Predictive Text for Mobile Devices with Reduced Keyboards

Olivier CHADENAT and Thibaut RABALLAND

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INTRODUCTION

Nowadays most people in developped countries uses a mobile phone and its SMS fonctionnality to communicate with friends, family or co-workers. The topic of this document is to have a eye on the predictive input functionnality of the recent cellphones .

To begin with, we are going to explain why the need of finding solutions for typing fast text on mobile devices appeared. Secondly, we are going to talk about the different kinds of solutions to write SMS and then to detail some predictive softwares for typing text. To finish with, we will compare the efficiency of the process of typing predictive text in different commercial solutions.

1 Why this need for solutions for typing text ?

1.1 SMS has become very popular

Users of digital mobile phone are welcoming more and more text-based services directly accessible with the small keyboard of their phones. Among others you find: Short Message Service (SMS), notes or reminders, schedule, chat, mail and web access through the Wireless Access protocol : WAP...

Short Message Service (SMS) or text messaging was created as a mean to send text-based messages to mobile devices. Since its creation in 1992, the market has rapidly expanded. In fact, traffic has dramatically increased from 4 billion messages per month in early 2000 to more than 20 billion messages per month today - a growth rate of nearly 10 percent per month since early 2000.

The trouble is that, although many services require text input, most of the phones offer only reduced keyboards. In fact, if the reduced keyboard is sufficient to type a telefon number, it is difficult to type SMS; but for ergonomy and design reasons, only few phones are available with a full QWERTY keyboard.

1.2 Keyboard are too reduced to type quickly and handy

There are only between 12 and 15 keys for numbers and letters on a mobile phone keypad (ISO/IEC 9995-8 1994). So it's not really designed for writing all the different numbers and letters you need when you write e-mail or a note in your diary. These 12-15 keys must cover the 26 letters of the alphabet (for the english or french people for instance) and all of the punctuation and numerical characters. For these reasons, each key is overloaded so that, for example, the key 2 is mapped to A,B and C (Figure 1) and some special characters. This overloading creates a need for methods that allow the user to specify which letter of a particular key they want when it is pressed. For the previous example, if a user presses the key 2, the mobile phone does not know whether the user wants an A, B or C. Several methods have been implemented to solve this ambiguity problem.

1 ’_ .	**2** ABC	**3** DEF
4 GHI	**5** JKL	**6** MNO
7 PQRS	**8** TUV	**9** WXYZ
* next	**0** .	# space

Figure 1: Example of a mobile phone keyboard

2 Different existing solutions apart predictive input

2.1 Multi-press with timeout

The multi-press with timeout technique uses a fixed timeout to decide when a user has finished cycling through letters on a key. Once the user presses a key a timeout starts and if the same key is pressed before the timeout expires (usually 1-1.5 seconds), the interface will cycle through the letters available on that key. For example, to enter ‘ABC’, the user must press the ‘2’-key, then wait for the time-out to expire. They then press the ‘2’-key twice, where the two presses are separated by less than the timeout interval. Once the timeout has expired, they must press the ‘2’-key three times where the time gap between each pair of presses is less than the timeout. In other words, ‘ABC’ can be entered using the key sequence 2-22-222 where a dash signifies waiting for the timeout to expire.

2.2 Multi-press with following key

The multi-press with next button technique replaces the timeout with a ‘next’ button. Instead of waiting between successive letters, the user presses the next button to signify that they have finished cycling through letters on that key. To enter the string ‘ABC’ the user would have to press the following key sequence: 2 ‘next’ 22 ‘next’ 222.

2.3 Long-press

The long-press technique works the same way than the multi-press with timeout, except that you don’t press multiple times the key, but one long time. The available characters for this key cycle on the screen, and you release the pressure when you obtain the wanted key. This technique is a bit slower then the first one.

2.4 Two Keys

The two-key method takes a substantially different approach. Instead of cycling through letters on a key, two key presses are used, where the first press indicates the desired key and the second press identifies the position

on that key. For example, the letter 'N' is on key '6' at the second position, so the user would press '62'. Likewise, a 'G' would be entered using '41' ('4'-key, first position). This technique means that every letter takes exactly two presses to enter, unlike multi-press where the number of presses ranges from one to three (or more for punctuation). Two-key, however, is not suited for entering punctuation or special characters, as the user needs to be able to see all the letters mapped to each key in order to determine the position of the key they desire.

2.5 Block letters and special characters

The constructors have chosen many different ways to choose between capitals letters or normal ones. For example, with the multi-press with timeout method in motorola phones, you press a character key a long time to switch between modes. With some sagem phone with a long-press technique, you have a special key like # for switching.

2.6 Abbreviating words

People can abbreviate words when sending text messages. It is a kind of laziness and there's no real need when so many new mobile phones have predictive text input. So using text abbreviations by now is only an affectation - and a rather droll one (Table 1)

Abbreviations	2morrow	CU l8r	PLZ 4GV ME
Mean	tomorrow	see you later	please forgive me

Table 1: Some examples of ridiculous abbreviations

2.7 Stylus input

The stylus is a kind of pen which is used with [1]PDA. It is a good hardware solution . The user writes his message on a tactile surface and it is interpreted by a characters recognition software.Although it is very fast to write with a stylus, the user must learn how to write in order the software recognizes the characters.

