An On-screen Keyboard for Over-The-Top Set-top Boxes Using an Open Source Operating System

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***Abstract*—Currently when users use Over-The-Top (OTT) Set-top Boxes (STBs) to input text using a traditional QWERTY on-screen keyboard, users often spend most of their time to move their eye concentration between various keys. Thus, this paper proposes an on-screen keyboard for OTT STBs to be used with an open source operating system. This on-screen keyboard uses a three-step hierarchical design, so users can omit the steps of moving their focus between the various keys. This design allows users to reduce the number of button operations on the remote controller (RC), to speed up their text entry speed and to reduce their input time.**

Keywords—On-screen Keyboard; Soft Keyboard; Set-top Box; Remote Control;

I. INTRODUCTION

Currently with the on-screen keyboard design of OTT STBs, users need to move their eye concentration to the desired target position, and then press the enter button on the RC to complete the text entry. The entire text entry button process accounts for a large proportion of the total number of button operations. With the currently used RC, text entry steps are also complex [1]-[2]. Thus, this paper proposes a three-step hierarchical design, so users only need to press the enter button once when inputting any alphabet keys from A to Y. This design provides users with a lower number of button operations on RC, and speeds up the total text entry speed.

II. PROPOSED METHOD

A. On-screen Keyboard Layout

The first layout of the on-screen keyboard contains arrow keys and an enter key, a total of five keys. Each of these five keys contains five letters, for a total of 25 letters. To prevent users from spending too much time looking for letters, the letters A to Y are in a specific order. The remaining letter Z usually has the lowest frequency rank of all letters in an English corpus. Therefore, the letter, Z, was placed on a separate key. Similarly as five numerals as a group are on one specific key, the numeric 0 to 9 will use a total of two keys. In order to speed up URL typing, the phrases "www." and ".com" are each placed on an independent key. The remaining keys of the on-screen keyboard are for the functions of "shift", "symbol", "space", "delete", and "enter" as shown on the left part of Fig. 1.

B. Software Design

At the bottom of the screen an on-screen keyboard will pop up when users want to begin to enter text as shown in the left part of Fig. 1. When users want to enter a letter of the alphabet from A to Y, they must move their focus to the first key (in a cross-shaped layout) and then press the enter button on the RC to lock on the first key. A mini keyboard will then appear as an overlay on the original on-screen keyboard. The entire operation flow charts of the proposed method are shown in Figures 2 and 3.

This mini keyboard has five key groups distributed in the up, down, left, right and middle direction. Each group has five alphabet letters. For example: If users press the arrow button "up" on the RC, a mini keyboard with the alphabet letters "abcde" will pop up, as shown in the upper right part of Fig. 1. The letters "b" "e" "d" "a" and "c" will appear in the direction of "up" "right" "down" "left" and "middle" respectively.

When users press the "enter" button on the RC, a mini keyboard with the alphabet letters "klmno" will pop up, as shown in the lower right part of Fig. 1. The letters "l" "o" "n" "k" and "m" are in the direction of "up" "right" "down" "left" and "middle" respectively, as shown in the lower right of Fig. 1. When users press the button key on the RC corresponding to the direction of the alphabet, the user can enter the letter.

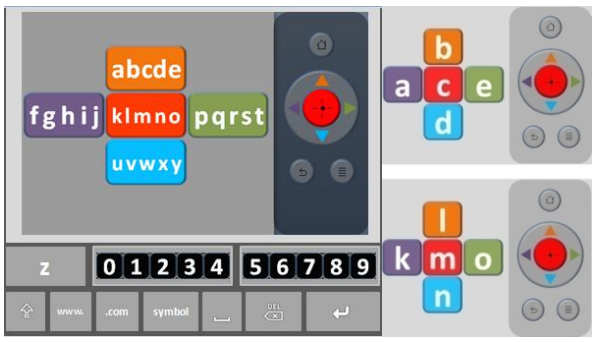

Fig. 1. Left: Full layout of the upper right/lower right on-screen keyboard, after locking on the first key, the user presses either the up button or the enter button on the RC in order that the corresponding direction mini keyboard will appear.

