Proceedings of the Second IASTED International Conference
HUMAN-COMPUTER INTERACTION
March 14–16, 2007, Chamonix, France
ISBN Hardcopy: 978-0-88986-654-6 / CD: 978-0-88986-655-3

SELECTION BASED MYANMAR TEXT INPUT INTERFACES: PROPOSAL OF DIVIDING ALL MYANMAR CHARACTERS INTO SIX GROUPS

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ABSTRACT
This paper introduces selection based Myanmar text entry techniques for small computing devices. We divided all Myanmar characters into 6 groups as consonants, medial/finals, vowels/special characters, stack characters, frequently used Myanmar words, and Myanmar numbers for easier selection. We used a click wheel mouse, a traditional game pad (4 arrow keys with some buttons), a today's dual-joystick game pad and a FPS battle stick for text entry experiments. We conducted a user study, which shows that our concept of dividing Myanmar characters into 6 groups supports an easy Myanmar text entry interface and appropriate text entry speed. Our selection based Myanmar text entry approach will be useful for many possible Myanmar language user interface devices such as PDAs, mobile phones, electronic dictionaries and information kiosks etc.

KEY WORDS
Text Input, User Interfaces, Selection Based, HCI in Mobile, Input devices, Myanmar language

1. Introduction

"Date Stamp" and "Soft Keyboard" are well known as selection based text input methods. But all these input techniques are based on English, and there is no research paper for Myanmar language selection based text input yet. An efficient text input method for Myanmar language is necessary for local people and development of Information and Communication Technology in Myanmar. Therefore, this paper is an attempt to find practical and efficient selection based input technique for Myanmar language. We believe that the study on selection based text input for Myanmar language can be applied not only to the user interface of Myanmar language but also to that of other Myanmar ethnic groups' languages such as Mon, Kayin, Shan, Rakhine etc. In this paper, we present four possible selection based text input interfaces for Myanmar language using different input devices. All of the input methods are based on the concept of dividing Myanmar characters into 6 groups. The 33 consonants from Ka to A and stack characters are sequenced according to Myanmar alphabetical order, and other characters such as Medial and finals are sequenced according to Myanmar language written order to get a user-friendly interface.

2. Myanmar Language

Myanmar language is the official language in Myanmar. It belongs to the Tibeto-Burman language family and derives from Sino-Tibetan. Myanmar alphabets adapted the Mon script, which in turns developed from a southern Indian script in the 8th century. Myanmar script is a system of writing constructed from consonants, consonants combination symbols (i.e. Medials), vowel symbols related to the relevant consonants, and diacritic marks indicating tone level. Myanmar language alphabet is recognized as containing 33 consonants, vowels (dependent and independent) and some conjunction alphabets or abbreviations. And Myanmar language contains many Pali words especially for religious things such as praying. In a Myanmar sentence, spaces are used to mark phrases, not dividing words. Myanmar language is written from left to right. The followings are some examples of Myanmar language writing system.

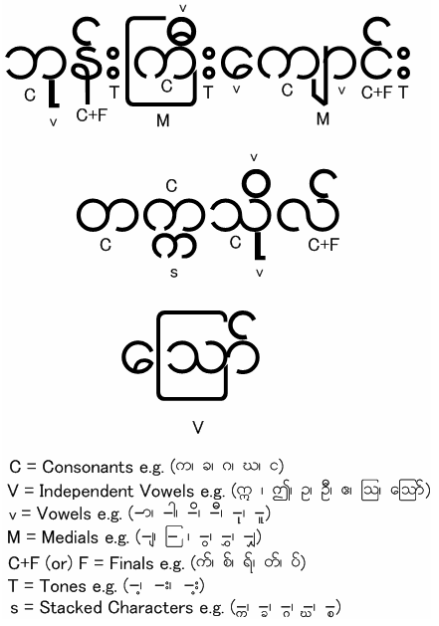

Figure 1 Myanmar Language Writing System

3. Design of Selection Based Text Input

Today we do not have standard keyboard layout for Myanmar language but we have traditional type writer keyboard layout. All of the Myanmar language PC keyboards layouts are based on type writer, and key mappings and encodings are different. And thus, we cannot make text processing like sorting, searching and word breaking etc. Some of the characters drop out when we copy from one application to another. Typing in Myanmar language is still difficult and not easy for novice users, and thus, almost all of the Myanmar PC users cannot type Myanmar language even if they are touch typists in English. We mentioned the above to get readers' understanding on current Myanmar language keyboard input background. In this paper, we concentrate only on selection based Myanmar language text input for small computing devices with limited number of keys. We considered following basic rationales as starting points for our design.

