The Design of interface and function of cellular phones for old people

Yusuke Oda

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The Design of Interface and Function of Cellular Phones for Old People

By

Yusuke Oda

Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Information Technology

Rochester Institute of Technology

B. Thomas Golisano College of Computing and Information Sciences

March 2004
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Master of Science in Information Technology

The Design of Interface and Function of Cellular Phones for Old People

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Date: March 19, 2004

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Abstract:

A cellular phone is hard to handle for older people in terms of interface and function. In this thesis, the word “interface” stands for hardware and software interface and the word “older people” refers to Japanese people who are over 60 years old. Fundamentally, the interface must be easy to handle and convenient. In addition, it must be easy to access all of the functions that the user needs. However, it is questionable whether the interface and function of the present cellular phones are taking older people into consideration.

Thus, the purpose of this thesis is to consider new interface design and function of cellular phones for older people. This paper will focus on an interface design and function for an old person whose eyesight and hearing are beginning to weaken and an old person who is not dexterous and cannot freely move his/her hands like a young person.

First of all, current state of affairs of cellular phones will be examined and the problems older people have with the present designs and functions of cellular phones will be considered. Therefore, a Web site that explains a hardware interface, a software interface, and function of cellular phone is shown. Moreover, will be clarified the problems that cellular phones present to older people on the basis of a survey. Finally, based on the results of the survey of older people, the interface design and functions that must be equipped with cellular phones using figures will be illustrated. The interface and function will be useful and will satisfy their needs.
1. Introduction:

Many people have been using cellular phones as a means of communication in many countries since they appeared on the market globally. For the past three or four years, cellular phones have made remarkable progress since the “i-mode” service, which is a packet-based information service for cellular phones, started in 1999. Figure 1 shows an “i-mode” interface.

![Figure 1: An interface of “i-mode”](image)

The “i-mode” provides Web browsing, e-mail, calendar, chat, games, online shopping and banking, ticket reservation, and customized news, and “i-mode” uses a proprietary system that uses a subset of HTML, known as Compact HTML (CHTML). As a result, cellular phones have been used not only as telephones but also as a multi-functional devices. However, functions and interfaces for older people were not considered important. For example, the function represented by “i-mode” targets mainly younger people, and “i-mode” is an important part of the realm of mobile multimedia (Enoki, 2001). Therefore, from the standpoint of older people, a function like “i-mode” is not important.

In addition, a portable device like a cellular phone, which is easy to carry, must be designed so that it can be easily handled by anyone. However, in the current state of affairs, most cellular phones have many attractive functions that younger people want, and the cellular phone
companies' target is younger people. For example, a web site that cellular phone users can download music has only music for younger people with their cellular phones, and a video game is installed in cellular phones as standard. For example, a popular video game among younger people in Japan that is "Final Fantasy" and "Dragon Quest" are installed in a cellular phone (as shown in Figure 2).

![Figure 2: A video game of cellular phones](image)

Theses examples suggest that the main target of cellular phones is younger people. In addition, as for the design of interface, the cellular phone companies target younger people too. The interface influences a handling of all of cellular phone's functions because these are run through the interface. Therefore, the design of interface is important.

As for a software interface design of cellular phones, although the interface that is based on Graphical User Interface (GUI) like desktop computers is not useful for a person who has poor sight by the limited size of display, most interfaces are used GUI interface. The size of LCD is from 176×198 to 240×320 pixels.

In addition, also other researchers state that the interface that is based on GUI is
no-good. For example, a researcher talks that “In comparison to desktop systems, mobile and wearable devices that have limited screen are generally restricted. Therefore, it is hard to design purely graphical or visual interfaces that work well under these mobile circumstances.” (Joanna, 2003). On the other hand, my opinion that GUI interface is not useful is similar to other researchers’ in that the GUI interface is not useful because a display is too small but because an interface is not improved in order to suit.

As for a hardware interface, this is restricted by the limited body size, and many functions must be assigned to the same buttons. This factor makes operation complicated for a person who is not dexterous. Therefore, some researchers talk about various hardware interfaces that are much easier to handle and different from current hardware interface. For example, a researcher talks that “Unlike desktop computers, input devices for mobile computers are often restricted by the limited size. Therefore, the researcher proposes a new input device for mobile devices, called PreSense.” (Jun, 2003). However, my approach is different from other researchers’ in that a form of hardware interface is not changed.

My approach is not to change the form but to change the balance of button size and buttons’ spacing in order to improve cellular phones’ handling. Currently, there is a digital divide in cellular phones between a person who can use them and a person who cannot, especially, between younger and older people. However, according to a report, which was published by the United Nations (UN) in Table 1(UN Population Division 2002), in most advanced countries, such as Japan, the United States, and West European countries, there will be an increasingly aging society. Accordingly, the consideration of older people will become more important. Judging from the features of cellular phones that are carried easily by even older people, there is a possibility that the cellular phone will become one of the most useful devices for older people.
Thus a cellular phone must be equipped with the interface and functions that are designed for them. Consequently, the interface and function will lead to an opportunity for a solution regarding the digital divide of cellular phones.

<table>
<thead>
<tr>
<th>Country</th>
<th>People of 60 years and up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2000</td>
</tr>
<tr>
<td>Canada</td>
<td>16.7%</td>
</tr>
<tr>
<td>Finland</td>
<td>19.9%</td>
</tr>
<tr>
<td>France</td>
<td>20.5%</td>
</tr>
<tr>
<td>Germany</td>
<td>23.2%</td>
</tr>
<tr>
<td>Italy</td>
<td>24.1%</td>
</tr>
<tr>
<td>Japan</td>
<td>23.3%</td>
</tr>
<tr>
<td>Sweden</td>
<td>22.3%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>20.7%</td>
</tr>
<tr>
<td>United States of America</td>
<td>16.1%</td>
</tr>
</tbody>
</table>

**Table 1**: The Comparison Percentages of individual over 60 in 2000 vs. 2050.

2. **The problem of the present cellular phones:**

The question we have to ask here is to what degree older people in Japan are considered in the design of cellular phones. Basically, the target audience of products influences the design of them. In other words, it is possible to presume who is the target of a product from the design
and features of that product. Therefore, in this chapter first considers the current state of affairs of the hardware interface, the software interface, the functions, and the differences between Japanese and Finnish regarding the target brackets of cellular phones. In addition, I would like to clarify the problems of older people on the basis of the results of a survey.

