STUDY FOR CORRELATION BETWEEN PERFORMANCE OF MOBILE PHONE TYPE HUMAN INTERFACE AND CAPACITY OF SHORT TERM MEMORY

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Abstract: Hospital Information System (HIS) has spread in internationally. Its human interface is keyboard and mouse in generally. However, The keyboard is not user-friendly in non-alphabetical area. In the area, some of users cannot input by touch typing. On the other hand, mobile phone also has spread. Most of users are able to write and send e-mail by one's mother tongue, since its human interface is user-friendly. It is considered that the novice class HIS users are able to input patient data exactly, if the mobile phone type human interface is realized as an input device. In this paper, usability of mobile phone type human interface is evaluated in comparison with capacity of short term memory.

Introduction

Hospital Information System (HIS) has spread. Most of HIS terminals have keyboard and mouse as principal input device. However, PC type keyboard is not friendly to users in non-alphabetical area. In the area, some of users cannot touch typing, since one's mother tongue is used in the area. On the other hand, mobile phone has spread in internationally. Most of users are able to write and send e-mail by one's mother tongue, since its human interface is user-friendly. The mobile phone has approx. 20 keys in generally. Especially, approx. 10 keys are enough to input character. If the mobile phone type human interface is provided in medical environment to input patient data and so on, medical accidents by mistake of input may be reduced. In this paper, easy operation of mobile phone is analyzed. The mobile phone has small number of keys. On the other hand, capacity of human short term memory (STM) is 7 ± 2 chunk. The total number of keys in mobile phone is small and near by the capacity of STM. It is considered that the easy operation of mobile phone due to correlate the capacity of STM. In this paper, new type human interface similar to mobile phone is also proposed. It is small in size. Its operation is easy like as mobile phone. Its applicability to medical environment is discussed.

Human Interface of HIS

HIS are used in many large sized hospitals in internationally. The system is convenience for management of patient data. Most of its terminals are located in a consultation room for examination in hospital. Supposed its users are medical doctors, nurses and so on. A human interface of the system is same to PC. Most of operation in the system can be carried out by pointing device like a mouse, since the systems have graphical user interface (GUI). Operation of GUI is easy in generally. However, input of characters is also important. Keyboard is also indispensable device in the operation like as input patient name, name of disease, diagnosis, details of treatment and so on.

Figure 1: An example of HIS terminal

In alphabetical area like as Europe and US, PC type keyboard is user-friendly device to some users. But, in non-alphabetical area like as Asia, operation by keyboard is not user-friendly, since most of people cannot touch typing. The people do not use foreign language in dairy life. In the area, human error due to use the PC type keyboard is predicted. On the other hand, ordinary keyboard of HIS is large in size. Especially, in ER or some medical environments, its size is not suitable. Nurses are able to describe the treatment in sick room if the human interface will be small in size. Realization of convenient device, which is friendly to all operators and small in size, is expected for HIS.

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Human Interface of Mobile phone

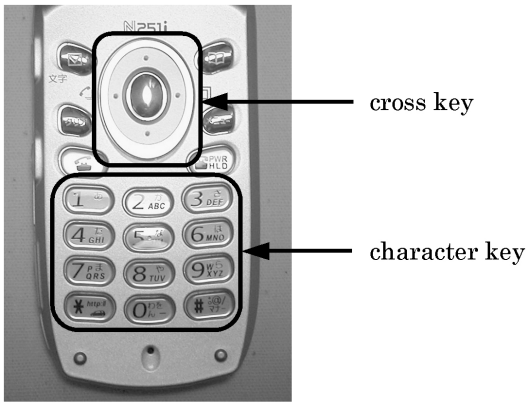


Figure 2: Human Interface of Japanese Mobile Phone

Human interface of mobile phone is designed simply. The interface is constructed by only approx. 20 keys. Its operation is easy for all people. Usability of the interface is not depended on distinction of sex, age, economical level and educational level. In the interface, some characters are located on each key. For example, "A", "B" and "C" are located on "2" key in internationally. In non-alphabetical area, principal characters of one's mother tongue are also located on the key with number and alphabets. Human interface of Japanese mobile phone is shown in Figure 2. In Japan, most principal character "あ" is located on "1" key. Another principal characters are also located on each key. Optional functions are provided by operation of cross key and small numbers of function keys. Most of people are able to input the characters by mother tongue using the key assignment.

