CLURD: A New Character-Inputting System Using One 5-Way Key Module

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Abstract. A character inputting system using one 5-way key module has been developed for use in mobile devices such as cell phones, MP3 players, navigation systems, and remote controllers. All Korean and English alphabet characters are assembled by two key clicks, and because the five keys are adjacent to each other and the user does not have to monitor his/her finger movements while typing, the speed of generating characters can be extremely high and its convenience is also remarkable.

Keywords: Character Input, Typing, 5-way Key Module, Mobile Device, Keyboard, Wearable Computer.

1 Background

People use cell phones, MP3 players, navigation systems, and remote controllers almost every day. Since these devices have to be small enough to hold and carry, only a limited number of keys can be installed in them. A challenge rises in that we have an increasing level of need to input text data using these devices. Therefore, with a few exceptions like Blackberry, which has 26 separate keys assigned for 26 English alphabet characters, device manufacturers has employed various methods that make possible for the users to input all characters conveniently with a small number of keys.

The oldest and most popular method should be the one we have in our telephones. This is a sort of 'toggle' method, in which each numerical key from '2' to '9' is made to correspond to 3-4 character keys, so that a desired character is selected and inputted. Fig. 1 is the key layout of this method.

1	2 ABC	3 DEF
4 GHI	5 JKL	6 MNO
7 PQRS	8 TUV	9 WXYZ
	0	

Fig. 1. This may be the most widely applied character inputting system as it is installed in most of the traditional telephones

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A serious limitation of this method is experienced when a user tries to input a word like ‘feed.’ Since the characters ‘d,’ ‘e,’ ‘f’ are assigned to the same key, the user has to either wait awhile or input a splitter signal in order to input ‘e’ after ‘f.’ It is because the phone does not understand whether the user attempts to input a new character, which happens to be assigned to the same key, or change the inputted character to the next character assigned to the same key.

In Korea, since the 'toggle' method requires too many times of manipulation when characters are inputted, to thus consume much time, other methods for inputting characters have been developed. The 'chun-ji-in' method and the 'naragul' method are two well-known examples. However, even with these widely-adopted methods in Korea, complicated and burdensome key manipulations are needed for inputting, and therefore characters cannot be speedily inputted.

A source of the problem is that, like the old method of inputting English alphabet characters mentioned above, the two methods use 11 or 12 keys that are spread widely over the surface of the device. Another is that, in case of chun-ji-in, a splitter is required for the same reason that the old English inputting method is inconvenient, and in case of naragul, two modifier keys have to be used very frequently to change an inputted character into others that have the same root. Because of these limitations, a user has to move his/her fingers around the 11 or 12 keys busily and click as many as three keys located apart to input one character.

2 The CLURD System

In order to overcome the limitations of the methods mentioned above, a new method of inputting characters using a 5-way key module has been developed and named “CLURD,” which stands for Center-Left-Up-Right-Down. 5-way key module comprises a center key disposed in the center, and an upper key, a lower key, a left key and a right key which are disposed in the top, bottom, left and right sides of the center key, respectively. Typical examples of the module are shown in Fig. 2.

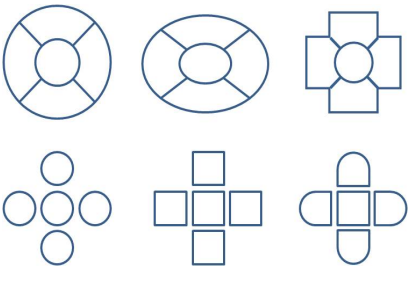

Fig. 2. Typical 5-way key modules that can adopt the CLURD system

Even though there are only five keys in the key module, the CLURD system does not use the ‘toggle’ method. Instead, the system makes it a rule to assemble a character with two key clicks. Theoretically, a total of 25 combinations can be created with two clicks of five keys(5x5). If these 25 combinations are assigned to 24 Korean characters and a space datum respectively, it should be feasible to input Korean words

with no additional splitter or modifier keys. The combinations for the 24 Korean characters are illustrated in Figs. 3 & 4. The only unassigned combination is Center-Center, and this is used to input a space datum. Incidentally, the data generator turns ‘ㄱ’, ‘ㄷ,’ ‘ㅂ,’ ‘ㅅ,’and ‘ㅈ’ into 'ㄲ', 'ㄸ', 'ㅃ', 'ㅆ', and 'ㅉ,' respectively when the second key is pressed longer than a predetermined time.

