World Academy of Science, Engineering and Technology
International Journal of Computer and Information Engineering
Vol:4, No:12, 2010

Development of User Interface for Path Planning System for Bus Network and On-demand Bus Reservation System

Seiichi Tamagawa, Takao Kawamura, Toshihiko Sasama, and Kazunori Sugahara

Abstract—Route bus system is one of fundamental transportation device for aged people and students, and has an important role in every province. However, passengers decrease year by year, therefore the authors have developed the system called "Bus-Net" as a web application to sustain the public transport.

But there are two problems in Bus-Net. One is the user interface that does not consider the variety of the device, and the other is the path planning system that dose not correspond to the on-demand bus. Then, Bus-Net was improved to be able to utilize the variety of the device, and a new function corresponding to the on-demand bus was developed.

Keywords—Route Bus, Path Planning System, User Interface, On-demand bus, Reservation system.

I. Introduction

IN Japan, the number of public bus users keeps decreasing by the change in social conditions. However, it is important transportation for a lot of people, such as children, senior citizens, and persons who does not have their own cars. Therefore, a supporting system named "Bus-Net"[1] is managed by us and bus companies in Tottori prefecture on the Internet. Bus-Net has functions of path planning and timetable printing, etc[2][3].

However, this system has some problems. Firstly, the user interface of the path planning function has displayed same screen for personal computer and the cellular phone regardless of the kind of the device. The convenience of the entire system has decreased due to this problem. Therefore, the function has been developed to display the input screen corresponding to each device, and the system has been improved to generate a search result with the intermediate format to convert into each output screen. Secondly, Bus-Net corresponds only to transportation that the schedule has been fixed, so the on-demand bus cannot be retrieved. The on-demand bus can promote efficiency of service by passing a bus stop without the user who reserved. It attracts attention of the local government having a depopulated area. To solve that problem, the reservation system of the on-demand bus has been developed.

II. Search result in intermediate format and converting into each output

In the previous method of Bus-Net, the search result was directly output in HTML format, so it was necessary to rewrite the HTML document when outputting it by a different display method. Therefore, Bus-Net was improved to generate search results in the XML document, to make it the appropriate format to the device, and to output it.

Figure 1 shows the input screen of the previous user interface, and figure 2 shows the output screen of that. These were unsuitable for the personal computer because it was a composition possible for cellular phone. Therefore, an user interface for the personal computer has been made. It is an example of the interface corresponding to XML format.

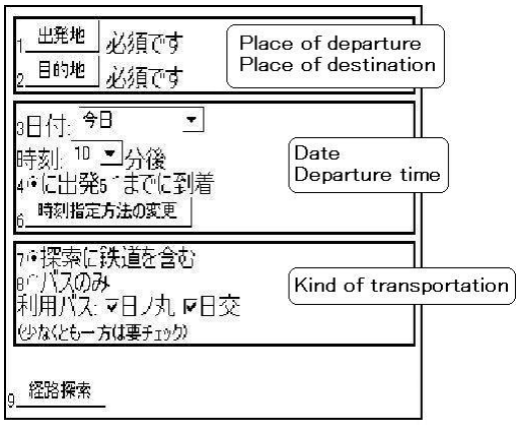

Fig. 1. Input screen of previous user interface.

Fig. 2. Output screen of previous user interface.

S. Tamagawa is with ME student in Graduate School of Engineering, Tottori University.

T Kawamura, T Sasama and K Sugahara are with Graduate School of Engineering, Tottori University.

A. Distinction of a web browser, distribution of the User Interface

It was necessary to distinguish the kind of the device automatically. Because it is necessary to display the search result and the user interface that is appropriate for devices. To meet this demand, the function is made that distinguish the kind of a web browser by referring to HTTP header.

B. Generation of search result in XML format

First of all, the search result is generated with XML format. Next, that XML document is converted into the output format that is appropriate for each device. In many cases, it is converted into the HTML or XHTML format. It is easier to convert the XML format into the HTML format than to convert the HTML format into another HTML format. By this method, it becomes easy to make the output screen for a new device. Figure 3 shows the relation of each step.

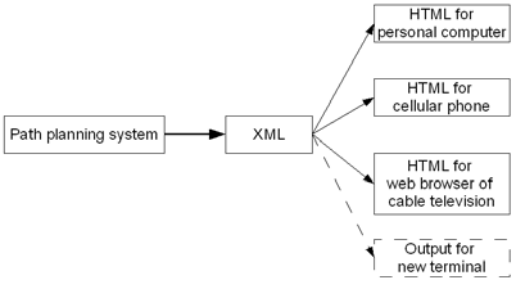

Fig. 3. Relation among path planning system, intermediate output, and output form of each device.

