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Design and Evaluation of Android Slide Keyboard for Myanmar Language

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ABSTRACT

Because of the large character set nature of Myanmar character, currently used Myanmar language soft keyboard look like QWERTY layout on Android devices's performance is degraded when using on small screens. The users are needed to switch keyboard layout frequently to get their desired characters. To reduce the user keyboard layout switching time, this paper proposed the slide keyboard to set the entire Myanmar character on one screen layout. User study was made by comparing slide keyboard with currently used Myanmar language soft keyboard that look like QWERTY layout (iTextMM). The user preferences and empirical evaluation is also analyzed. According to the evaluation, the parpicipants can take minimum learning time with slide keyboard and can type at a rate of 17 Character per Minutes (CPM) and have got average 0.65 error rates.

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1. INTRODUCTION

In early commercial mobile phone for example T9 [5], researchers are motivated to reduce the number of buttons required to support a full Latin alphabet on limited space available in mobile devices. Because of the hard keyboard nature on earlier mobile devies, their only target is to use word disambiguation strategy that each key represent more than one alphabet. The user had to use by pressing the key that corresponds to a desired letter one or more times [4]. On touch screen, keyboard is the software based, thus the design of the soft keyboard is changed or is innoviated to meet the ease of user usability. The soft keyboard consumes no physical space in the real word. However, it takes much precious resources on the phone such as the screen area and some part of the screen where data is typed. Thus, the input mechanism that requires only a few keys or a small set of input primitives has been hot areas of research on today era of 2012.

Many existing input method editior on touch screen lack a good interface for typing Myanmar text and inputting performance is not good as imagine because of the inconvenience need to switch frequently between multiple layout to correct spell the intended syllable or words. The future trends will become promising growth in the age of touch screen devices and it is nedded to explore the better input method

mechanism on tocuh screen for Myanmr language. The English QWERTY type keypads alone are not suitable in the long run because the native Myanmar user wish to send SMS message with Myanmar language, want to send email with Myanmar language and prefer to connect with social media with Myanmar language from their personal touch screen gadgets. It is needed to explore the more effective keyboard layout for Myamar language.

The proposed slide keyboard suggested a keyboard layout that has been optimized for accurate, easy, speedy and efficient typing on small touch screen handheld gatgets. For evaluation of the proposed soft keyboard, two types of evaluation: automated empirical evaluation and user evaluation is performed. The automated experimentes on Myanmar language showed that the text entry speed is comparable with existing Myanmar language input method look like QWERTY layout in the market. The result of the user evaluations are also described detail in Section 5. The rest of the paper is organized as follows. Section 2 discusses related research in soft keyboard layout design optimization with few keys. Problem description to develop Myanmar language slide keyboard is presented in Section 3. Design and implementation of the slide keyboard is described in Section 4 and concluded this paper in Section 6.

2. RELATED WORK

There are many virtual keyboard designs for either mobile phone or handheld devices that condense the rows of keys in the normal QWERTY layout in the realm of Human Computer Interaction (HCI) researcher [2, 7, and 12]. On example of such a keyboard is the Vector keyboard [7] of Martin Klim and Pavel Salvik. Their keyboard layout consists of three blocks for alphanumerical characters, each block organized in a matrix of 3x3 characters. Typing is produced by simple strokes sourcing from one of four blocks of letters. According to the lecturature review, more and more researchers are trying to explore a technique of flick and swipe gestures to replace touch screen button [2]. The distinguish example is 1Line keyboard. 1Line keyboard reduced layouts to be single line that condenses the three rows of keys in the normal QWERTY layout and gestures to replace buttons or keys. The major idea of 1Line keyboard can saves 60% of the space occupied on the screen.

