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# Positional Mapping for Bangla Mobile Phone

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## 1. Introduction

Over the last two to three years, the number of mobile phone subscribers in Bangladesh has been more than doubling on an annual basis [1]. Short messaging service (SMS) or text messaging is also becoming popular there. But text typing in Bangla on a mobile phone or 12 keys (0-9, \*, #) keypad is an ambiguous and tedious task. And thus, most of the mobile phone users are sending SMS messages in English today. We believe that easy Bangla text typing method for mobile phone is necessary for the Bangladesh people. From our studies, current key mappings (e.g. AKTEL and our proposed multi-tap [2]) for Bangla multi-tap are not easy to memorize for the novice users and it may lead to slower typing speed. In this paper, we present novice key mapping idea on mobile phone keypad for Bangla. The key mapping is based on the Bangla script writing nature and we called it "Positional Mapping (PM)". PM concept is very simple and easier to memorize. The results of the first user experiments with simulation program prove that novice users can easily to memorize the key assignments and can type Bangla text with appropriate typing speed. Significant merit of PM concept is that it can be extended to other phonetic scripts such as Myanmar, Khmer, Lao, Thai and Indic etc.

## 2. Bangla or Bengali Language

Bangla is the official language of Bangladesh. Bangla scripts being a member of the Indo-Aryan languages, is derived from Sanskrit.

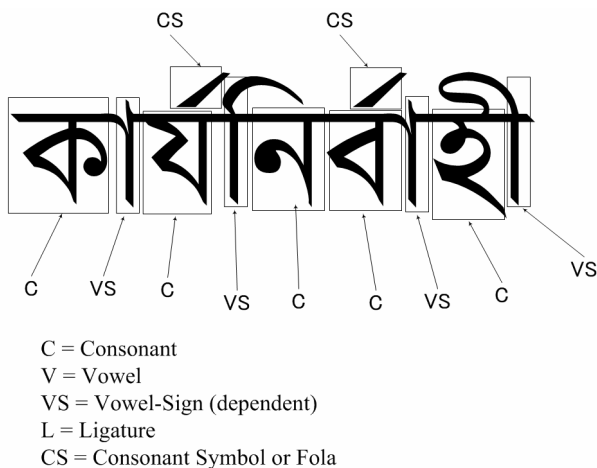


Fig.1 An Example of Bangla word Kaarzanirbaahi (Executive in English)

It consists of 11 vowels, 39 consonants and 10 vowel signs. There are total 60 symbols in total. Moreover many ligatures (conjuncts) and few consonant symbols are also used in Bangla scripts. It is written left to right, top to bottom of page as in English (refer to Fig.1).

## 3. Concept of Positional Mapping

Positional Mapping is a concept of key mapping for mobile phone based on phonetic scripts like Bangla language writing system.