C. User Interface for personal computer

The user interface for personal computer should meet some requirements. This user interface is created to satisfy these requirements.

First request is to use functions of the personal computer effectively. The current user interface cannot use they effectively because it is a composition possible for cellular phone. Therefore, the new user interface for personal computer use functions which cellular phone dose not have: using JavaScript, opening sub windows, displaying big image, etc.

Second request is to reduce the frequency of screen transition. Because a needless screen transition gives the stress to users, it is necessary to improve it. The web browser of a cellular phone cannot open two or more windows, so screen transition frequency increases. However, like the said article, personal computer can decrease the screen transition frequency by opening sub window and using JavaScript if necessary.

Figure 4 shows the input screen of the user interface for a personal computer, and figure 5 shows the output screen of that. Both a lot of links and images are displayed compared with the previous user interface.

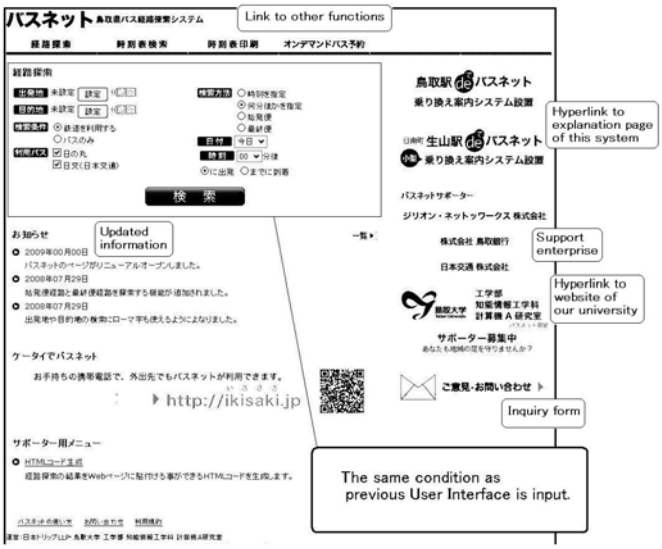

Fig. 4. Developed input screen of user interface for personal computer.

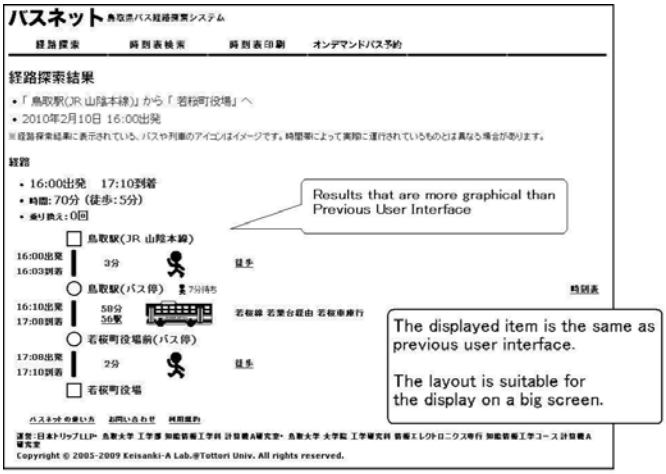

Fig. 5. Developed output screen of user interface for personal computer.

III. Reservation System of the On-Demand Bus

The on-demand bus is a public bus that changes or decides the path according to the reservation from users. This reservation system is the one for the on-demand bus whose whole area of path is appointment system. In this method, the bus does not stop in the bus stop that has not been reserved. It enables efficient operation, on the other hand, it makes the path change every day. It is a reason why it cannot correspond to the path planning system of Bus-net. Moreover, because the reservation is accepted by the telephone, operator's labor cost is needed. To solve these problems, the system has been developed that was able to reserve the on-demand bus through the Internet.

In this development, it cooperated with Nichinan town, Tottori Prefecture, Japan that had actually managed the on-demand bus. Nichinan town manages the on-demand bus that consists of five routes, and all homes use the cable television in this town. These are effective methods to solve the deterioration of communications and transport because of

depopulation. In consideration of it, this reservation system is assuming use from a cable television.

A. Assumed user and hardware

Almost all users of the on-demand bus are the inhabitants of the area. Therefore, people except the inhabitants should not be able to use it easily. In this development, Internet services of a local cable television are used, that is to say, only the inhabitants in the area where the cable television corresponds can use the reservation system.