This idea of 1Line keyboard is not the new one. They transplanted their idea from stick keyboard of Nathan Green and group [8]. In their stick keyboars, text entry is done by mapping four rows of a standard keyboard on to the home row in which three rows of alphabetical keys are merged into a single row. The resulting stick keyboard has similarities to a cell phone keyboard, in overloading single keys with multiple characters, but the layout and proportions are derived from the QWERTY design. The next interesting example of shriking the number of key button to text entry is Watch-to text entry of Mark D Dunlop [6]. This idea is the first approach in setting key layout with watch-face. Although watch-face text entry does not support capitalization, punctuation, error correction or menu commands, the researchers realized to explore the way of optimization the layout with few keys since that time. Various keyboard designs have been proposed in the past to optimize the placement of letters on keys by minimizing ambiguous key sequences [3, 4 and 5]. But, most of the keyboard layout optimization approaches are for Latin alphabet. There is still an underdeveloped research area in keyboard layout optimization for Myanmar language. The proposed Myanmar language slide keyboard utilizes both tap detection and slide detection to provide a reduced keyboard layout and mimimum key searching time for the users.

3. PROBLEM DESCRIPTION

To support typing Myanmar text on touch screen without additional hardware, many touch screen devices, such as iPad, iPhone, Adroid mobile phone and tablet implement a soft QWERTY keyboard. The soft keyboards that look like QWERTY layouts consume many layouts and sometime the user is annoyed in key searching time. There is no standard keyboard layout for Myanmar language, although the number of mobile subscriber is 450,000 in early 2010. Most of the soft keyboard developer for Myanmar language, imitate the key layout arrangement of Zawgyi keyboard that is the most popular keyboard layout in personal desktop PC. However, to transplant the idea of keyboard layout arrangement the same as Zawgyi keyboard, there is some confusing problem for the soft keyboard developer. Because, the screen size and number of key available is less than the keyboard layout arrangement in Zawgyi keybord. Thus, most developers tried to place the key similar to Zawgyi keyboard and place the remaining key in suitable place. This behavior leads to the different number of keyboard layout for Myanmar mobile user and the users have to try to get familiarity in keyboard layout changes and have to search their intended key difficulty via switching keyboard layout as much as they can.

The next keyboard layout that did not use the idea of Zawgyi layout is the iTextMM keyboard layout [9]. The observation of this keyboard is to develop effective Myanmar language soft keyboard layout

according to their probability statistics. In this keyboard, the most frequent used consonant characters are interleaved with dependent vowel characters to reduce the hand movement time. To get the user familiarity of key placement, for example the upper vowel is set on the upper row of the keyboard layout and the lower vowel is tried to set on the lower row of the soft keyboard layout. However, the user did not take this proposed keyboard layout and wish to get their already familiarized Zawgyi layout.

After conducting a small survey with 30 touch phone users (17 male, 13 female), the user experiences indicated that there is a desire to do a keyboard layout that can see the entire Myanmar character on one screen layout. According to the user feedback from survey, the user want to cut the learning curve of learning a new keyboard layout and especially most female reluctant to use Myanmar language on their phone and want to use Latin QWERTY keyboard. To cover all of the Myanmar character on one screen, one key needs to represent many characters and have to embed with a method that employed fling gestures on keys for typing individual characters. In this manner, the slide keyboard is designed with minimum key switching time and learning time.

4. DESIGN AND IMPLEMENTATION

The concept of the slide keyboard is to combine the keys according to the order of Myanmar consonant with priority behaviour in order to represent five Myanmar alphabets. Now, each key is associated with five Myanmar characters. The proposed key priority behaviour is based on the previous work [9] in this area. The central characters are set with the highest unigram frequency score of Myanmar character. The remaining is ordered in position of slide left, slide down slide up and slide right according to the unigram frequency usage and behaviour of character postion. As shown in figure 1, the central characters are needed to type with tab and the surrounding four characters have to use with finger slide on key. For example, to type second consonant of Myanamr character (Kha Kway - ☐) the user is needed to slide up finger on the intended key. Similarity, the users have to slide left to input the third consonant of Myanmar character (Gha Nge-☐).

