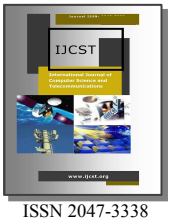

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Eye Based Human Computer Interaction using One Button and Single Line Moving Keyboard

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***Abstract*— Due to enormous evolution in computer technology in the last decades, dealing with the computer in various fields became a normal activity for nearly everybody. Many researches arise to make interaction between humans and computers easier, more axiomatic and more reliable. The interaction with computers is not limited to keyboard and printers anymore. Eye gaze is one of the most important devices for computer interaction nowadays because of its ease of use, interaction speed-up and the possibility of use by normal and handicap persons. In this paper, we develop new interface for improving the speed of Eye Based key-in of phoning and internet browsing in particular, the proposed interface different from the old one in using one button and single line moving keyboard which would speed-up the process.**

***Index Terms*— Eye-based HCI, E-Learning, Interface and Keyboard**

I. INTRODUCTION

THE eye-based Human Computer Interaction (HCI) has been extensively used to help not only the handicap users but also the normal users [1], [2], for the handicap users they use the eye-based HCI to help them in the daily life such as input text to computer [3], communication aids [4], controlling wheelchair [5], [6] having meal on table using robot arm [7] etc.

The researches that were conducted to discuss the eye-based HCI are categorized into vision based [8], [9] and bio-potential based [10], [11], in the vision based method the user sight is captured by the camera and then estimated, the main issue is how the system could deal with the environment changes [12], while in the bio-potential based method the user behavior is estimated by measuring user's bio-potential [13].

One of the most important researches that propose eye-based HCI that allowing phoning, reading E-Book, E-Leaning and E-Comic, and TV information extraction [14], the objective of [14] is how to replace the use of touch screen to input a command that always rely on hand and is limited on normal users to be used by the handicap users using the eye sight. This method also improves the response time of typing since the sight is faster than hand control.

This method designs user interface that consists of main menu and four sub menus that connect with the main menu in both directions, as shown in Fig. 1.

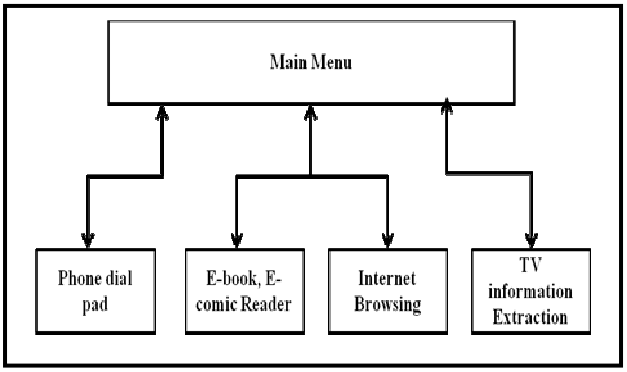

Fig. 1: User interface

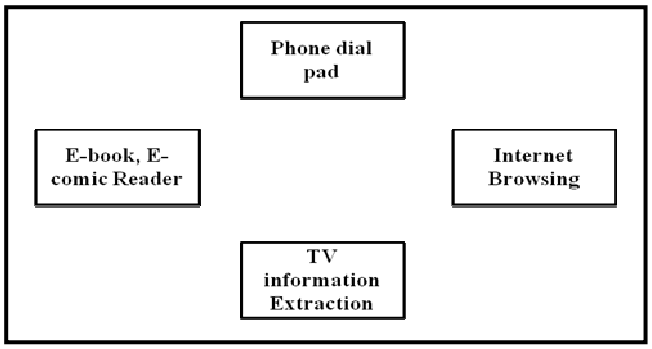

Fig. 2: Main menu

Each sub-menu in the main menu provides different functionality that could be chosen by the user, as shown in Fig. 2.

If the user selected the phone dial pad, an interface such as in Fig. 3 will appear, it consists of a single line moving keyboard and four buttons. (LEFT and RIGHT) buttons are used to move the moving keyboard while the (CALL) button is used to call the selected phone number and finally the (BACK) button is used to return to the main menu.

The single line moving keyboard consists of numbers and symbols that are used in the usual phone dial pad, user have to locate the candidate of selecting number to the center using the navigator buttons (LEFT and RIGHT). The located number in the center is shown in bigger size to help the user distinguishing it easily.