B. Prevention of improper reservation

In that method, neither a fixed schedule nor a path exist because it decides the route according to the reservation. However, the progress direction of the bus is decided. Therefore, an unsuitable reservation for the traveling direction cannot be accepted.

Figure 6 shows one of routes that exist in Nichinan town. When moving from a-point to b-point, an advanced from east to west bus cannot be selected. If it is a reservation by the telephone, the operator properly judges it. So even this reservation system must make a similar decision. One of the methods is to consider the possibility of all reservations. However, it has the problem that the pair of the bus stop becomes enormous. In the case of figure 13, there are 55 bus stops, and the possible reservation reaches 1,485. Because there are five routes in that area, the number in total of possible reservations exceeds 7000. It costs very much to consider all these. Therefore, a method is adopted to divide a route into some areas. Figure 7 shows the example of the area division. This system judges the bus which a user can reserve from the position relations of these areas. For instance, when the user reserves it from a bus stop in area A to a bus stop in area C, the bus that can be used is only advanced from east to west. As for area A and area C, because bus stops is almost arranged in a straight line, it is possible for the reservation that obeyed the traveling direction of the bus in these. Because bus stops does not line up in area B, the movement in area B shall be able to use all buses. Only the bus that move from east to west can be used when heading from area A to area B or area C. It is similar in case of heading from area B to area C. Table 1 shows relations of positions of bus stops and available buses.

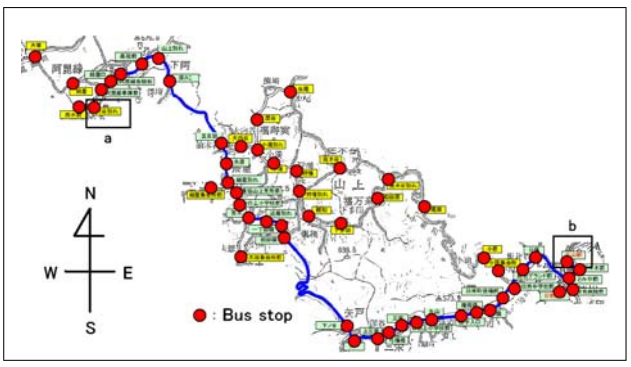

Fig. 6. Example of the route that an on-demand bus operates.

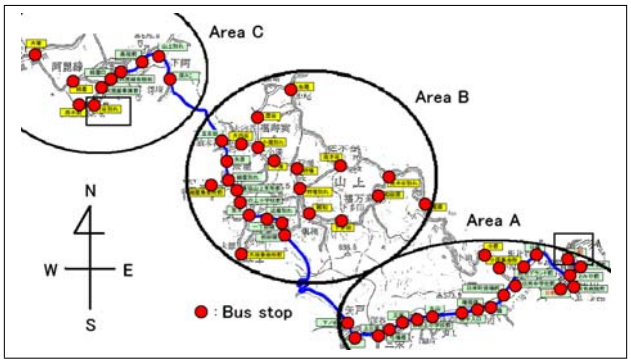

Fig. 7. Example of the on-demand bus area division.

TABLE I
CORRESPONDENCE LIST OF BUS STOPS AND AVAILABLE BUSES.

Area to take	Area to get off	available buses
		Judgment from position of bus stops
		From east to west
		From east to west
		From west to east
		All buses are available
		From east to west
		From west to east
		From west to east
		Judgment from position of bus stops

C. User Interface for reservation system

The user interface for the web reservation system should meet some requirements.

Firstly, it should be able to be operated by a television remote control. There is neither a mouse, a keyboard nor a touch panel in the television. A cable television can be operated only by push buttons of a remote control like cellular phone. Concretely, they are directional buttons and a decision button.

Secondly, it should be able to be displayed on television screen. The cable television cannot display the website just like the personal computer. Because the performance of a web browser and the display is different from it. For instance, the small character that can be displayed on the personal computer screen might not be able to be displayed on the television screen. The scroll of the screen is convenient for the personal computer. However, it is often inconvenient for the cable television.

Figure 8 shows the top page of the user interface for reservation system. There are two links. One is a link to the page for the reservation, and the other is a link to the page for the confirmation of the content of the reservation.

First of all, it explains the page for the reservation. Figure 9(a) shows the page of list of routes that can be reserved. It can be used without scrolling page. Figure 9(b) shows the selection screen of bus stops and the date. These lists are displayed by the pull-down menu. Because other selection methods are inconvenient for the user. For example, the list box is unsuitable for use by remote control, and the list that uses the radio button might not be able to be displayed without the scroll. Figure 9(c) shows the pull-down menu

for the bus stop selection. Figure 9(d) shows the selection screen of bus service. Only the service that can be reserved at that time is displayed on this screen. Next, it explains the confirmation of the content of the reservation and the cancellation of the reservation. Figure 10(a) shows the list of reservations. When the rightmost button is pushed, the cancellation confirmation screen is displayed. Figure 10(b) shows the cancellation confirmation screen. A final decision of the reservation cancellation is done on this screen.