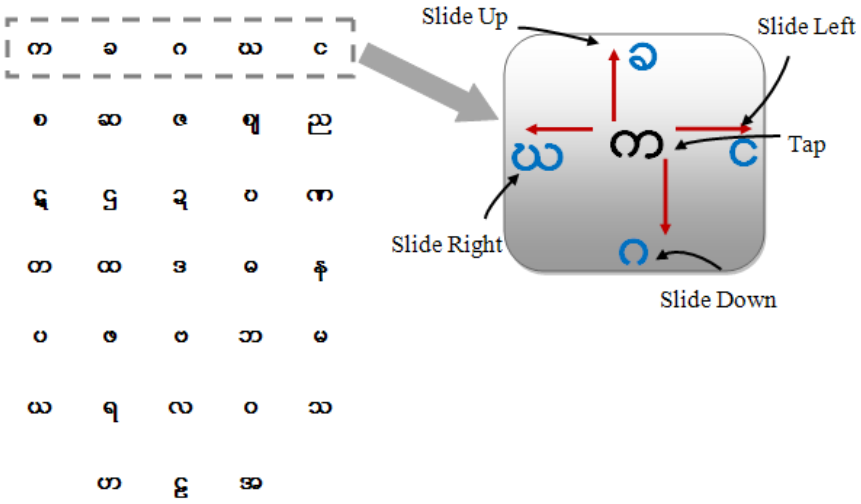

Figure 1. Myanmar Consonants and Slide Keyboard's Key Usage

The proposed slide keyboard is intended to be comfortable size and right position of key for the users. As mention above, each key can represent five Myanmar character. As depicted in figure 2, the proposed slide keyboard used the leverage of user familiarity of Myanmar consonant character alphabetically; the less frequent used characters are set on the far most place of user's finger. For example, the 11th Myanmar consonant character (Ta Ta Lin Chike - ☐) and the remaining four are set on the right most side of slide keyboard.

Thumb length and circumference also effect in consideration of key size and the position of key placement. According to the mini survey with touch screen user, there are only two types of group in mobile phone holding behaviour. The first group prefer small screen device and use only left thumb in pressing keys on soft keyboard. The another group adore large screen devices and use only left pointing figure while pressing keys on soft keyboard

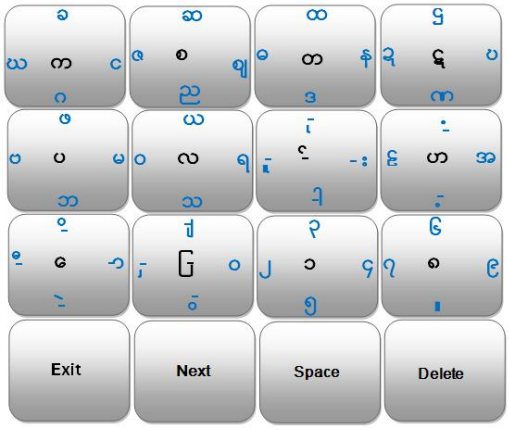

Figure 2. Slide Keyboard Layout

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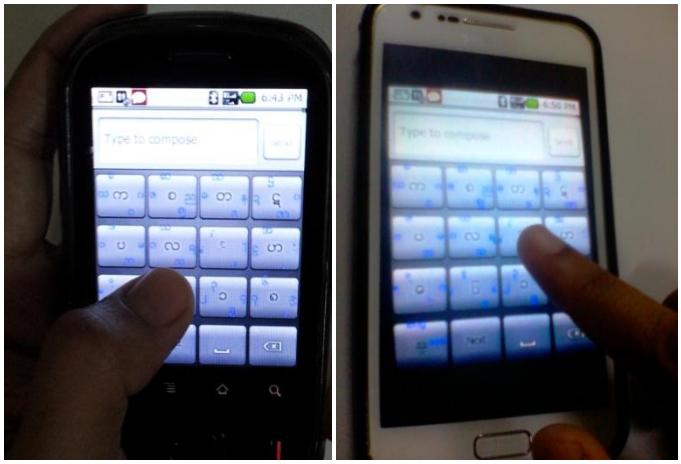

Figure 3. Two Types of Mobile Phone Holding Behaviours

For the first group of user, sliding left character make him or her feel stiff in long run. Thus, among the first row of Myanmar consonant, the least frequent used characters are placed on slide left position. For the second group of user, the four sliding is not the big task for them and all type of slides are preferable. Myanmar language is a syllabic script language which composed of vowel or consonant and vowel signs. There are 34 consonant (□, □, □, etc.), one devowwelizer sign (-□), 11 dependent vowel signs (-□, -□, -□, □-, -□, etc.), 4 medial signs (-□, □-, -□, -□), 2 diacritics signs (- □, -□)and 10 digits (□, □, □, □, etc.) [9].

