

Lolo Language Input Method

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Overview

This article describes how to input Lolo language (彝語) using a standard keyboard. Two keystrokes are required to enter one phonetic syllable using Lolo Pinyin. The phonetic syllable is then converted to standard Lolo.

This article focuses on our design of the input method and how the user can memorize the keyboard layout.

1. LOLO LANGUAGE

1.1 Overview

The Lolo language is spoken by just over 6.5 million (1990) hill people dwelling near the Chinese and Indochinese borders.

The language referred to in this article is standard Lolo defined in the "Sichuan Standard Lolo Letters Proposal (四川彝文規範方案)," whose implementation was approved by the Chinese State Council in 1980.

Lolo consists of 1102 phonetic syllables. Phonetic syllables take two forms - -an initial consonant, vowel, and tone, or a vowel and tone only - - and are

referred to as Pinyin symbols. Pinyin symbols, which are used only for reading the language, are written using the English alphabet (a to z). Pinyin symbols are not used in actual Lolo text.

The relationship between Lolo characters, which are used in text, and Pinyin symbols is similar to that between Japanese phonetic characters (KANA) and the letters of the English alphabet (Table 1). Both Lolo characters and Japanese phonetic characters represent complete syllables, and do not represent only part of a syllable such as a single consonant.

Table 1 Example of Lolo characters and Pinyin symbols

Lolo character	Pinyin symbol
𑄎	fu (fu, high tone)
𑄏	fu (fu, rising tone)
𑄐	fu (fu, normal tone)
𑄑	fup (fu, descending tone)

1.2 Features

A syllable has three sound characteristics:

1. The consonant can be voiceless or voiced.
2. The vowel can be lax or tense.
3. The tone can be high, rising, normal, or descending.

1.2.1 Distinction between voiceless and voiced consonants

Lolo has 43 consonants - - 21 voiceless and 22 voiced (Table 2).

Table 2 Lolo consonants

Voiceless	Voiced	Voiceless	Voiced
b	bb	zh	rr
p	nb	ch	nr
hm	m	sh	r
f	v	j	jj
d	dd	q	nj
t	nd		ny
hn	n	x	y
hl	l	g	gg
z	zz	k	ng
c	nz		ng
s	ss	h	w
		hx	

1.2.2 Distinction of lax and tense vowels

Lolo has the 5 lax and 5 tense vowels listed in Table 3.

Table 3 Lolo vowels

Lax	Tense
y	yr
i	ie
o	uo
u	ur
e	a

1.2.3 Tone types

Lolo has 4 tone types. A tone is represented by the Pinyin symbol following the vowel in a syllable (Table 4). No symbol is added for the normal tone, which is the most frequently used.

Table 4 symbols representing tones

High	t
Rising	x
Normal	no symbol
Descending	p

2. PROBLEMS WITH CONVENTIONAL INPUT METHODS

2.1 Overview

Lolo is conventionally input using Roman characters. That is, the user inputs Pinyin symbols using English letters. These are then converted to Lolo characters by pressing the conversion key or automatically. This method presents the following problems, however:

1. A large number of keystrokes
2. A time delay for conversion

2.1.1 Large numbers of keystrokes

Some Pinyin symbols require two English characters to represent the consonant or vowel (Tables 2 and 3). The number of keystrokes required to enter a phonetic syllable can thus be as high as five - - a two-character consonant, a two-character vowel, and a one-character tone.

2.1.2 Time delay for conversion

The characters p, t, and x are used for both consonants and tones depending on the position (Tables 2 and 4). In automatic conversion, when one of these characters is keyed in following a vowel, it cannot be immediately determined whether it is a tone or a consonant until the next character is keyed in. If the next character is a consonant, then the last character represents a tone; if the next character is a

vowel, a consonant is assumed. Pinyin symbols are thus converted to Lolo characters after each symbol is determined to have been entered.

2.2 Solutions

To solve the problems discussed above, we developed a method in which phonetic syllables can all be entered using only two keystrokes. That is, all consonants are represented by a single keystroke and all vowel - tone combinations by a single keystroke. This would also solve the problem of knowing whether certain characters such as (p, t, and x,) were a tone or consonant.

3. INPUT METHOD CONVENTIONS

3.1 Overview

The following rules govern input:

All syllables are input using two keystrokes. The first keystroke represents the consonant or lack thereof. The second keystroke represents the vowel and tone.

A special key was designated to mean that there is no consonant in the syllable. All syllables thus require exactly two keystrokes.

3.2 Problems

In our input method, 44 keys - 43 consonants plus the no-consonant key - are required for consonant entry and 40 keys - 10 vowels multiplied by 4 tones - for vowel - tone entry.

A problem occurred due to the new key placement, however. With standard entry using English characters, the keys are in the same positions as a QWERTY keyboard and only 26 positions need to be memorized. With our system, 84 positions must be remembered. The tradeoff is that, to reduce the number of keystrokes, more key positions, must be

memorized.

3.3 Solutions

We studied Lolo sound characteristics to arrange the keys more efficiently. By sound characteristics, we mean the distinction between voiceless and voiced consonants, the distinction between lax and tense vowels, and the tone types summarized in Section 1.2.