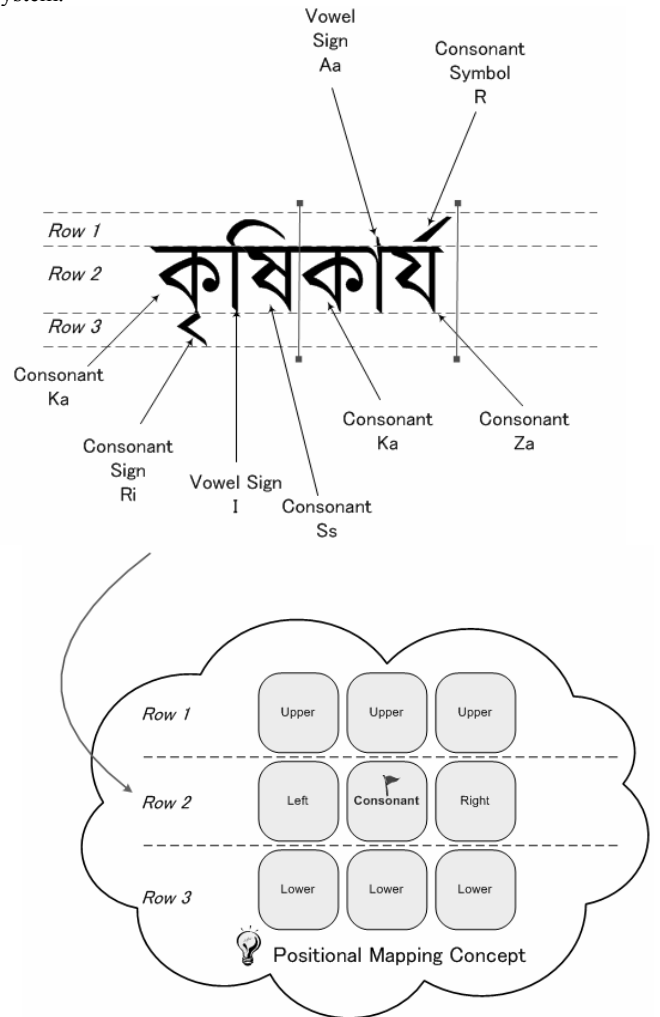


Fig.2 Positional Mapping concept for Bangla mobile phone

When we make an analysis on Bangla sentences, basically we can consider that Bangla characters are written in three levels (upper, middle, lower) and most of them have their defined positions (e.g. Vowel signs "ি", "ে", "ে" should be written in

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the left side of consonants, vowel signs "া", "ী", "ু" (্য়) and consonant symbol "ৌ" should be written in the right side of the consonants, vowel signs "ু", "ু", sign hashant "্" and consonant symbols "়" (্র), "়" should be written as a lower characters and consonant symbol "়" (র) and consonant "়" should be written as upper characters). And for the ligatures or (combine consonants) such as "ক্", "ক্", "ক্", "ক্", "ক্", "ক্", "ক্" are written in the middle like consonants. Taking this into consideration we developed a new concept of characters mapping for the mobile phone keypad.

We divide mobile phone keypad into three rows, e.g. 1, 2 and 3 keys are upper row, 4, 5, 6 keys are middle row and 7, 8 and 9 keys are lower row (refer to Fig. 2). In the middle row, 5 key as the center position, 4 key is seen as the left side and 6 key as the right side. And \*, 0 and # key can be seen as lower row and these buttons can be used for special characters assignment such as ligatures, symbols and frequently used characters etc. Logically, the middle row must not need to be 4, 5 and 6 key. We can adjust according to the language natures and numbers of keys.

**4. Prototype Development**

We developed text input simulation program (refer to Fig.3) for Bangla mobile phone based on the concept of PM. We used Microsoft Visual Studio .Net 2003 for program development.

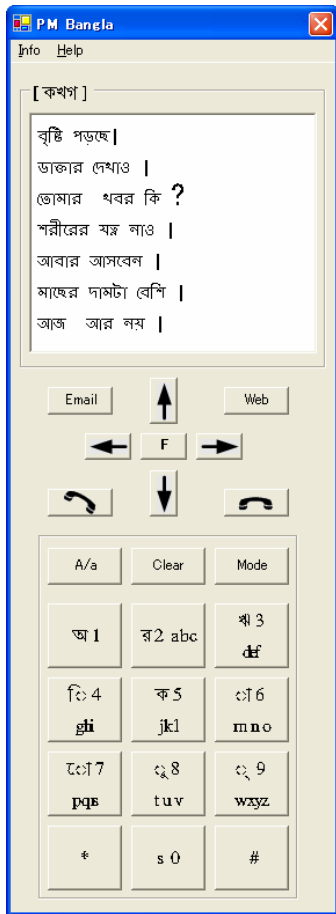


Fig.3 Positional Mapping prototype for Bangla

With this prototype, key mapping can be changed through configuration file (i.e. not only for PM but also for other key mappings). Configuration file is the text file that contains the key assignments for each mobile phone button. This prototype is design for using with various phonetic scripts and we already tested for Myanmar language PM [3].

The detail of mapping for Bangla mobile phone is as follows:

- 1 = অ|আ|ই|ঈ|উ|ঊ
- 2 = ঝ|ঞ
- 3 = ঞ|এ|ঐ|ও|ঔ
- 4 = ি|ে|ৈ
- 5 = ক|খ|গ|ঘ|ঙ|চ|ছ|জ|ঝ|ঞ etc.
- 6 = া|ী|্য|ৌ
- 7 = ো|ৌ
- 8 = ু|ূ
- 9 = ়|্র|়
- 0 = space|enter|
- \* = ক্|ক্|ক্|ক্|ক্|ক্|ক্|ক্|ক্|ক্ etc.
- # = |,|!|?|!|;|:

Fig.4 New key mapping for Bangla Mobile Phone

In this key mapping, number 5 (for all consonants) and \* (for all ligatures) keys are assigned many characters and it will be shown as a list. This may lead to reduce not only user's typing speed but this may also reduce user's spending time for choosing correct keys for desired character as in other models. To improve typing speed we design number 2 key for "Page Up" and number 8 key for "Page Down" functions while the list is shown. And we assign number 7 key for "ো" and "ৌ" characters to avoid choosing left (number 4 button) and right part (number 6 button) separately. Except number 5 and \* keys, all other keys will work as multitap in Bangla text mode. With this PM model we assume that native users can type Bangla text easily even for their first experience.

