Applications of Mobile Research in Japan

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MOBILE INFRASTRUCTURE BASED ON GPS

Implementation of the System

Most mobile phones recently available in Japan have a GPS (Global Positioning System) function, which can open up a variety of applications for getting necessary information near the current location. Here we present the basic infrastructure that we have developed, by which useful information at a person's current location can be accessed without troublesome operations like Web navigation searches.

The GPS system shown in Fig. 1.1 is divided into two units: a service provider unit and a mobile user unit. These units can be uniquely connected through a content distributing server via the Internet.

The service provider unit includes a customer service section, a content creation section, and a business supervision section. Those sections are suitably combined to support the service provider unit through networks. Various types of applications can be developed on the above infrastructure, such as marketing tools, public information tools, and educational tools. Public services in the case of disaster and applications for education will be discussed later in this chapter.

(A) Functions of the Overall System

We have developed a GPS system having the following basic functions:

- The system contains a server, service providing and controlling functions.
- In a particular area of the server, the service provider must store the information in advance, which is to be accessed when a user's location is in the particular area defined by latitude and longitude at the left top and right bottom position.
- Mobile users will obtain the data on their location with a DoCoMo mobile device using satellite signals.
- The mobile device sends data on the device's location to the server.
- The mobile device obtains the necessary information related to its location without troublesome operations.

(B) Constituent Elements of the System

The system developed consists of the following devices:

① Data storing and distributing server

The server connected via Internet to other devices works as the heart of the system, which stores various data to construct the database of information, and it stores several applications to maintain the database and to control the system.

② User service device

Using a service control application in a user services device, data from the information supplier is registered into the distribution server through any Web browser.

③ Business control device

A business control application located in the distribution server has functions to supervise the overall system via a Web browser.

④ Content creating device

Through this device, the contents that will be retrieved for a mobile user are created by editing original text and image data, prepared by the information supplier.

(C) Types of Services

- Once an information supplier has been registered, a special identify number will be issued to identify each supplier.
- The information registered will be open to retrieval for a specified duration.
- Mobile users can post their comments concerning the information, up to a maximum of 30 comments.
- At the end of the specified duration, all the data including comments are deleted automatically.
- Once a month the business control device will send a report containing the access number and stored records of their electronic coupons and so forth to the information supplier.

Service Providing

(A) Outline

The procedure to obtain the information corresponding to the current location is given in Fig. 1.2. First, a user accesses the service site from a browser of the mobile device. The i-application program can be downloaded from the service site with the acquisition of the location information. As a first time user does not have the i-application program, it must be downloaded and installed. The location information is acquired from the service site and the start screen of the i-application program is displayed. Because the list of information on (?) the surrounding area is displayed when the i-application program is started, the acquired information is downloaded and the coupon is saved.

The number of acquired points and the coupon can be confirmed by starting the i-application program installed in the mobile device.

(B) Procedure for Acquiring Information

The procedure to acquire the information is summarized below:

1. The mobile user accesses the information distribution service site via the Web browser built into the mobile device.
2. When the URL of the service site is accessed via Web browser, the download will start as shown in Fig. 1.3 (a) and the service site will be displayed as shown in Fig. 1.3 (b), in which three buttons are included: “information retrieve”, “download of i-application program”, and “help”.
3. When a mobile device is used for this service for the first time, its user must download the i-application program and install it into the mobile device by using the “download i-application program” button.
4. For a mobile device with an i-application already installed, a user can obtain the location data by using the “information retrieve” button, as shown in Fig. 1.4 (a).
5. By using the “obtain the current location” button, the current location will be obtained as shown in Fig. 1.4 (b) via GPS satellite. After the location is determined, Fig. 1.4 (c) is displayed with the scale level.
6. By using the “OK” button, a list of information corresponding to the surrounding area will be displayed as shown in Fig. 1.5 (a), from which the detailed information is displayed as in Fig. 1.5 (b). When the “coupon” button is pressed, a coupon will be displayed as in Fig. 1.5 (c), which will be stored in the mobile device together with the service points that are used for various types of advantages.

(C) Confirmation of Stored Coupon

The procedure to confirm the preserved coupon images is the following:

1. By executing the “Confirmation of stored data” button when the i-application starts, the name of the information supplier corresponding to the stored coupon will be displayed together with the points stored.
2. By selecting a particular information supplier, the list of information corresponding to the information supplier will be displayed.
3. By selecting a particular coupon image the stored coupon will be displayed.
4. By using the “delete” button, the coupon will be deleted.

Control Functions

(A) User Service

The user service terminal installed at a registered shop performs the necessary operations to accept information from suppliers. The user service terminal uses the Web as shown in Fig. 1.6, through the service control applications located in the server.

The URL to access the user service applications is given by

http:// Address of server /kanri/loginservice.html

In order to use the user service application, a user ID and password are required, which are registered by the business control terminal introduced below in (B). The following functions are available at the user service terminal:

- To register the information on applicants
- To register the information of suppliers
- To register the information data supplied by suppliers

(B) Business Control

The business control terminal installed at a business center performs the necessary functions to supervise all the business operations. The business control terminal uses the Web as shown in Fig. 1.7, through the business control applications located in the server. The URL to access the business control applications is given by

http:// Address of server /kanri/logingyomu.html

In order to use the business control applications, the user ID and password registered with the business control terminal are required. The following functions are available at the business service terminal:

- To register the operator of the user service terminal and business control terminal
- To control the comments submitted
- To report access data to an information supplier as shown in Fig. 1.8

Discussion

We have developed the basic structure of a GPS system, which can be modified or extended to various type of applications. It may be used effectively to advertise surrounding shops near the current location as shown in Fig. 1.9. In an emergency case, such as an earthquake, the first notice can be announced as shown in Fig. 1.10.

Some examples of events and work done elsewhere are reported in Japanese at the following URLs:

- http://bb.watch.impress.co.jp/cda/event/17601.html
- http://plusd.itmedia.co.jp/mobile/articles/0706/07/news076.html
- http://www8.ric.co.jp/expo/wj2007/index.html#kousei

There is a summary in English of work by Higaki et al. on GPS mobile phone and PDA applications for providing spoken guidance to the visually impaired, at:

- http://ci.nii.ac.jp/naid/110003286553/

As a useful application combined with a road map, a powerful human navigation system may be developed in the near future.

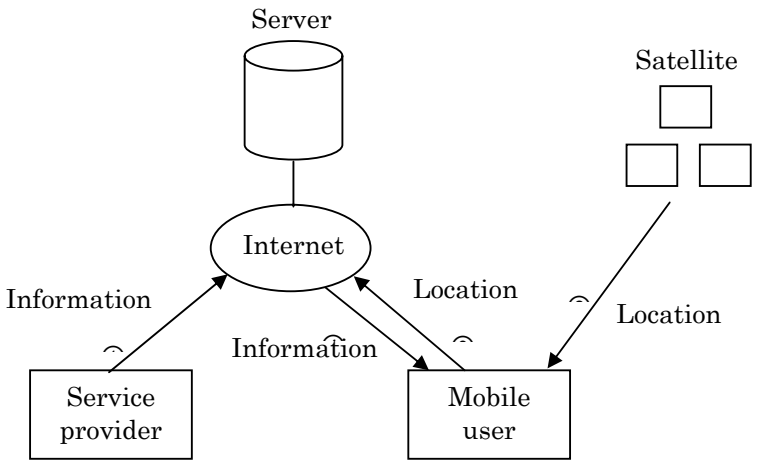


Figure 1.1　GPS system overview

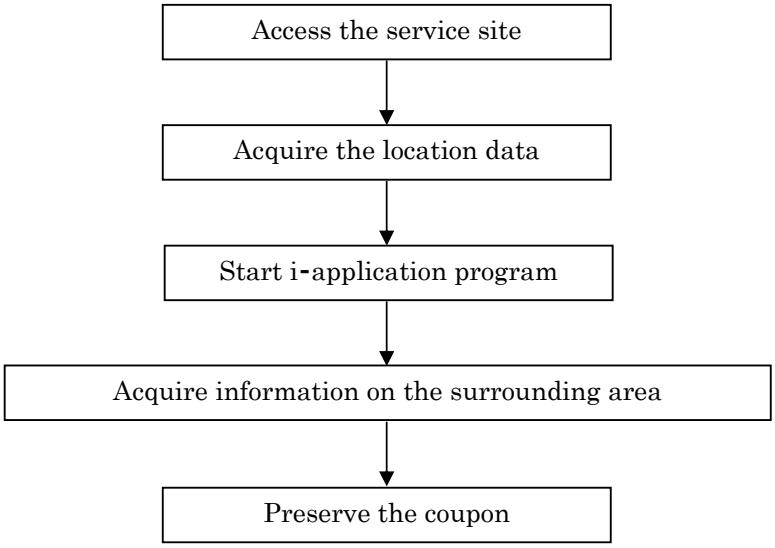
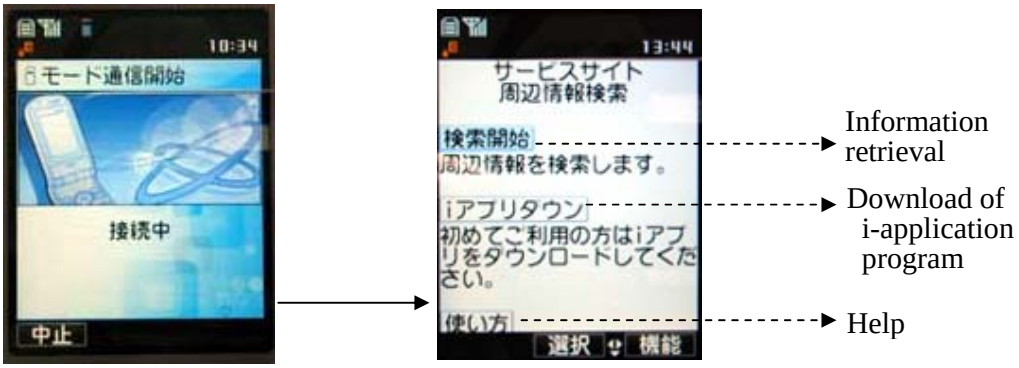