1. Suitable for small screen computing devices such as mobile phones, portable electronic dictionaries, PDAs etc.
2. Characters grouping and ordering should be simple and easy to memorize.
3. Novice users should be able to use the input method easily without much practice (short learning curve).
4. Intend to get appropriate text entry speed. Although we do not expect to get equivalent typing speed of PC Keyboard, it should give reasonable typing speed to expert users.
5. Not dependent on a specific input device.

4. Concept of 6 Myanmar Characters Groups

We divide all of the Myanmar characters into 6 groups based on Myanmar language nature as consonants (က to အ), medials/finals (◌ျ, ◌ြ, ◌ွ, ◌ှ, ◌ါ, ◌ိ, ◌ီ, ◌ု, ◌ူ, ◌ေ, ◌ဲ, ◌ံ, ◌့, ◌း etc.), vowels/special characters (ဣ, ဤ, ဥ, ဦ, ဧ, ဩ, ဪ, ၌, ၍, ၎င်း, ၏, ဿ etc.), stack characters (◌္ကျ, ◌္ခြ, ◌္ဂွ, ◌္ဃှ, ◌္ငြ, ◌္ဆွ, ◌္ဇြ, ◌္ဈှ, ◌္ဋြ etc.) , frequently used Myanmar words (ပါ, ၏, ဝါ, ဒီ, သူ,ထို etc.) and Myanmar numbers (၀, ၁, ၂, ၃, ၄, ၅, ၆, ၇, ၈, ၉). Although this is the very first grouping concept for Myanmar language, native Myanmar users can understand very easily.

Here, the sequences of the consonants, vowels, stack characters and numbers in the list are based on the Myanmar alphabetical order. Medial/finals are sequenced by written order. And special characters and frequently used Myanmar words are sequenced by usage frequency, because we have no other choice. Note that there has been no proper usage frequency table for either Myanmar characters or words yet, and the frequencies that we use in this paper is the result of our experiments made so far [1]. All Myanmar people are very familiar with alphabetical and written ordering since they are in primary school. Although we can consider to order by frequency for all Myanmar characters to improve expert users' performance, it would cause bad user interface for novice users. And we believe alphabetical ordering is more transparent to the all users. And our design is intended for typing short messages, adding new records to an address book, typing name for recording game scores etc. on a small computing device, not for writing longer texts.

5. Implementation

To apply the concept of dividing 6 characters groups to selection based text input, we consider for various input devices. Theoretically, it is possible to apply this grouping concept on various input devices, if we have appropriate user interface (UI). To get users feedbacks and measure text entry speeds, we implemented 4 different types of UIs and experimented with different input devices.

5.1 Wheel Mouse

Wheel mouse is the same as normal PC mouse. But it includes scroll wheel, which is normally located between left and right mouse buttons. The scroll wheel is used for scrolling, and it can also be used as a third mouse button by pressing on it.

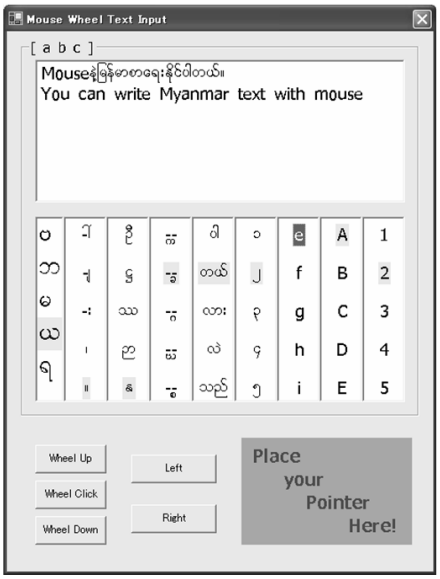

Figure 2 UI for Input Device like Wheel Mouse

We choose wheel mouse as the first experiment tool for demonstrative purpose, because every PC user is already familiar with mouse device. And another reason is to prove that our grouping concept can be applied even to devices with very few buttons (only 3 buttons mouse + a scroll wheel in here) and there is no need to memorize difficult combination of keystrokes like in today's Myanmar PC keyboards [2].

