Research and Development of a Mobile Accessor Technology

- To improve usability and accessibility through a personal adaptation-type human interface -

Koichi Takeuchi, Toshio Ueda, Masayuki Tokumitsu, Hiroyuki Miki
Shigeru Fukunaga, Yoko Takano, Takashi Nakayama, Yoshiro Suetake

Introduction

The human interface section of public terminals, which customers operate, such as ATMs and ticketing machines, are in most circumstances offered in a fixed format particular to certain equipment. The selection of a human interface, to suit a customer's individual physical characteristics, cognitive capacities or preferences, is ordinarily not possible.

Naturally, human interfaces of public terminals are equipped with devices to make use easy for as many people as possible, as described in other papers in this issue. Still, there is a limit as to how many functions a fixed, single human interface can accommodate. For this reason a new configuration of equipment is needed that can accommodate customers who have various physical characteristics and cognitive capacities as well as differing preferences.

The system proposed in this paper was researched and developed with just such a background. A part of the input/output function of the equipment subject to operations was separated from the rest of the functions in this system and configured to establish a distribution of functions and link ups between the equipment and handheld devices such as PDAs and mobile phones, which are referred to as "mobile accessors" (Fig. 1).

By adopting such system configurations it is possible to use a personal adaptation-type human interface that is better suited to differing physical and cognitive capacities, as well as the preferences of individual customers, while usability and accessibility are improved by the diversification of the operating methods and display methods.

This paper introduces a new human interface that uses such mobile accessors, by first describing the advanced research on these devices and their characteristics. Descriptions of an overview and evaluation of the prototype system that was created based on this idea follow. Further, the development status for practical application and related standardization trends will also be introduced.

Case example of a personal adaptation-type human interface

Several proposals have been made for a personal adaptation-type human interface of a kind that involves separating a part of a human interface and linking up handheld devices with the relevant equipment , as a means to gain access to information equipment, primarily for persons with disabilities.

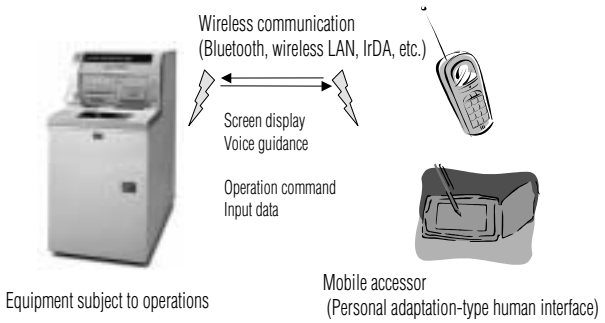

Fig. 1 Basic configuration and basic concept of mobile accessor

For example, Neil Scott of the Archimedes Project at Stanford University's Center for the Study of Language and Information (CSLI), developed the Total Access System[1)] that enables the operation of personal computers and household appliances by individuals with disabilities through input/output means suitable for various input and output devices connected to a relay device called the Total Access Port (TAP). Various input and output devices that comply with the connection specifications of the TAP relay device are available for this system and the system is configured in such a way that users can freely make their selection and use only those suitable for them. Through this it is possible, for example, to use a sight tracking system as an alternative to a mouse or a voice recognition system to control lighting and air conditioning. This system has already been commercialized and is widely recognized for its usefulness as a technology for persons with disabilities in the United States.

Further, Marney Beard and Peter Korn of Sun Microsystems, have realized a personal adaptation-type human interface[2)] by proposing a "downloadable human interface" that uses Java*1) and a distributed object technology, Jini. When this interface is implemented onto a vending machine, an individual in the possession of a PDA (considered to be the mobile accessor), is able to download a program from the vending machine to their PDA to remotely control the vending machine. It is also possible to purchase beverages from a vending machine without relying on vision, even if the vending machine itself does not have voice output or braille displays, simply by manipulating a PDA that supports voice commands, which is a personal adaptation-type human interface.