As shown in Figs. 3 & 4, the combinations are not randomly assigned to characters. Rather, the combination for each character is determined based on the geometric shapes of the keys. (See the first round-shape key module in Fig. 2.) The shapes of five keys are apparently different, and if the shapes of the two keys to be clicked are combined, they should resemble the shape of each of the 24 Korean characters fairly closely.

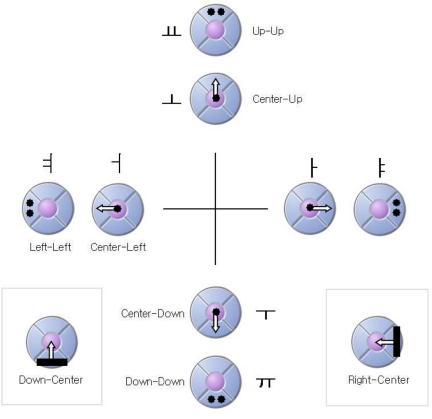

Fig. 3. CLURD Combinations for 10 Korean Vowels

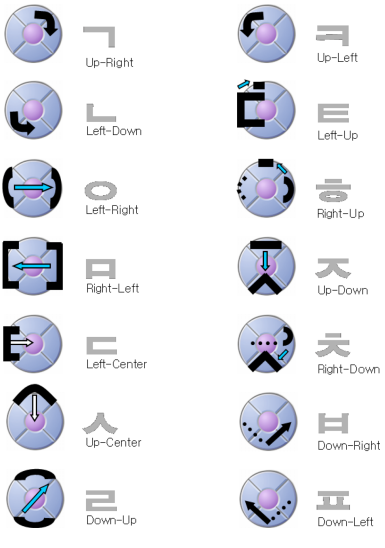

Fig. 4. CLURD Combinations for 14 Korean Consonants

The CLURD system works for English alphabet characters in the same logic. As in the case of Korean, the combinations are thoughtfully assigned to characters so that they resemble the shapes of the characters as closely as possible. As shown in Fig. 5, the data generator assembles 'n', 'D', 'U', and 'C' among the English alphabetical characters if a signal generated by clicking each key combination of Up-Center, Right-Center, Down-Center, and Left-Center is input. The data generator assembles 'm', 'B', 'W', and 'E' if a signal generated by clicking each key combination of Up-Up, Right-Right, Down-Down, and Left-Left is input.