2-1. The analysis about the present state of cellular phones

2-1-1. Hardware interface design

The hardware features of cellular phone, interfaces are to provide a digital camera, to enlarge a Liquid Crystal Display (LCD), and a large number of buttons. J-phone (Vodafone) was the first company that equipped cellular phones with a digital camera in order to begin their new service that was called “Sya mail”. The service was started in 2001. The service was to attach a photograph, which was taken using the digital camera of cellular phones, to e-mail. The service was a great success; as a result, Vodafone expanded the market share of cellular phone sales in Japan. Inevitably, other companies began to equip their cellular phones with a digital camera. At first the digital camera was only able to take a photograph. However, the present digital camera has made progress, so that it can also record video animation; besides, some digital cameras can function as a part of a TV-phone. Almost all of the cellular phones on sale in Japan at the present are equipped with a digital camera; some of them are mega-pixel. Judging from the fact that about 93% cellular phones that were sold from 2002 to 2003 are equipped with digital cameras, the tendency to equip cellular phones with digital cameras will continue to grow.

As for the LCD, the present biggest display is 2.4 inches (a length of diagonal). This LCD size is about one-and-one-half times as large as its size of two or three years ago. In addition, the LCD can display 260,000 or more colors. From the standpoint of the LCD,
enlargement of it is a good improvement for not only younger people but also older people. Similarly, it is a good improvement for the LCD to become highly efficient because it can display larger and clearer characters and pictures. In addition, the larger displays support the solution of usability issues. As a consequence, everyone can look at characters and pictures more easily.

On the other hand, regarding the digital camera it is not always a good improvement for older people. Certainly, people can do a larger variety of things with cellular phones that have a digital camera; for instance, people can send and take pictures and video by only carrying cellular phones. To take an example, people who cannot often meet with each other because they live at a distance can get a visual confirmation if their contacts have a digital camera. This usage must be of great value to older parents and grown-up children because most families do not live with their parents in Japan, a so-called “nuclear family.” This is a term used in cultural anthropology, and it means the immediate family of husband, wife, and children only.

It is necessary to handle many buttons when people want to use the various functions of cellular phones. Moreover, it is not easy to make the body of cellular phones larger because they are basically designed with the premise that they are portable devices and can be used with only one hand. Certainly, some people use cellular phones with both hands. However, the width of cellular phones has changed from 46 to 51 mm, and it is not enough width to use with both hands. If cellular phones are designed to use both hands, the width of cellular phones should be wider than present’s like portable game machines. As a consequence, there is a tendency to increase both the handling and the numbers of buttons. To take an example regarding the buttons, Figure 3 shows that cellular phones have buttons in not only the front but also on the side.
That is, people need to use both the front and the side buttons in order to use their phones efficiently. Therefore, there is not much merit for older people because those who are not generally manually dexterous cannot efficiently use various functions including the digital camera. In addition, it is likely that to equip a cellular phone with a digital camera does not benefit them considering an increase in cost and weight. In Japan, the income of almost people over 60 years old is mainly their pension (Ministry of Health, Labor and Welfare, 1997). Therefore, they tend to avoid all unnecessary costs.

Up to this point, it is clear that there is some merit for older people to used advanced LCDs because they can clearly see a picture and characters easier by enlarging LCD. On the other hand, it is likely that there is not much merit in equipping cellular phones with a digital
camera for the elderly because of cost, weight, and handling consideration.

2-1-2. Software Interface:

Almost all of the present main-menu interface of cellular phones used is Graphical User Interface (GUI). Because of using icons, the GUI gives the impression that it is easy to handle at the beginning compared with an interface using characters. However, the present LCD size of cellular phones that are on sale is mostly 2.1 inches. For that reason, information using the GUI that is displayed on the LCD at the same time is decreased by restriction of the LCD size. Therefore, it is necessary for people to choose icons and menus on the LCD over and over again in order to access the function that the user needs. Also present cellular phones have many functions. On the other hand, suppose that more information simultaneously is displayed on the LCD. Icons must become smaller and, as a result, difficult to see. This is not easy to use for older people considering their physical disabilities. The following lists common physical problems of older people (The physical ability of older people; Masaka, 2004).

➤ Weakening eyesight and/or hearing.
➤ The decline of discernment between colors.
➤ The deterioration of memory.
➤ Loss of movement in hands and fingers.
➤ The deterioration of input speed and the increased likelihood of errors on push button handling.

The physical ability gets worse with their increasing years. As for the handling of buttons, mistakes tend to increase if the button size becomes smaller and/or the space is narrower between buttons.
Figure 4 shows a general interface of cellular phones, and the left side is the actual size of the interface on the LCD. It is likely that the characters and icons of the interface are too small for older people to read.

![Real size and Expansion Interface](image)

**Figure 4**: A general interface of cellular phones

It is said that a person's eyesight begins to fail after 40 years old, and again especially, rapidly over 60 years old. The eyesight weakens about 0.3 (20/60) vision by the age of 80 (The lab of older people). In addition, it is difficult for older people to see material that is a short distance away because of farsightedness due to old age. It is necessary not only to make the characters and icons of the interface larger but also to decrease the number of them displayed at the same time to compensate for the failing eyesight of older people.

As for the color of the interface, some of the interface uses a combination of colors that is easy to distinguish for everyone. For example, if a background of an interface is black, a character is white and if a background is blue, a character is orange. The arrangement of colors is important for older people too. Nearly 80 percent of people in their seventies have cataracts, that
is, the lens of their eyes become clouded (Cataract). Therefore, whatever they see is reddish and out of focus. In other words, there is some possibility that they cannot see distinguish between the arrangement of colors. Figure 5 shows both good and bad examples of the combination of colors. The bad example is not clear because of a lack of the contrast of colors between background and characters, or because the characters of the interface are too small. On the other hand, the good example is clear due to the contrast colors. Therefore, it is likely that not only old but also partially color-blind people can more easily see an interface with a greater contrast between colors. Partially color-blind people cannot distinguish colors according to the combination of colors, for example, the combination of cream-colored and yellow and colors between yellow and green (Masaka, 2004).

Certainly, some of the software interface has well-arranged colors. However, it is not evident whether the interface considers older people. In addition, it is likely that the size of characters is not suitable for older people. Judging from the present software interface, it clearly does not always consider older people’s needs.

