the liberalization of telecommunications. Since 1990s, telephones have been miniaturized and the cost has become cheaper. Then, with the digitization of communications network, i-mode models which had an Internet connection were released. The appearance of i-mode caused the explosive increase of customers.

Figure 2 shows the transition of the number of cell phone contract from 1999 to 2005. It was increasing year by year. In 2005 the number was over 87 million and increased double during six years[2].

The number of Internet-connected cell phone contract reached 80% of the total in 2005. Cell phones are changing from just a tool of conversation to a tool of Internet connection.

Figure 3 shows the result of a survey against users what kind of functions their cell phones have.

The camera function is 84.4% with the highest percentage and the moving picture function is 63.8%.

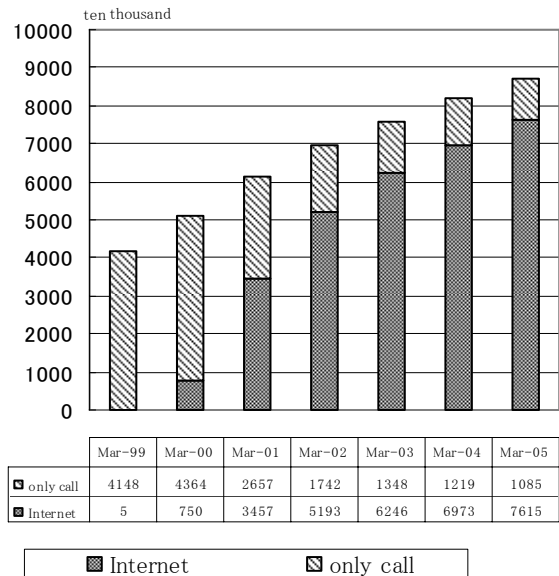


Figure 2: Transition of the Spread of Cell Phones Ministry of Internal Affairs and Communications, Japan, "Information and Communications in Japan", White paper 2005, p.85

Then the Appli[3], the infrared communication function, the two-dimensional bar code reader and the function as a music player are following in that order[4]. However, in this question, users were allowed multiple answers and this result came from such a survey. Cell phones on sale in recent years have at least top 6 functions per cell phone. That is the functions of a camera, moving picture, Appli, infrared communication, two-dimensional bar code reader and music player.

Figure 4 shows the intention of users to utilize each function of cell phones.

After checking a research what function people want to use from now, including the existing functions, the camera function accounted for 72.7% with the highest percentage. The moving picture was 46.9%, the function as a music player was 35.8%, the Appli was 31.7%, and the function as a television was 27.6%. The number of cell phones with the function as a music player and a television is fewer compared with that of cell phones with the function as a camera and Appli. However, such cell phones which can be used as a music player and a television are very popular among young people. In the future, it is expected that cell phones with such functions will be developed widely[5] Compared the rate in 2001 with the rate in 2004, the use of the Internet through cell phones has increased in every age group. The use rate between the ages of 13 to 49 accounts for over 60% but the rate among users over the age of 50 has decreased on the contrary. There is still a generation gap.

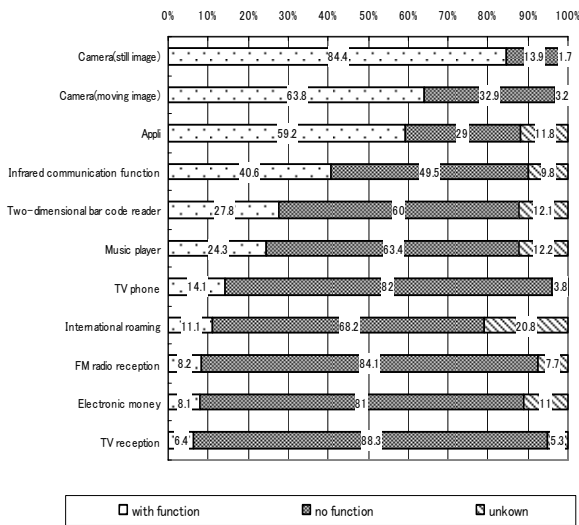


Figure 3: Presence of Each Function  
Ministry of Internal Affairs and Communications, Japan, "Information and Communications in Japan", White paper 2005, p.87