For example, if the pairs of voiceless and voiced consonants in Table 2 are assigned to the same key, one of the consonants could be entered with a single keystroke and the other consonant with a shift key and keystroke.

This would almost cut in half the number of key positions that need to be remembered.

Next, we assign the shift key to the less frequently used consonant for each pair. This would allow the most frequently used consonants to be entered with a single keystroke.

Care must be taken in the design to ensure easy use of the shift key.

4. EXAMPLE OF INPUT KEYS AND KEY POSITIONS

4.1 Internal Implementation of Dual - Purpose Input Keys

A Lolo syllable is always input by a keystroke for the consonant and a keystroke for the vowel - tone.

A flag is provided in the input processing program to determine whether the input is a consonant or vowel - tone. When the flag is off, the input is a consonant; when the flag is on, the input is a vowel - tone. Each time a valid key is pressed, the flag is toggled between off and on and vice versa (Figure 1).

Using the flag enables the keys for consonant input and vowel - tone input to be combined, thus

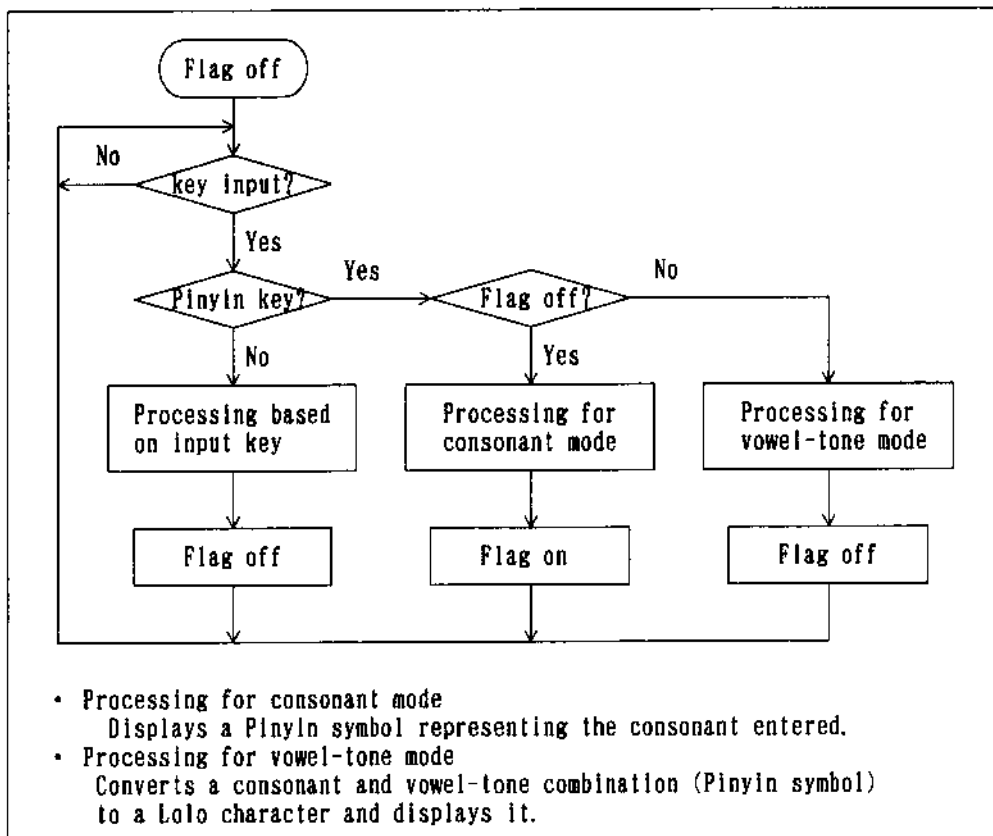


Figure 1 Internal processing using dual-purpose input keys

decreasing the number of keys used.

4.2 Examples of Input Key Arrays

Designing a keyboard should take frequency statistics into consideration. Since these statistics are not readily available for Lolo, they are not presented here.

For this reason, we have introduced a Lolo input method that uses a modified key array originally used to input Mandarin Chinese. Symbols common to Chinese Pinyin and Lolo Pinyin are assigned to the same key wherever possible. This enables a person familiar with inputting Chinese Pinyin using the key array in Figure 2 to learn the Lolo Pinyin array easily.

For details on inputting Chinese using the keyboard

in Figure 2, see Reference (1).

4.2.1 Initial key array

Figure 3 shows arrays of Lolo language consonant keys.

In Figure 3, two consonants are assigned to most keys. The lower consonant on the key cap is input by pressing the key alone; the upper consonant on the key cap is input by pressing the shift key together with this key. The keyboard in Figure 3 has two shift keys, which have different functions when Chinese is input. Their function is the same, however, for Lolo input, so either one can be used.