The selection based text input UI for wheel mouse is very simple. We layout 6 groups of Myanmar characters orderly (the most left column in the list is consonants) from left to right (figure 2). Users can choose the characters group rotation (from left to right direction) by pressing a scroll wheel button. By scrolling up or down, users can choose a character within selected group. The highlighted character will be typed by pressing a left mouse button. By pressing a right mouse button, the small context menu will be displayed and users can do some text editing operation such as backspace, clear all text etc.

This UI is not limited to the use only with a wheel mouse, and we also make a text input experiment with FPS (First-Person Shooter) Battle Stick. FPS Battle Stick is a game input device, which contains 2 buttons and 1 click wheel. Although physical design is different, it works as a wheel mouse. The purpose of the experiment is to understand that this UI can be applied to various input devices that contain 2 buttons and a 1 click wheel (e.g. some portable electronic dictionaries with a click wheel). Actually, this UI doesn‘t necessarily need a wheel click. .

Figure 3 FPS Battle Stick Game Input Device

5.2 Game Pad or Single Joystick

The second UI is also very simple; we add all 6 Myanmar characters group into one list box. Users can select and type very easily by using Game Pad or Single Joystick. The text typing process requires only 2 steps; selecting characters group, and then selecting a character and typing. Usually the system will go back to main menu automatically, however, in some case like medial/finals, users need to go back to main menu or group selection menu manually. The reason is that users mostly need to choose more than one medial in Myanmar language.

Users can move character highlight with 4 arrow keys (Up, Down, Left and Right) or Single joystick. Users can go back to main menu by pressing X button. Y button is for typing a character and selecting a character group, and A button is for “Space”. B button is assigned as “Backspace” and L button is for Myanmar characters combination confirmation. We plan to use L button for checking some impossible Myanmar character combinations such as “အ◌”, “ဆာ”, “မုး” etc. In this interface, we made user experiments with ELECOM game pad (figure.5).

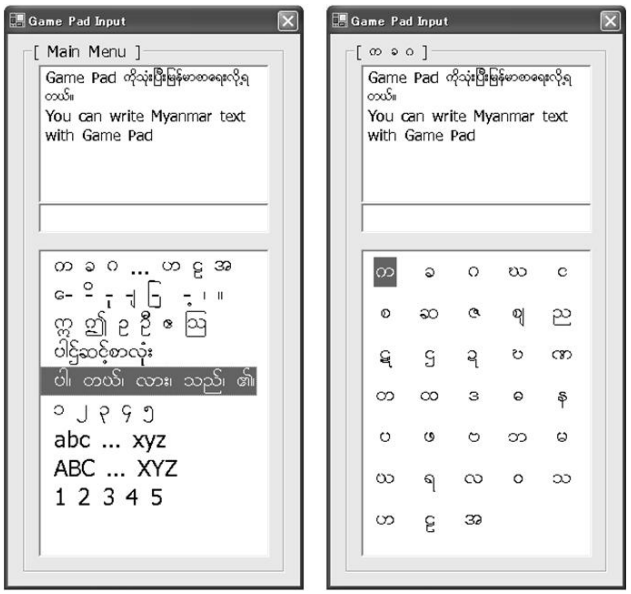

Figure 4 UI for 4 Arrow Keys with 2/3 buttons

Figure 5 ELECOM Game Pad

5.3 Dual Joystick Game Pad

Myanmar character grouping for “Dual Joystick Game Pad” is the same as “Normal Game Pad Interface”. But this interface takes the advantages of using 2 joysticks or thumb sticks (figure.6) Users can move character group highlight with left joystick. Right joystick is used for character highlighting and typing. Button 1 is assigned for “Backspace” and Button 5 is for character combinations confirmation. To enter “Space”, users must move both sticks to the right. For the “Enter”, users must move both sticks to down. We used Logitech Dual Joystick for user experiments (figure.6).