[1]Personnal Digital assistant like Palm or Pocket PC

3 Predictive text input

3.1 What is predictive text input?

3.1.1 Definition

Predictive Text Entry, also know by the most popular type, T9, allows you to enter text by pressing only one key per letter. As you enter a word, the phone will automatically compare all of the possible letter combinations against a built-in dictionary of words, and determine which word you intended to type. If it guesses incorrectly, you can scroll through other possible words without re-typing the word.

3.1.2 Word completion

The word completion is often a useful functionnality. Most of predictive text software offer this option. It consists in completing a word when the user has entered only a part of the word. For example, if the user begins to enter HELL the software completes by adding a O to form the word HELLO. The word completion doesn't always work efficiently. Indeed, for instance, if the user wants to write the word COMPLETE, with the alcatel oneTouch 301, he must type COMPLET before the software suggests him the whole word.

3.1.3 Statistical informations on the probability of words

Let's take the following sentence : "I have already eaten". If we focus on the second word i.e. HAVE, for the combinaison 4283, we can have the following words: GATE, HAVE, GAVE, HATE (without using word completion). If the software uses statistical information on the probility of words, the first word it is obviously going to suggest is HAVE. Concerning the alcatel onetouch 301, we can guess that it does not use statistics since the proposed word is GATE.

3.2 Other functionnalities

Most of available sofware offer the possibility of personalizing the database. You can add new words like proper names for instance.

3.3 Comparison between the actors of the market

There are not a lot of companies on the market of predictive text software (Table 2). Tegic[2] with his software T9[3] is the indisputable leader.Eatoni[4] is an important challenger.Some mobile constructors as Motorola with his own software iTAP developped their own software

It is important to notice that these different software haven't got the same performances (Table 3).

Concerning the Alcatel onetouch 301, we can guess that it does not use statistics but alphabetical order.

Software	T9	iTAP	LetterWise
Compagny	Tegic	Motorola	Eatoni
Client	Nokia, Ericsson	Motorola	Siemens,Philips Panasonic

Table 2: Comparison of software chosen by different companies

Word wanted	**Nokia** (T9)	**Motorola (iTAP)**	**Alcatel 301**
have	have	have	gate
hand	hand	hand	game
summer	summer	summer	runner
rare	rare	rare	rape

Table 3: Examples of the proposed word for the same input

3.4 The mathematical theory

Most of the predictive text software may be modelled as a stochastic finite-state machine, in particular, a tree with probabilities corresponding to frequencies observed for words and their prefixes in suitable corpora.Finite state machines are a model to describe complex objects or systems in terms of the states they may be in. In practice they can be used to create regular expressions,scanners or other program code.

A sharper definition would be :

> A model of computation consisting of a set of states, a start state, an input alphabet, and a transition function that maps input symbols and current states to a next state. Computation begins in the start state with an input string. It changes to new states depending on the transition function. There are many variants, for instance, machines having actions (outputs) associated with transitions (Mealy machine) or states (Moore machine), multiple start states, transitions conditioned on no input symbol (a null) or more than one transition for a given symbol and state(nondeterministic finite state machine), one or more states designated as accepting states (recognizer), etc.

To obtain more information about it, you can read this article [5].

3.5 The results

We decided to complete the results for input obtained by a research team [6] by including our own results concerning predictive text. We also included results with stylus input.

For this test, words are composed of 5.98 characters in average.

Methods	Words per minute
Multi-press input with a next button	7.2
Multi-press input with timeout	6.4
Two-key	5.5
Predictive text	16.9
stylus	18.7

Table 4: Results in words per minute

3.6 There is still a lot of progress to make

3.6.1 How to improve the software ?

The problem is to reduce the ambiguity degree in order to suggest the word that the user wants : The ambiguity degree of a key sequence is the number of different words that map to that sequence.(Table 5) presents some examples without using word completion.

Key sequence	Ambiguity degree	Propositions
2256	1	calm
2355	3	bell,belt,cell
4283	4	gate,have,gave,hate

Table 5: Some examples of ambiguity degree

3.6.2 Grammatical analysis

For example,we can take the same example : "I have already eaten". When the user validate the word I, the sofware can suppose that the following word would be a verb and propose HAVE instead GATE. This improvement can be use at the same time that the statical informations on the probability of words for best results.

3.6.3 Lexical analysis

When we enter a SMS, we may make mistakes and so waste time. The software could include a lexical analysis program which corrects the errors.

3.6.4 Speech recognition

The best solution would be to use speech recognition. The current hardware in the mobile phones does not quite allow to consider this solution because of the need of large memory and sufficient performances. It will not be in the spirit of the SMS because SMS allows you to write whenever and wherever you want...and quietly.

CONCLUSION

Predictive text input is an interesting improvement. SMS are easier to write but it is not still very handy. Mobile phones offer more and more options or services. Their capabilities will increase even more when the 3G mobile phones will be created. The mobile phone will then be very close to a PDA (Personal Digital Assistant) and the keyboard, even by using predictive text software, will not be sufficient. At this time, the issue could appear to be a hardware solution like a stylus combined with a predictive text sofware.

References

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[3] http://www.t9.com/

[4] http://www.eatoni.com/

[5] Mickel L.Forcade : *Corpus-based stochastic finite-state predictive text entry for reduced keyboard*

[6] Lee Butts and Andy Cockburn : *An evaluation of mobile phone text input methods*