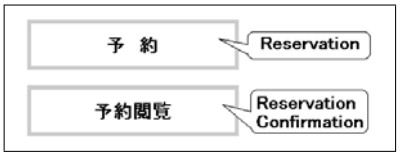

Fig. 8. Top page of interface for reservation system.

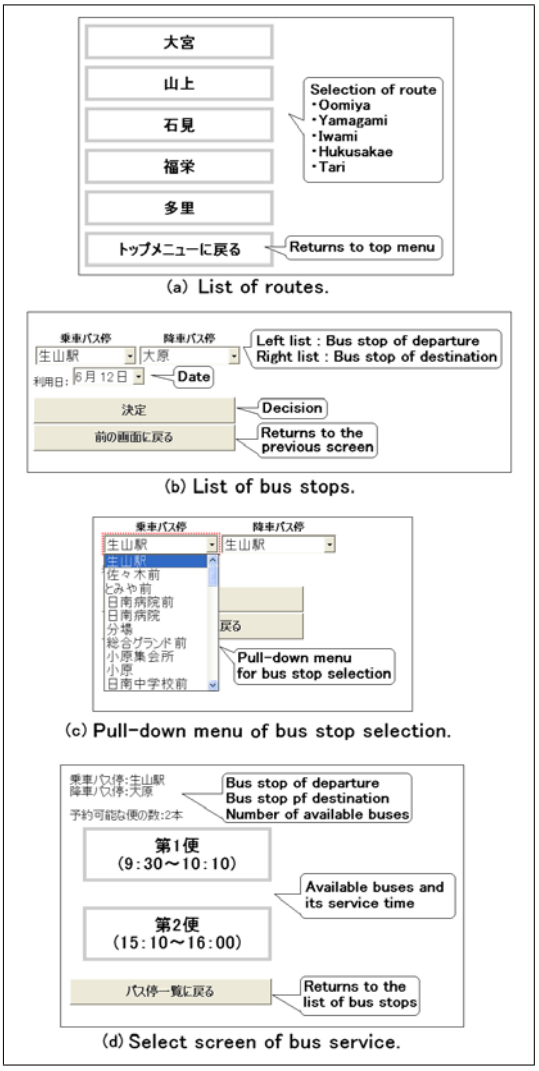

Fig. 9. Screens of the reservation procedure.

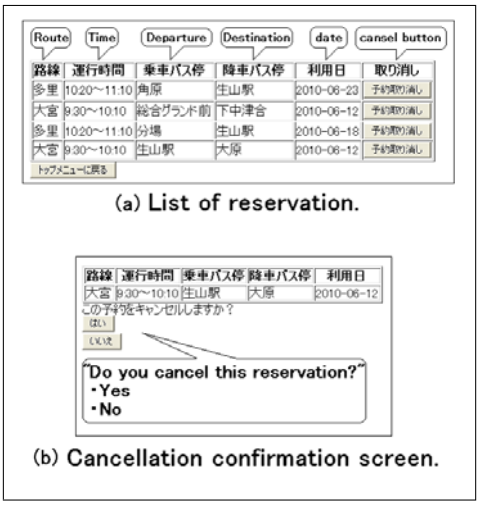

Fig. 10. Screens of the reservation cancellation procedure.

IV. Conclusion

Three improvements has been added to Bus-Net. First, the system has been improved to generate the search result with the intermediate format to convert it into the format that correspond to each device. Secondly, the user interface has been developed that is suitable for a personal computer. Lastly, the reservation system of the on-demand bus and its user interface have been developed.

As a result, it becomes easy to make the output screen for new devices, possible to use the on-demand bus through the Internet, and it come to be able to help the use of the public bus within the wider range.

References

[1] ”Japan Trip LLP:BUS-NET.” [Online]. Available: http://www.ikisaki.jp/
[2] Kusugami,G.,Ikehara,S.,Masuyama,H.,and Kawamura,T.(2005), *Research on application to development of technique of search for path of public transportation net and the Tottori City public bus net*, Tottori University.
[3] Toshioka,K.,Masuyama,H.,and Kawamura,T.(2009), *Research on development of public transportation use help system*, Tottori University.