Figure 1.2　Procedures to obtain information corresponding to the current location

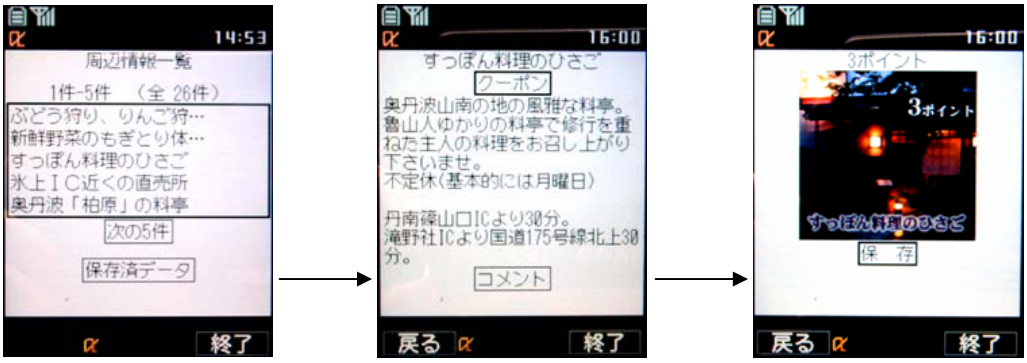


(a) i-mode (b) Display of service site

Figure 1.3 Access to the service site

(a) Current location (b) Obtaining the current location (c) Location obtained

Figure 1.4 Series of mobile displays to obtain the current location.



(a) List of information (b) Detail of information (c) Coupon image

Figure 1.5 Access to information and a coupon

Figure 1.6　Functioning of the user service terminal

Figure 1.7　Functioning of the business control terminal

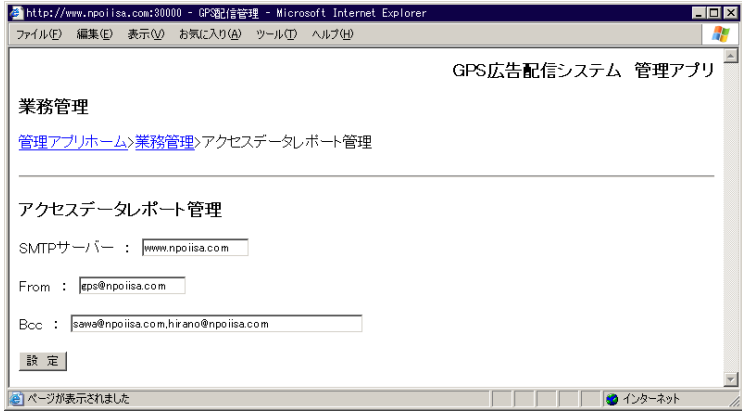


Figure 1.8　Report of access data

(a) Information

(b) Coupon

Figure 1.9　Advertisement of a shop near the present location

Disaster Information

An earthquake occurred in your nearby area around 1:00 P.M, January 22nd, 2007.

- Earthquake Disaster Information
- Guide to Hospital
- Water Supply Guide
- Meal Supply Guide
- Lifeline Information

(a) First notice

Guide to Hospital

The hospital in your area is the following:

- General Hospital

Number of patients acceptable: 300

TEL: 078-123-4567

(b) Location of first aid agent

Figure 1.10　Emergency announcements with links in the case of an earthquake

A SUPPORT SYSTEM FOR DISASTER VICTIMS IN UNFAMILIAR ENVIRONMENTS

This section proposes a framework of appropriate evacuation guidance and a decision support system for disaster victims in unfamiliar environments. Given the risk of massive social unrest such as in a major earthquake, countermeasures for disaster mitigation and crisis management tend to be focused on the government role.

Disaster support systems have not been much investigated for victims in unfamiliar environments such as sightseeing travelers and people on business trips. One cause is that a major concern of administrative agencies is residents. It is often the case that the disaster plan for visitors is to guide them home, yet the plan does not include any concrete procedure.

When the great Hanshin-Awaji earthquake disaster occurred in the international sightseeing city of Kobe in 1995, there were few tourists among the victims (Yokoyama, 1995). This is partly because the beginning time of the earthquake was the early morning after a holiday and there were not so many tourists, and partly because many hotels were of earthquake-proof construction. If the next earthquake occurs in the afternoon, many tourists will be involved in severe damage. Disasters may differ according to the local conditions, and the local government disaster plans are very important for the safe evacuation of visitors. In many cases the visitors have no one to turn to. It may take a long time to get home. It could be the case that they do not know the detailed route to go home. There are few researches about visitor support in disasters.

This section analyzes the potential problems facing visitors in disasters and proposes a new method to support them. First, the decision-making process of the visitors is modeled when they meet disasters. Based on this model, a decision support system for visitors is proposed using a multi-agent framework and a shotgun speaker system. We apply this framework to Kyoto City, which is the most famous sightseeing city in Japan, with many sightseeing facilities and festivals. This study was performed as an academic cooperative research organization project of a consortium of universities in Kyoto, and part of this study was funded by the Kyoto city disaster risk management investigation agency.

The Basic Concept

(A) Visitors and Disasters

People have largely relied on “Public Rescue” for many years when they are struck by disasters. “Public Rescue” means the activities by the local government and public enterprises, such as the police and the fire department, in order to minimize damage. In the great Hanshin-Awaji disaster, many local governments themselves were severely damaged and about 80% of the rescuees were saved by “Cooperative Rescue”, that is, by their neighbors (Yamamoto, 2007). Since that disaster, a balance of “Public Rescue, Self Rescue and Cooperative Rescue” is widely recognized as important. As many problems are not solved by each person, “Cooperative Rescue based on Self Rescue” becomes an important theme of city planning which makes cities stronger against disasters.

As very wide area damages are predicted concerning the next Nankai and East-Nankai great earthquakes, the basic concept is required that each area is saved and recovers by itself (Kawata, 2001). The disaster mitigation plans must consider the visitors as well as inhabitants, who can be major obstacles or of great help. For example, visiting crisis managers, medical doctors, construction workers, and foreign language users are expected to be among the visitors. And even in the difficult conditions of disasters, people can be calmed by the assignment of useful roles. In an emergency, the attempts of the local government trying to manage and control all the matters may raise unsettling possibilities and dissatisfaction among residents and visitors. To mitigate this, it is necessary to provide the visitors with detailed information of the disaster and damage, and the media which collect and provide the information.

(B) The Current Situation of Countermeasures for Visitors

Hearings and investigations have begun in the disaster prevention office of Mie prefecture which has the possibility of severe damage by Tokai, East Nankai or Nankai earthquakes (Mie Prefecture, 2005). Mie invites many visitors to the Grand Shrines of Ise, Ise-Shima's beautiful bay area, its aquarium, hot spas, pearl island, and seaside beaches, and countermeasures against earthquakes and tsunamis are being developed with a view to visitors in the unfamiliar environment. Approved details of the reports will be published next year, dividing sightseeing sites into three categories: places with large-scale guest facilities (e.g., hot spa villages), the places of tourist agent assemblies, and many small beaches. A major guideline of evacuation instruction is that the tourist agents and residents have a responsibility to guide people to designated refuges. Through the hearings, many problems have been recognized as needing to be solved but for which it is difficult to find a specific right answer.

(C) Decision Process Model

There are many cases in which people encounter disasters in unfamiliar environments, and the situation changes as time goes by. According to the situation, appropriate support methods may differ. In order to clarify the decision-making process of visitors, their choices in unfamiliar environments were modeled. The model is shown in Fig. 2.1. The model involves some critical decision steps, such as if visitors are on the move, if they are in big facilities, if they can obtain information of traffic conditions, and so on. At last there should be a decision based on guidance in any of the situations, such as "stay on-site," "try to go home," "search for a refuge," "information collection," "try to move closer to the destination" or "wait for instructions." This model shows us what kind of information is required in what kind of situation.

System Design

In this chapter, two kinds of systems are proposed: systems that provide information about the possible situations which visitors may encounter, and an information system that support visitors in their unfamiliar environments.

(A) Emergency Case-base

The interests of mass media are mainly in the residents and are not on the visitors in unfamiliar environments.

Corporate social responsibility is highly required now, and sightseeing agents have responsibility to guide people to safety in emergencies. For this purpose, an evacuation support system is necessary to cover various kinds of disasters and receives a great deal of public attention.

When the Chiba eastward offshore earthquake occurred in 2005, the instruction for many visitors in Disneyland was criticized by the mass media, and this is one of the few examples. Newspapers can be effectively used to abstract the actual condition of the disasters, problems that the visitors encounter and effective support methods which can be applied in the future. This was realized by collecting newspaper articles about disaster victims in unfamiliar environments and support systems for the visitors in their unfamiliar environments, and was compiled in our database system. Although there are not many articles of this kind, it is useful to provide the database to visitors in disasters to teach what kind of situation may occur, by gathering valuable but distributed information resources. At present, only 20 articles have been collected from the Asahi Newspaper in 2005, because the mass media have not paid much attention to tourists in disasters yet. This database is used in the information service system described in (B).

(B) An Information Service System for Visitors

In order to start developing the information service system, the possible trouble situations that may affect visitors are listed up. Based on the result, required functions for the system were discussed among our research group members. Among the several proposed systems, two systems were selected and their prototype systems were developed. The current system integrates these two systems into one information service system.