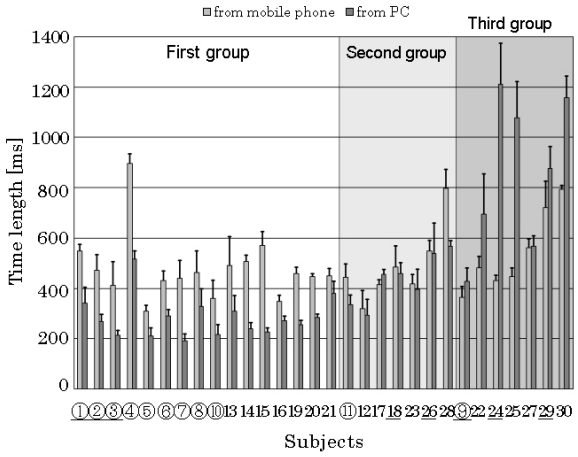
Human Memory System and Usability of Human Inter face

Human STM is used in operation of some equipment. For example, an operator is thinking next data unconsciously in data input. In this time, supposed object is device like as a key for input. In the PC operation, the operator is supposing the suitable key from over 100 keys. On the other hand, in the case of mobile phone, suitable key is supposed from approx. 10 keys. Especially, capacity of human STM is small. It is 7 ± 2 chunk. It is also considered that small numbers of operating objects accommodate the human memory characteristic. However, it is not necessary for expert operators with touch typing.

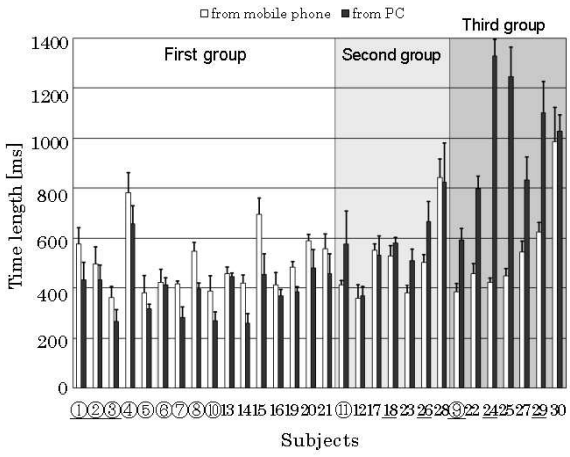
Performance of Mobile Phone Type Human Interface

Performance of the human interface of the mobile phone is evaluated[1, 2]. In the experiment, subjects input two short Japanese sentences to PC and Mobile phone. The short sentences are constructed 10 and 100 Japanese characters. In the case of PC, ordinary over 100 key keyboard is used in the experiment. Time length for input each sentence is measured as an index of performance in each interface. Time length is measured 5 times in each type sentence and each human interface. After the experiment, maximum data and minimum data are deleted in each data group. Average of three remained data is time length in each data group. Total numbers of the subjects are 30. All subjects are healthy male and female students.

Experimental results are shown in Figure 3. In the figure, result for 10 characters experiment is given in (a). Result for 100 characters experiment is also given in (b). In each result, subjects are separated three groups. First group (left side) is expert for PC operation. Third group (right side) is novice class user for PC operation. Second group is intermediate group. In each figure, horizontal axis shows subject number. Vertical axis shows time length in one-key operation. There are two types bar in each subject in the figures. Left side bar means one-key operation time length for mobile phone.