![Bad Example](image1.png) ![Good Example](image2.png)

**Figure 5:** A bad and good example of interface
2-1-3. Function:

The present functions of cellular phones can be classified into two types. One is a supporting function as a tool for communicating and the other is a function as used for a tool for enjoyment. The tool for communicating function provides an address book, e-mail, read e-mails aloud, an answer-phone, voice memo, and calling. The enjoyment function offers information service represented by “i-mode” and “i-appli”, checking one’s position by Global Positioning System (GPS), playing the videogames, downloading music, watching TV, listening to the FM radio, editing a picture, and taking a picture with a digital camera. It is not too much to say that all of the cellular phones that are now on sale can function as a tool for enjoyment, and that is a substantial consideration. In addition, people can get a function that is not installed in their cellular phones by installing corresponding software using the Universal Serial Bus (USB) from a PC or downloading from the Internet at any time. However, the function that people can download is not as a tool for talking but as an enjoyment. From the standpoint of older people, it is more important for them that the function is not as a tool for enjoyment but as a tool for talking. Certainly, people can do various things using only cellular phones that have many functions as a tool for enjoyment; for that purpose it is necessary that people can use the phone’s functions efficiently.

To take an example, will people who want to take a picture buy a cellular phone that has a digital camera? If they can use the function of not only telephone and e-mail but also taking and editing a picture efficiently, they may purchase the cellular phones. On the other hand, if they cannot use the functions as a tool of talking or as a tool for enjoyment efficiently, they will not buy them. In other words, even if cellular phones have many attractive functions like taking a picture by digital camera, it is worthless if people cannot use the basic function of the telephone.
However, almost all cellular phones that are now on sale have the functions of a tool for enjoyment more advanced than ever before, assuming everyone could use all of the functions efficiently. Of 109 models of cellular phones that were sold from 2002 to 2003, and 101 out of these 109 models (93 percent) had a digital camera. On the other hand, the cellular phone that has a function of reading e-mails aloud as standard is included in only one model.

The function of reading aloud is very important for older people because they have difficulty obtaining all of their information from only their eyesight. Nevertheless, almost none of the cellular phones have that function. The fact that there is a great difference regarding the number of the cellular phones that have a digital cameras or the function of reading e-mails aloud suggests that people the supporting function as text reading for groups such as older people, is not considered important.

2-1-4. Concept:

In Japan, the total number of subscribers of cellular phones was 79,281,000 as of November 30, 2003 and the diffusion of cellular phones is 62.4%, a number derived by dividing the total population of Japan by the total number of subscriber of cellular phones (Mobile New Letter, 2003). However, a glance at Figure 6 will reveal that the use of cellular phones has not spread among older people in their sixties compared to other age brackets in 2001.
Figure 6: The situation of using cellular phones in Japan 2001

In addition, the diffusion of cellular phones for people who are over 60 years old is 16.3% as of March 2003 (Nikkei market yearbook about IT 2003). This fact clearly shows that the use of cellular phones has not spread among older people. To take an example, the diffusion of cellular phones in Finland is about 93% as of October 2003, and as for older people in their sixties, the diffusion was about 55% in 1999 (The world news; The Japan Ministry of Posts and Telecommunication, 2001). In the same way, the diffusion of cellular phones was over 80% in Sweden in 2002, and the diffusion regarding older people in their sixties was about 60% in 1999 (The Japan Ministry of Posts and Telecommunication, 2001). The fact suggests that cellular phones have spread irrespective of age in Finland and Sweden, which is different from in Japan. Of course, it is difficult to compare simply Japan and Finland or Sweden regarding the diffusion of cellular phones because there is a great difference in population and life style between these countries. However, from the standpoint of efficiency of the LCD and the functions of “i-mode”
and "i-appli", cellular phones of Japan are more advanced than Finland's or Sweden's. For all that, there is a great difference in the diffusion of cellular phones between them. Well, why is there such a great difference?

One of the reasons is how far cellular phone designers have considered older people. In Finland, there is a concept that is called "design for all" that permeates designers. The concept is that not only cellular phones but also other products must be designed so that everyone can easily handle them. In other words, products are designed with consideration for older people. Figure 7 shows a cellular phone from Finland.

![Figure 7: Cellular phones of Finland](image)

It is likely that the cellular phone is easier to handle than ones from Japan because the buttons are big compared to ones from Japan. In addition, in Nokia mobile phones, the concept shows "design for all" (Aaron, 1998). On the other hand, Japan has a tendency to design products so that not everyone can handle easily them but to instead focus on how to get the people who are the target of companies to purchase their products. Necessarily, the cellular phone manufacturers give high priority to developing new cellular phones that are wanted by the main target people,
who range from the older teens to people in their thirties. As a result, it is conceivable that cellular phones are considerably widespread among the target people. On the other hand, cellular phones are not widespread among older people who are not the target of the manufacturers. Moreover, there is little possibility that the cellular phones that are considerate of older people will appear as long as the cellular phone manufacturers continue to design future.

Up to this point, I have presented my research on how far the present cellular phones are designed with consideration of older people from four standpoints: the hardware interface, the software interface, the function, and the concept. Judging from these four points, even if the result was not led by considering of older people, there are some good points of cellular phones for also older people, for example, enlargement of display and the arrangement of colors. However, there are many not-so-good points, on the whole. It follows from this that present cellular phones are not sufficiently considerate of older people and there is still room for improvement.

2-2. The questionnaire survey:

The author conducted a questionnaire survey about cellular phones on Japanese people who are over 60 years old and received the reply from 38 out of 44 respondents. As for the survey, the respondents were interviewed about cellular phones, and their responses were written down. Those who conducted the survey asked the respondents and collected their opinions, and they told the author about the results of the survey.

Fifteen respondents are from 60 to 70 years old, fourteen respondents are from 71 to 80
years old, and nine respondents are from 81 to 90 years old. Selected respondents had specific requirements: to be over 60 years old, spry, and not senile. As for the condition of respondents, my friends judged. The following questions were posed to them in order to clarify the problem that many elderly have with cellular phone usage.

1. Do you have a cellular phone?

2. If yes,
   - Why do you choose to have one?
   - What is the main purpose you use it for?
   - What has become convenient for you since you used a cellular phone?
   - What kind of problems or complaints do you have with cellular phones?