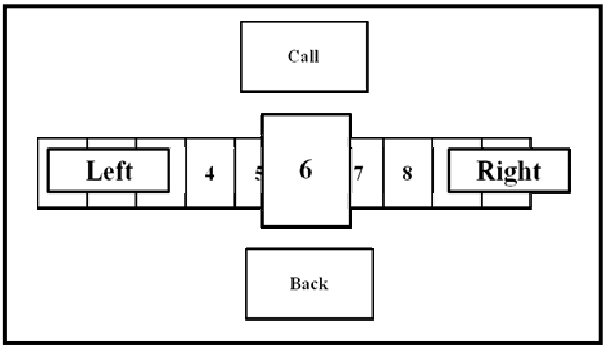

Fig. 3: Phone dial pad sub menu

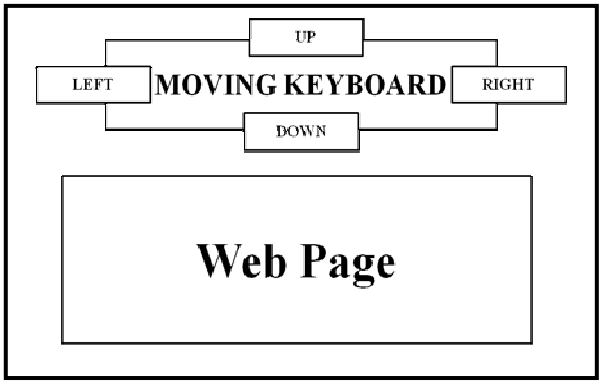

Fig. 4: Internet browsing sub menu

The other sub menu that we are interested in is for internet browsing, the user can use this sub menu to browse the internet by utilizing his eyes only. This interface consists of multiple lines moving keyboard that the user can use to type the needed URL using it by four key navigators, (UP) to move the keyboard upward, (DOWN) to move the keyboard downward, (LEFT) to move the keyboard leftward and (RIGHT) to move the keyboard rightward. After the user input the needed URL address the web page will be shown in bottom part of the interface. As shown in Fig. 4.

II. PROPOSED METHOD

The handicap student who has difficulty to use hands will face problems when using E-Learning system, for this many researches tried to prepare such system for handicap students. At the same we cannot ignore the speed factor in the process.

In this paper we develop new interface for improving the speed of Eye Based key-in of phoning and internet browsing in particular, the proposed interface different from the old one in using one button and single line moving keyboard which would speed-up the process.

A. Proposed user interface

1) The enhanced phone dial pad sub menu

Fig. 5 shows the Phone dial pad sub menu, it contains three buttons with single button moving keyboard, using this interface the user can dial the needed phone number by looking to the single button keyboard that contains the

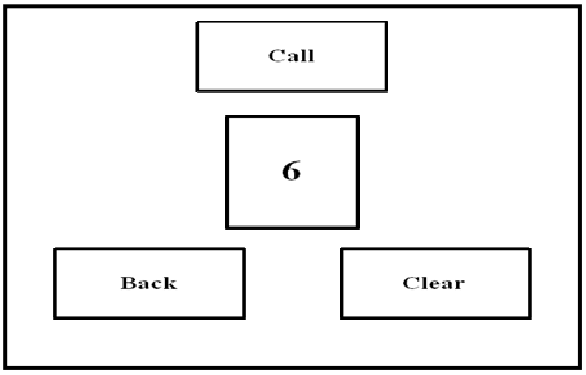

Fig. 5: The proposed Phone dial pad sub menu

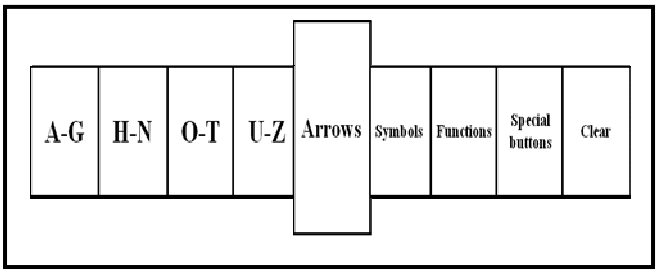

Fig. 6: The enhanced single line keyboard

numbers and symbols (0, 1, 2, 3, 4, 5, 6, 7, 8, 9,*, #) and start blinking until the needed number arise then wait for a second (this way the number is dialed) and then start again to choose the next number. The other three buttons are used to delete the wrong number (Clear), call the dialed number (Call) and go back to the main menu (Back).