(a). For 10 Characters Sentence



(a). For 100 Characters Sentence

Figure 3: Performance of mobile phone type human interface

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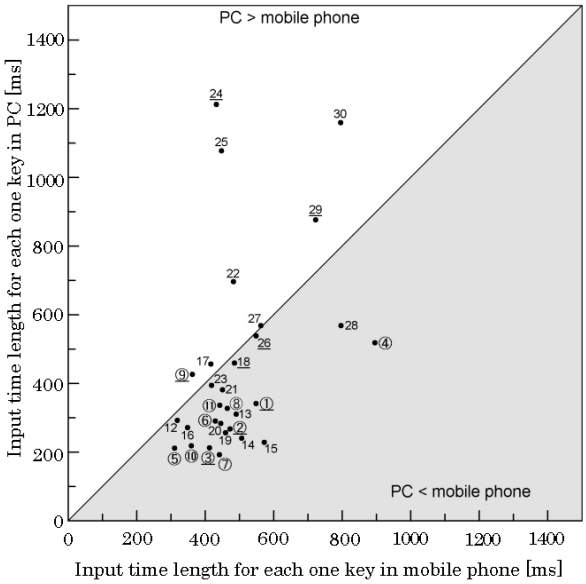
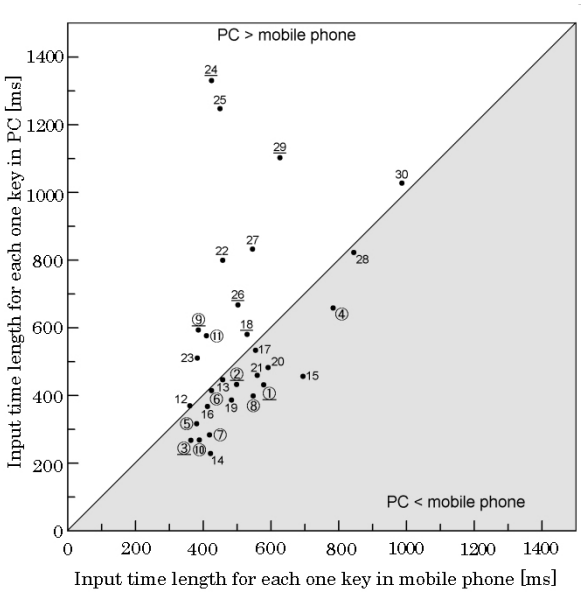


(a). For 10 Characters Sentence



(a). For 100 Characters Sentence

Figure 4: Distribution chart for comparison between performance of mobile phone type human interface and PC keyboard

Right side bar means one-key operation time length for PC.

In the first group subjects, difference between both human interfaces is small. However, In the third group subjects, the difference is large. Especially, in this group subjects, time length for PC operation is so large. But, in the case, the time length for mobile phone operation is small. It is considered that the mobile phone type human interface is effective for novice class PC user. Time length for mobile phone shows small difference between first group subjects and third group subjects. It is considered that the mobile phone type human interface is also useful for expert PC users.

Distribution chart of the same data are shown in Figure 4. In the figure, result for 10 characters experiment is given in (a). Result for 100 characters experiment is also given in (b). In each figure, horizontal axis shows time length in one-key operation for mobile phone type human interface. Vertical axis shows time length in one-key operation for PC keyboard. In each figure, the subjects who are located upon an oblique line show shorter time length in mobile phone operation. They are novice class PC user. The figure also shows effect of mobile phone type human interface for novice class PC user. The interface is also effective to expert class PC user.

Correlation between Performance of Mobile Phone Type Human Interface and Human Short Term Memory

1. Method

In this study, correlation between performance of mobile phone type human interface and human short term memory (STM) is evaluated. In this experiment, the STM and character input time length are measured.

In the first step of the experiment, STM of each subject is measured. In the measurement of STM, subjects inspect a picture on PC display in 10 sec. There are 20 items in the picture. Then the picture is closed. Subject answer the items in the picture in one minute from end of inspection. STM is measured 5 times. After the experiment, maximum data and minimum data are deleted. Average of three remained data is STM in the subject. One of the pictures is shown in Figure 5. This picture is constructed by 20 items, which are related to animals. Location of each