A common concept shared between the

*1) Java and Jini are registered trademarks or trademarks of Sun Microsystems, Inc., in the United States and other countries.

aforementioned advanced research and the proposal of this paper suggests that the relevant equipment does not have a wide range of human interfaces suitable for a variety of customers and their needs. However, such diversity is provided through the linking of the personal adaptation-type human interface (mobile accessor) of individuals with the relevant equipment. By choosing such a configuration, it is possible to limit the costs involved with loading the functions onto the relevant equipment, while making it possible to offer human interfaces that are suitable to each individual.

Characteristics and applications of a mobile accessor

Systems that incorporate mobile accessors have the following two major characteristics:

(1) They can be operated using a human interface that is suited to each individual.

(2) They can be operated remotely, in terms of spatial and temporal distances.

The following application examples utilize such characteristics:

- Visually impared persons can use their regular mobile telephones, with which they are familiar, as keypads to input commands or headsets used for voice guidance.
- Persons in wheelchairs may use their own PDAs as operation panels for purchasing tickets at vending machines.
- A driver is able to use a PDA to withdraw cash at a drive-through ATM while remaining seated in the car.
- Fund transfer designation information can be entered in advance at home or in the office, while traveling or while waiting in line at an ATM to minimize the operation time in front of the ATM.
- “Electronic invoices” that contain fund transfer information (fund transfer destination, amount, etc.) can be received by mobile phone and linked up with an ATM.

Examples of systems that apply configurations to incorporate mobile accessors with ATMs, which are also loaded with a part of the aforementioned functions, will be introduced in the next section.

Prototype system (1): ATM access system using PDAs

A prototype ATM access system was created in which PDAs can be used as if they were remote controls for ATMs. The PDA has remote control over both the spatial and temporal distance with a personal adaptation-type human interface using its communication capabilities with Bluetooth[*2], a short-range wireless communication standard or wireless LAN linked up with the ATM. Basic principles of the following functions were loaded into this prototype:

(1) Distribution of the operating screen's display functions.

(2) Distribution of input method functions.

(3) Advance inputs.

Display of the ATM operating screen on the PDA was made possible with item (1) (Fig. 2). Screen displays that suit the capabilities and preferences of the user are available for this purpose. For example, it is possible to transmit screen images on a PDA with larger characters or with a different display language. The operating screen of the PDA also displays in English, as it was loaded into the system of this prototype. Alternative displays using voice or braille are also possible although no descriptions are provided here.

Operations and entries can be executed with hand drawn characters on the PDA or by using the keys as with item (2). This assumes the use of the PDA as an alternative input method, for situations when the touch panel of the ATM cannot be used. Because the input method uses a device similar to that regularly used, there is no confusion associated with the arrangement of keys or character input methods.

It is possible to enter the amount for withdrawal in advance while waiting in line at a distance from the ATM, so that as soon as the ATM is accessible, the desired amount of cash can be provided simply by entering the cash card and the personal identification number as with item (3).

Fig. 2 Prototype of an ATM access system

By applying items (1) to (3) it is possible for users who find it difficult to use ordinary touch panels on ATMs as a means for input, to use mobile accessors with which they feel most comfortable for entering as much information as required. If necessary it can be done with the assistance of a bank employee, at a distance from the ATM, so that the operation time with the ATM can be limited to an absolute minimum, such as by simply entering the PIN number. Further, it is also be possible to set up a cafe-type bank branch, where customers can take their time selecting investment products at a table and then stop briefly at an ATM on their way out to finalize the purchase procedures or deposit funds.

*2) Bluetooth is a registered trademark or trademark of Bluetooth SIG, Inc., in the United States and other countries.

Prototype system (2): ATM linked mobile electronic invoice system using mobile telephones

A prototype of an ATM linked mobile invoice system was created through the linking up of a mobile phone with infrared communication capabilities and an ATM supporting infrared communications, as a system which has a simpler configuration than the aforementioned prototype and one that could be realized at this point in time (Fig. 3). This prototype system is also a system that resolves the spatial and temporal limitations that resulted in users standing in front of an ATM and operating it under the pressure of time. Fund transfer information, such as fund transfer destinations and amounts are included in an e-mail, which is sent as an "electronic invoice" to this prototype system. The fund transfer information received by a mobile phone is linked up with i-mode and i αppli*3) and transferred as an "electronic fund transfer card" to the ATM via infrared communications. In this way, the amount of operation time required to complete a fund transfer operation at the ATM is minimized.

