An Improvement Design of a Four-quadrant and Voice Interaction User Interface of a Smartphone for the Visually Impaired User

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Abstract—As a result of the previous design of a user interface of a smartphone for the visually impaired (VI) user, in this paper, we propose an improved design of the VI user interface which is based on the operation frequency of when a specific user uses a particular smartphone. As a result of the accumulation of the operation frequency of the smartphone function, this design will move this function with the highest frequency of operation to the first position. As a result, the next time a user uses this function with a less time.

Keywords—smartphone; visually impaired user; user interface

I. INTRODUCTION

Generally, as a smartphone has too many buttons on one screen, VI users experience some difficulty when choosing the function they want to use. So, previously we designed a four-quadrant and voice interaction user interface for a visually impaired (VI) user [1]-[2]. The previous design, which had four options on each screen, made it easier for a VI user to use the smartphone. In addition, although we added an emergency function to our design so a VI user could make an emergency call even when experiencing an emergency, such as when falling down, when being wounded, or when lost, it still took time for VI users to find the function they needed to use. In this paper, we propose our improved user interface. After a phone number is called, this design counts the number of attempted calls to each number. This design sets up the higher frequency called numbers in the higher layers in order to make it possible for a VI user to use fewer steps to find the number or function.

II. SINGLE VIEW

To make the smartphone convenient for a VI user, this design uses a four-selection interface design, which consists of four big buttons on the four-quadrant of the smartphone screen. Moreover, the button arrangement order will change according to the use frequency of each frequency.

III. APPROACH

A. Top-down design with priority sequence

This design uses a top-down design. A user can select the function he wants to use and complete his desired procedure step by step. In addition, when a user uses a specific function more often than other functions, this design will move the function to the top of its classification. If a user wants to use any specific function which is used often, it will take less time and step to initiate a specific function. Figure 1 shows our top-down design.

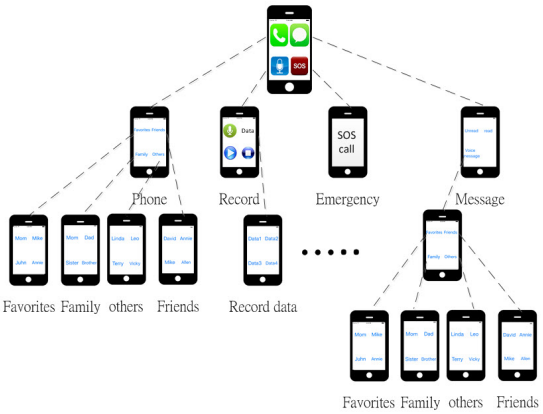

Fig. 1. Top-down design.

Figure 2 (a) shows the smartphone function for a phone number which was called more times, with a higher priority sequence. Figure 2 (b) shows the number of times each phone number has been called.

(a)

Name	Call times
Mom	20
Mike Hsu	18
John Wong	16
Annie Chou	10
David Chen	9
Mary Lee	4
Cindy Lin	3

(b)

Fig. 2. (a) Phone number priority sequence. (b) Phone call data.

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B. Direction Detection

Because VI users don't know the correct direction to place a smartphone at a particular location, when they place the smartphone in the wrong direction, they can't use the function correctly. This design uses a tri-axis accelerometer in a smartphone to detect the direction of the smartphone. If a user places the smartphone in the wrong direction, the smartphone both will show and will broadcast an audio wrong direction message. If the smartphone is turned upside down, this design will change the button's position so the smartphone can be operated by a VI user. Figure 3 shows the direction detection flowchart and Figure 4 shows the smartphone acceleration value when the direction is inverted.

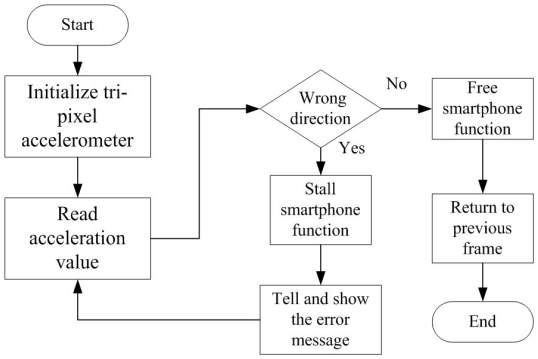

Fig. 3. Direction detection flowchart.

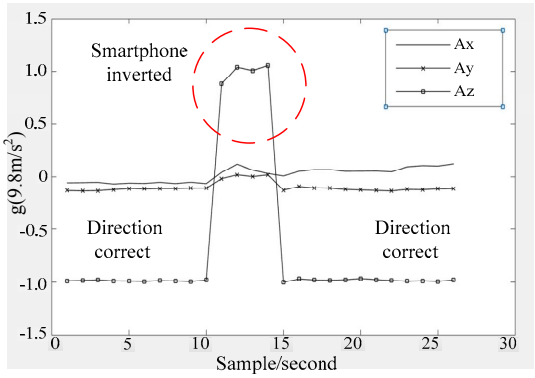

Fig. 4. Acceleration value when the smartphone inverted.

C. Main function

In this design, there are four main functions: Phone, Message, Record, and Emergency. All buttons use voice feedback, so VI users can understand what function each button is when they push a particular button. First, the smartphone function uses are grouped by telephone number. The user can easily find the number they want to call. In addition, this design uses a priority sequence. A number, which is called more times than any other numbers, will be put in the front of the list of all numbers that have been called. So, the next time a user wants to call the number they usually call, it will take less time for him to find it.

Second, the message function offers a selective reply option. When VI users receive a message, instead of typing words, they can use some simple selective words to reply, such as "OK", "Yes", "No, Thanks", "Understand". Moreover, this design also offers a voice message option. A VI user can send a voice message instead of typing words.

Third, When VI users have something important to remember, they can't always use a pen and paper to write down things. The record function makes it easier for VI users to record things.

Finally, the emergency function is the most important function. When VI users encounter an emergency situation or need some help, such as if they are wounded or are lost, pressing the emergency button will allows them both to contact their relatives directly and to send a message simultaneously which contain user's current location. Moreover, this design offers another way to use the emergency function by shaking the smartphone up and down 10 times within a period of 10 seconds. In some emergency situations it may not be convenient for users to press the emergency button. This smartphone emergency shaking will make it easier for users to call for help.

IV. Experimental Results and Comparison

This design's main purpose is to make it possible for VI users to use less time to find the function they want to use. Users don't always use same function all the time. They may usually call one friend during one period of time and call another friend at another period of time. So, this design counts each time a user uses a specific function, and uses the last few counts to compute a priority sequence. Table 1 shows the comparison of the average use time of each function when a function is included in the priority sequence.

TABLE I
A Comparison of Use with Priority and Without Priority [2]

	No priority sequence	Average step	Priority sequence	Average step
Phone	27.6 s	24	13.4 s	12
Message	40.5 s	36	25.3 s	22
Record	11.8 s	5	11.3 s	5
Emergency button	6.3 s	1	6 s	1
Emergency function by shaking the smartphone	3.4 s	1	3 s	1

V. Conclusion

In Table I, only the phone and message have obviously improved as the operation frequency of the other functions did not need to be connected. This design, which can effectively reduce the time when a VI user wants to find phone number of the party he wishes to call, therefore, helps VI users use a smartphone more easily.

References

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