The visitors want to get the latest information on their present situation. We consider two kinds of information provision as shown in Fig. 2.2. One type is for the visitors who have mobile terminals or mobile phones with an Internet function. They can get information through the wireless LAN equipped on the streets. Another type is for the visitors who do not have such an information device. Information is provided through digital map board systems and parametric high directivity loudspeakers on the streets. For the digital map board, we plan to develop touch-panel based maps with a large-sized LED display. A similar system has been introduced in Tokyo for trial use. The high directivity loudspeaker system uses an ultrasonic wave as a carrier, and generates beams of audible sound with much higher directivity within an angle of 20 degrees as shown in Fig.2.3 (Yoshida, 2004). Due to its extremely high directivity, people find it very easy to identify the direction of the sound source and to find their proper evacuation routes.

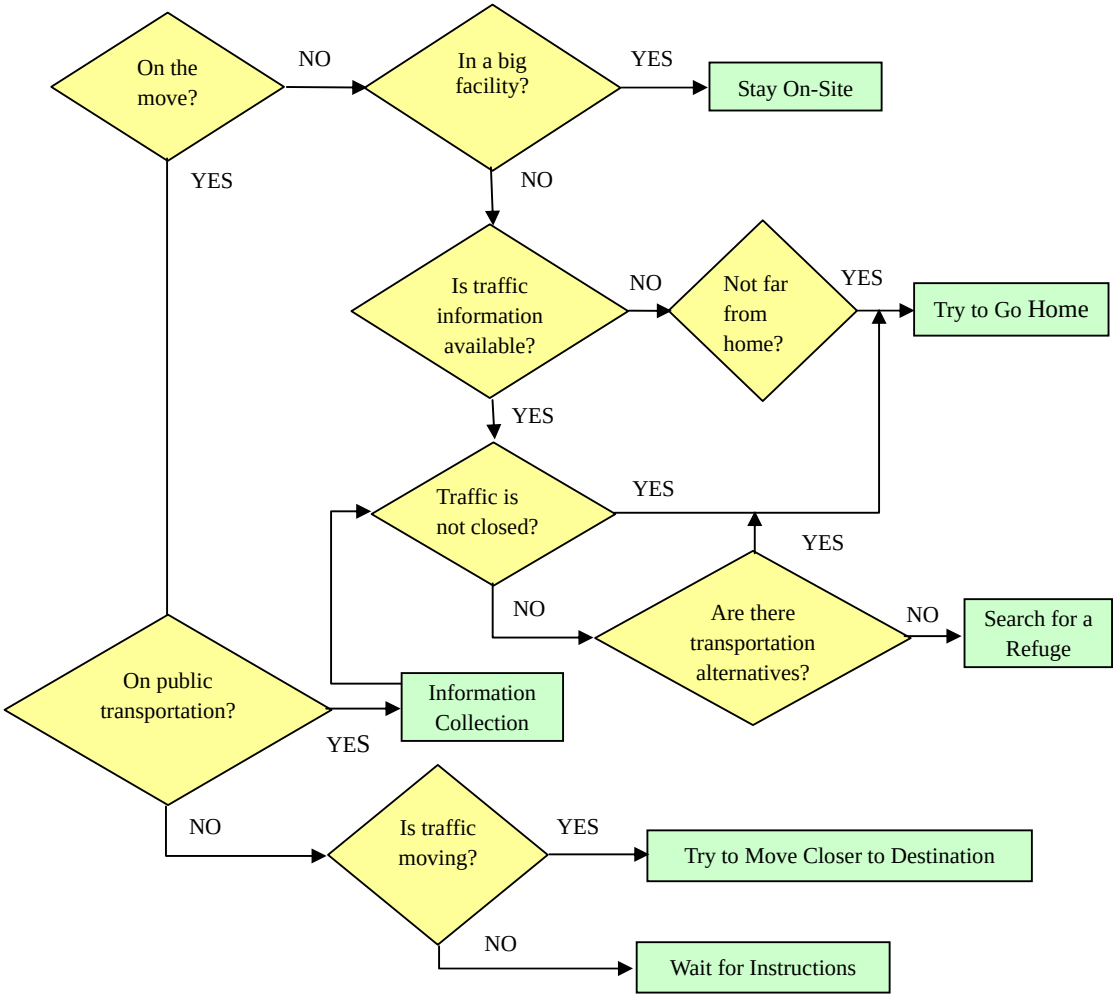


Figure 2.1 Decision-making process model for visitors in unfamiliar environments

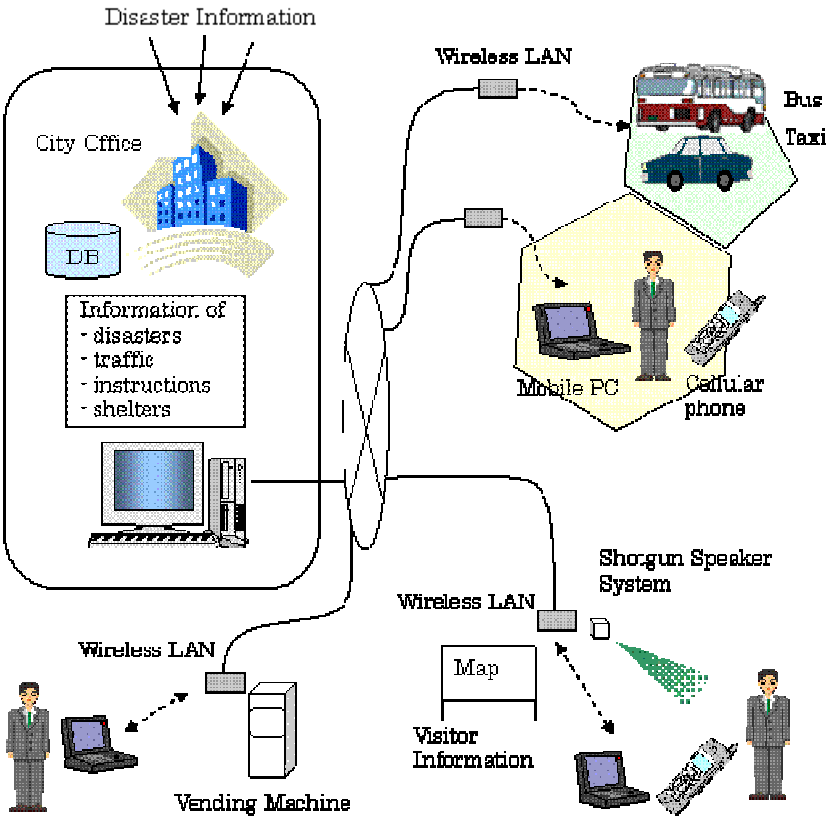


Figure 2.2 System architecture

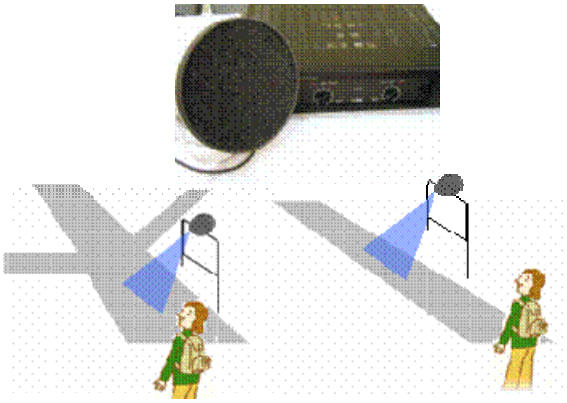


Figure 2.3 Information provision by the parametric speaker system

The places that the parametric loudspeakers are to be equipped are supposed to be the big facilities like shrines and temples, shopping centers and on the long straight streets, with the digital map board.

It is very important for the support system to be used seamlessly from the daily use to the emergency use. Our basic concept is not making the new systems only for disasters, but considering their extended use as a

daily-used system. In daily life this system provides sightseeing guidance, shopping advertisements and discount tickets, and realizes “the continuity from daily use to emergency use.” This characteristic promotes the system’s acceptance by the neighborhood residents.

This system has another function which is very important in the very early stage of disasters: safety confirmation. Every time passing through the wireless LAN spots, the information of “communicating” with the network is recorded. This information is transferred to the mail addresses of the registered families and other people, and families can trace the movement of the user. An important thing is that this confirmation is automatically done by communicating between the system and the individual mobile terminal, because the visitors are very busy finding their countermeasures against the emergency in the first stage of disasters.

(C) Agent-Based Evacuation Instruction Framework

Evacuation instruction is issued through mobile terminals/phones and parametric loudspeakers. The instruction is determined and transferred based on the multi-agent decision support framework which covers the whole city. The outline of this framework is as follows:

a. The system consists of hierarchical software agents, each of which covers a local area, collecting data with sensors, making decisions, .and issuing instructions to visitors through wireless networks and parametric loudspeaker systems. There are three hierarchies, including the parent agent (top level), child agents (second level) and grandchild agents (third level). In Kyoto city, for example, the parent agent covers the whole city of Kyoto, recognizing the latest situation of the city based on information from the lower level agents, and making general decisions. The child agents cover smaller areas, wards in Kyoto for example. The grandchild agents cover spots, Kiyomizu temple for example.
b. The grandchild agents recognize the situation of their spot through various kinds of sensors, and report the results to the child agent.
c. When the child agent receives information from the grandchild agents, it summarizes the overall situation of the ward, decides how to guide people of the ward, and sends the guidelines to the grandchild agents. The grandchild agent receives information on its neighborhood agents from the child agent and shares the situation of the ward.
d. The grandchild agent decides concrete instructions for visitors, considering the guidelines of the child agent and the characteristics of the area.
e. The grandchild agents continue to send the latest information to the child agent. When the situation makes a considerable change, the child agent changes the guidelines, and the grandchild agents change the instructions.
f. This framework insures the robustness of the system. Even when the network does not work, the grandchild agent can continue to guide people.

The basic philosophy of instruction is to guide people to safe places. It is, however, often the case that evacuation all at once causes a concentration of people in specific places such as stations, which is very

dangerous and creates greater confusion. In order to avoid such confusion, one possible strategy of instruction by the grandchild is to guide people to stay at the current location for a while.

