Improvised Layout of Mobile Keypad for Filipinos

Gecynth Namo, Jung-hwa Lee and Hong-won Yun, *Member, KIMICS*

***Abstract*—Filipino language is an Austronesian language based on numerous native languages with influences from other major languages such as English and Spanish. The Filipino alphabet is consists of 26 English alphabets, with the addition of two letters, "ñ" and "ng", a total of 28 letters. Filipino language expressions and sentences are still incomparable to English and Spanish even though there are numerous borrowed words from these languages. This study aims to discover the uniqueness in the Filipino language by identifying the frequencies of the letters in common words used and be able to introduce a revolutionary keypad for the Filipinos which is scientifically efficient. To compare the efficiency of the revised and the original keypad, computations using Fitts' Law, Hick-Hyman Law and KSPC were done. Results showed that the new keypad layout was more effective than the original keypad. Introducing a improvised keypad to the Filipinos is one step closer in achieving customized services and features to Filipinos in mobile computing.**

***Index Terms*—Mobile Keypad for Filipinos, Filipino Alphabets, Improvised Keypad, Mobile Computing.**

I. INTRODUCTION

"The Text Capital of the World" and "The most Savvy Mobile Phone Users" [1] are the two titles given to the Philippines and the Filipinos. This is because of the way Filipinos interact with their mobile phones. Compared to other nationalities, Filipinos rely heavily on their phones for communication rather than using the internet. With these same reasons, this study is developed to make a major contribution in enhancing the keypad of the cellular phones of the Filipinos [2].

The primary goal of this paper is to develop an improvised keypad for the Filipinos using the 12 button mobile phone layout. This study will find out the unique characteristics of the Filipino language and be able to present an effective keypad layout that is advantageous to the Filipinos. Another objective of this study is to pinpoint the most convenient positions of the keys in a 12 – button mobile phone. In order to achieve the first goal, a program is created to scan the articles collected and count the frequencies of the letters. The second goal can be achieved by conducting a random survey to respondents using 12 – button cellular phones. To present valid arguments, Fitts' Law, Hick-Hyman Law and KSPC theories are used to compare performances of the proposed keypad and the commonly used 12 – button keypad [3]-[5].

Thus the objectives of this study can be stated as: "the development of improvised 12 – button keypad for the Filipinos based on Filipino alphabet frequencies and survey results." Improvement on the arrangement of Filipino keypads opens the floodgates to innovations that would focus on distinctly Filipino. This study focuses on the distinct frequencies of the Filipino Alphabets. The survey results presented are valuable information on preferences of users with regards to cellular phone's keys layout. These information may serve as reference to further studies on the ergonomics of the 12 – button keypad positioning. In the future, this study can be used to design input devices that would be the basis of creative gadgets customized for Filipinos.

II. BACKGROUND OF THE STUDY

A. Background of the Philippine Language

The country is composed of 7,100 islands, with over one hundred distinct languages. Few of these languages are Ilocano, Pangasinan, Pampango, Tagalog, Bicol, Hiligaynon, Cebuano, and Waray – Samarrnon. The Filipino alphabet is composed of 28 letters, 20 of these are based on the Pilipino ABAKADA. These are a, b, k, d, e, g, h, i, l, m, n, ng, o, p, r, s, t, u, w, and y. The other 8 additional letters come from two languages, English and Spanish. These are c, f, j, ñ, q, v, x, and z [6].