Evaluation of prototype systems

This prototype system (1) enables a PDA with a wireless communication function to be used as a remote control for ATMs. By using such a configuration, it was possible to adapt the operating screen of the ATM for individuals (the operating screen is also offered in English on this occasion). It was verified that the PDA, which is familiar to the user, could also be used for operations even from a remote location of up to dozens of meters away, the limit for radio waves.

Depending on the communication situation, however, technical problems did occur, such as the problem with synchronization of screen displays and a time lag in the operational response time. In terms of security, there were also critical issues for the administration that require consideration, such as the fact that a portion of operations can be completed without standing in front of an ATM.

It was verified that with the prototype system (2), which links a mobile phone with an infrared communication function to an ATM, the need to enter such characters as the bank name, branch name, fund transfer destination specification, by using touch panels on ATMs, was eliminated. Entry of these were considered to be difficult and took the longest time out of all the ATM operations, therefore, the required amount of time was reduced for fund transfer operations and operations were improved. Through this the occupation time at an ATM by each customer is reduced and therefore, the waiting time in line for an ATM is expected to decrease as well.

It was verified that it was technically possible to use a personal adaptation-type human interface for screen displays and input methods to operate public terminals from remote locations (in terms of spatial and temporal distances), with any loaded function mode of either prototype system, simply by adapting a system configuration that uses mobile accessors. It was further verified that by this it was possible to resolve the spatial and temporal limitations, which resulted in time pressure on the operation as users stood in front of the ATMs. It was further found that it was possible to expect an improvement in the usability and accessibility of public terminals. The biggest advantage is the fact that each piece of relevant equipment does not have to be loaded with a wide range of human interfaces in order to be linked with mobile accessors. Further, it was also verified that by entering information in advance, operations , could be performed in advance at a remote location away from where an ATM is installed, to reduce the time and trouble of operations.

In terms of security, an evaluation and a study were conducted based on the international standard on information security, ISO/IEC15048. Since the prototype was created merely for the purpose of prototyping principles, the functions that were loaded consisted only of terminal authentication, encrypted communications, as well as the coordination of handheld devices with advance entries and ATMs. When applying this technology to fields, particularly to such fields as those of ATMs where a high level of security is required, security that assumes a variety of risks, such as interceptions, impersonations and tampering, will be required.

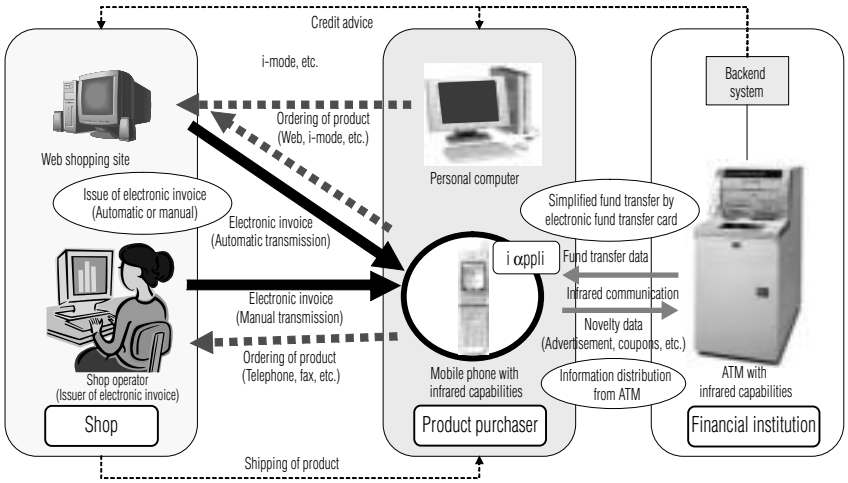

Fig. 3 Prototyped mobile electronic invoice system

*3) i-mode and i αppli are registered trademarks of NTT DoCoMo, Inc.