The main idea is that choosing the needed phone number by blinking single button is much faster than choosing the phone number using the single line moving keyboard that depends on moving the specified number to the centre first and then blink to enter the number especially as the number of the keys (both the numbers and the symbols) in the phone dial pad does not exceed twelve keys.

III. THE ENHANCED INTERNET BROWSING SUB MENU

What we think about in this interface is to classify the multiple lines keyboard into nine buttons lined in single line keyboard. The enhanced single line keyboard is shown in Fig. 6.

As we can see that the new single line keyboard contains nine buttons, each button contains a combination of characters as the following:

- Button (A-G) contains characters a, b, c, d, e, f and g, the same for buttons (H-N, O-T, and U-Z).
- Arrows button, contains the keyboard arrows (←, ↑, →, ↓).
- Symbols button, contains the keyboard symbols (!, @, #,$, %, ^, &, *, (,), -, _, +, =, /, \, [,], {, }, <, >, ?).
- Functions button, contains keyboard functions (F1 to F12).
- Special buttons button, contains the keyboard special buttons (Tab, CapsLk, Shift, Ctrl, Alt, Space, Enter).

- Clear button, contains the keyboard clear buttons (Delete and Back space).

The proposed sub menu for internet browsing is shown in Fig. 7.

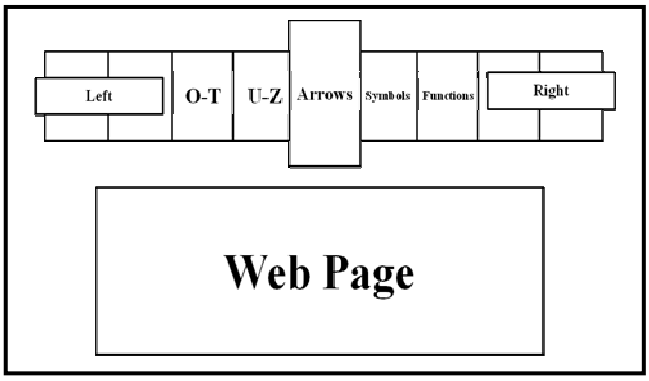

Fig. 7: The proposed sub menu for internet browsing

User can use the internet browsing interface to browse the internet using his eye only; first the user has to enter the URL address via the moving single line keyboard using two buttons, Left button to move the keyboard leftward and Right button to move the keyboard rightward.

The user has to locate the needed button to the center first (when the needed button located to the center, it will grow up to the user) then the user will start blinking to get the needed character. After the user entered the needed URL, the web page will be shown in bottom part of the interface.

IV. IMPLEMENTATION

We proposed Move-Blink algorithm (MB) which presents the whole process of the existing interfaces and the proposed ones, and then we developed the MB algorithm under C++ language of visual studio 2005.

Fig. 8 represent MB algorithm for the existing phone dial pad. We can abbreviate the process steps as the following:

1- Start.
2- Check if the needed button locate in the center.
3- Check if the needed button locate to the left.
4- Check if the needed number is finished.
5- If 2 then Blink and go to 4
a. If 4 then End else go to 2.
Else go to 3.
6- If 3 then Move one button to the left and go to 2.
Else Move one button to the right and go to 2.

While the MB algorithm can be implemented for the proposed phone dial pad sub menu as shown in Fig. 9.

1- Start.
2- Check if this is the needed button.
3- Check if the needed number is finished.
4- If 2 then go to 3
a. If 3 then End else go to 2.
Else Blink and go to 2.

The same way, the MB algorithm can be implemented over the existing internet browsing sub menu, as shown in Fig. 10.