Evaluation

We evaluated this framework by conducting computer simulations in an actual sightseeing spot. Currently we are performing computer simulation to validate the effectiveness of the framework by applying this framework to Kiyomizu temple and its neighboring areas in Kyoto.

(A) Target Area

We selected the Kiyomizu temple area in Kyoto, Japan, as the target area. We selected this area because Kyoto is the most popular sightseeing city both for Japanese and foreigners in Japan and because this area is the most crowded area among the sightseeing spots in Kyoto. The Kiyomizu temple is the most crowded temple in Kyoto. The characteristics of this area are as follows:

a. There are many visitors including sightseeing people and business people.
b. There are many steep slopes, such as the San-Nen-Zaka, Ninen-Zaka, and Kiyomizu Zaka, which are popular shopping streets.
c. The roads are crowded with people and cars including motor coaches.

If we can propose an effective evacuation support system for this area, it is quite possible that the system will also be effective for other areas. A possible route of evacuation starts from Kiyomizu Temple to Maruyama Park which is designated as an emergency refuge. This area can be divided into nine sub-areas based on their regional differences in geographical and socio-economic characteristics as shown in Fig.2.4: Kiyomizu temple, Kiyomizu slope, San-Nen-Zaka slope (Fig. 2.5), Ninen-Zaka slope, Nene street, Maruyama Park, Yasaka Shrine, Gion and Kawaramachi (station area).

Before the computer simulation, we conducted a general survey in this area several times. We confirmed the possible routes of evacuation in emergency situations, and estimated how many people can be in these sub-areas by counting the actual number of people and by calculating the number of people based on the width and the length of these sub-areas. Four people can be allowed per 1 m^2. The allowable numbers of people of the sub-areas are shown in Table 2.1.

We also investigated suitable spots for setting the parametric speakers and the wireless LAN antennas for possible routes of evacuation and in the representative sightseeing spots. We selected (a) the entrances and exits of the sightseeing spots, (b) the forks on the routes, and (c) the middle points of the straight roads.

(B) Hierarchy of Agents

Kyoto City is composed of a number of wards. The target area is located in Higashiyama Ward. We model the multi-agent supervisory framework of this target area. Multi-agents are designed to supervise this area hierarchically as shown Fig. 2.6. Each sub-area is supervised by one grandchild agent, the sub-area agent. Each ward is supervised by one upper agent, the ward agent. Kyoto City is supervised by the parent agent as

a whole.

Each agent holds evacuation instruction knowledge in the form of IF-THEN rules. Knowledge of upper agents is abstract and knowledge of the sub-area agents is closely related to the sub-area characteristics. For example, the parent City agent has a rule “if emergency occurs, guide people to regional refuges.” This instruction is transferred to the ward agents. The Higashiyama Ward agent has a rule “if instruction from the City agent is to guide people to regional refuges, guide people in the Higashiyama area to Maruyama Park.” This instruction is transferred to the sub-area agents. The San-Nen-Zaka agent has a corresponding rule “if instruction of the ward agent is to guide people to Maruyama Park and if Ninen-Zaka is not too crowded, guide people to Ninen-Zaka.” The crowdedness of Ninen-Zaka is judged by data from the ward agent who collects these data from the Ninen-Zaka agent. This instruction is realized by using the media in this sub-area, such as the parametric speakers and the wireless LAN.

The agent system is implemented by using Java on Windows PC.

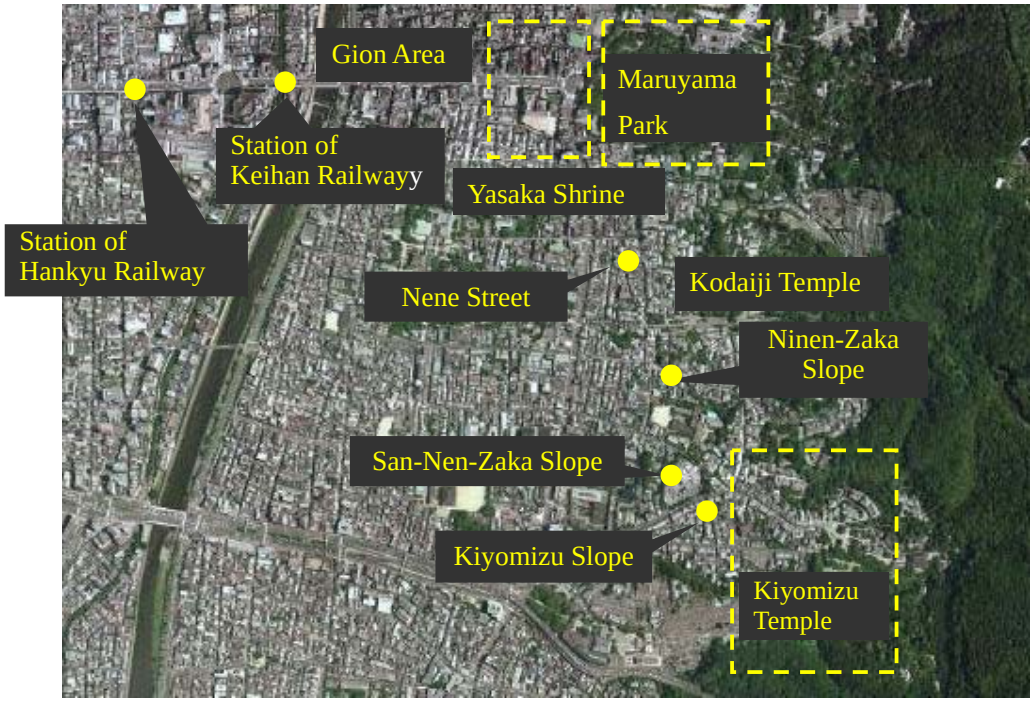


Figure 2.4　Kiyomizu temple area

Figure 2.5　San-Nen-Zaka slope

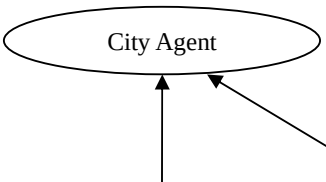
(C) Simulation

Figure 2.7 shows an example of a simulation display. The left figure shows an evacuation route and major spots on the route. The right tables show simulated numbers of people in each spot and the degree of crowdedness.

There are many kinds of methods to simulate human behavior, and our simulation model represents the target area as a network, which consists of nodes (major spots) and links. Each node has a capacity of people. If there is room for people in the neighboring node, a corresponding number of people can move to the node. The simulation system calculated the behavior of multi-agents and people every 5 minutes, and the crowdedness of each node is also evaluated at the same time. The walking speed of people to pass through each node is set as a constant based on our investigation of the spot on holidays. We did not consider any effects of attributes of sex and age. For example, people walk through the San-Nen-Zaka slope in 10 minutes if the next node, the Ninen-Zaka slope, is not too crowded. If the number of people in the next node reaches its capacity, people do not move at all.

Table 2.1　The allowable numbers of people in sub areas

Spot	Max. people	Spot	Max. people
Kiyomizu Temple	20,000	Nene street	7,200
Kiyomizu-Zaka	3,000	Maruyama park	39,300
San-Nen-Zaka	2,000	Yasaka shrine	20,000
Ninen-Zaka	2,400		



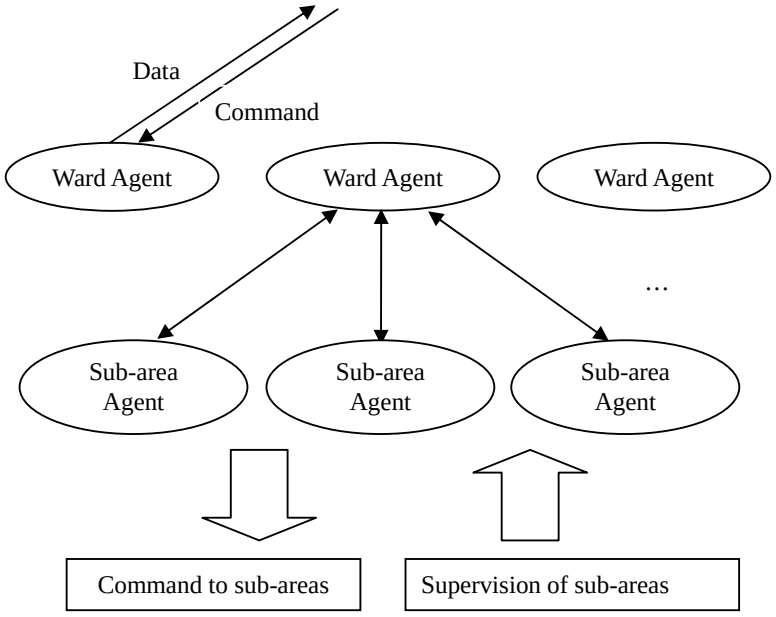


Figure 2.6 Agent hierarchy

The crowdedness of each node is evaluated in four degrees. The degree is calculated as a percentage of people in proportion to the capacity of the node: level 0 is 0% to 50%, level 1 is 51% to 75%, level 2 is 76% to 99%, and level 3 is 100%. Crowdedness is used by agents to regulate people's transfer to the next node. This regulation is represented as a rule "if the crowdedness of the next node is level 2, the agent regulates transfer of people to the node."

When a simulation starts, shaking by an earthquake has just finished and the multi-agent system starts to guide people. The initial number of people in each node is set based on our investigation. An example of the initial number of people is shown in Table 2.2. Our system assumes that all people follow instructions provided through the parametric loudspeakers and the wireless LAN.

(D) Evaluation of Simulations

Case 1: Without evacuation instructions

Without any instruction, people started to move, heading to Maruyama Park. This caused level 3 crowdedness in the San-Nen-Zaka slope and the Kiyomizu-Zaka slope, 15 minutes after the start of the simulation. This suggests the necessity of proper evacuation instructions.