Characteristics of the Filipino language being emphasized in this study are focused on things that are important in designing the keypad. These are characteristics that focus on the patterns of letters found in most of the Filipino words used in daily conversations and expressions. It has been discovered that the vowel "A" is the most used letter in the Filipino language followed by the letters "I" and "O". Furthermore, the consonant "N" is the most frequently used consonants followed by the letters "G" and "S". In terms of the least used letters in the Filipino alphabet, these are the letters "X", "J" and "Ñ". It has been observed that words containing these letters are

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Gecynth Namo graduated the Department of Computer and Information Engineering, Silla University Graduate School, Jung-hwa Lee is with the Department of Computer Software Engineering, Dongeui Univesity, Hong-won Yun (Corresponding Author) is with the Department of Information Technology, Busan, 617-736, Korea (Email: hwyun@silla.ac.kr)

often proper nouns or borrowed words from different languages. In terms of letter combinations, the most common letter combinations in Filipino words are "AA", "AN" and "NG". It is already known that the Filipino alphabet has the letter "NG". Therefore, it is assumed that this the reason why the letter combination "NG" belongs to the top 3 most commonly used letter combinations among Filipinos [7].

B. Researches on Enhanced Mobile Phone Keypad

Many articles discussed the importance of the input scheme in a mobile phone. A study of Mittal and Sengupta [8] proposed an optimized layout for keypad entry system in multi – tap mode [9] that can compete with the less - tap mode [10]. The keypad layout was developed with the assumptions that no errors are committed during the encoding, no ambiguity and all words used are from the dictionary. One of the many considerations in designing the said keypad was the probability of the commonly used letters in English alphabets. This method is similar to method of the researchers from the International Islamic University Chittagong. Evaluation tools used were theoretical evaluations and user testing. Theoretical evaluations include KSPC, WPM, DA and OM [8] while user testing was done through simulated software.

Evaluation tools are presented in many articles on cellular phone keypads. The most popular evaluation tools are Fitts' Law, Hick – Hyman Law, keystrokes per character (KSPC), Disambiguation Accuracy (DA) and Optimization Metric (OD). Fitts' Law is a quantitative model for rapid, aimed movements [11]. Fitts' law is a tool used for expert users. In this way, the movement is direct with no additional overheads. On the other hand, Hick-Hyman Law considers the reaction time thus becoming the basis for lower – limits of movement time per character [12]. Keystrokes per character or KSPC refers to the number of strokes required to generate a character of text for a given text entry technique in a given language [13]. Disambiguation Accuracy indicates the fraction of times in which the word with the highest frequency of occurrence is the one intended by the user and can only be applied to methods using the dictionary. The last evaluation tool is the Optimization Metric (OP), a balance between KSPC and DA [8].

III. DESIGN OF THE MOBILE KEYPAD FOR FILIPINOS

A. Analysis of Preferred Keypad Positions

The subjects were randomly chosen and were given a questionnaire containing a table as a representation of the keypad numbered from 1 to 12. The respondents were clearly instructed to rank the keypad positions based on their preferences.

The table below (Table 1) shows the actual results generated in the survey. Numbers are expressed in percentage by dividing the actual results to the total number of respondents. The ranking column represents the rank of the keypad that had the most number and the percentages represent the percent of the total number of votes of the keypad position from the survey.

TABLE 1
RESULTS OF THE SURVEY

Ranking	Keypad	Percentage
1st	1	22%
2nd	5	14%
.....		
11th	11	14%
12th	8	6%

The results show the 22% of the respondents chose the keypad number 1 as the most convenient position of the keypad. Convenience is defined as the easiest position to press and reach in the cellular phone keypad. 6% of the respondents thought that the key number 8 is the most inconvenient among all the keys preceded by the keypad 11 that got 14% of the total number of respondents. Table 2 shows the ranking of the places based on the results of the survey.

TABLE 2
RANKING OF THE KEYPAD POSITIONS

1st	4th	3rd
5th	2nd	6th
7th	12th	9th
8th	11th	10th

The key located at the top – leftmost of the keypad (Number 1) is the most convenient place to respondents followed by the key located at the middle column and the second row of the key (Number 5). The 12th position or the least convenient of all keys belongs to the key at the middle column and the third row of the keypad (Number 8).

B. Frequencies of Filipino Alphabets

Table 3 shows the results of the frequencies of each character generated from 500 articles. The first column of the table represents the Filipino Alphabets, the second column represents the total number of occurrences of the given character and the third column represents the percentage of the frequencies from the total number of characters present. Percentage is computed by dividing the total number of occurrences to the total number of characters. The Table 3 is sorted in descending order based on the frequency.