Practical application and functional enhancements

Due to the technical level at this time and also operational issues, the ATM remote control introduced with prototype system (1) is not scheduled to be put into practical application right away. A portion of the functions of the ATM linked with mobile phones that were introduced with prototype system (2), however, have already been loaded into ATMs and implemented at a regional bank. The service started in April 2004.

Although for our internal prototyping we aimed to simplify fund transfer operations by linking up a portion of the operation of the ATM with mobile phones, the system at the aforementioned bank makes it possible to use a mobile phone instead of a cash card. Specifically, an exclusive cash card application is provided to customers who apply for it from tellers at the bank. By using this application certain services, such as fund withdrawals and balance inquiries, are made available, with ensured security measures.

In the future it will be possible to simplify fund transfer operations or transmit sales information from ATMs to the mobile phones of customers by using the system as a new marketing tool.

Related technical standardization trends

Mobile accessors become meaningful when they are not dedicated to a particular piece of equipment, but when they can support a wide range of equipment. In this aspect, the role of standardization is vast.

The International Committee for Information Technology Standards in the United States (INCITS) is currently promoting the formulation of a standard called the Alternate Interface Access Protocol - Universal Remote Console (AIAP-URC)[3]. The aim for this is to establish a common standard that will make it possible for individuals in possession of personal adaptation-type devices (referred to as “mobile accessors” in this paper) to use them for controlling equipment, such as computers, mobile phones and household appliances. Many major businesses in the information and communication industries are participating in the establishment of this standard and the progress and dissemination of it is expected in the future. Interest for this standard in recent years has been growing in Japan as well.

As the standardization and dissemination of this standard proceeds it will become possible to manipulate public terminals (such as ATMs or ticketing machines), as well as household appliances (such as lighting or air conditioners) and office equipment (such as copy machines and printers), from a human interface that is dedicated to a particular user, without limits to the use of any given human interface, but a human interface suitable to an individual person.

Conclusion

A mobile accessor technology for the handheld devices of individuals, which links with and distributes functions with public terminals, was introduced as a method for improving the usability and accessibility of public terminals.

Two types of systems with loaded functions were still at the level of principle prototyping, but the application of such configurations on ATMs was tested and their feasibility and validity have been verified.

Although it is not possible to resolve all issues related to usability and accessibility merely by implementing such configurations, we believe that we can get a step closer to realizing a technology that is friendly to humans by combining devices and technologies, such as those introduced in this special issue.

When we consider the further sophistication and dissemination of mobile phone functions, as well as the progress of the aforementioned AIAP-URC standardization, we feel hopeful that usability and accessibility with the linking of handheld devices and public terminals as introduced in this paper, will continue to improve, as link ups and functional distributions between public terminals and handheld devices become a natural progression.

References

1) Neil Scott et al: The TASCLOUD: A Networked Total Access System, Proc. Technology and Persons with Disabilities Conference 98
2) Marney Beard, Peter Korn: What I Need is What I Get: Downloadable User Interfaces via Jini and Java, CHI '01 extended abstracts on Human factors in computing systems
3) V2-Information Technology Access Interfaces http://www.ncits.org/tc_home/v2.htm

Authors

Koichi Takeuchi: Corporate Research and Development Center, Human Interface Laboratory

Toshio Ueda: Corporate Research and Development Center, Human Interface Laboratory

Masayuki Tokumitsu: Corporate Research and Development Center, Ubiquitous System Laboratory

Hiroyuki Miki: Corporate Research and Development Center, Human Interface Laboratory

Shigeru Fukunaga: Corporate Research and Development Center, Ubiquitous System Laboratory

Yoko Takano: Financial Solutions Company, Terminal Systems Div., ATM Solutions Dept.

Takashi Nakayama: Financial Solutions Company, Financial Solutions R&D Div.

Yoshiro Suetake: Financial Solutions Company, Financial Solutions Development Div.