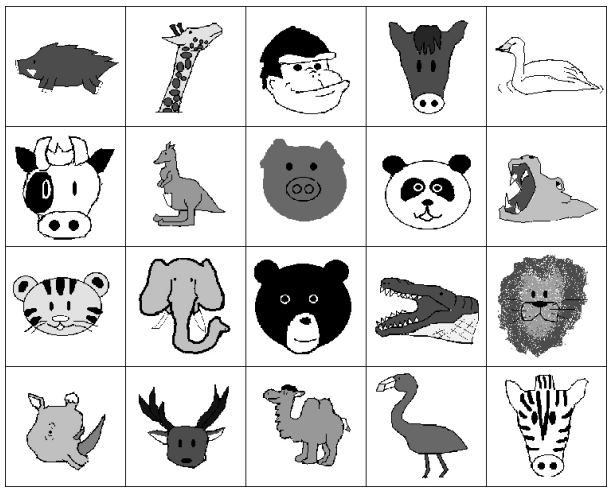


Figure 5: One of the pictures for experiment

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items in the picture are changed at random automatically. 20 types of the pictures are prepared. Theme of the pictures is “animals”, “foods”, “vehicles”, “tools” and so on.

In the second step, performance of character input by mobile phone type human interface is measured. In the experiment, subject input 10 characters short sentences to Mobile phone. The short sentences are constructed Japanese characters. The time length is measured as an index of performance of mobile phone type human interface. Time length is measured 5 times. After the experiment maximum data and minimum data is deleted. Average of three remained data is input time length in the subject. Total numbers of subjects are 33. All subjects are healthy male and female students.

2. Results

2.1 STM

Experimental result for STM is shown in Figure 6. In the figure, horizontal axis is sorted subjects. The subjects numbers are sorted by capacity of STM. Vertical axis is capacity of STM in each subject. 27 subjects are located in 7±2 in STM. Subject #1 has larger STM than another subjects. Subject #33 also has smaller STM than another subjects.

2.2 Input Time Length

Experimental result for input time length is shown in Figure 7. In the figure, horizontal axis is sorted subject. Its sequence is same to subjects in figure 6. Vertical axis is time length in one-key operation. In the figure, opposite tendency is displayed against figure 6. However, the tendency is not smooth like as figure 6. But, subject #33 shows extremely long input time length.

2.3 Discussion

The sequence of sorted subject is same in Figure 6 and Figure 7. However, both figures display opposite tendency. Both characteristics are given in Figure 8. In the figure, horizontal axis is STM. Vertical axis is input time length. For example, the shorter time length means higher performance. In the Result, the correlation between the capacity of STM and the time length of the character input is analyzed. For example, the subject who has small capacity (approx. 4-7) of