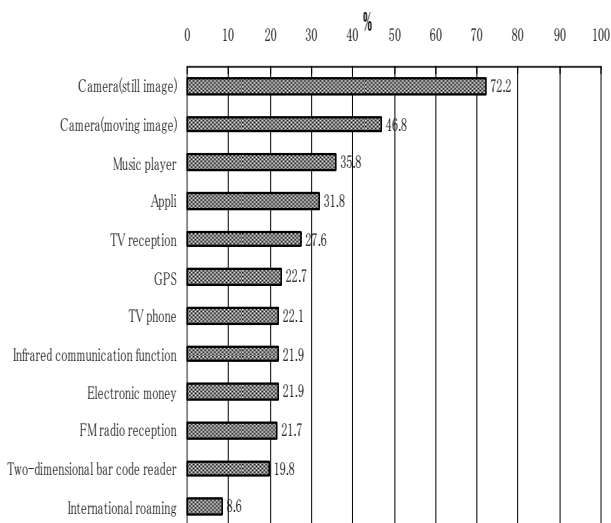


Figure 4: Intention to Use Each Function  
Ministry of Internal Affairs and Communications, Japan, "Information and Communications in Japan", White paper 2005, p.87

However, as time goes by, the disparity will be narrowed. Figure 4 shows the rate of Internet use with cell phones. Also, there are differences in other factors, gender, urban size and annual income. All things considered, the factor of age group has the greatest effect.

From the results stated above, users of the Internet through cell phones have been increasing steadily, and people are looking for value-added cell phones. That is a

reason we say this is the time of ubiquitous computing.

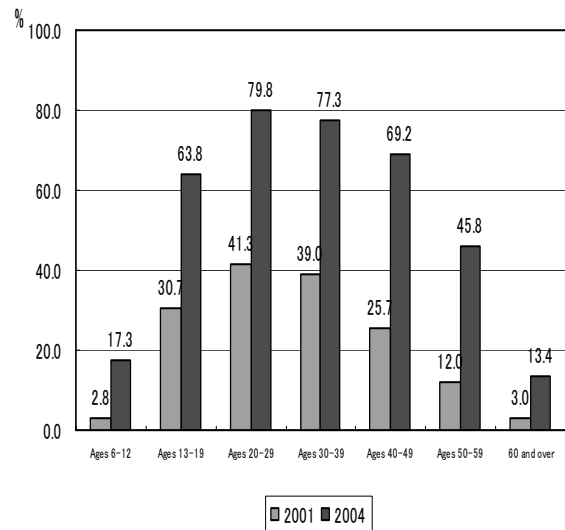


Figure 5: Rate of Internet Use with Cell Phones  
Ministry of Internal Affairs and Communications, Japan, "Information and Communications in Japan", White paper 2005, p.118

### 3. Abstract of Experimental System

In this chapter, we clarify technical issues and look at problems of system administration and management on the basis of system configuration and a questionnaire. Then we study the usefulness of this system.

#### 2.3 System Configuration

We made three systems on trial which could be used through NTT Docomo, Ezweb and Vodafone. Table 1 shows a data format for each carrier.

Table 1: Data format of Each Carrier

Carrier	Language	Multimedia	Graphics
NTT Docomo	C-HTML,X-HTML	Mfi,3GPP	GIF,JPEG
Ezweb	HTML,X-HTML,HDML	SMAF,AMC,3GPP2	PNG,GIF,JPG
Vodafone	HTML,X-HTML	SMAF,3GPP	PNG,JPG

The languages of Table 1 are made on the basis of HTML language to built website and they are the specific standards of each carrier. Additionally, music file like MP3 is not played and set as ring alert on cell phones. Therefore,

the reproduced sound using video files is substituted. As a result, 3GPP and 3GPP2 of multimedia can be played on Quick Time Player. Mfi and AMC are the specific standards of each carrier. Moreover, SMAF is the compression format of music which was developed by YAMAHA CORPORATION.