Table 2.2 Initial number of people in each spot

Spot	Initial number	Spot	Initial number
Kiyomizu Temple	12,000	Nene street	2,2000
Kiyomizu-Zaka	1,500	Maruyama park	5,000
San-Nen-Zaka	1,000	Yasaka shrine	5,000
Ninen-Zaka	1,200		

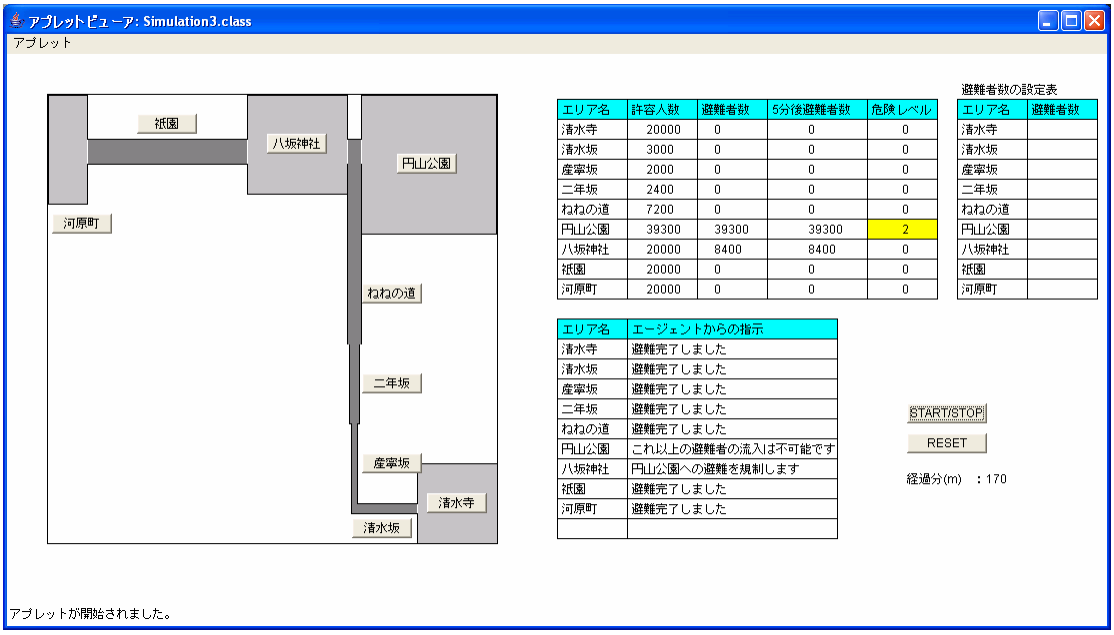


Figure 2.7　An example of simulation

Case 2: With evacuation instructions

In this situation, multi-agents regulated evacuation by using the parametric speakers and the wireless LAN when level 2 crowdedness occurred in the Kiyomizu-Zaka slope. The result showed that instructions had an effect on suppressing severe crowdedness. Crowdedness of both the San-Nen-Zaka slope and the Kiyomizu-Zaka slope after 15 minutes was level 2. On the other hand, the instructions caused a (brief?) delay of evacuation.

Case 3: With evacuation instructions to bypass an overcrowded area

The Kiyomizu-Zaka slope agent issued instructions to bypass the San-Nen-Zaka slope to Nene street when level 2 crowdedness occurred on the Kiyomizu-Zaka slope (as shown in Fig.2.8). In this situation, level 2 crowdedness occurred only on the Kiyomizu-Zaka slope. The crowdedness of the San-Nen-Zaka slope after 15 minutes was suppressed to level 1. Evacuation time was shorter than in case 2. Table 2.3 shows a comparison of time (minutes) before people in each spot come to zero. In case 3, the time for evacuation was shortened by 20 to 35 minutes in all spots. This kind of flexible guidance is very effective for safe and secure evacuation. This result supports the effectiveness of this multi-agent evacuation guidance system.

Table 2.3　Comparison of time before people in each spot come to zero (time: minutes)

Spot	Time	
	Case 2	Case 3
Kiyomizu Temple	80	60
Kiyomizu-Zaka	105	75
San-Nen-Zaka	125	90
Ninen-Zaka	130	95
Nene street	135	100

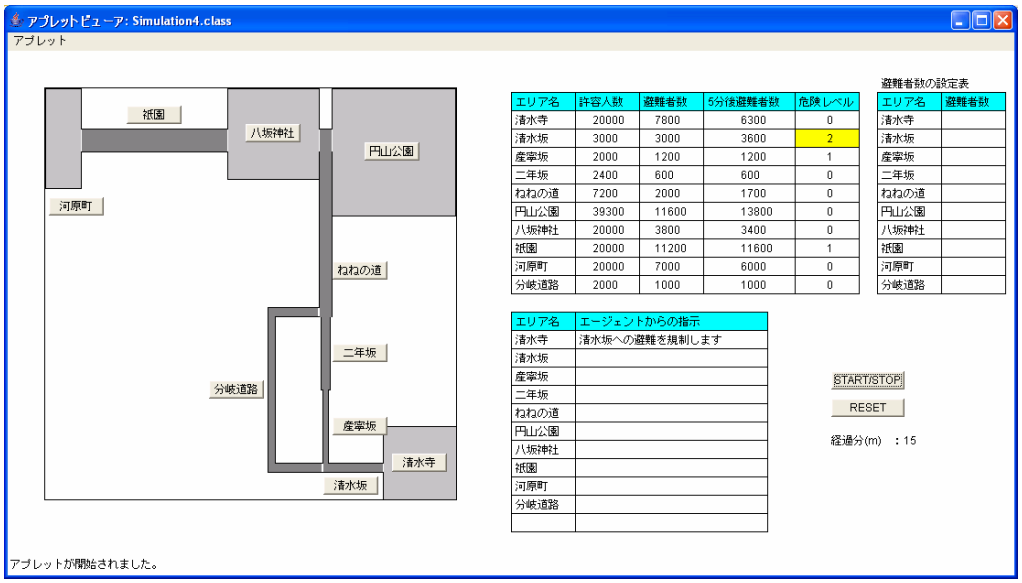


Figure 2.8　Simulation with instructions to bypass crowded streets

Conclusions and Future Work

We propose a multi-agent approach to manage emergency evacuation, especially for visitors who do not know the local geography well. Multi-agents collaborate to collect information about emergencies and the behavior of people, to decide and issue instructions to guide people to the refuges via roadside loudspeakers, and mobile terminals including mobile computers and mobile phones.

Future work involves the detailed design of instruction knowledge as the rule base, experimental verification of location of information provision equipment, the wording design for having people follow instructions, and a backup networking design when the optical fiber network does not work due to disasters such as earthquakes.

A DRIVER SUPPORT SYSTEM CONSIDERING SPATIAL COGNITIVE ABILITY AND ITS APPLICATION TO HUMAN NAVIGATION

Intelligent Transportation Systems (ITS) offer a number of solutions for modern transportation problems. The advanced navigation system is one of the effective ITS solutions. Many car navigation tools, such as car navigation systems and the Vehicle Information and Communication System (VICS) in Japan, have been introduced, which have truly improved convenience in travel. However, these tools have not adequately addressed ease of use and visibility issues for individuals who have difficulty with orientation. In this section, we propose a support system that enables automobile drivers to efficiently learn a route before actually driving it. This study examines human cognitive ability, particularly spatial cognitive ability. We also performed experiments to evaluate the effectiveness of drivers' way-finding ability while using the proposed system.

Related Research

(A) Cognition and Movement

Way-finding ability and orientation processes are integral to our daily lives. We applied Naiser's cognitive circulation model to human transfer behavior as a loop structure that consists of perception, cognition, environment, and action as shown in Fig. 3.1. People collect geographic information and integrate that information as a mental map in their minds. The mental map is used to locate a destination while moving. The relation between the mental map and cognitive load during motion has been studied. For example, the thinking is that the complexity of an intersection and road width at a turn affect a person's perception of how difficult it will be to reach the destination (Matsuda, Sugiyama, & Doi, 2004). Also, a study in the field of cognitive science identified some of the factors common to individuals who do not have a good sense of direction, such as problems with the ability to acquire adequate information from the environment and problems with mental rotation (Shingaki & Nojima, 2001). Way-finding behaviors depend on these individual cognitive abilities. Existing car navigation systems, however, are designed for the general population and are not designed with sufficient consideration for individuals who are weak in these cognitive abilities.

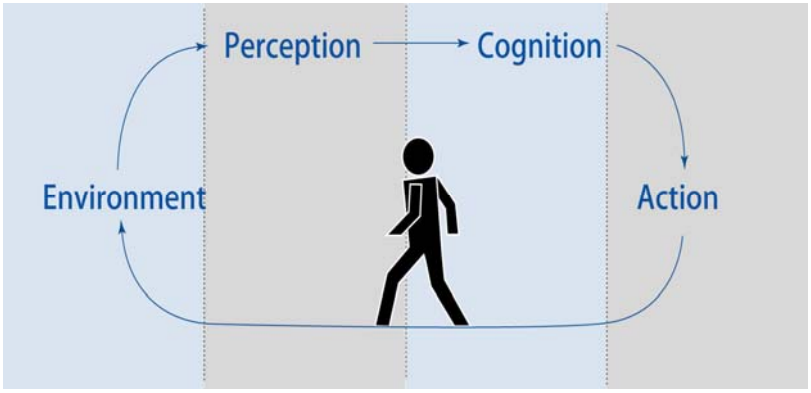


Figure 3.1 Human transfer model

(B) Learning and Movement

Some studies in the field of cognitive science have focused on the importance of mental rehearsal. Reports

have shown that training with different media affects human navigation styles, and gaze targets in a mental rehearsal affect human navigation performance (Kurano et al., 1999). Studies have been conducted to discover the relation between individual mental rotation ability and navigation behavior (Ogata et al., 2003). These studies have proposed effective ways to conduct mental rehearsals. One such study suggests that people have a preference for the process by which they plan their route (Furukawa et al., 2000). However, there is little argument about how people use what they have learned.