3. If not,
   - Why do you choose not to have one?

4. What kind of interface or function do you expect cellular phones to have in the future?

As for older people, the survey is performed using the above questions in a non-random survey in cooperation with my friends. Two of them have their cellular phones and work at a home for the aged as nurses, and others who have their personal computers and cellular phones and live with their grandparents or are in contact with their grandparents. Even if respondents did not have a cellular phone, my friends asked their opinions after demonstrating their cellular phones.
2-2-1. Results of the survey:

The result of this survey of older people, regarding cellular phones usage, was performed in November 2003. The following result was summarized.

1. Do you have a cellular phone?

Figure 8-1 shows that whether respondents have a cellular phone or not.

![Pie chart showing percentages of ownership of cellular phones]

**Figure 8-1**: Percentages of ownership of cellular phones

- Yes I have one. - 9 persons, 23.6%
- No, I do not have one. 29 persons, 76.4%

2. If yes,

2-1. Why do you choose to have one?

Figure 8-2 shows the percentages of the reasons why they have one.
Figure 8-2: The percentages of the reasons

Reason 1: My son or daughter gave me a cellular phone. 6 persons.

Reason 2: My friend recommended me to get a cellular phone. -2 persons.

Reason 3: I won a cellular phone in a raffle. 1 person.

2-2. What is the main purpose you use it for?

Figure 8-3 shows the percentages of usage of cellular phones.

Figure 8-3: The percentages of usage of cellular phones
Reason 1: I have used a cellular phone for sending e-mail to my grandchildren and my family. - 4 persons

Reason 2: I have used a cellular phone for calling my friends. 4 persons.

Reason 3: Actually, I seldom use a cellular phone. 1 person.

2-3. What has become convenient for you since you used a cellular phone?

- I can make a telephone call by using a cellular phone even if there is not a payphone nearby.

- I can keep in touch with my grandchildren and children who live at a distance more frequently and cheaply by using e-mail.

- Even if I get separated from my companions in crowded place, such as a department store, a shopping mall, or an amusement park, I can get them to come find me by calling them on my cellular phone to let them know where I am.

- I can carry a cellular phone easily because it is very light.

- There is a sense of security from carrying with a cellular phone.

- It is easy to stay in touch, not only for me but also the person who has business with me as long as I carry a cellular phone.

- A person who worries about me can inquire my health anytime without seeing me in person.
As for the survey, my friends asked questions face to face with interviewee. Therefore, even if interviewee did not know a word like “icon” or “information”, the interviewer was able to explain these words to them.

2-4. What kind of problems or complaints do you have with cellular phones?

- The characters on e-mail and the menu are too small for older people to read.
- It is difficult for some older people to understand the meanings of icons because they are unfamiliar to us.
- The buttons are so small that some older people cannot always push them right, and it is difficult to push them. Therefore, they sometimes make a mistake by pushing the wrong buttons.
- It is difficult for older people to check the channel or the level of battery power remaining because that information is shown by small bar that is hard to see.
- Cellular phones have so many functions that it is hard for older people to find the function that they want to choose.
- The price of a cellular phone and the monthly bill are expensive.
- The operation manual for cellular phones is thick, therefore some older people do not feel like reading it.
- I cannot easily master how to use a cellular phone because the procedure is complicated to learn.
- Cellular phones do not have a function of voice instruction or explanation.
Sometimes it is hard for older people to see a display because of the arrangement of colors on the icons, for example yellow and orange printed on a light background.

Some older people cannot use a digital camera feature on cellular phones because its usage is complicated.

Some older people cannot operate their cellular phones without seeing the display.

3. If not.

3-1. Why do you choose not to have one?

Figure 8-4 shows the percentages of the reason why they do not have one. The number in the graph corresponds to the number in parenthesis.

![Figure 8-4: The percentages of the reason](image)

**Reason 1:** It is not necessary to have a cellular phone. – 13 persons.

**Reason 2:** A cellular phone seems to be complicated to learn to use. – 8 persons.
Reason 3: The price is high. – 6 persons.

Reason 4: I am not interested in cellular phones. – 2 persons.

4. What kind of interface or function do you expect cellular phones to have in the future?

4-1. As for the search function of telephone numbers.

- This function can identify the place where the person is now and to search the telephone numbers of the nearest public facilities, such as library, a city hall, a train station, or a hospital by using the GPS.

4-2. As for the function of voice recognition.

- If I only have to push the talk button to say a name that I want to call, the cellular phone calls that person.
- Guidance and explanation of the functions and handling are by voice.
- I want the cellular phone to read aloud the name and telephone number of the person who is calling when the cellular phone receives a telephone call.
- They want the cellular phone to read aloud the condition of the total battery power remaining and the channel.

4-3. As for the hardware interface.

- The design of the present cellular phone is almost always a folding type; however, that form is unfamiliar and disagreeable for older people.
The form of the present cellular phone is linear and the surface is smooth, so it is easy to drop it by mistake. Therefore, I want to change the design of cellular phones.

I like the old-style telephone receivers (as shown in Figure 9).

Some of older people want bigger buttons on cellular phones because the present buttons are small for them to use accurately.

Some of older people want the LCD to be enlarged and easier to see than the present models have.

Figure 9: The old-style telephone in Japan

4-4. Other opinions regarding function, interface, and design suggest that older people want the following:

A function that they can call for help to the police or an ambulance by pushing only one button in an emergency.

A diagnosis of their medical condition or injury by using the digital camera of cellular phones without going to a hospital.

Using cellular phones to buy train or bus tickets because many older
people use public transportation on a daily basis in Japan.

- In Japan, the construction of some big train stations is very complex; therefore, they want cellular phones to guide them to their destinations and a change of trains and buses announced by voice and by displaying characters on the LCD.

- They would like cellular phones to be able to read information about products from scanning the Universal Product Code (UPC) on these items.

- They want to be able to write on the LCD like a Tablet PC because they are more used to writing characters than inputting keystrokes.

- They hope that cellular phone usage will be simplified so that all of the functions can be handled easily by older people.

- They hope that they will be able to list a telephone number and a person's name in a personal telephone directory by voice.

- They hope that a purchase price and monthly service bill will be cheaper than it currently is.

- They hope that the number of functions of cellular phones will be reduced because the present ones are too complicated to use.

In this chapter, I have presented the current state of affairs regarding how far the present cellular phones are viewed by older people. Based on this information, we see that many older people do not have a cellular phone or are discontented with their present cellular phones, especially because of issues about the hardware and software interface. It is a natural result
because the target market of present cellular phones is not older people, and cellular phones companies do not consider them. On the other hand, from the standpoint of functionality, certainly a cellular phone is a convenient device not only for younger people but also older people. No matter how excellent a cellular phone’s functions are to younger people, they are meaningless to older people. Consequently, present cellular phones are not taking older people into consideration and are therefore not a useful device for older people.