A trial system configuration diagram is illustrated in Figure 5 and the explanation is below.

The system developed here, converts the data with a text into the synthesized voice data, and compresses it. The system stores the compressed voice data in the database. And, the data can be accessible to the database from the cellular phone. The compressed voice data is downloaded by the XML program, and reproduced on the cellular phone. The following steps are performed.

- (1) Conversion of instructions to text
- (2) Conversion of Japanese document to Chinese and English text
- (3) Conversion of text into sound file  
In the conversion into sound file, the input text data is converted into voice data by oral software.
- (4) Compression of sound file into formats for each carrier

Human can recognize only the sound of about 20Hz~20 kHz as MP3, in principle.

Human do not hear any frequency, with the same sensitivity, but roughly 3~4 kHz with the top sensitivity. Then, the sensitivity of a low region and a high region is reduced. In a word, there is a limit in hearing the frequency of the sound, and the sound below the limit is not heard. The principle of cutting the sound is used as that of the compression.

- (5) Web for download

When data with large volume was downloaded, it is necessary to have the specialized software in using the conventional HTML language. However, in the XML consider the interface with the data base.

Figure 7 shows an example of XML program on the screen.

- (6) Distribution to each carrier

There are peculiar character strings that can be identified in OS of each cellular phone and the personal computer, respectively. This is called environment variables. The CGI programs are accessed from each cellular phone in the Perl language. Then, the access can be distributed according to the career by displaying the environment variables. Figure 8 shows an example of the program.

When a browser accesses the Web server, not only URL but also information on a browser etc. is sent together. Then, homepage information on the server and access information and browser information, etc. can be acquired by using the environment variable. The environment variable is stored as the hush data of \$ENV{---}, which is referred for the access log etc. Browser information can be acquired by \$ENV{HTTP\_USER\_AGENT}. Character information on "DoCoMo" or "Docomo" has entered browser information if the cellular phone used is NTT Docomo. Similarly, the character of "Ezweb" has entered if the character of "J\_PHONE", "PHONE", "J\_PHONE", "Jphone", and "Vodafon" is Ezweb if it is Vodafone

When the outline of the program is expressed by the flow chart, it is very easy. Figure 10 shows the flow chart. NTT Docomo use TCP/IP in protocol and Ezweb use UDP/IP in wireless communication. Each carrier has the advantages, such as the reliability and the high speed of data transmission, and also has the disadvantages.

In recent cell phones, XML, proposed as global standard by W3C (The World Wide Web Consortium) on December 2000, is set as standard. Moreover, we can display still images using JPEG in cell phones of all carriers. In the meanwhile, the data format of multimedia and the program to download data differ from each carrier because of its protocol. Vodafone and NTT Docomo allowed to use 3GPP as sound file format. However, we couldn't play sound files automatically in the Vodafone model, therefore, we changed the format from 3GPP to SMAF.