Figure 6 UI for Dual Joystick Game Pad

5.4 iPOD

We tried to apply our 6 groups of Myanmar characters input methods for small screen MP3 players like Apple iPOD. Here, we use only one line of screen space for Myanmar text input. In Apple iPOD, there are five keys (Menu, backward, forward, play/pause and center) and click wheel. Click wheel is very famous because of its space-efficient design. In our simulation program, "Left" and "Right" buttons work as left and right turn in iPOD click wheel. Although we can install "iPOD Linux" [3] and run on real iPOD, in this paper, we just developed simulation program and made experiments on a PC.

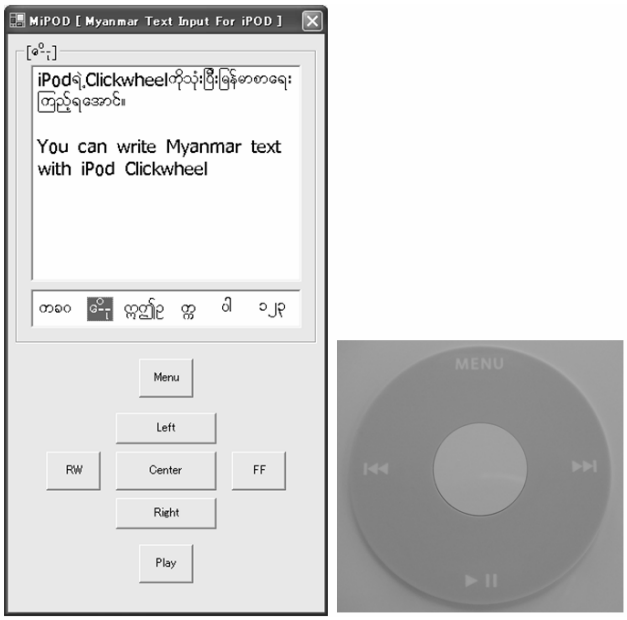

Figure 7 UI for Apple iPOD MP3 Player

In our simulation program, key assignment will be as follows:

Menu Button → back to main menu
RW Button → move to previous characters list / backspace key in main menu
FF Button → move to next characters list /space key in main menu
Left Button → move highlight left
Right Button → move highlight right
Play Button → Enter key
Center Button → select current highlighted characters group or type a character

In this typing method, users need to press more keystroke to get a desired character, because we simulated only one line of small screen space environment for selecting. And in one screen, the system can only show 5 characters. Therefore, the typing speed will go down compared to the above 3 user interfaces.

6. Characters Combinations Error Checking

The important function in selection based Myanmar text input method is "character combinations error checking". Users can make impossible combinations of Myanmar characters when they are typing. Our program supports error checking for impossible combinations. This is like spell-check feature in English. But in Myanmar language, we need to make 2 steps of checking; first is checking of impossible or meaningless combinations (character level) and the second is checking of word level spelling mistakes. In our program, we support only characters combinations error checking. There is no proper spelling checking engine for Myanmar language yet, and we assume that this is not necessary for small computing devices.

An example of meaningless Myanmar characters combinations are "ကျ", "ဒြ", "ငေး", "ဋြ" etc. The meaningful characters and meaningless characters combination can be represented by the following permutation calculation:

$$\sum_{i=1}^{m} {}_{m}C_{i} = \sum_{i=1}^{m} \frac{m(m-1)\times(m-2)\cdots(m-i+1)}{i(i-1)(i-2)\cdots 1}$$

$$\boxed{mf + ml = \sum_{i=1}^{m} {}_{m}C_{i}}$$

Here,
m = total number of Myanmar characters in a word
mf = number of meaningful combination patterns
ml = number of meaningless combination patterns

7. Experiments

7.1 Subjects

To evaluate the performance of our selection based text entry techniques, we made a small user study for all UIs. We recruited 5 subjects, most of whom are university students in Japan. Four are natives (right-handed) and one is Japanese (also right-handed), who are between 23 and 31 years old. All had experiences of using computers, but only one of them had experiences of using game pads. All are touch typists in English (with QWERTY keyboard) but not in Myanmar language. And, the Japanese participant can read and write Myanmar language. No subjects had any prior experience with our UIs.