**5. Experiments**

**5.1 Subjects**

To evaluate the performance of our PM text entry method for mobile phone, we made a small user experiment. We recruited 5 native subjects (between 26-35 years old), most of whom are university students in Japan. All had experiences of using AKTEL multitap and our proposed multitap [2] text input methods in our previous experiments. They use using mobile phone but they send SMS messages in English or Bangla Romanization. The subjects were paid 5000 yen for a 5 hours test in which they entered Bangla text using PM text entry method

and AKTEL multitap. No subjects had any prior experience with PM concept.

## 5.2 Apparatus

We conducted a test in two of our university laboratories using a 1.90GHz Intel Pentium 4 Toshiba notebook (Dynabook E8/X19PDE model) running Windows XP OS with 512MB RAM. Screen size is 15 inch and set to 1280X1024 resolution and 32 bit color. Users were required to use a mouse for text input experiments with two simulation programs.

## 5.3 Procedures

Throughout the experiment, we briefly explained the idea of PM key mapping and Bangla characters assignment on mobile phone. We also introduced AKTEL key mapping with J2ME mobile phone emulator. Then, we demonstrated how to type Bangla text (e.g. type a consonant first, and then combine other left, right, upper and lower characters) and how to edit them with our developed simulation program (e.g. space can be inserted by pressing "Right Arrow Key").

- (1) আঙ্গালানামু আনাইকুম।
- (2) তুমি কেমন আছ?
- (3) অনেক দিন দেখা হয়না।
- (4) ৩০ ০৬ ২০০৭ দুপুর ১২ টায় এসো।
- (5) এই মোবাইলে ০১৭২১৯৭৪৫৩৬ ফোন করো।
- (6) আমি ভাল আছি।
- (7) ভাল থেকে।

Fig.5 Bangla email message

- (76) বৃষ্টি পড়ছে।
- (104) ডাক্তার দেখাও ।
- (22) তোমার খবর কি ?
- (64) শরীরের যত্ন নাও ।
- (16) আবার আসবেন ।
- (46) মাছের দামটা বেশি ।
- (81) আজ আর নয় ।
- (57) দুইটুকি করোনা ।
- (55) গোলমাল করোনা ।
- (40) এখন খাবনা ।

Fig.6 Randomly selected 10 Bangla sentences

Before making record of their typing speed, we gave 10 minutes practice time to each user to learn how to type with our simulation program and AKTEL J2ME mobile phone emulator. After that, we recorded the total time (including error correction time for typing mistakes) spent to type one Bangla SMS message (137 Bangla characters and 26 words) (refer to Fig.5) and 10 messages (121 Bangla characters and 24 words) (refer to Fig.6). These 10 messages were randomly selected by the program from a file which contains 120 sentences of very common daily Bangla conversations. Note that some of the sentences contain ligatures (e.g. line number 76, 104, 64, 57). Finally, we try to get users' evaluations and comments for our PM text input model with follow up questionnaires.

## 6. Results

In this section, we will mention the user experiment results and then make evaluations of our new PM model with AKTEL multitap and our proposed multitap [2]. For the evaluations we will consider keystrokes requirements, typing speeds and users' impressions.