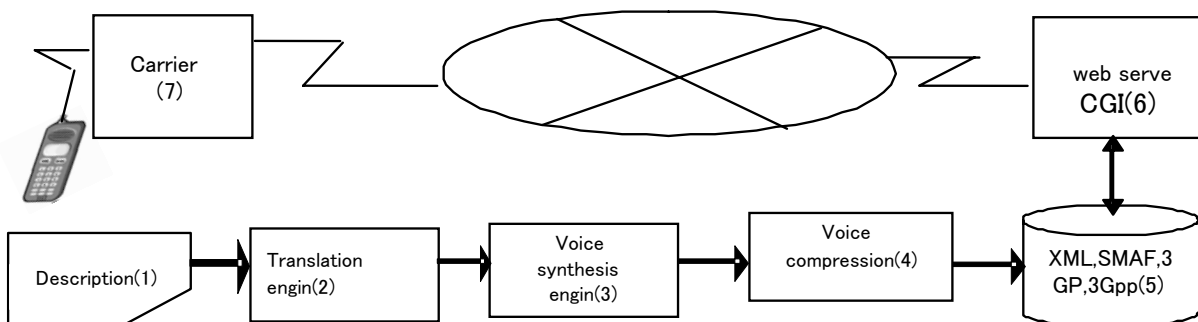


Figure 6: Diagram of System Configuration

```
<?xml version="1.0" encoding="Shift_JIS"?>
<!DOCTYPE html PUBLIC "-//OPENWAVE/DTD XHTML 1.0/EN"
"http://www.openwave.com/DTD/xhtml-basic.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="ja" lang="ja">
<html>
<head>
<title>A commentary of Okazaki Castle</title>
</head>
<body>
<center>
<table border=0>
<tr>
<td><center><b>A commentary of Okazaki Castle</b></center></td>
</tr>
<tr>
<td><center></td>
</tr>
<tr>
<td><center><object
data="http://www.geocities.jp/nari_pc/okazakijyou.3g2"
type="audio/3gpp2" copyright="no" standby="Explanation 1 ( click)">
<param name="disposition" value="devmpzz" valuetype="data"/>
<param name="size" value="181775" valuetype="data"/>
<param name="title" value="okazakijyou" valuetype="data"/></center>
</object></td>
</tr>
</table>
</center>
</body>
</html>
```

Figure 7:XML Program

Unfortunately, the capacity to convert to SMAF was limited.

In Perl program which is sorted by carriers, we adopted that each carrier could have special characters in environment variables. Figure 9 shows a diagram of system contents.

(7) Base station to access the Internet through each cell phone

```
#!/usr/bin/perl

$agent = $ENV{"HTTP_USER_AGENT"};
$str0 = "http://www.geocities.jp/nari_pc/ntt/okazaki.html";
if ($agent =~ "DoCoMo"){ $str0 = "http://www.geocities.jp/nari_pc/ntt/okazaki.html"; }
if ($agent =~ "docomo"){ $str0 = "http://www.geocities.jp/nari_pc/ntt/okazaki.html"; }
if ($agent =~ "J-PHONE"){ $str0 = "http://www.geocities.jp/nari_pc/vdf/okazaki.html"; }
if ($agent =~ "PHONE"){ $str0 = "http://www.geocities.jp/nari_pc/vdf/okazaki.html"; }
if ($agent =~ "J_PHONE"){ $str0 = "http://www.geocities.jp/nari_pc/vdf/okazaki.html"; }
if ($agent =~ "jphone"){ $str0 = "http://www.geocities.jp/nari_pc/vdf/okazaki.html"; }
if ($agent =~ "ezweb"){ $str0 = "http://www.geocities.jp/nari_pc/okazaki.html"; }
if ($agent =~ "UP.Browser"){
    if ($agent =~ "Vodafon"){ $str0 = "http://www.geocities.jp/nari_pc/vdf/okazaki.html"; }
    else
```

Figure 8: Example of Perl Program

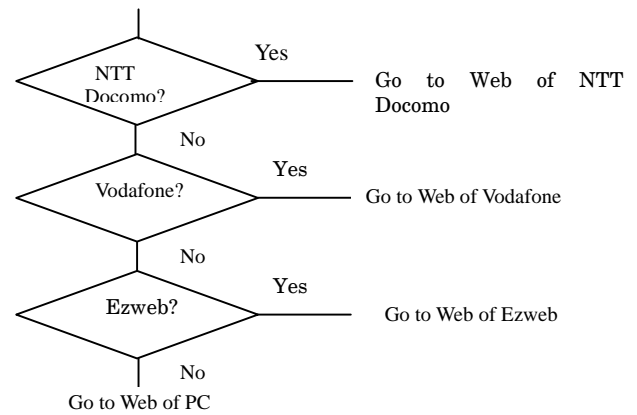


Figure 9: Flow chart

### 2.4 System Contents

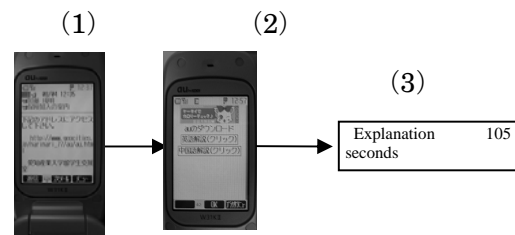


Figure 10: shows a display panel for cell phone.