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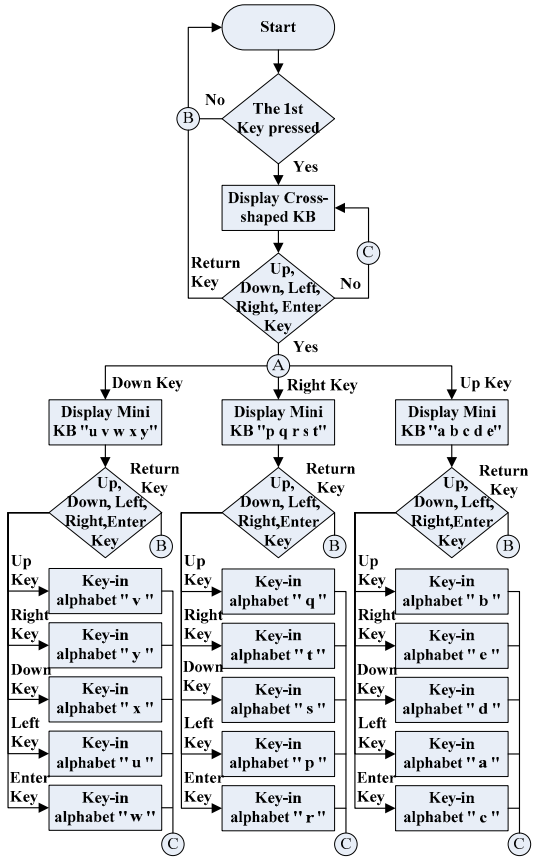

Fig. 2. Flowchart A of the proposed method

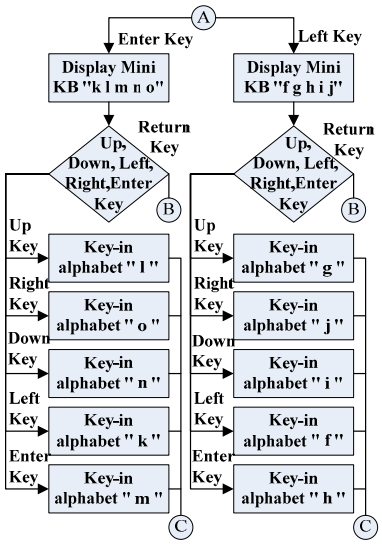

Fig. 3. Flowchart B of the proposed method

III. Design Evaluation and Test Results

A. Design Evaluation

Eq. (1) shows the arithmetic mean used to derive an analysis of these three input methods. Since the user first presses the enter button on the RC to lock on to the first key, the total number must be added to 1, which is shown in Eq. (2).

$$Mean = (X1 + X2 + ... + X36)/36 \quad (1)$$

$$Mean = (X1 + X2 + ... + X36 + 1)/36 \quad (2)$$

$X1$, $X2$ and $X36$ are the desired number of button operations of each letter or numeral. The arithmetic mean of these three input methods is as shown in Table I. Therefore, the number of button operations of the proposed method is less than that of other on-screen keyboards.

TABLE I. Arithmetic Mean of These Three Kinds of Input Methods

Test items / *Input Method*	*26 letters and 10 numeral*	*Nine commonly used*
6x6-Key	6	4.33
QWERTY	7.39	5.44
Proposed Method	2.72	2.11

B. Test Procedure

According to the above data we calculated both the character per minute (*CPM*) and the error rate by using the minimum string distance (*MSD*) method. The evaluation parameters of these methods are as shown in Eq. (3) and (4). "*INF*" includes the wrong words but not the input words. "*C*" represents the correct words, and "*T*" represents the total input time.

$$MSD\ Error\ Rate = (INF/(C + INF)) \times 100\% \quad (3)$$

$$CPM = (C + INF)/T \quad (4)$$

C. Test Results

The test results of these three on-screen keyboard designs are as shown in Table II.

TABLE II. The Arithmetic Mean of The *CPM*, The *MSD Error Rate*, The Sentence and The URL Input Time

	6x6-Key	*The Proposed Method*	*QWERTY*
CPM	12.58	14.71	12.94
MSD Error Rate	3.74%	3.05%	4.48%
Sentence	2:53	2:22	2:43
URL	00:33	00:38	00:53

IV. Conclusion

In this paper we proposed a three-step hierarchical on-screen keyboard. The experiment result shows that our proposed method as measured by the sentence input speed test is the fastest, and the URL test is the second fastest.

References

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