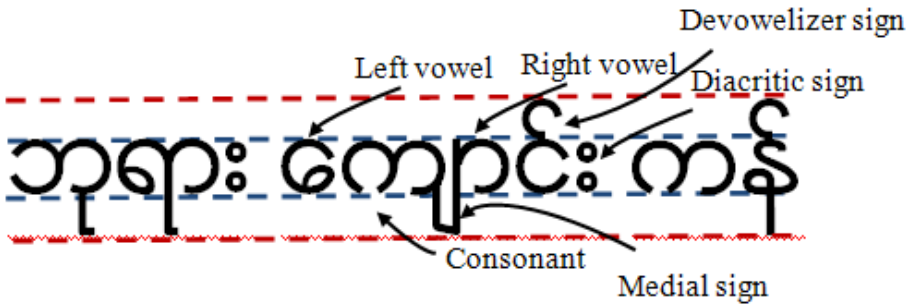

Figure 4. Sample Myanmar Text

For dependent vowel, devowelizer, medial and diacritics, the unigram frequency usage alone is not the key factor in consideration of key position. For those characters, it is needed to take the leverage of key

searching habit of users after disguishing the most frequent used character (□-, -□, □-), E_vowel(□-) have to set in the left side of the keyboard. However, E_vowel (□-) need to set in the middle of key because it is the most frequent used character, the diacritics sign (-□) is most suited to set in slide left position.

5. EVALUATION

Before user evaluation study is making, text entry speed also known as empirical evaluation of the proposed keyboard is calculated with core java and analyzed. The text entry speed of a keyboard can be calculated by calculating mean Movement Time (MT^) [9]. To calculate MT^, it is needed to calculate over all possible digraphs as depicted in algorithm 1. Fitt's law is formulatged mathematically to get Movement Time (MT). MT is assumed the time taken to move from Key_i to another Key_j for a given distance D_{ij} and key size W_{ij}. In this calculation, the value of a and b are assumed 0.5 as empirically determined coefficients. In addition, RT is the average reaction time of user key searching. Where n is the number of keys in the keyboard, b` is a constant and its value is determined empirically as 0.5.

Algorithm1- Text Entry Speed

{Assuming the inputs are n,D_{ij}, $P_{ij,}$ a, b and $b`$ }

RT := $b` \ log_2 (n+1)$;

for (int i=0; i<n; i++)

{

for (int j=0; j<n; j++)

{

Calculate D_{ij}

P_{ij} := Bigram (key_i,key_j);

MT_{ij} := a +b * $log_2 (\frac{D_{ij}}{W_{ij}+1})$;

$MT^{\wedge} := (P_{ij} * MT_{ij})$+RT;

}

Text_Entry_Speed := $\frac{1}{MT^{\wedge}} * \frac{1}{60}$;

According to the automated text entry speed analysis, the text entry speed of slide keyboard is 4.31 that is comparable with (4.53 the average text entry speed of first and second layout) iTextMM (QWERTY Keyboard.)