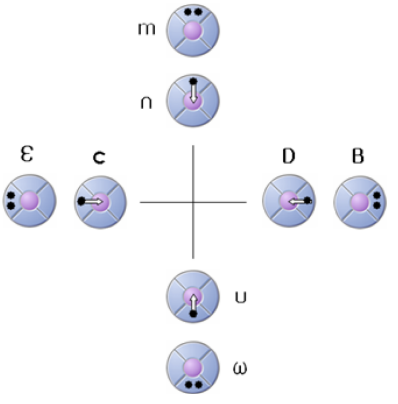

Fig. 5. CLURD Combinations for English characters – Group 1

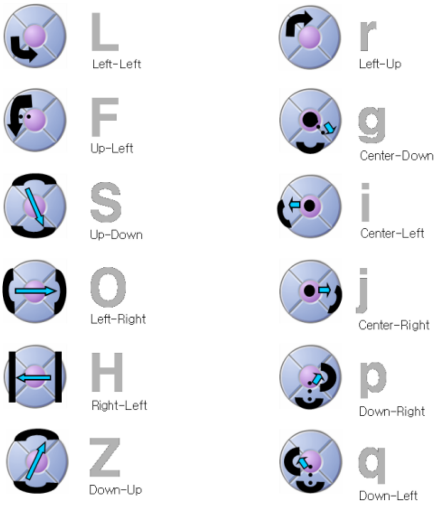

Fig. 6. CLURD Combinations for English characters – Group 2

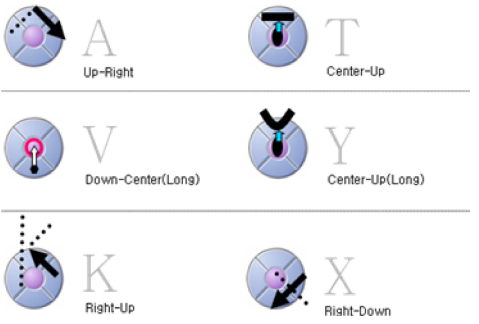

Fig. 7. CLURD Combinations for English Characters – Group3

The Figs. 6 and 7 illustrate the key combinations of 'A', 'F', 'G', 'H', 'I', 'J', 'K', 'L', 'O', 'P', 'Q', 'R', 'S', 'T', 'X' and 'Z'. The data generator assembles 'V' and 'Y' as it does 'U' and 'T', respectively, however the second key should be pressed longer than a predetermined time. In the case that the language mode is set to be the Chinese Pinyin, 'Ü' is generated instead of 'V'.

3 Functionality and Usability of the CLURD System

The CLURD system is compared with the existing methods, that is, the 'chun-ji-in' Korean character inputting method which is used in mobile phone terminals produced in Samsung Electronics Co., Ltd., the 'naragul' Korean character inputting method which is used in mobile phone terminals produced in LG Electronics Co., Ltd., and the Korean character inputting method which is used in mobile phone terminals produced in SK Telecom Co., Ltd., and illustrated in Table 1.

In Table 1, the numeric values are theoretical input time expressed in units of milliseconds (ms; 1/1000 seconds). The numeric values in the parentheses means the number of the input typographical hits. These data in the specification have been

Table 1. Theoretical comparison with the existing methods in light of typing speed and number of key clicks

Sentence to be input	Samsung	LG	SK	CLURD
사랑해	8975(13)	6740(9)	6805(10)	6480(16)
지금 전화해줘	19800(28)	19070(27)	18935(24)	14580(36)
늦을 것 같으니까 조금만 기다려	40115(54)	36435(46)	37350(50)	29970(74)

cited from the paper of Kim S., Kim K., Myung R. [1], and the data of CLURD are calculated in the same manner by the present authors.

The CLURD system uses five keys that are adjacent to one another and located below a thumb of the user. Thus, a time consumed for moving fingers is greatly reduced compared with the existing methods, and the user's gaze needs not to be shifted between the screen and keys because the user can easily locate five adjacent keys forming a '+' shape located under his/her thumb. Thus, although the number of typographical hits increases by 50%, the total input time greatly decreases in comparison with the existing methods. Here, since the above-indicated times are theoretical input times calculated by a formula, and are presented for a purpose of comparison, an input can be performed within a shorter or longer time in all systems described.

Also, the CLURD system has a merit in that the user is capable of inputting characters with the same hand holding his/her phone. The CLURD system can be used, though some level of caution is necessary for a safety reason, even when the user walks, drives a car, or puts the hand taking hold of the mobile device under table or in his/her pocket.

The CLURD system does not have the kinds of problems that the existing methods have. That is, it does not need a splitter or a modifier key. The users only have to recall the combinations and input in the device using the key module. Also, the fact that the CLURD system has the space datum included in the key combinations improves its usability, according to the testers who experienced the system for a few days.

4 Limitation

As the CLURD system works based on the predetermined key combinations for Korean and English characters, the users need to invest some time and efforts to

Table 2. Results of memory test using an instructional animation (Korean)

		After Watching the Animation ...					
		Once		Twice		Three Times	
gender	age	vowels	consonants	vowels	consonants	vowels	consonants
male	17	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect
male	17	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect
male	17	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect
male	16	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect
male	16	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect
male	16	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect
female	17	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect
female	16	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect
female	16	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect
female	16	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect
female	16	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect
male	17	Perfect	ㅈ	Perfect	Perfect	Perfect	Perfect
male	16	Perfect	ㅊ	Perfect	Perfect	Perfect	Perfect
female	16	Perfect	ㅊ	Perfect	Perfect	Perfect	Perfect
female	16	ㅓㅗ	ㅊㅋ	Perfect	ㅋ	Perfect	Perfect
female	16	Perfect	ㅊ	ㅓ	Perfect	Perfect	ㅎ
female	16	ㅗ	ㅅㅈㅊㅋ	ㅗ	ㅋ	ㅗ	ㅅ

memorize the combinations. Thanks to the fact that the combinations are not random, but associated with the shapes of the characters fairly closely, the memory burden seems not significant. Table 2 is the results of a memory test with junior high school students.