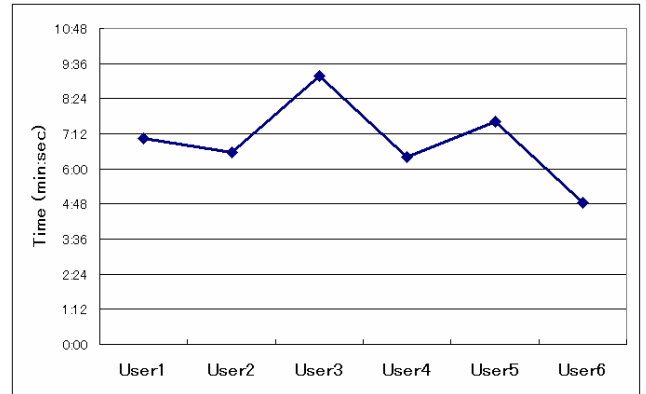


Fig. 7 Typing speeds of 6 users for proposed multitap model

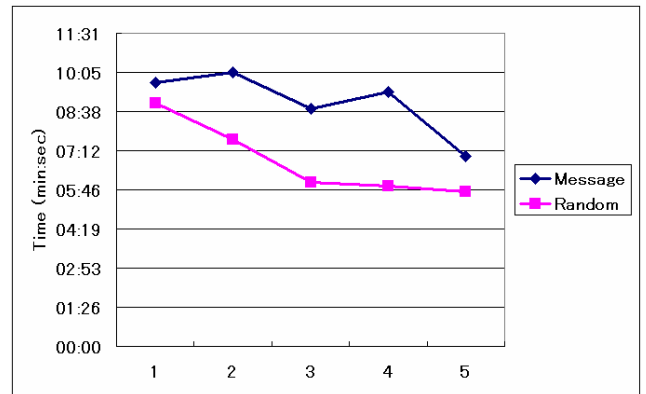


Fig. 8 The record of 5 fastest typing speeds for AKTEL model

According to the results of previous experiments [2], our proposed multitap (or) Reduced Keystroke Multitap allowed over 15 percent higher typing speed than present AKTEL key assignment. And from the current experiments, we found that average typing speed of PM is better than both AKTEL as well

as previous proposed multitap. (refer to Fig.7, Fig.8 and Fig.9)  
The fastest typing speeds from the experiments for "Bangla email message" (refer to Fig.5) are as follows:

- PM = 4 min 17 sec
- Proposed Multitap = 4 min 51 sec and
- AKTEL = 6 min 59 sec

We also made typing speed comparison of "10 random sentences" for PM and AKTEL model. The results are as follows:

- PM = 4 min 59 sec
- AKTEL = 5 min 42 sec

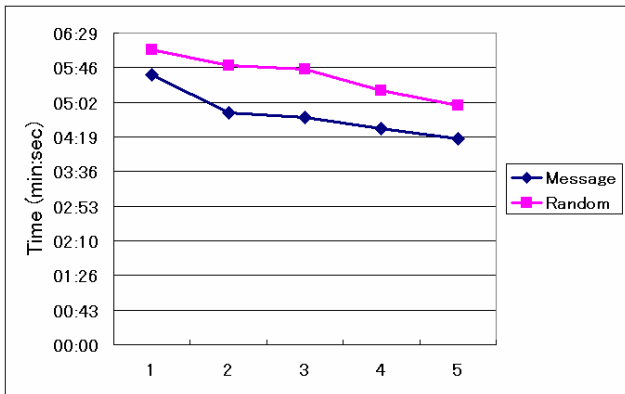


Fig. 9 The record of 5 fastest typing speeds for PM model

From the results of keystroke comparisons for each model (refer to Table.1), our previously proposed multitap is the lowest keystrokes. PM requires a little more keystrokes required than previously proposed multitap and AKTEL requires the most keystrokes.

Table.1 Keystroke Comparison for AKTEL, our proposed Multitap and Positional Mapping

Bangla Text	AKTEL	Our Proposed Multitap	Positional Mapping
Message	545	324	362
10 Random Sentences	446	387	434

Table.2 Users' evaluations for PM text input (here, S1, S2 means Subject1, Subject2 etc. and higher values are better)

Likert Scales (range 1-5)	S1	S2	S3	S4	S5	avg
Difficult-Easy	3	5	4	5	4	4.2
Painful-Enjoyable	3	4	3	5	4	3.8
Slow-Fast	4	3	3	3	5	3.6
Dislike-Like	4	4	4	5	4	4.2

We conducted a small questionnaire to subjects after typing experiments in order to learn how users feel about the PM model. (refer to Table.2) We gave subjects four Likert scales (1-5), which rate the PM model. Here, the problem is that all of our experiments are held by simulation models and the subjects' impressions are very much depend on programs' user interfaces and input devices (e.g. mouse and buttons' size etc.). From the overall average results, subjects' impressions or evaluations for PM is very good (refer to Table.2) and we assume that PM concept can be apply in a real world.

## 7. Discussion

From the experiments, we noticed that "Positional Mapping" approach is good key mapping interface. User can get accustomed to this key mapping within 5 minutes. On the other hand, assigning many characters on the number 5 key and \* key lead to reduce typing speed. Many users suggested improvement on this, and we should consider it for the next model. However, average results from the experiments with current PM model were satisfactory.

## 8. Conclusion

We proposed the new idea of key mapping for Bangla mobile phones based on Bangla characters writing positions. We also developed simulation program to make comparison with other mobile phones text input models. The experiments proved that our proposal enables appropriate text entry speed and very easy typing even for the first time users. The proposed idea can be applied not only to Bangla language but also for other phonetic scripts such as Myanmar, Thai, Khmer and Hindi etc. We are planning to make user experiments with real mobile phones in the near future.

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