The distortion of a cognitive map is another reason why people easily lose their way. The finding is that perceived distance, which depends on how much information is acquired or searched for in learning a route, is responsible for the distortion (Milgram, 1973). On the basis of this finding, a learning method that promotes the acquisition of information needed to learn a route to an intended destination is important. Thus, an effective way to learn a route through rehearsal should be considered.

(C) Car Navigation Systems

Car navigation systems have considered some aspects of these abilities, and especially have improved their functions in order to provide the effective display systems which support the drivers understanding of the information. For instance, some systems contrive ways to show a driver the result of the route search effectively as follows.

Car navigation systems have considered some aspects of cognitive abilities in their design and have made improvements in their display systems to make the information provided easier to understand. For example, the following features, which have improved user abilities so as to help them reach their destination, have been developed:

1) three-dimensional computer graphics, which provide realistic images of landmarks;
2) indication at the top of the map of the direction of travel (the top of the map always indicates north);
3) lines that connect the place of departure and the destination;
4) adjustability in the number of landmarks to be displayed;
5) change in the display to a bird’s eye view when a car approaches an intersection; and
6) display of different types of maps in different windows.

Most of these functions were not developed based on analyses of human cognitive features, but rather to develop new business. Functions of car navigation systems remain inadequate for people who have problems reading maps or who have a poor sense of direction. Although many car navigation systems offer voice assistance, many users are uneasy about following these directions because they doubt their accuracy. Voice navigation prompts the driver with phrases, such as “x meters from here” and “soon come to a turn,” which are often misleading and can increase the risk of traffic accidents.

Learning a Route by Rehearsal

(A) Rehearsal

As we drive using the car navigation system, we need to learn the route at the same time. However, the mental load associated with multitasking makes driving difficult and dangerous. In fact, many researchers have cautioned against using car navigation systems. We previously mentioned that mental loads affect our moving behavior and have a relation to cognitive characteristics, which vary in individuals. Also, difficult to read geographic names and physical conditions are thought to affect driving tasks. We believe that driving routes should be learned in advance to reduce the cognitive load while driving.

The type of information needed by drivers is different depending on whether they are learning a route in advance or actually driving. In our study, we presented the subjects with three types of maps to determine which type of map is most suitable for learning a route in advance: a) *north-up* type map, which keeps the map top to the north; b) *heading-up* type map, which keeps the map top to the current direction; and c) *destination-up* type map, which keeps the map top to the destination. In addition to maps, we provided video images and text to support route learning.

(B) Video Images and Maps

Most people occasionally use maps to identify a destination. Most maps, such as atlases, are the *north-up* type; therefore, this is the type of map that most of us are accustomed to. Nevertheless, many people have trouble confirming their current location when using a map. The global positioning system (GPS) has significantly improved location identification; however, many people still have some difficulty identifying a location when comparing a map with the surrounding environment. Information on maps provided as text or icons is often misleading. Video images and photos, which are more realistic, are thought to be more effective. Therefore, our system provides users with video images of the actual route in advance, which the user can recall while actually driving. This approach makes the drive easier.

(C) Video Images and Maps

Learning a route in advance involves the recognition of landmarks, such as convenience stores and schools, along with learning the route. However, it is not always easy to find the names on landmarks while actually driving the vehicle, even when they are located directly in front of us. We all have a preconceived image or schema for something. Without access to actual photos or videos, we sometimes apply our own schema to the real world and fail to notice the real thing, the landmarks, if they do not match our schema. For example, if a school building is surrounded by a concrete wall, we may not notice the school. Another problem is that it takes longer to locate names in the real world than it does to find them on a map. Video images are effective because they provide drivers in advance with detailed real-world information related to landmarks, such as the color of a building, names of streets or buildings, and vegetation. Furthermore, advanced images of a landmark decrease the mental workload of drivers. The goal of our system is not to provide each landmark in detail, but to provide enough information about a landmark for drivers to feel confident that they are traveling the right route.

(D) Approach to Car Navigation Systems

Our prototype system considers the above-mentioned cognitive characteristics that are associated with the way-finding behaviors of drivers. A screenshot of the prototype system is provided in Fig. 3.2.

Area “a” represents a *north-up* type map image of the entire route, which can be zoomed in or out and scrolled. The user can view images that can be seen from the car window by linking them with the location on the route. Explanatory text is displayed at area “e,” which identifies landmarks that may be helpful along the route. The text also indicates some characteristics of the route that may be confusing, such as road curves and distances. Users often read the text on the display very carefully (Nakajima, 1996); therefore, the text should be brief to decrease the mental load.

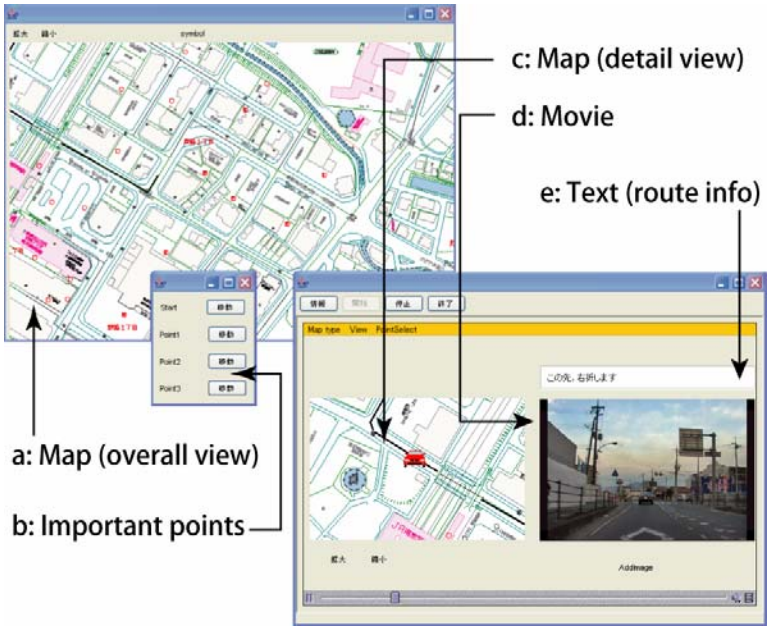


Figure 3.2 An example screen image of the system

Because of the aforementioned differences in cognitive abilities, the system provides three types of maps so that the user has a choice:

- *North-up* type map, which keeps the map top to the north
- *Heading-up* type map, which keeps the map top to the current direction
- *Destination-up* type map, which keeps the map top to the destination

Area “d” provides video images of geographic information, such as landmarks. These mental images are expected to make it easy for the driver to identify the actual images while driving. In situations where long distances are to be traveled, area “b” identifies important points along the route that may be helpful, such as a turn from a wider road to a narrower street. When a point is selected, the navigation starts. These functions will help the driver acquire and organize information and eliminate triggers of human error to avoid traffic accidents.

Experiments

Using this system, we performed two types of experiments to confirm the effectiveness of our approach. In Experiment 1, a map drawing task was used. In Experiment 2, the user navigated a vehicle on an actual road to confirm their recall of the route.

(A) Experiment 1: Map Preference and Spatial Cognition

In Experiment 1, the subjects were 22 university students (16 men and 6 women). We classified subjects as having a poor or good sense of direction on the basis of their responses to a 20-item questionnaire developed by experts on cognitive science (Takeuchi, 1998). The subjects were required to view and remember an unfamiliar route with the new system using a designated type of map. The route involved 7 turns, and the video lasted 3 minutes. The subjects were free to scale the map on the computer display. The first part of the route involved recognizable landmarks, whereas the last part of the route had no landmarks because it was a residential area. Whether or not the subjects remembered the route was determined on the basis of a drawing they made of the route on a paper map. The results were as follows:

1) Six of 11 subjects who were good at directions correctly drew the route, whereas only 3 of 11 subjects who were poor at directions correctly drew the route. This finding confirms that the sense of direction affects the task performance of remembering the route, even with this system.
2) The subjects generally reported that they referred to both the navigation map and the video image. The subjects who were not good at directions referred to them less and often referred to the whole route map and to the explanatory text.
3) The *north-up* type map was most effective for all subjects, regardless of their sense of direction. The *direction-up* type map was not helpful for any of the subjects.
4) The landmarks were very useful in helping the subjects remember the route. All subjects who failed to remember the route made mistakes in the latter part of the route; this part of the route had no landmarks.

(B) Experiment 2: Effectiveness in an Actual Situation

In Experiment 2 we attempted to confirm the effectiveness of our approach in an actual driving situation. At the beginning of the experiment, we conducted a survey with the same questionnaire used in Experiment 1. Ten university students (7 men and 3 women) completed the questionnaire, and 4 subjects (1 who had a good sense of direction and 3 who had a poor sense of direction) were selected to participate in the experiment. The participants were required to learn the route with our system until they were able to perfectly trace it. They were then asked to navigate a driver to the destination on real roads while verbalizing the route as the driver followed their driving instructions. An experimenter rode with the navigator and driver, and recorded the process and utterances with a video recorder.

The results were as follows:

1) All the participants successfully navigated the driver to the destination.

2) The participants preferred to use the *north-up* type map in learning the route.
3) The participants often used demonstrative pronouns during the navigation.

These results led us to the following conclusions: a) the system is effective for actual route navigation, b) the *north-up* type map is better than the two other map types, and c) video images are useful for learning the route.

Future Work

We propose this rehearsal system as an advanced navigation system that takes into account the personal spatial cognitive abilities of drivers. Because drivers have different driving abilities, particularly different cognitive skills, cognitive ability must be considered in the design of navigation systems. In recent years, the number of elderly drivers and women drivers has increased rapidly. This trend requires improvements in the car design and support system for drivers (Kido, 2000). For the next step of this study, we plan to apply the current results to a mobile human navigation system that helps pedestrians and tourists get around in unfamiliar places.