TABLE 3
FREQUENCY – COUNT RESULTS

Letter	Frequency	Rate	Letter	Frequency	Rate
[space]	147,057	17.7984	y	17,999	2.1784
A	142,926	17.2984	k	17,665	2.1380
.....					
U	20,093	2.4319	j	359	0.0434
P	18,878	2.2848	ñ	144	0.0174

Based on the table, the letter "A" got the highest frequency with the rate of 17.3% followed by the letters "N" with the rate of 10.7% and letter I with 6.8%. The three bottom - most letters are "X", "J" and "Ñ" that got rates of .05%, 0.04% and 0.02% respectively.

Table 4 shows the top ten two–letter combination results for the frequencies of two characters (digraphs). The first column represents the letter-combination (digraph), the second column represents the total number of occurrences of the two letters and the third column represents the percentage of the frequencies from the total number of combinations present. Percentage is computed by dividing the total number of frequencies to the total number of characters. The top two digraphs based on the Table4 are *aa* and *an* with rates of 2.06% and 1.94%.

TABLE 4
TOP TEN TWO – LETTER COMBINATIONS

Two_Letter	Frequencies	Rate
Aa	68,037	2.06%
An	64,112	1.94%
.....		
Ai	25,063	0.76%
Pa	22,921	0.69%

C. The Proposed Keypad Layout

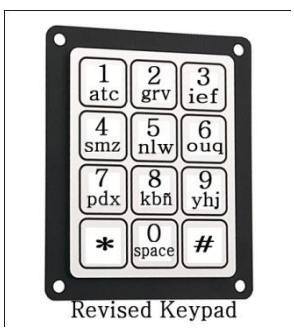

Fig. 1 The revised Keypad

The positions of the letters are in accordance to the rankings of the survey results. The first key position from the survey is the top – most and left – most portion of the key or the number 1. In the revised keypad, the letter with the top most priority, the letter "A" is situated in the above – mentioned key. The second key position based on the survey is the number 5, where the letter "N" is situated, and the second letter in the frequency results. The processes of placing the letters "I", "G", "S", and "O" into their designated key positions are the same to the processes used for letters "A" and "N", which are based on the survey results. The proposed keypad is a multi-tap keypad. It takes two or more taps to enter a certain letter, basing on letter's position in the keys. The letters "T", "L", "E", "R", "M" and "U" are positioned as second letters to key numbers 1, 5, 3, 2, 4 and 6. The upper portion of the keypad is more convenient to use than the lower part. The survey only covers the single key positions, not considering the multi-tap theory. However, it is evident in the survey that users preferred the upper keys than the lower keys, basing on the rankings of the key positions. Letters "P"/"D", "Y"/"H" and "K"/"B" are placed on the keys numbered 7, 9 and 8 respectively. The remaining letters of the frequency counts serve as the third letters from keys 1 to 9. The arrangements of these letters are still based on the survey rankings. Symbols like asterisk, pound sign and space are positioned on the last 3 keys of the mobile phone, common to almost all mobile phones nowadays. These positions are included in the survey to minimize confusions among the respondents.

IV. EXPERIMENTAL RESULTS

A. KSPC Results

The results show that KSPC of the revised keypad is smaller than the original keypad, therefore, nearly efficient as to that of the actual QWERTY keyboard. The test materials were chosen randomly, with 2 sets containing words coming from the actual articles used to get the frequency of the characters from the previous tables. The Table5 below shows the results of 2 tests on the original and revised keypads. Test1 is consisted of 24 words gathered from the 500 articles collected from the online newspaper while Test2 is consisted of 19 words. Each test is composed of 5-letter words for uniformity purposes. These tests contain words that are commonly used by Filipinos in text messaging.