The consonant part of the Chinese Pinyin keys in Figure 2 (uppercased characters or no consonant "'") are assigned to the same key in Figure 3. With this

ong	'ang	Seng	Can	Zen
o	Lu	Ne	Ti	Da
u/er	Xal	Qei	Jao	You

ZHen	CHan	SHeng	Rang	ong
Ba	Pl	Me	Fu	o
Wou	Gao	Kei	Hal	u/er

Left shift

Right shift

Figure 2 Keyboard for Chinese input

	hx	ss	nz	zz
	'	s	c	z
	hl	hn	nd	dd
	l	n	t	d
	y	nj	jj	ny
	x	q	j	(y)

rr	nr	r		
zh	ch	sh	(r)	
bb	nb	hm	v	
b	p	m	f	
ng	gg	mg	w	
(w)	g	k	h	

Left shift

Right shift

Figure 3 Example of initial key arrays

uot	urt	yrt	iet	at
uox	urx	yrx	tex	ax
uo	ur	yr	ie	a
uop	urp	yrp	iep	ap

et	it	yt	ut	ot
ex	ix	yx	ux	ox
e	i	y	u	o
ep	ip	yp	up	op

Left shift

Right shift

Figure 4 Examples of vowel-tone key arrays

assignment, symbols shared by the Chinese and Lolo versions of Pinyin can be input using the same keys. In the keyboard in Figure 3, since the pairs of voiceless and voiced consonants in Table 2 are assigned to the same keys, a user familiar with Lolo sounds can easily memorize key positions. The consonants in parentheses have also been assigned to

another key, and both consonants have the same function. Consonants not in parentheses are arranged based on Lolo sounds. The consonants in parentheses are assigned to the key to which the same symbol had been arbitrarily assigned in Chinese Pinyin. This assignment thus allows Lolo Pinyin input using the same keys.

uot	HX 'urt	SS Syrt	NZ Clet	ZZ Zat	RR ZHet	NR CHit	R SHyt	Rut	ot
uox uo	HLurx Lur	NNyrx Nyr	NDlex Tie	DDax Da	BBex Be	NBix Pi	HMyx My	Vux Fu	ox o
uop	Y Kurp	NJ Qyrp	JJ Jiep	NY Yap	NG Wep	GG Gip	MG Kyp	W Hup	op

Left shift
Right shift

Figure 5 Example of Lolo Pinyin notation

Step	User	Input key	Input processing program	Display
Input the consonant for ma.	Press the key marked m.	HMyx My	(Flag off) Display the consonant for the My key. The flag is set on.	m
Input the vowel-tone for ma.	Press the key marked a.	DDax Da	(Flag on) Converts the syllable consisting of m and a with a normal tone to a Lolo character and displays it. The flag is set off.	⊖
Input the consonant for lix.	Press the key marked l.	HLurx Lur	(Flag off) Display the consonant for the Lur key. The flag is set on.	⊖l
Input the vowel-tone for lix.	Press the key marked ix.	NBix Pi & shift key	(Flag on) Converts the syllable consisting of l and i with a rising tone to a Lolo character and displays it. The flag is set off.	⊖l
Input the consonant for bu.	Press the key marked b.	BBex Be	(Flag off) Display the consonant for the Be key. The flag is set on.	⊖lb
Input the vowel-tone for bu.	Press the key marked u.	Vux Fu	(Flag on) Converts the syllable consisting of b and u with a normal tone to a Lolo character and displays it. The flag is set off.	⊖lb,

Figure 6 Example of Lolo input

4.2.2 Vowel - tone key array

Figure 4 shows examples of Lolo language vowel - tone key arrays.

Vowel keys are classified by tone. The upper row of keys in Figure 4 is assigned to high - tone vowels. The middle row of keys is assigned to normal - tone vowels without the shift key and rising - tone vowels with the shift key. The lower row of keys is for descending - tone vowels.

Lolo characters representing rising tone syllables are represented by adding an arc overmark (^) to characters representing normal tone syllables (Table 1). The shift key thus adds this in the array in Figure 4.

In Figure 4, lax vowels are assigned to the right and tense vowels to the left, so that the pairs in Table 3 are keyed in using the same finger on the right and left hands.

A user who knows Chinese Pinyin input and must memorize the vowel arrays in Figure 4 is advised to memorize the lax vowel positions first, and then recall the corresponding positions of tense vowels. Of the vowel symbols shared by Chinese Pinyin and Lolo Pinyin, only "a" is located in a different position.

4.2.3 Example of input

A key may contain both a consonant and a vowel. Characters marked on keytops are shown in Figure 5 (Figures 3 and 4 stacked). The consonants are written in uppercase to distinguish them from vowels.

An example of entering the Lolo character $\ominus \square \downarrow$ meaning sphere, is as follows: For the keyboard in Figure 5, each syllable is input using two keystrokes.

The input processing program then converts Lolo Pinyin to a Lolo character (Figure 6).

4.3 Projected Work

Assigning frequently used keys to convenient

positions is an important factor. Since we have not studied the frequency of use for Lolo thoroughly, array design emphasizing this could not be given in this article. This will require that statistics on the frequency of use for Lolo consonants, vowels, and tones and their combinations be investigated and a better design made for the keyboard.

References

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