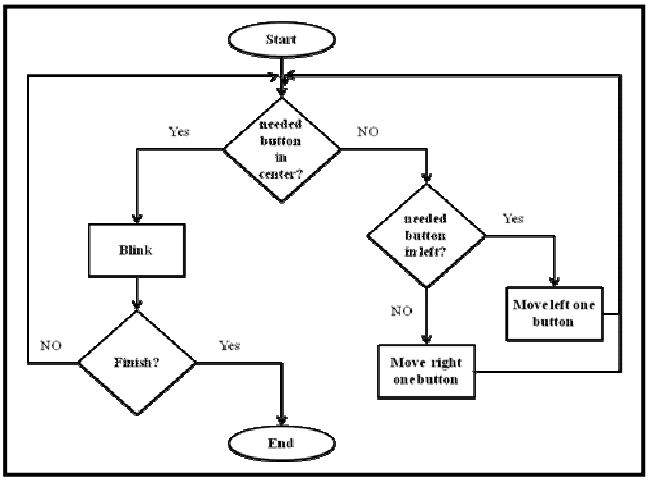

Fig. 8: MB Algorithm for the existing phone dial pad

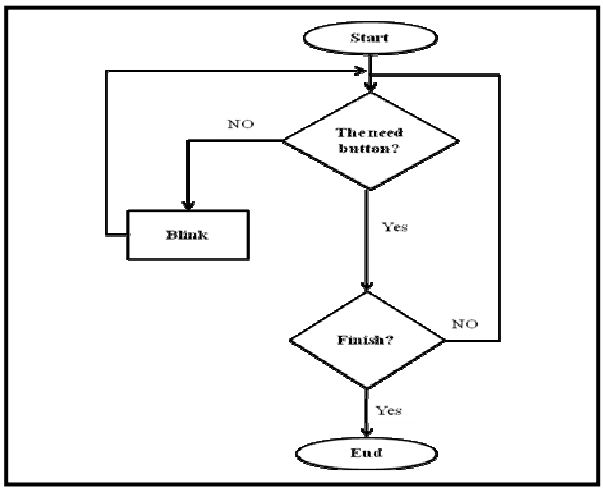

Fig. 9: MB Algorithm for the proposed phone dial pad

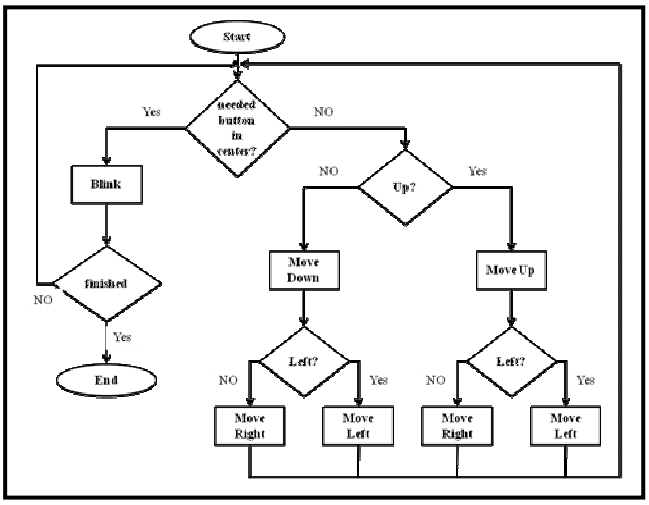

Fig. 10: MB Algorithm for the existing internet browsing sub menu

1- Start.
2- Check if the needed button locate in the center.
3- Check if the needed button locate up.
4- Check if the needed button locate to the left.
5- Check if the needed number is finished.
6- If 2 then Blink and go to 5.
a. If 5 then End else go to 2.

Else go to 3

b. If 3 then Move up and go to 4 else Move Down and go to 4.

7- If 4 then Move left and go to 2
Else Move right and go to 2.

And easily we can apply the MB algorithm over the proposed internet browsing sub menu as shown in Fig. 11.