PODCASTING FOR MOBILE-ASSISTED ENGLISH EDUCATION

In the field of English as a Foreign Language (EFL) education in Japan, Mobile-Assisted Language Learning (MALL) has become an extension of CALL (Computer-Assisted Language Learning), both influenced by a new generation of user-driven Web services called Web 2.0 for imprecise convenience. While other sections of this chapter represent Japanese research and engineering, this section focuses on MALL, particularly the uptake of iPods utilized in EFL education. The content dimension in this form of mobile learning is provided primarily by podcasting, which will be introduced in the context of Japan. At the first college in the world to distribute iPods to all students, since early 2004 iPods have provided a hybrid mobile infrastructure enabling students to handle English medium classroom instruction. ‘Coursecasting’ will also be touched upon, where in one case all the lecture parts of a course in Bilingual Education were offered to students in a podcasting blog for review and online research. In line with recent trends to video blogging, Web 2.0 services also offer easy workarounds to make movies for video iPods.

Podcasting, iPod and iTunes

Another form of learning with mobility is to download sound and video files onto an iPod or similar portable multimedia player. A barebones technical definition of podcasting is as follows:

> [A] podcast is content such as a radio show that is recorded in the ubiquitous MP3 format and broadcast (or more accurately, published) on a web site for download by anyone who cares to listen to it on a mobile device or a computer. Through the use of RSS (Really Simple Syndication), information about the web site and the podcasts (or other content) that is available on the web site is provided in a lightweight XML format. The RSS files, or “feeds,” can be harvested by content aggregators designed for podcasts, such as iPodder or iPodderX, or by other aggregators, such as iTunes, all of which can download ‘subscriptions’ either on demand or at predetermined intervals. (Rogers, 2005)

As for iTunes, it is a browser, but only of the Apple iTunes Music Store, with Web browsers such as Firefox and MS IE excluded from access. The iTunes program is the only authorized way to transfer the media files to the iPod. iTunes also serves a less essential role as a media player of audio, video (MP3/MP4 variants), and Internet radio stations. It is free, but needed to 'synch' files to an iPod, such as purchased music or free podcasts. A podcasting blog can be configured for how it appears in iTunes and its Music Store with a description, categories where it can be found (such as Higher Education or International), and a logo image. A podcasting site has to be submitted, however, with no guarantees of prompt entry, only by someone with a credit card account with the U.S. Apple iTunes Music Store to be available internationally. With the iTunes program podcasts can be browsed by categories or found through keyword searches. As alluded in the above definition of podcasting, however, subscribing to podcasts is not confined to iTunes but any manner of capturing the XML or RSS feed of a podcast, provided the goal is just to listen to podcasts by computer. Although Apple monopolizes the process from the Music Store to iPods for affluent users, with the Apple iPhone extending this functionality to mobile phones, current technology allows anyone who can download the files to take advantage of free educational podcasts.

Although proprietary and less than ideal in terms of usability as well, the Apple iTunes Music Store has become such a popular interface for young people that it cannot be overlooked as a platform to exploit for educational purposes. Best known for music, iTunes also offers subscriptions to podcasts, some of which are educational and most of which are free. In the U.S. only at this time, iTunesU for universities delivers some functionality of learning management systems to the iPod, but Apple Japan shows no signs of hurrying to provide a service that has thus far been free. Nonetheless, the iPod is one of the few foreign products to dominate the Japanese market, and the uptake of podcasting for education has been rapid and particularly strong in the field of English as a Foreign Language (cf. Diem, 2005; Thomas, 2006). International literature on how podcasting and coursecasting can be applied to education is reviewed in McCarty (2007).

Podcasting sites can be of several types, as a blog with the most recent entry automatically on top, or placed in Web pages for those with the skills to control the arrangement and appearance as they wish. Free sites are available for both of those types, often with unwanted advertising, or users can pay for more functions, storage space, or ease of use. As an example of the latter, Google Maps can be easily embedded in a podcasting blog entry showing not only where the author is but allowing the site visitor to move the location and view anywhere else in the world map database.

[1] Elements of Podcasting Blog Entries

A podcast entry tends to consist of a sound or video file in formats such as MP3 and MP4 that are readily playable on audio and video iPods, respectively. The entry also typically includes a title and an annotation briefly describing the show, to which could be added directions for novices on how to use the podcast. Adding discussion questions or other assignments can turn the podcast into homework or a learning object, a one-off lesson offered to any other teachers or learners who find it relevant to their discipline. So not only the content of the podcast but how it is used is limited mostly by one's imagination.

A podcasting entry should further include tags, which are metadata keywords for searching, categorizing and aggregating similar content. The volume of user-generated choices then tends to add a sort of artificial intelligence to an otherwise mechanical process, sifting the content meritocratically to improve information gathering for everyone who uses tags. Comments can also be added to entries, and other forms of rating can help users choose among the plethora of media offerings.

Links in a podcasting entry as elsewhere on the Web provide a helpful hypertextuality connecting the entry to some disciplinary or other context. The links can be either to other Websites or to files the podcaster makes available for download. Links can provide for further research, class materials or assignments. If the podcast is not in the learner's native language, the links can be to an outline or transcript (to read while listening) in order to assist comprehension.

An essential element for any user of a podcasting site is the unique URL of the site and of each entry, which can open as a distinct page. Generally even a blog and each of its entries ends in a familiar Web extension such as .html, which is the most basic programming language that signals to Web browsers how to display a page. But when it comes to subscribing to a podcasting site via RSS, the address tends to be that the main site but ending in .xml. That is, the home page file address is often not visible but for a slash that represents a file name such as index.html, so the RSS feed in that case would be the same address ending in index.xml.

There can be other elements of a podcast entry particularly when hosted not at a blog but at a Website where the skilled designer or programmer has more choices and control over what is presented.

[2] iPods for Education pioneered in Japan

It is a little-known story that the first school in the world to give iPods to all students was not Duke University but rather Osaka Jogakuin College in Japan, where podcasting is therefore particularly made to order. Soon after iPods were introduced to Japan, a junior administrator, reflecting on her own struggles to learn English, saw the opportunity represented by the iPod for listening to foreign languages on the go. Particularly where many students commute by public transportation for long hours, the iPod opens up new educational potential in terms of using hitherto unproductive time for learning. Yet at the time, in early 2004, as a longtime Mac user she was in the minority, and few foreign products had ever dominated the Japanese electronics market. Students just out of high school were not likely to have heard of the iPod at first or to have been able to perform its synching operations without training by the college CALL center staff. This was considerably before Apple Japan's iTunes Music Store was inaugurated on August 5, 2005, which opened up free access to the same podcasts and categories as the U.S. online store but with a Japanese language interface.

All the incoming students received iPods on April 3, 2004**,** nearly a half year before Duke University, which has been widely credited with being the first. Moreover, the iPods students received at Osaka Jogakuin College were not just distributed but loaded with listening materials made by the college such as conversation strategies to help the students adjust to the content-based curriculum where, unusual for Japan, English was

largely taught *in* English from the start, with a relatively large number of native speaking faculty members.

All students have continued to receive iPods since 2004, and they are integrated into the curriculum. For instance, in a required course on current events, students need to acquire the latest news stories by synching their iPods with campus computers in order to do homework assignments. This practice reflects ambitious goals for students in terms of English proficiency test scores as well as understanding global issues. Besides the time taken by part-time jobs, many students are strap-hanging for about three hours a day to and from the city center, so assigning foreign language lessons to listen to on the go makes better use of their time.

With the mobile infrastructure in the hands of every student, the school can incorporate podcasting for the students and faculty members, both as listeners and creators. Other colleges have also started to utilize iPods, and the trend will be to adopt video iPods. Though the technology from shooting video to playing movies on the iPod is not easy enough to reach the threshold of popularization, online video sites have provided for more familiarity and services such as conversion of file formats. Thus one easy workaround is to upload a file to Google Video <http://video.google.com>, then simply select the MP4 format for the iPod and download it to one's hard disk for synching with the iPod.

[3] Issues in Experimenting with a Podcasting Site

With the popularization of iPods and the relative ease of working with digital audio, many podcasting sites for EFL listening were launched in Japan from 2005. Attention then turns to quality as listeners have a plethora of choices. A podcasting blog or Website needs a coherent theme in consideration of certain potential listeners. The site also needs a purpose beyond trying the latest technology just because it is there and one has the requisite skills. There is also no use in transplanting the same content to a new medium, such as by reading previous publications out loud, since they could be read more quickly. Of all the possibilities open to listeners in their limited time, what episodes would make for just-in-time learning or expand their horizons? What contents would give the site recognition or sustainability? Whether it is to reach a different audience that is not so academic or to provide content that benefits from being spoken, in any case a podcasting site that goes public should be suitable to the new media and engage the affordances thereof.

As one example, the "Japancasting" site <http://stevemc.blogmatrix.com> includes a trilingual podcast. The author recorded Chinese and Japanese students speaking in both their native language and English, addressing the question whether there were equivalent proverbs in Chinese, Japanese and Western culture. The content was well suited to the audio podcasting medium and could serve various listener purposes of learning any of the three languages or comparative culture.

The two stated audiences for Japancasting at the outset in 2005 were those studying Japan or EFL. Episodes were broadcast on Japanese culture, comparative religions, contemporary issues such as the educational system and the human rights of minorities in Japan including foreigners. Ancient legends, *Noh* and *bunraku* plays were analyzed with discussion questions for listeners abroad to discover East Asian values. The podcasts could thus be used freely by educators elsewhere as learning objects. Some of the podcasts were

accompanied by links to scripts, photos or illustrations, for reading while listening, or links to online sources for further research. Where the scripts were available and the level of difficulty of the language was controlled, the podcasts could serve as content-based EFL for students in Japan and elsewhere. There were also broadcasts in Japanese or bilingual, serving learners of content-based Japanese as a Foreign Language (JFL). Thus the site offered one-off lessons for college or high school classes anywhere along with informal learning for pleasure and contemplation of intercultural issues by any individual interested. Japancasting aimed to add fuller dimensionality to content suitable for spoken libraries or spoken Internet to go.