5 Augmentation of the CLURD System

For the case in which the user of the CLURD system decides not to monitor the screen while typing for any reason, it should be better to add some sort of function notifying him/her in the case in which an error has occurred. Because the user's vision is likely to have been allocated to another task in such a situation, it should be wise to utilize another sensory modality. A short vibration may be a good idea in case of a cell phone. Also, if the CLURD system is used as the main communicating device by speech-handicapped persons, it can be combined with a text to speech (TTS) module which converts texts into sounds.

6 Devices Using the CLURD System

In the case of cell phone, PDA or wearable computer, the CLURD system can be used as a substitute for a regular keypad/keyboard. In the case of the remote controller for a digital TV set, the CLURD system is used for the purpose of searching program titles, inputting identification and password, or writing in the user's address to order a product. Some examples of devices(cell phone, TV remote, door lock, typing mouse) are shown in Fig. 8. Other examples, though not shown, may include watch phones, wearable computers, and so on. For watch phone, the 5-way key module can be installed on the surface of the window in the form of transparent thermal touch pad. A watch phone can be used as an inputting device for

Fig. 8. Cell phone, remote controller for digital TV set, door lock, typing mouse with the CLURD system installed (Conceptual illustrations or prototype models)

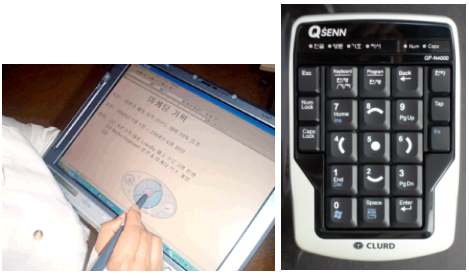

Fig. 9. The on-screen keypad and the palm-size full-function keyboard with the CLURD system installed (Available in market); The palm-size keyboard was developed with a financial support from the Korea Agency for Digital Opportunity and Promotion

wearable computers with a wireless connection to the CPU. The on-screen keypad program and the palm-size keyboard shown in Fig. 9 are the first official products in market (introduced in April 2009) that adopt the CLURD system.

7 Conclusion

As described above, CLURD is a character inputting system suitable for a mobile device where a sufficient number of keys cannot be arranged due to space restriction. Besides the fact that this character inputting system takes up little space on the surface of a device, the system has remarkable edges that other existing methods cannot materialize. First, it requires only one or two fingers for operation, and this allows the user to allocate the other hand and/or the rest of fingers to other concurrent tasks. This also means that the physically handicapped people who can use only one hand or one finger can type characters speedily. In fact, a Korean lady who is partly paralyzed and thus can use only one hand has passed an official computer literacy test that requires a fair speed of typing only with this palm-size keyboard. Another edge of the CLURD system is that the user does not have to look at the keys while typing since his/her finger knows where the five keys are located. This allows him/her to monitor whether he/she makes any typo by fixing his/her gaze to the screen. The CLURD system is also useful to the blind, especially when they take a note reading a book in Braille. They may read a book with left hand and type in a computer using the CLURD keyboard. (Taking a note on paper is meaningless for them because they cannot read it later.) A possible application for the mute is a hand-held device in which the CLURD system is installed together with a TTS system so that when the user presses the TTS button the device reads what he/she has just typed in the device using the CLURD system.

The CLURD system can be nicely installed in the form of a virtual keypad in touch-screen interface. This has been confirmed with the on-screen keypad program designed for tablet computers and the prototype model of typing mouse.

The time and efforts needed to get familiar with the key combinations may be the only limitation with the CLURD system. A good sign was that most of the testers (over 2,000 people) who have used add-on software designed for cell phone stated

that the time and efforts needed for learning the combinations were quite minimal and its functionality and usability were remarkable enough for them to willingly make such an investment.

Reference

1. Kim, S., Kim, K., Myung, R.: Hangul input system's physical interface evaluation model for mobile phone. Journal of Korean Institute of Industrial Engineers 28(2), 193–200 (2002)