7.2 Apparatus

We conducted a test in a silent room using a 1.90GHz Intel Pentium 4 Toshiba notebook (Dynabook E8/X19PDE model) running Windows XP with 512MB RAM. Screen size is 15 inch and set to 1280X1024 resolution and 32-bit color. We used four different types of simulation programs or UIs (wheel mouse, game pad, dual joysticks game pad, iPOD) mentioned above. All of the programs are developed with Microsoft Visual Studio .Net 2003, and used DirectInput from Microsoft DirectX Ver.8 for detecting game pad and dual joystick game pad.

7.3 Procedure

Throughout the experiment, we briefly explained the idea of Myanmar character grouping and demonstrated how to type Myanmar text with game pad, dual joystick game pads, FPS Battle Stick and wheel click mouse. Then, we gave 10 minutes practice time for each user to learn how to use game pad arrow keys, joysticks and buttons etc. We recorded the total time spent to type 5 Myanmar sentences (including error correction time), which are very common in daily conversation like "See you later!" We decided to use very simple and short sentences (i.e. not including Pali and stacked words), since our UIs are not designed for long and difficult combinations of text. However, all of the developed UIs allow typing every combination of Myanmar texts.

Table 1 Myanmar Sentences Used in Experiments

No.	Myanmar Sentence	Meaning in English
1.	ကျောင်းသွားမယ်။	I will go to school.
2.	အိမ်မှာရှိတယ်။	I am at home.
3.	စားလို့ကောင်းတယ်။	This is very delicious.
4.	မင်္ဂလာပါ။	Hello!
5.	နောက်မှတွေ့မယ်။	See you later!

8. Results

First of all, we would like to present the experimental results of normal game pad and dual joysticks game pad together, because their input methods are similar.

8.1 Results for game pad and dual joysticks game pad

As a result, the fastest typing speed for 5 Myanmar sentences with "single joystick game pad UI" is 3 min 16 sec and 2 min 50 sec for "dual joystick game pad UI". 5 Myanmar sentences (Table.2) used for this user study is equivalent to 17 Myanmar words and 69 characters (refer Table.1). We found that both of the selection based text entry interfaces are very user-friendly, although the difficulty was that most of the users were not familiar with game pads.

Table 2 Total Time Spent (including error correction time) to Type 5 Myanmar Sentences with Single and Dual Joystick Game pads (only mention fastest typing speed)

Interface	User1	User2	User3	User4	User5
Single	6min17s	6min43s	4min58s	3min16s	7min12s
Dual	6min50s	4min24s	6min08s	2min50s	6min10s

8.2 Results for Wheel Mouse and iPOD UIs

The fastest typing speed to finished 5 Myanmar sentences (Table.2) with "wheel mouse UI" is 5 min 02 sec and 6 min 08 sec for "iPOD UI". Here, we expect the speed for "iPOD UI" can be high if we make experiment with real iPOD device. We plan to make user study with read iPOD device in the near future.

Table 3 Total Time Spent (including error correction time) to Type 5 Myanmar Sentences with Wheel Mouse and iPOD (only mention fastest typing speed)

Interface	User1	User2	User3	User4	User5
Wheel Mouse	5min44s	6min00s	5min23s	5min20s	5min02s
iPOD	7min54s	6min35s	6min08s	6min40s	6min10s

8.3 Questionnaires Results

We conducted a small questionnaire to participants after typing experiments, in order to learn how users feel about the four selection-based UIs. We gave participants four Likert scales (1-5), which rate the 4 entry techniques [4]. Here, the problem is that we don't have a chance to compare with other selection based Myanmar text entry techniques because of their non existence for Myanmar language yet. And thus, we try to make a comparison among our 4 UIs and understand users' experiences. Table.4 is the result of the questionnaire. Labels for scale endpoints are in the most left columns. Higher values are better.