3. Results of the usability test and discussion about the cellular phone:

   In this chapter, I would like to consider the hardware interface, the software interface, and functions of cellular phones for older people based on the results of the above survey in order to reflect their opinions. Details of the survey are explained in chapter 2. Based on the results of the survey, older people seem to have a lot of opinions about the present cellular phones, especially many negative opinions. In other words, the most important findings is that older people are definitely not satisfied with the present cellular phones. Therefore, I would like to show a new concept of hardware interface, a prototype software interface and functions of cellular phones that are reflected in surveyed opinions from older people.

3-1. Interface:

3-1-1. Software Interface:

   A summary of the majority of older people’s opinions about the present software interface is as follows:
➤ The characters of e-mail and menu listings are too small to read.
➤ It is difficult to understand the meaning of icons, which are unfamiliar to older people.
➤ The cellular phones have too many functions for older people to easily understand or learn.
➤ Sometimes it is hard to see a display because of the juxtaposition or arrangement of colors.
➤ It is difficult to view the channel or to check the total battery power remaining because that information is displayed by small bars that are hard for older people to read.

The prototype software interface is designed for older people. Therefore, my prototype is based on the above opinions in order to be suited to older people because Dan Hawthorn argued that “designers needed to involve older users in the design process when designing for older users” (Dan, 2003). The following is the main concept of the prototype software interface design.

➤ Characters are enlarged as much as possible in order to be easily seen by older people. A comparison of the size of characters appears in Figure 10.
➤ The interface of icons is unpopular with older people; therefore I use only characters instead of icons. GUI depends on icons whether the interface is easy to understand. That is, icons that are not well abstracted of matters make the meaning difficult instead of making the meaning clearly. In addition, many English word coined in Japan that
are not familiar to older people are used in GUI. It is likely that these factors make icons unpopular with older people.

- As for colors, the contrast is the most important element. Therefore, color combinations chosen for their contrasting qualities are white and black, black and blue, and black and orange.
- Older people consider that the present cellular phones have too many functions. Therefore, I will install only the basic functions of cellular phones in the prototype interface.
- Information displayed on the screen is summarized and reduced as much as possible in order to increase usability for older people.
- The window size of the prototype is adjusted to actual size of cellular phones and the screen size is adjusted to actual one’s in order to simplify to compare the prototype to the actual cellular phones for older people.

Prototype  A real interface

Figure 10: The comparison of the size of characters
3-1-1-1. The Menu:

Figure 10-1 is a menu screen of the prototype interface that includes the considerations listed above. We see from Figure 8 that the number of functions of the prototype cellular phone is reduced, as compared with the present cellular phones on the market, in order to make basic functions as simple as possible. Therefore, the functions of the prototype mainly consist of four functions: voice calls, e-mail, various set-up functions, and storage/access of personal information. In addition, I eliminated all functions that seem to be unnecessary for older people to simplify the cellular phone and facilitate its use for them. As for the way of input, the prototype software interface was designed on the assumption that users use a “Jog-Dial” (as shown in Figure 11). This is installed in Sony’s cellular phones and PCs. “The Jog Dial control enables you to access and retrieve information one-handed because a simple click and turn lets you scroll through the menu of applications and information, selecting what you need” (Jog-Dial).

Figure 11: Jog-Dial of cellular phones
Figure 10-1: The menu screen of the prototype interface

3-1-1-2. The Telephone function:

Figure 10-2 is a menu screen of the telephone function including accessing an address book, adjusting the volume on phone calls, and offering the call history that informs an owner of who has called and when. As for the address book, people can call a person up and check the personal information anytime by making a selection from the list of names in the address book.

As for volume function, users who are hard-of-hearing can adjust of the volume level on their
cellular phones. As for the record function, an owner can not only check who called and at what time but can also return the call easily by selecting that information.

Figure 10-2: The menu screen of the telephone function
3-1-1-3. The E-Mail function:

Figure 10-3 is the menu screen of the e-mail function, including composing, receiving, sending and reading or re-reading e-mail messages. When people write e-mail, first of all they choose a name from their address book and then select the person’s e-mail address. Secondly, they write their message and title of the e-mail. Finally, they check their message, make any edits or addition, then complete the transmission of the e-mail by pushing the button to send the message.

Figure 10-3: The menu screen of the e-mail function
3-1-1-4. The various Set-up functions:

Figure 10-4 is the menu screen of the various set-up functions: the set-up music that sounds when someone calls an owner, the set-up of the display, and the set-up of the total charges and time of the call. As for the set-up of music, an owner can change the music and its volume. As for the set-up of the display, an owner can adjust brightness of the screen. As for the set-up of the charges and time, an owner can check the total charges and time or can reset and clear that information.

Figure 10-4: The menu screen of the various set up function
3-1-1-5. The function of personal information:

Figure 10-5 is the menu screen of the function of personal information: owner information including name, cellular phone number, and e-mail address; the telephone number to be called in an emergency; and the owner’s present location. As for the function of the telephone number in an emergency, the cellular phone determines the present location information by GPS and downloads the telephone number of the nearest police station, the nearest fire station, and the nearest hospital from the database when the owner judges it to need emergency call. As for the function of the owner’s present location, the owner can find his or her present, detailed position on a map that pinpoints the location by using GPS. In addition, the detail information of owner’s present location is pinpointed by characters.

Figure 10-5: The menu screen of the function of personal information
3-1-2. The usability test:

3-1-2-1. Methods:

I ran a usability test on the prototype software interface for older Japanese people, and I received ten responses. As for the usability test, I instructed testers through cooperators by using telephone how they ran the test. All of the usability test was run with cooperators’ PC by downloading data of the prototype interface. None of the respondents have had a cellular phone. The age groupings of older people who participated in the usability test as follows: sexagenarian, two persons; septuagenarians, four persons; octogenarians, three persons; and one nonagenarian. The point of the evaluation was to determine optimal qualities in the size of characters, the arrangement of colors, ease of handling, the number of functions, and all opinions regarding the prototype interface. In addition, there was difference in feeling in actual handling the cellular phones because the older people who were testers needed to use a mouse when they ran the usability test of the prototype interface. However, hardware interface is not point of evaluation in this part.