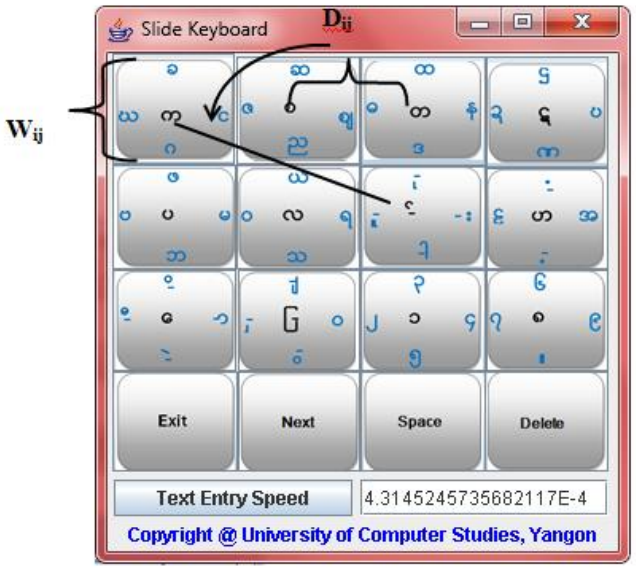

Figure 5. Text Entry Speed of Slide Keyboard

The user evaluation study is conducted using Android OS phone because of its open source Software Development Kit (SDK). Twelve participants from age 20 to 35 (4 male and 8 female) were recruited for the evaluation session. The initial session was used to obtain an understanding of initial usability of the slide keyboard and its learning curve of novice that already familiar with Myanmar language touch screen text entry look like QWERTY keyboard layout. In the initial session, the users said they prefer to use

slide keyboard and take minimal learning time. After taking learning time, they are allowed to use ten times trials of their preferred sentences. To calculate Character per Minutes (CPM) and Error Rate (ER), the slide keyboard is modified to record the starting time and ending time. Before starting each sentence, each user is needed to press start key on soft keyboard to record start time. Similarly, after inputting each sentences, let them to press end key on soft keyboard and calculate CPM and ER.

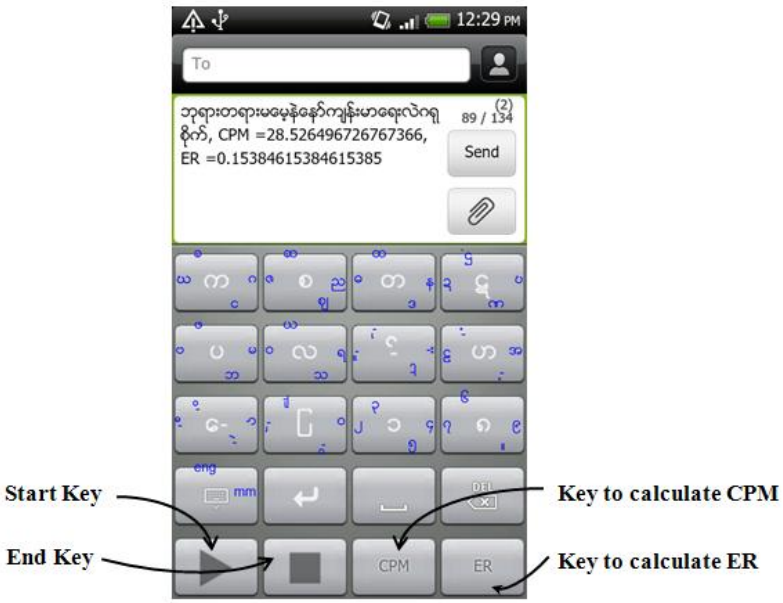

Figure 6. Slide Keyboard Used in Evaluation Process

The CPM is the number of inputted Myanmar character in one minute and ER is the error rate to input the desire sentence by using this keyboard. The CPM and ER can be calculated with the equation as depicted in equation 1 and 2. The evaluation results revealed that the user can type Myanmar character in average of 16.89 characters per minute and have got average of 0.67 error rates. Although the users prefer to use optimized keyboard layout in initial survey, the participants on evaluation said they are not familiar with the slide keyboard. Instead of avoiding key switching time in QWERTY like keyboard layout, they made wasting time in key searching with slide keyboard. Sometimes, they made ambiguity error such as confusing to use the key with normal tap or slide.

$$CPM = \frac{Number\ of\ Desired\ Character}{(End\ time\ in\ Millisecond - Start\ time\ in\ Millisecond) * 0.001/60} \quad (1)$$