- (1) in Figure 10 is a mail reception screen and the message contains URL.
- (2) is a screen for downloading music.
- (3) The prototype system can play voice for 105 seconds.

### 4. System Evaluation

A questionnaire survey for the prototype system was carried out. 40 foreign students from China were surveyed and the respondents were 32 students and the collection rate was 80%. The number of people surveyed was small because the respondents were limited to users who had a specific cell phone. The evaluation of the questionnaire is 5-point scale. The items are described below.

- (1) Was the operation performance to output voice guidance good?
  - (2) Was the time to download voice data short?
  - (3) Was the content of explanation good?
  - (4) Was the voice clear? (Sound quality)
  - (5) Was it economical to download?
  - (6) Was the system useful? (Free description)
- 5-point scale consists of "1:bad 2:a little bad 3:normal 4:a little good 5:good."

Table 2 shows the total results and Figure 10 shows the frequency distribution on the questionnaire.

Table 2: Total Results of the Questionnaire

	Operation performance	Downloading time	Content	Sound quality	Economy
<b>Average</b>	3.187	3.031	3.062	3.312	2.437
<b>Dispersion</b>	1.027	0.905	1.183	1.527	0.683
<b>Standard Deviation</b>	1.013	0.951	1.087	1.235	0.826

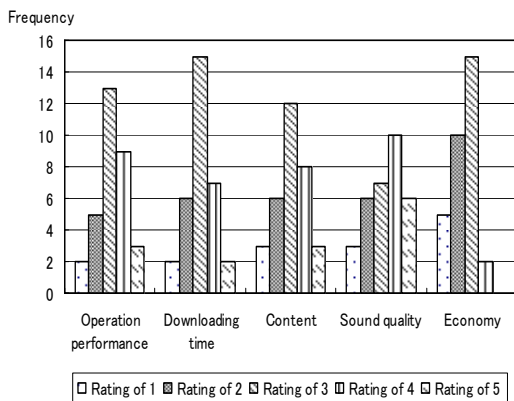


Figure 11: Frequency Distribution Table

Though the data was not statistical because of a small number of respondents, there were no problems except economic efficiency.

Moreover, most of the respondents answered the system was useful by filling in free description. The amount of the data is 171kB in the system. In case someone downloads the data on the assumption that one packet is 128B and 0.2 yen, it costs about  $171\text{kB} \times 1024/128\text{B} \times 0.2 \text{ yen} = 274 \text{ yen}$  in disregard of the header. If a user subscribes packets at a metered rate, he would have the economic problem. In the future, the flat rate system for packets will spread.

### 5. Conclusions

Under the declining birthrate and the aging population, the number of foreigners in the Japanese labor market is increasing and their working patterns vary from foreign labors in technological fields to Japanese ancestry, international students working part-time and apprentice to learn skills. Many of them have a Japanese cell phone.

The white paper in 2005 which was released by the Ministry of Internal Affairs and Communications says the number of cell phone contracts is over 87 million and 80% of the totals have an Internet connection. In addition, most

of cell phones have concomitant high functions as a camera for still images and moving images, a stereo music player and application. The survey results show that users hope to utilize the high functions continuously.

Moreover, cell phones with high functions are accepted especially by Asian people compared with European and American because of differences in value and culture.

This system was built in the form of "Voice Guide System for Foreign Laborers by Cell Phones." The weakness of the prototype system was that short sentences at conversation level can be translated generally but long sentences can not be translated properly. In case someone uses the system he require the knowledge of computer including server, therefore, the system ought to be simplified to enable the public to operate it. These problems are challenges for the future.

### References

- [1] Cell phone provider (NTT Docomo, AU and Vodafone in general)
- [2] Ministry of Internal Affairs and Communications, Japan, "Information and Communications in Japan", White paper 2005, p.85
- [3] Application software
- [4] Ministry of Internal Affairs and Communications, Japan, "Information and Communications in Japan", White paper 2005, p.87
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