3-1-2-2. Results:

The following are the results of the usability test that was run with ten elderly subjects who were testing the prototype software interface:

1. Size of characters.
   ➢ The size of characters is a legible size for older people.
   ➢ E-mail characters are too small for older people to easily read.

2. Arrangement of colors.
   ➢ The color combination of orange and blue is little too light for some
older people to easily read.

- The combination of the color about the prototype that is black, white, blue, and orange is easy to see and distinguish other colors.

3. Handling of the prototype.

- The interface of characters is easier to handle for older people than the interface of icons.
- When they choose a function, they want the interface to explain that function to them.

4. Number of functions.

- The reduced number of functions of the prototype is satisfactory to older people.

5. All opinions about the prototype interface

- It is difficult for older people to see the map because it is confusing and gives too much information.
- The explanation of the present position by characters is useful.

6. Do you want to get a cellular phone whose interface is this prototype?

6-1. Yes. four persons. Why?

- This prototype interface is useful for older people.

6-2. No. - three persons. Why?

- The prototype is much different from cellular phones that are sold to young people. Therefore, the prototype does not make a good impression on some older people who feel that they are being negatively distinguished from younger people.
6-3. I do not know. - three persons. Why?

- Depends on the price.

Based on the results of this usability test, four out of ten persons said that they might get a cellular phone, and three out of ten persons might not get a cellular phone that has the software interface as in the prototype, which suggests that the software interface design of cellular phones is one of the important factors for older people when they choose whether they will get a cellular phone or not. However, it is natural that the software interface is one of the important factors because none of the functions are carried out without using the software interface. To put it briefly, a cellular phone that does not have a useful software interface is not a useful device. Naturally, the reverse is also true. As a consequence, older people who do not have a cellular phone are more likely to get one if it included a more usefully designed software interface.

3-1-3. Hardware Interface:

The nine respondents had their cellular phones and other respondents were showed cooperators’ cellular phones in order to grasp what cellular phone was. Therefore, not everyone but some respondents had good and bad opinions about hardware interface. The following is a summary of the respondents’ opinions of the present hardware interface:

- It is very light; therefore, it is easy for older people to carry a cellular phone.

- The buttons are so small that they cannot always push the right ones and end up making a mistake.

- They cannot master easily how to use the functions of cellular phones because the operation method is complicated and they
have to learn too many things.

- The form of the present cellular phone is linear and the surface is smooth and easy to drop. Therefore, they want to change the exterior design of cellular phones.
- They want the LCD to be more enlarged and easier to see than the present models have.

Based on these opinions from older people, the buttons are especially problematic. The hardware interface design directly influences the handling of cellular phones. Therefore, it is essential to consider the physical dexterity of older people when the author redesigns the hardware interface design. Accordingly, I would like to refer to an experiment conducted by the Research Institute of Human Engineering for Quality Life (HQL) in 1998 regarding the physical ability of older people (Human Engineering for Quality Life, 1998). The study investigated regarding the ease of handling and the ease of making mistakes when pushing buttons by using the four sizes of buttons: 7 millimeters wide (mm), 12mm, 17mm, and 20mm in width. The study’s result follow:

- As for ease of handling, the estimate of the smallest button (7mm) is low compared with other sizes buttons, which were more convenient.
- Comparing the same button size, it seems that there is an optimum space between buttons that makes it easier for older people to handle the buttons. However, even if the space between buttons is too narrow or too wide, the tester feels that the handling of 7mm and 12mm buttons was poor.
- When the space between buttons is 14mm, there is no difference in
handling between the 7mm and the 12mm buttons. On the other hand, there is a great difference regarding the percentage of users who made mistakes. To put it concretely, in the case of the 12mm button the number of users who made mistakes is higher than those who used with 7mm buttons.

- When the space between buttons is 30mm, the ease of handling is good, as the button size become larger.
- The ratio of the person who made mistakes gets higher as the space between buttons becomes narrow.

From the above result of the experimentation, there is a correlation between the button size and the space between buttons regarding the feeling of the button’s handling. Based on the result of experimentation, cellular phones can ideally be designed. On the other hand, actually both the button’s size and the space in between are willy-nilly restricted by the premise that a cellular phone is a portable device and used with only one hand. Therefore, I have to take the width of present cellular phones, ranging from 48 to 51mm, when I consider the hardware interface design. Based on the results of the aforementioned research, the following is an example of a good hardware interface design of cellular phones. Each button is 7mm wide, the space between buttons is 10.5mm, and the space of both to the edge of the cellular phone is 3mm. The research found that basically the wider the button’s spacing becomes, the more older people do not make a mistake about buttons handling. Of course, the LCD is better as it becomes bigger. In addition, some older people said that they dropped their cellular phones by mistake. Therefore, cellular phones must have a device to prevent slipping on their surface still could be dropped.
The hardware interface design greatly influences the feeling of handling and the first impression of appearance, and the software interface design greatly influences how people can easily use a cellular phone. If the hardware interface is not a good design, cellular phones are not easy to handle, and if the software interface is not a good design, cellular phones are difficult to use. In brief, cellular phones that are not useful if they lack a good interface, which makes the cellular phone easy to handle and provides all of functions that the user needs. Therefore, cellular phones should have a good interface so that everyone can easily use it; otherwise it is meaningless if cellular phones with however excellent functions are not useful. In addition, it is clear that these considerations positively impact the usability of cellular phones for older people. In other words, cellular phone usage will increase among older people if they are designed with a good interface. Of course, a good interface design means suiting everyone irrespective of age.

3-2. Function:

Currently, cellular phones have a lot of various functions. However, all of the functions are not always useful for older people because who have different needs and abilities the target market for cellular phones is younger people, therefore, even if a function is not useful for older people, cellular phones are equipped with it. Judging from the standpoint of marketing, the above situation may be valid. However, providing older people with the functions that they need is also important and would open up a new target market for cellular phones. Therefore, I would like to show functions that older people want.
3-2-1. The voice function

As for the functions of cellular phones, a primary requirement for older people is related to voice operation, for example, a voice explanation of all of the functions, a registration in the telephone book, an ability to search a telephone numbers from the telephone book, and to write e-mail by voice, or announce the condition of the total battery power remaining and the state of receiving a radio channel. Judging from their opinions, older people want to handle cellular phones easily and to get information not only visually but also by voice. Indeed, older people want to be able to handle all of the functions of cellular phones with voice commands. Currently, there are two ways that voice recognition is realized at cellular phones. One is the application of PCs’ voice recognition to cellular phones. As for the voice recognition of PCs, users can “dictate memos, reports, and other documents; enter data; fill-in forms; send e-mail by using voice recognition” (The voice recognition of PC’s). PCs are not restricted by machine power compared to cellular phones. Therefore, from the standpoint of machine power, software of PCs is easy to develop compared to cellular phones’. That is, cellular phones will have voice recognition by improving its performance. The other is development of original voice recognition for cellular phones. In the current state of affairs, although a function is restricted, there is a cellular phone that realizes voice operation is called “Xelibri 3” (Siemens Information and Communication Mobile Group). Users can handle it with only voice command. The voice recognition of “Xelibri 3” realizes by using a technology that is called “smARTspeak NG” (Advanced Recognition Technologies, Inc). This is developed for cellular phones. Certainly, “Xelibri 3” does not have many functions like present cellular phones. However, it shows a possibility of one of the future of cellular phones.