TABLE 5
RESULTS OF KSPC TESTS

Keypad	Test1	Test2
Original Keypad	1.7958	1.8772
Revised Keypad	1.4407	1.3632

B. Upper Bound Results

Table 6 shows the results of the computation done. It shows that the revised keypad has the higher upper bound than that of the original keypad. In Test1, the original

keypad has the result of 37WPM while the revised keypad has a higher result of 42 WPM. In Test2, there was a difference of 8 points in terms of WPM in favor for the revised keypad with 40 WPM. According to Fitts' Law, these figures are slightly higher than the actual results .

TABLE 6
RESULTS FOR THE UPPER BOUND

Type of Keypad	Test1	Test2
Original Keypad	8.26	8.48
Revised Keypad	8.81	9.02

C. Lower Bound Results

Table 7 shows us the lower bound results of tests 1 and 2. These are the same tests used for the upper bound results using the Fitts Law. On the other hands, these results were computed using the Hick – Hyman Law. Based on the figures below, the original keypad has lower figures than the revised keypad. This means that the user types lesser words compared to the revised keypad with higher words per minute. The same is true to the results of test number 2.

TABLE 7
RESULTS FOR THE LOWER BOUND WPM

Type of Keypad	Test1 (WPM)	Test2 (WPM)
Original Keypad	37	32
Revised Keypad	42	40

IV. CONCLUSIONS

Numerical results show that improvised layout of the keypad is more efficient than the common keypad used in the Philippines. By computing the number of keystrokes per character, it is evident that lesser strokes and lesser time are needed to encode text messages using the improvised keypad. The average KSPC of the improvised keypad is 1.40 compared to the average of the original keypad which is 1.84. The same indications are given by the results of the Upper Bound and Lower Bound computations. The Upper – Bound computations show that the improvised keypad is better since it has the average of 41WPM compared to the average of the original keypad which is only 35. In addition to the results of KSPC and Upper – Bound computations, the Lower – Bound results reinforce the same idea that the revised keypad is better than the original keypad. The improvised keypad lower – bound average is 8.915 compared to the average of the original keypad which is 8.37.

This study presented an improvised keypad designed only for the Filipinos. The design process started with a survey to 154 random respondents. Collection of Filipino articles from an online newspaper was conducted to form the corpus of this study. Analysis of the results of the survey and experimental tests on articles collected were done to obtain necessary results in designing an improvised keypad. After the layout, several theories were used to compute for the different performance metrics of both the improvised and existing keypads. Comparisons of the results were presented to show the differences. KSPC results show that it takes more strokes to input texts into the mobile phone using the original keypad than that of the revised keypad. Moreover, more words or texts can be entered per minute using the improvised keypad than that of the original keypad as shown by the results of the computations of Lower – Bound and Upper – Bound. Therefore, the improvised keypad is more time-saving compare to the available keypads in the Philippines. Introduction of an improvised input device such as mobile phone keypad has a great impact on the amount of time spent by Filipinos in text messaging. This study contributed largely on the discovery of the frequencies of the Filipino alphabets. Most Filipinos would be surprised to the fact that even though many of the Filipino words and expressions are from English and Spanish Languages, we still have letter frequencies or patterns that are distinctly Filipino.

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Gecynth Torre Namo graduated a Masters Degree of Silla University, Busan, South Korea. She completed her B.S. Degree Major in Computer Science from University of Saint La Salle, Philippines last March, 2001.Her research area includes database.

Jung-hwa Lee
received his B.S. and the Ph.D. degrees at the Department of Computer Science from Pusan National University, Korea, in 1995 and 2001, respectively. He is a professor at the Department of Computer Software Engineering, Dongeui University in Korea. His research interests include database and semantic web.

Hong-won Yun
He received his B.S. and the Ph.D. degrees at the Department of Computer Science from Pusan National University, Korea, in 1986 and 1998, respectively. He is a professor at the Department of Information Technology, Silla University in Korea. His research interests include temporal database and semantic web.