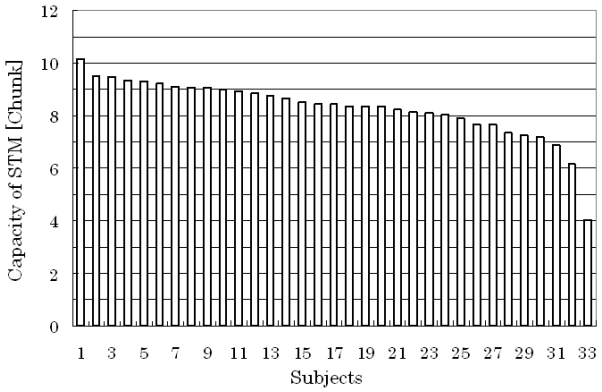

Figure 6: Capacity of STM in each subject

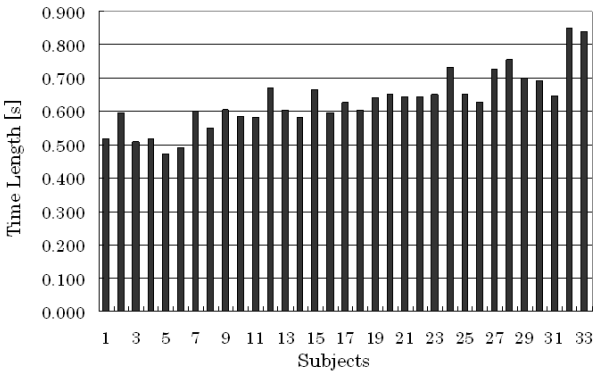

Figure 7: Input time length in each subject

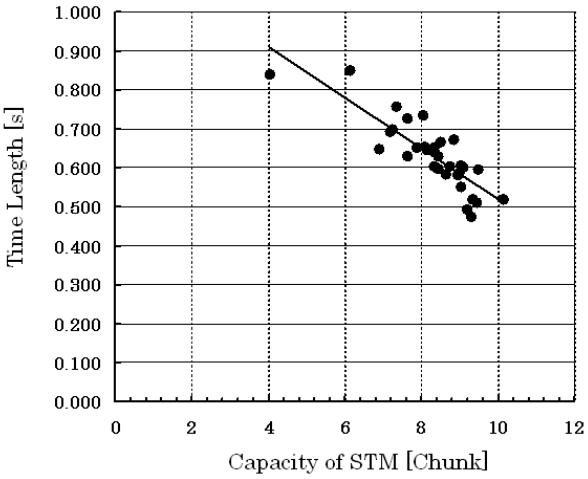

Figure 8: Relation between capacity of STM and input time length

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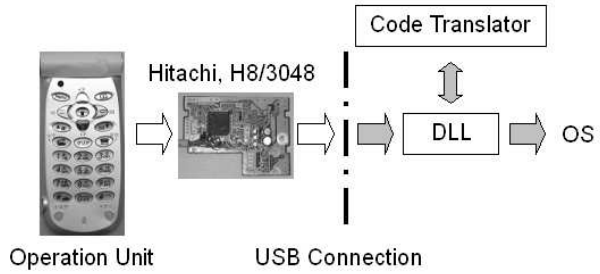
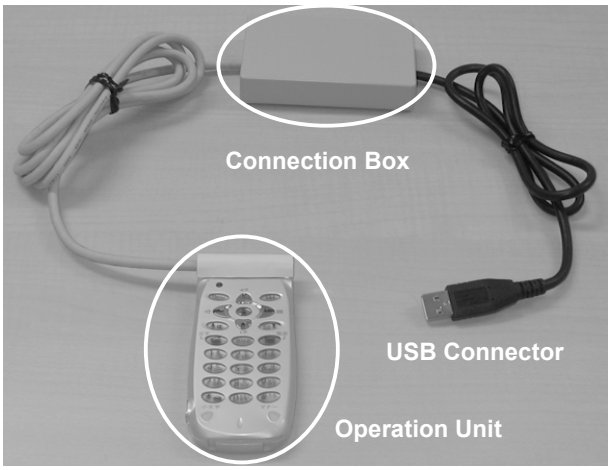
STM needs longer time to input the character. On the other hand, the subject who has large capacity (approx. 9-10) of STM is enough shorter time to input the character. A coefficient of correlation is calculated as -0.87 in 33 subjects

Trial Production

Mobile phone type human interface is developed as a trial production[3]. The proposed interface is shown



(a). Data flow in proposed interface



(b). Construction of proposed interface

(c). Proposed interface in use

Figure 9: Mobile Phone Type Human Interface

in Figure 9. It is constructed by operation unit and connection box. Shape of the operation unit is similar to mobile phone. The interface can be connected to PC by USB interface. In the operation unit, several small switches are located under the keys. The operator is able to input some characters like as a mobile phone. Key assignment of the operation unit of optional functions can be changed to similar to one's private use mobile phone. It is possible by adjustment of control program. Input data are translated to suitable type code that is similar keyboard code by Hitachi H8/3048 small sized RISC computer. The small sized computer is put into the connection box. By using the proposed interface, user identification is completed when the USB connector plug in, since the ID information is described in ROM in the operation unit. The system like as HIS, can detect the operator name using the interface. The interface designed for windows plug and play system. Weight of the new interface is approx. 80 g. It is handy enough to use in medical environment. If the USB connector is prepared near the terminal, easy operation like as mobile phone is provided to all medical staff. It is easy to realize the system, since most of present HIS terminal have several USB connectors.

Conclusions

It is obvious that the mobile phone type human interface is useful for novice class PC users from the experimental result. It is also obvious that the information input performance of the interface depends on small of STM in operator. STM in most of medical staff are trained, since the medical environment is busy. So, It is considered that the mobile phone type human interface is suitable for medical environment. If mobile phone type human interface for medical environment will be realized, efficiency of information input is improved for many staffs. It is also considered that mistake of input will be reduced. It is effective to keep safety of patient.

Code translation for USB interface is easy. It will be realized by small and low-priced processor. All circuit for code translation is put into a body of the mobile phone type human interface. Its cost can be estimated approx. 15 – 20 US $ or EUR.

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