The multiple voice functions are important and useful considering the physical ability of
older people because their eyesight and hearing are beginning to weaken and their hands do not move freely anymore. Therefore, it is easier for older people to handle cellular phones and get information though a combination of voice, eyesight, and hearing. In addition, most user manuals contain between 300-500 pages, increasing in proportion to the number of functions of the model of the cellular phone. As a result, cellular phones give the impression that people have to learn many things about functions before they can use them successfully.

This is one of the reasons why some older people do not want to have cellular phones. On the other hand, if people could use all of the cellular phone’s function without reading the manual, cellular phones would be very useful devices for older people. One way to facilitate this is to provide the explanations of functions and their usage by voice. Such explanations delivered by voice would be more useful than a thick manual, especially for older people whose eyesight is weak. As a matter of fact, many older people who have cellular phones want this voice function.

3-2-2. Medical treatment by cellular phones

Almost all older people go to the hospital in order to receive treatment when they get ill or are injured. However, not all people are always able to go to a hospital. For example, an old person who lives alone and gets ill or is injured, may not be able to get himself or herself to a hospital. Second, in Japan some of the people who live on an isolated island cannot go to a hospital or clinic easily because a doctor is not permanently stationed there and many local administrations have not devised a countermeasure to deal with an emergency case on those isolated islands. Third, people cannot go to a hospital and receive sufficient treatment immediately when they meet with an accident in the mountains or a place that is located far from
Fourth, people who are not patients with a serious illness always have to wait for a long time in order to receive treatment at most hospitals or clinics, irrespective of living the city or in the country. Therefore, some people, including older people, hesitate to go to the hospital when they get a mild illness. If people can receive treatment by using cellular phones anytime and anywhere, it would be especially convenient for older people if the treatment were a simple one. Therefore, I will discuss this function in more detail. The cellular phones that have a digital camera and GPS system are a prerequisite for using this function. Of course, people must not be outside of the range of a cellular phone’s reception and transmission.

The medical treatment by cellular phones

Figure 12: The example of the medical treatment by cellular phones
① When a person calls a medical center or hospital on a cellular phone, hear she is connected to a medical center or hospital that is nearest to where the owner is calling from. The cellular phone finds the nearest medical center or hospital by GPS and get the telephone number from a Data Base (DB) that has information about the hospital or medical center.

② The operator of the medical center or hospital briefly inquires about the patient’s condition and judges which medical specialist is the most appropriate.

③ Next, the operator puts the patient through to the medical specialist and then reports the patient’s condition.

④ The doctor examines the patient through the digital camera that is equipped with the cellular phone. The present cellular phone can be used as a TV phone; therefore, this kind of examination is possible. In addition, when the doctor judges that it is necessary to send an ambulance for the patient, the medical center dispatches the ambulance to the patient’s location, which is identified by GPS.

⑤ The patient can tell his/her condition to the doctor by not only voice but also by picture or animation, which is more exact.

The function is useful for older people, especially if they live alone, because no one cares for them if they get ill or are injured. However, older people can easily receive treatment by using the function without going to hospital. In addition, the percentage of older people who live alone increases year after year in Japan (see Figure 13: The white paper about the aged 2003). Consequently, it becomes more and more important to consider older people who do not live
with their family nor do they have anyone to help them in an emergency. In addition, they are older people; therefore, they need to pay extra attention to their health. Consequently, medical treatment though cellular phones will be very useful for older people, especially those who live alone.

There is some possibility of realizing the function of the medical treatment by cellular phones. However, there is a problem to realize this function. The problem is that not everyone can talk through cellular phones because when people use this function, they generally have a problem of their health like get hurt and ill. Therefore, it is necessary to consider a function that supports the function. For example, a function is that cellular phone users can ask medical center for help only push one button without talking. Then medical center dispatches an ambulance to use’s location where is identified by GPS. In addition, many present digital cameras of cellular phones are over mega-pixel, therefore, it is not problem about the quality of the digital camera.

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<td>2010</td>
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<td>19.6%</td>
<td>16.4%</td>
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</table>

Figure 13: The percentage of family structure regarding older people who are over 65 years old
3-2-3. The guidance of changing trains and payment of the train fare by cellular phones

In Japan, almost all of the older people travel mainly by trains and buses, irrespective of living in the city or the country. In the country, there are few routes for trains and buses. Therefore, older people seldom make a mistake changing buses or trains. On the other hand, there are a lot of routes for trains and buses in the city, and older people sometimes make a mistake. Of course, they can ask bus drivers whether the bus will go to his or her destination or not; therefore, the mistake is as drastic with buses as it is trains. Older people cannot ask the train conductor, and the train route is quite complicated when transferring in big city like Tokyo. In addition, a lot of people use the train, so a station in a big city is generally big and crowded. Therefore, it is difficult to find any station staff.

To use Tokyo station as an example, the gross area of the train station is 180,000 meters square (18ha), the main entrance of the station has three entries, and the number of ticket barriers is 15, and the number of platforms including ground-level and underground is 28. About 4,000 trains arrive and departure each day, 17 routes link up at the Tokyo station, and the number of riders at the Tokyo station is 1,750,000 a day. Stations that are located in other big cities are similar in a situation. Therefore, older people want cellular phones that can guide them to their goal, help them to change trains and becomes instead of tickets. The older people want the following functions:

- Guidance to changing trains and for payment of the train fare by cellular phones using GPS and wireless networks.

- When an older passenger passes a ticket-checking machine, he or she brings the cellular phone close to a reader on the ticket-checking machine, which then reads a two-dimensional bar code on the display as a digital
ticket (as shown in Figure 14).