Many students have played roles or have presented their own creation in the podcasts. The Japancasting site keeps students anonymous without close-up photos, but it is nevertheless exciting for the students themselves to know that their voices are on the Internet. Interviews with colleagues and other informants were also conducted in English and Japanese. Podcast themes at this particular site continued to be more experimental than coherent or on a regular schedule for a subscriber base, but a long tail was anticipated where listeners could find most of the podcasts useful in future years. Later podcasts have tended to be recorded speeches with the PowerPoint presentations also available online. In some cases listeners could click on a media player to start the podcast and then click through the slides, reportedly feeling as if they were present at the synchronous event that was now asynchronous.

[4] How to Record Audio Podcasts

There are a number of ways to record podcasts, and the audio techniques may be of reference when working with online multimedia for other purposes as well. Apple Macintosh users of recent models have an easy solution in the Garage Band program that comes with iLife. Then there are audio programs free to download such as Audacity, suited to most purposes insofar as users master the program. This author started by using a program that came with a paid podcasting blog service. The program, however, is neither the whole process nor the emphasis here, since a certain program is not assumed. The best advice is often just to study the manual, but it can be added as a caveat that programs free for download often have minimal or out-of-date online manuals.

More basic is the device actually capturing the sound, which can be more important than the program that works with the data files. Then there is the issue of where one records podcasts, whether in an office, recording studio, or on the road. Regarding the device, it is important to capture audio clearly in the first place with a microphone that is more professional than one would need for audioconferencing, videoconferencing, VoIP, Webcasting and the like. Also, rather than recording with a mic built into the computer, better results can be obtained with a digital mic whose small jack plugs into the computer, and higher end digital video cameras also work with the same size jack connecting to a computer to achieve professional sound quality in digital videos.

This author used two approaches, depending on the location. In the office, as indicated above, a mic was plugged into the computer and the program turned on to capture the audio with certain parameters. On the road, however, or when coursecasting classroom lectures, an MP3 format digital voice recorder was utilized,

among the considerable selection of voice recorders available in major city electronics stores in Japan. The MP3 format simplifies the process in that the file format does not have to be converted for most purposes of podcasting. The sound quality can vary according to the model and conditions, but is adequate for most academic purposes. Among the conveniences, recording on the go becomes another form of mobility for education. It is remarkable as an example of Japanese gadgetry how small and lightweight the voice recorders are, which encourages their use to capture sound for a variety of purposes, such as in lieu of note-taking.

[5] Dimensions and Purposes of Educational Podcasts

To sort out some of the parameters in this variegated phenomenon may be useful in examining possible applications and effects of podcasting, or in weighing the decision whether or not to embark upon a certain form of online technology at all.

After factoring in various institutional imperatives and goals, such an analysis may lead to unexpected conclusions. For instance, video is often privileged over audio for its fuller dimensionality, hence its attractiveness to students. And yet, in an era of lowering birthrates, many private colleges are acutely concerned with avoiding any trouble that could affect their local reputation, which impulse may trump the pursuit of a positive result openly. Japan even has a new personal privacy law that unavoidably impacts upon educational institutions. While student-generated content and EFL public performances are lauded as cutting-edge innovations, the appearance of students in online videos could lead to stalking, among other risks of personal information leaking onto the Internet. Thus an institution might tolerate audio but not video podcasts, with students involved anonymously, no close-up photos or other identifying information in online documents supplementing the podcasts.

One dimension is the stakeholders who make, listen to, or acknowledge podcasts. On campus these include administrators, faculty members, lecturers, staff and students. Off campus they include graduates and the local community, to whom podcasts could be directed as a sort of asynchronous radio program to involve them in the college. An institution may also be concerned with the news media or wider recognition that may affect its reputation positively. For such purposes an institution may decide which courses and events, if turned into podcasts or other online media, are made available publicly and which are password-protected on campus servers. Finally, given the global nature of the infrastructure, Netizens generally can be given a stake in the institution through educational materials and broadcasts offered unconditionally.

Another dimension is the media or technological approaches that offer many alternatives, some of which are discussed elsewhere in this chapter. To just illustrate this complex of factors, audio vs. video has been mentioned, then podcasts can be housed in blogs, Websites, wikis, suites of integrated software or learning management systems, with any of those either password-protected for a certain audience, unavailable to search engines, or on the open Web. Then there are the operating systems in contention where compatibility becomes an issue affecting access. For institutions or individual educators there is also the choice of hosting a podcast or other site off campus, for certain affordances or as a hedge against perceived liabilities, or on

campus with its domain name prominent, embracing the recognition and responsibilities of fully identifying with the content and effects of the site.

Aside from the issue of internal vs. external site, which often is hardly noticeable, physical geography may sometimes be a factor in terms of location of the recorded event whether on campus or off campus, or the scope of the perceived relevance, whether local, regional, national or global. Even within an institution there is a distinction between materials available campus-wide and those restricted to a certain class or division. Perceptions vary on whether materials should be shared or not, or whether the classroom proceedings should be seen or heard by administrators or peers. In a favorable environment there is a choice for educators whether or not to open a window into the classroom with these new technologies.

The purpose of a given activity is a determining factor in the audience and scope of its offering. A podcast or other online production emanating from a college as a community could serve purposes as varied as education, public information such as health advice or disaster readiness, attracting applicants, entertainment, social networking, cultural or artistic events such as a poetry reading or classical music recital. A podcast may be intended for a certain class in a certain semester or it may be portable across classes and semesters as a learning object. Conversely, the podcasts of other institutions or special events, if available openly for academic purposes, may be incorporated into a course. An educator can even attend a public lecture by a visiting expert and, with permission, record the presentation as a podcast for students or others not present, which is generally welcomed as amplifying the message of the speaker.

The content has been a factor in other dimensions, but other parameters of content could be analyzed specifically, such as the disciplinarity involved. The relevance for certain purposes can differ according to whether the subject of a podcast is specialized, at a graduate level, interdisciplinary, generalist, or according to other ways that academic content is organized.

Then there are the many ways that language and languages are a factor in assessing the potential benefits of certain content for a certain audience. Some combination of a regional or national language such as Japanese plus an international language like English tends to widen the possible benefits for developing bilingualism along with content knowledge. With a certain language the content can also be graded or otherwise controlled for non-native listeners, thus becoming more suitable for second or foreign language learning. That can be the specific mission of a podcast series, with a progression of content such as a functional-notional syllabus for EFL, whereby the learner can build upon previous input that became comprehensible, but without having the benefit of authentic interactions included with those language patterns. However, at the very least, the problem of scarcity of input in foreign languages, thanks to sharing by educators, has to some extent turned into a problem of choice in what to access with the facilities and time available. As with the written Web, although there is an imbalance of languages represented, also with the oral/aural Web specialists will offer lesser used languages in an attempt to preserve them and the culture of their users.

[6] Benefits of Podcasting for Various Stakeholders

Rather than a taxonomy of the myriad possibilities for types of content, for the purposes of this section, the general benefits for various stakeholders in an institution of higher education can be examined, particularly for English as a Foreign Language (EFL). Here coursecasting or recording class lectures is included as a major application of educational podcasting, though it is better suited to lecture style courses or content-based EFL than the interactive exercises in most foreign language learning classrooms. Even so, coursecasting was hypothesized in McCarty (2007) to be pedagogically useful, supporting the conclusion that coursecasting and other podcasts of related educational events are useful for learners and learning institutions. As reported by the students in the Bilingual Education class investigated, in various ways coursecasting could support their review, comprehension and retention of lectures, plus providing additional sources for research papers.

By using a podcasting blog for the first time, students also acquire a Web-based technological skill that provides another avenue to use their iPods for education, not least by opening up the vast listening resources available through the iTunes program and at free podcasting sites. As detailed elsewhere in this section, since 2004 all the students at this particular institution have been using iPods. Based on research findings and the semester pilot class experiment, the usefulness of coursecasting and educational podcasting accrues to all stakeholders who take advantage of the available technologies.

For EFL students, coursecasting provides review, target language listening practice, alternative access to class lectures in the case of unavoidable absence, written reinforcement of lectures through podcasting blog entry titles and annotated descriptions, downloading of course documents, citations for their written course work, and a base for online research. Moreover, insofar as the voices of students are recorded in podcasts, whether as course work or public performances, the students can check their own pronunciation and other speaking skills. Perhaps most significantly, the students become not just consumers but producers of online English content, which places them more fully in the target language community with benefits for developing intrinsic motivation and a bilingual identity. This work in Japan has been taken up in terms of student-generated content by the Sloan Consortium for online education based in the U.S. (Sener, 2007).

For teachers, coursecasting and podcasting can provide various forms of professional development such as checking the comprehensibility of lectures, offering more supplementary materials, and making various online connections to and from the classroom. For the learning institution, more documentation of course content is provided, and various imaginative uses of iPods and podcasting can be suggested, such as for campus tours or school festival activities. A portion of faculty lectures or special events can be offered as public podcasts to the credit of the institution. The college is seen as one that embraces new technologies that are empowering for students and other stakeholders involved. The fruits of its research become more visible and audible as educational benefits to the community. The general public, stakeholders insofar as they are given a stake, can learn from the proceedings of the college or enjoy its special events such as concerts. Coursecasting and podcasting thus provide all stakeholders of the college with more of a window into the classroom and other sites of educational activity.

CONCLUSION

Diverse applications of technologies have been presented, but which have mobility in common, and whose convergence promises an expanding future infrastructure for m-learning. For future research, to bring together the technologies and needs presented above, first the GPS infrastructure can be incorporated into public service information applications. With a view to m-learning, the mix-and-match nature of current developments under the rubric of Web 2.0, and cutting-edge products such as the Apple iPhone that point to convergence, the authors will continue cross-disciplinary research in Japan and welcome international collaboration.

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Source: Ubiquity Volume 8, Issue 38 (September 18, 2007 - September 25, 2007)

<http://www.acm.org/ubiquity/>