$$ER = \frac{Number\ of\ Error}{Number\ of\ Desired\ Character} \quad (2)$$

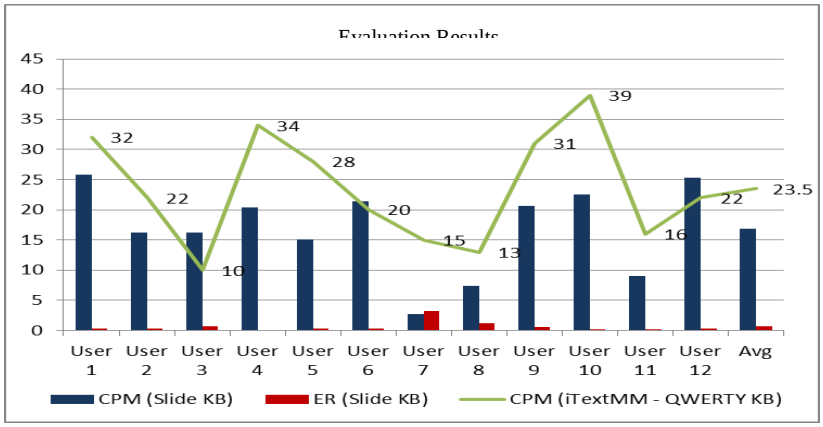

Figure 7. Evaluation Results Comparison

6. CONCLUSION

The objective of this work is to reduce the user key switching time on soft keyboard. The key placement is designed by taking the leverage of user familiarity of Myanmar consonant character order. Characters operations are normal tap, slide up, slide down, slide left and slide right on the intended character. The investigation indicated that the slide keyboard allows the user to type their desired character without needed to switch the keyboard layout to type their desired characters. However, it adds the extra burden of key searching time for the user and had got average 17 CPM and 0.65 ER. When compared with QWERTY like keyboard layout (iTextMM), the slide keyboard can catch 75% of the iTextMM's inputting performance.

REFERENCES

[1] A. Habib, M. Iwatate, M. Aasahara, Y. Matsumoto, "Keypad for Large Letter-Set Languages and Small Touch-Screen Devices (Case Study: Urdu)", *IJCSI International Journal of Computer Science Issues*, vol.9, Issue 3, No 3, May 2012.

[2] F. C. Y. Li, R. T. Guy, K. Yatani and K. N. Truong, "The 1Line Keyboard: A QWERTY Layout in a Single Line", *UIST`11, ACM, Santa Barbara, CA, USA*, October 16-19, 2011.

[3] J. Gong, P. Tarasewich, "Testing Predictive Text Entry Methods with Constarined Keypad Designs", *Human Computer Interfaces International (HCI) – Citeseer*, 2005.

[4] J. Gong and P. Tarasewich, "Alphabetically Constrained Keypad Designs for Text Entry on Mobile Devices", *CHI 2005, Portland, Oregon, USA*, Aprial 2-7,2005.

[5] K. Tanaka-Ishii, Y. Inutsuka and M. Takeichi, "Entering Text with A Four-Button Device", *Proceedings of the 19th International Conference on Computational Linguistics*, 2002.

[6] M. D Dunlop, "Watch-top text entry: Can phone style predictive text entry work with only 5 buttons*", Mobile Human-Computer Interaction- Mobile HCI*, Springer, 2004.

[7] M. Klima and P. Slavik, "Vector Keyboard for Android Platform-Based Devices", *Human Interface, Part I, HCI 20011*, LNCS 6771, pp. 435-442, 2011.

[8] N. Green, J. Kruger, C. Faldu, R. St. Amant, "A Reduced QWERTY Keyboard for Mobile Text Entry", *Extended Abstracts of the ACM SIG CHI Conference on Human Factors in Computing Systems*, New York ACM, 1429-1432, CHI 2004.

[9] N. P. Oo and N. L. Thein, "Effective Myanmar Key Layout Design Analyzing for Android Soft Keyboard", *International Journal of Engineering Science and Technology (IJEST)*, 2012.

[10] N. Henze, E. Rukzio and S. Boll, "Observational and Experimental Investigation of Typing Behaviour using Virtual Keyboards on Mobile Devices", CHI`12, Austin, Texas, USA, May 5-10, 2012.

[11] P. A. Cabdadim R. Godinho, M. Zacarias and F. G. Lobo, "Easy Write: A touch-based entry method for mobile devices", *13th IFIP TC13 International Conference on Human Computer Interaction*, INTERACT 2011.

[12] S. MacKenzie, R. W. Soukoreff and J. Helga, "1 Thumb, 4 Buttons, 20 Words Per Minute: Design and Evaluation of H4-Writer", *UIST`11, ACM, Santa Barbara, CA*, USA, October 16-19, 2011.

[13] T9, http://www.t9.com

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