- The reader that is installed on a ticket-checking machine reads information that is needed to determine the train fare from a two-dimensional bar code.

- The cellular phone reads information about a departure station in order to start guidance, which begins after the person tells his or her destination to the cellular phone. If people do not know the station name's but know the name of a landmark that is near their goal, DB can search the station by the name of the landmark.

- Guidance for changing trains is carried out by using GPS. Reaching a transfer station, the cellular phone informs the owner. The way to identify the transfer station and the owner's present location used GPS, which exchanges data with Data Base (DB) that has information regarding the station and route.

- When older people exit through a ticket-checking machine, they bring cellular phones close to the reader again. Then the reader determines information about the departure station and sends information about the departure and arrival station to the Fare DB in order to calculate the train fare.

- The train fare will be charged by the cellular phone company at the rate of a telephone call in additional to the fare. Therefore, the older person who uses this function does not need to pay the fare at the station.
Figure 14: The two-dimensional bar code

Figure 15: Guidance for changing trains and payment of the train fare by cellular phones
1. The cellular phone sends information about the departure station and route to be used.

2. The cellular phone sends information about the destination station.

3. The Station & Route DB searches for a station that fits the requirements and a suitable route.

4. The Station & Route DB sends data about the destination station and the route to be used.

5. The Fare DB calculates the train fare to the destination station and sends the fare to the Station & Route DB.

6. The Station & Route DB sends information about the train fare, the necessary time, and any change of trains to the cellular phone.

7. The cellular phone gives and takes information about the place where the owner is now in order to determine the location of both the transfer station and the owner.

8. The cellular phone starts guiding the user to the destination. Then the cellular phone gets the information about the user’s present location from GPS all the time until the owner arrives at the destination.

9. When the owner passes a ticket-checking machine at the arrival station, the cellular phone sends information about the train fare and finishes giving directions. The Fare DB checks the train fare whether it is right or not. Then if there is no mistake, the Fare DB sends information about the train fare to the cellular phone company to charge the fare.

It is no longer necessary for older people who have cellular phones to wait in line to buy
tickets or to pay an additional fare to riding past a station. Payment is made by using the cellular phone’s function. Moreover, the most important function that to guide the user to the destination and to tell the user where to change trains. Older people can avoid mistakes in transfers by using cellular phones that have this function. Consequently, the cellular phones that have the function will become very useful and familiar device for older people.

It is necessary to cooperate with each railroad corporations and cellular phone carriers in order to realize the function of Guidance for changing trains and payment of the train fare by cellular phones. However, it is not easy to realize the function because railroad corporations will hesitate to cooperate with each other. In Japan, there are many private railroad corporations, and it is a tendency that a station that many people use is linked up with many private railroads and becomes complicated structure. That is, the station that older people are wanted to guide is that railroad corporations always compete each other. For example, when people go to Kyoto from Osaka, there are five private railroads, and the train fare and the necessary time are different each other. It is naturally that they hesitate to be given passengers better information about a route, because some passenger will change to other private railroads. Railroad corporations keenly have competed with each other before, therefore, it is difficult to cooperate with each other. That is, it is difficult to realize the function of Guidance for changing trains and payment of the train fare by cellular phones.

Up to this point, I have shown a concept of the hardware interface, the prototype software interface, and three functions of cellular phones that will be useful for older people. As for both of the interfaces, the most important concept is how to make them easy to understand and to simplify handling of cellular phones for older people. As for the functions, the most
important concept is how to increase the convenience and usefulness for older people. Based on the results of the usability test, if the hardware and software interface are easier to use than the present cellular phone, some older people who do not have cellular phones may think about getting one. At the same time, all of the functions that are desired by older people and introduced in this chapter are connected to their everyday lives. In other words, older people want cellular phones to become a device that is not only functional as a telephone but also a useful multi-functional device in daily life. The above facts suggest that older people think that they may purchase cellular phones if they were easy to handle, useful, and convenient. In concluding, I should note that if there is a cellular phone design that considers older people, there is a good chance that cellular phone use will spread among older people.

4. Conclusion:

In this thesis, in order to lead to an opportunity for a solution regarding the digital divide of cellular phones between younger and older people, at first I have presented how far the present cellular phones are useful to older people. In addition, I clarified what the problems are for older people, based on the results of the survey. Furthermore, I showed the concept of hardware interface, the prototype software interface, and functions that are easy to handle and convenient for older people. As for the prototype software interface, ten older people participated in a usability test. The result of the usability test shows that it is not sufficient to solve the digital divide regarding cellular phones completely even if they were to be designed for only older people. Certainly, four out of ten testers said that they might get a cellular phone. Forty percent is a high number compared with the current distribution of cellular phones among older people. However, three out of ten testers might not have a cellular phone. The prototype is for older
people’s use; therefore, three testers feel that they are being distinguished from young people. From this fact, it is concluded that the most important factor about the design of cellular phones is that not to design for specific target people but everyone must be able to handle it easily.

Of course, the word “everyone” includes older people who are blind, cannot move their hand freely, and cannot talk. For example, even if people who cannot move their hand freely or cannot talk, they can use cellular phones whose interface is used the eye-tracking interface without using their hands and voice. The eye-tracking interface is that people select functions from a movement of person’s eyes. That is, people can use cellular phones only move their eyes.

Other example, even if people who are blind, they can use cellular phones whose interface is voice recognition and can read a movement of lip without seeing the display. Although voice recognition interface is useful, people need to produce a sound. Inevitably, a place where people can use voice recognition interface is restricted. Therefore, people can use cellular phones in order to combine interfaces that are voice recognition and reading a movement of lip. People do not need to produce a sound by using the interface that read a movement of lip because cellular phones judge from a movement of lip which functions are chosen by users. In other words, even if older people have a physically handicapped, they can use cellular phones without feeling be distinguished by installing these interfaces as standard in cellular phones.

Therefore, there is need for a cellular phone whose design is based on the concept of not “Design for Target” but “Design for All” or “Universal Design”. These concepts are that cellular phones must be designed so that everyone can easily handle them. That is, these concepts mean suiting everyone irrespective of not only age but also physical ability. When all of the cellular phones are so designed, the digital divide will be solved. Consequently, cellular phones will become one of the most useful devices for also older people.
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&key2=3209858701&coll=GUIDE&dl=GUIDE&CFID=13632981&CFTOKEN=N=74675364

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Figure of list:

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