Table 4 Means (and standard deviations) of Likert scales

Likert Scales (range 1-5)	Wheel Mouse	Game Pad	Dual Stick	iPOD
Difficult-Easy	4.2 (0.45)	3.4 (1.14)	4.6 (0.55)	2.8 (0.84)
Painful-Enjoyable	3.8 (0.84)	4.0 (1.41)	4.6 (0.89)	2.6 (0.55)
Slow-Fast	3 (0.71)	3.6 (0.89)	4.0 (0.71)	2.2 (0.84)
Dislike-like	3.4 (0.89)	4.2 (1.30)	4.4 (0.89)	2.4 (0.55)
Average	3.6 (0.72)	3.8 (1.19)	4.4 (0.76)	2.5 (0.69)

9. Discussions

We compared the typing speed of four UIs based on the results of fastest typing speeds of 5 novice users. In this research, we focused only on maximum typing speed of novice users, in order to prove that our proposal of grouping idea with appropriate UI is easy to use even for novice users. And this grouping method can be applied to selection based Myanmar text input effectively, especially for small screen mobile devices. Among four UIs, iPOD UI that uses only one line of screen space is the best example of the fact that our proposal can be used with very small screen mobile devices. Actually, four UIs that we developed and used in our experiments are some possible examples of many alternative UIs. The UI that we experimented with dual joystick game pad makes it possible to finish typing 5 Myanmar sentences (Table.1) in 2 min and 50 sec. But, the typing speed can vary depending on what type of input device is used, how input UI is designed and also how much user-friendly UI is (Figure.8).

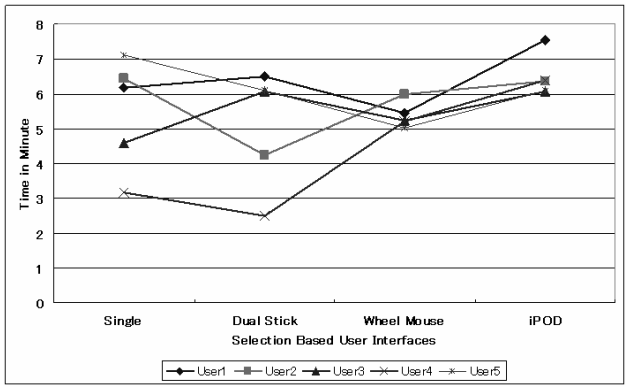

Figure 8 Typing Speed Comparison for 4 UIs
(Lower values are better)

Although we did some typing experiments with FPS Battle Stick, we did not make any user study for Wheel Mouse UI. And we do not mention keystroke per characters for each UI, because all of our UIs are designed for selection based. In selection based input method, most of the keystrokes can be reduced by holding arrow keys. An interesting point is that although we collected frequently used Myanmar words and made as one group (i.e. No. 6th group), most users forgot to use this feature while they were typing. One of the possible reasons is that we didn't urge them to use it when we made an explanation before experiments.

From the questionnaire results, we noticed that most users enjoyed Myanmar text entering with game pads and game pad UIs. And as we had expected, iPOD text entry UIs was difficult for them. This is because Myanmar language has many characters compared to English and also requires many combinations step. Another reason is that we designed to display only 5 or 6 characters in one screen. One of the participants mentioned that "Wheel Mouse UI" design was very impressive because he had never thought that Myanmar language could be typed with a mouse only.

10. Conclusion

We proposed the idea of dividing all Myanmar characters into 6 groups for selection based text entry. We also developed 4 UIs for demonstrative purpose. The experiments proved that our proposal enables appropriate text entry speed and very easy typing. The proposed idea can be applied to Myanmar text typing with small mobile computing devices.

Acknowledgements

This research was supported by Prof. URANO Lab., Graduate School of Global Information and Telecommunication Studies, Waseda University, Tokyo, Japan. We would like to give special thanks to 'Mr. Ye Kyaw Thein' (younger brother of Ye Kyaw Thu) who assisted us in information gathering and experiments.

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