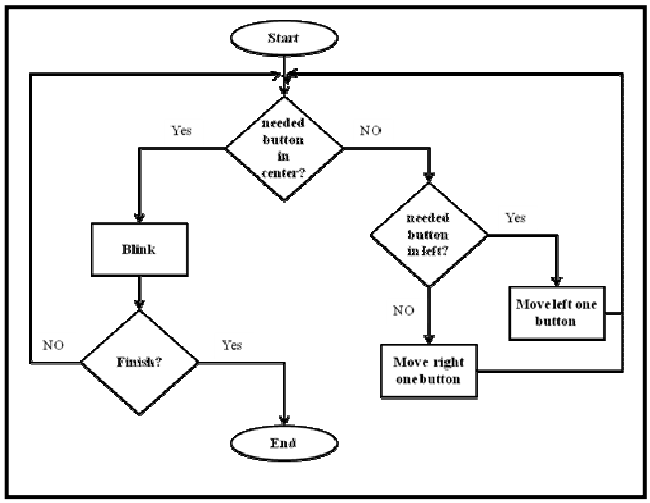

Fig. 11: MB Algorithm for the proposed internet browsing sub menu

We can note that the MB algorithm for the proposed internet browsing sub menu is the same as the existing phone dial pad sub menu.

V. EXPERIMENTAL RESULTS

To measure the effectiveness of the proposed method, we calculated the complexity of the existing sub menus as well as for the proposed ones and then compared the complexity in terms of accuracy and speed.

A. Effect of high number of keys to accuracy

We developed the MB algorithm of the existing phone dial pad and internet browsing sub menus as well as for the proposed ones. The results showed that the performance is better when the number of the keys is reduced. As shown in Fig. 12.

This means that the proposed sub menus give better performance, since we have only one key for the telephone dial pad sub menu and only nine keys in the internet browsing sub menu.

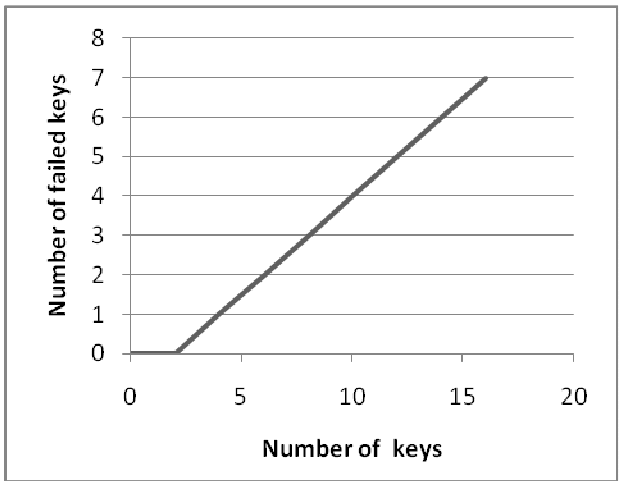

Fig. 12: Effect of number of keys to accuracy

B. Process speed

In this part we measured the speed of entering the keys; the comparison process was taking place between the single button phone dial pad and the single line phone dial pad as well as between the single line moving keyboard and the multiple lines moving keyboard.

The experiments involved eight users with different experience of using the system. The results were as shown in Table 1 and Table 2 respectively.

Table 1: Users speed using the phone dial pad sub menus

User	Single button phone dial pad (s)	Single line phone dial pad (s)
1	99.8	117.3
2	100.3	121.1
3	102.3	123.4
4	109.6	128.3
5	98.7	116.7
6	99.4	116.9
7	97.2	115.2
8	99.2	116.8
Average	**100.81**	**119.46**

The results showed that the speed of the proposed sub menus (avg.=100.81s for phone dial pad and avg.=124.46s for internet browsing) is better than the existing sub menus (avg.=119.46s for phone dial pad and avg.=133.2s for internet browsing).

Table 2: Users speed using internet browsing moving keyboards

User	Single line moving keyboard (s)	Multiple line moving keyboard (s)
1	122.3	131.1
2	126.1	135.3
3	128.4	137.5
4	133.3	141.6
5	121.7	130.2
6	121.9	130.3
7	120.2	129.1
8	121.8	130.5
Average	**124.46**	**133.2**

VI. CONCLUSIONS

It is concluded that in order to increase the accuracy and speed of the HCI system we have to reduce the number of buttons in the keyboard for both the phone dial pad and the internet browsing. The idea came from the principle of "it is easier to Blink than to Move your eyes". So the results were better when we collect the related buttons in the keyboard into one button and moving through by Blinking.

ACKNOWLEDGMENT

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