

# TEMPEST: A Text Input System for Musical Performers

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**Abstract.** Recently, due to the widespread use of computers, text-based communication methods, such as e-mail and chat, have attracted a great deal of attention. If pianists can apply their musical expressions to the text input, they can input texts with their own emotion richly. Therefore, the goal of our study is to construct TEMPEST (TEText input and Musical PERforming SysTem) that is a text input system to input texts with various musical expressions using a clavier. Since this system provides text input methods considering musical artistry, a performer can input texts like playing music.

## 1 Introduction

Recently, due to the widespread use of computers, text-based communication methods, such as e-mail, blog, and chat, have attracted a great deal of attention. Moreover, various communication media, such as pictures and movies, are used for expressing own emotion, and various new interfaces for such purposes are investigated and developed[1].

Here, the best device for pianists to express their emotion is obviously the piano. A pianist creates a marvelous sense of his emotion using a piano. If pianists can apply their musical expressions to the text input, they can input texts with their own emotion richly. Therefore, the goal of our study is to construct TEMPEST (TEText input and Musical PERforming SysTem) that is a text input system to input texts with various musical expressions by using a MIDI keyboard. Since this system provides several text input methods considering musical artistry, a performer can input texts like playing music.

## 2 Design of TEMPEST

All keys in a keyboard are divided into two types in our method; Text-input keys and Execution keys. The former is used for inputting characters with sounds, and the latter is used for only playing sound.

### 2.1 Text Input Methods

We propose two types of text input method for Text-input keys; Monophony method, and Polyphony method.

**Table 1.** The character code chart in two text input methods

(a) Monophony method							(b) Polyphony method												
Alphameric		C	C#	D	D#	E	F	Alphameric	C#	D#	F#	G#	A#						
First	Second							C	C, D	D	D, E	E	E, F	F	F, G	G	G, A	A	
C		a	b	c	d	e	Enter	C	a	b	c	d	e						
C#		f	g	h	i	j	Space	C, D	f	g	h	i	j						
D		k	l	m	n	o	Back	D	k	l	m	n	o						
D#		p	q	r	s	t	MS	D, E	p	q	r	s	t						
E		u	v	w	x	y	IC	E	u	v	w	x	y						
F		z	!	?	.	,		E, F	z	!	?	.	,						
F#		1	2	3	4	5		F	1	2	3	4	5						
G		6	7	8	9	0		F, G	6	7	8	9	0						
G#		+	-	*	/	=		G	+	-	*	/	=						
A		(	)	{	}	^		G, A	(	)	{	}	^						
								A	Enter	Space	Back	MS	IC						

**Monophony method**

In Monophony method, a user presses two keys successively to specify an input character. Table 1 (a) shows the character-code chart in this method. It uses 10 keys from C note to A note. To generate “h”, the user presses C# key followed by D key.

If a user wants to input other characters such as Function keys and Arrow keys, he/she inputs “MS (Mode Shift)” to change the character mode. When the user selects “IC (Input Conversion)”, the last entered character is changed to lower-case/upper-case character alternately.

**Polyphony method**

Instead of pressing keys in sequence to specify the input character, multiple keys are pressed simultaneously in Polyphony method. Table 1 (b) shows the character-code chart in Polyphony method. This method uses 11 keys from C note to A# note chords that have two notes and three notes. To generate “h”, the user presses C, D, F# keys simultaneously. Since this method and Monophony method are independent, they can be used at the same time.

**2.2 Musical Artistry**

To dissolve the lack of artistry in output sounds for Monophony method and Polyphony method, our system translates the output sounds of Text-input keys according to output sounds in Execution areas. Concretely, the system extracts note-numbers that are harmonious with note-numbers played in Execution area, and it replaces note-numbers of Text-input keys by the extracted note-numbers according to the following algorithms.

**Replacement methods of note names**

**1. Random method**

When a Text-input key is pressed, the system randomly picks out and uses one note name played in Execution areas. For example, when C3, E3, G3 and B3 in Execution area are played, the system randomly allocates one of them for Text-input keys.

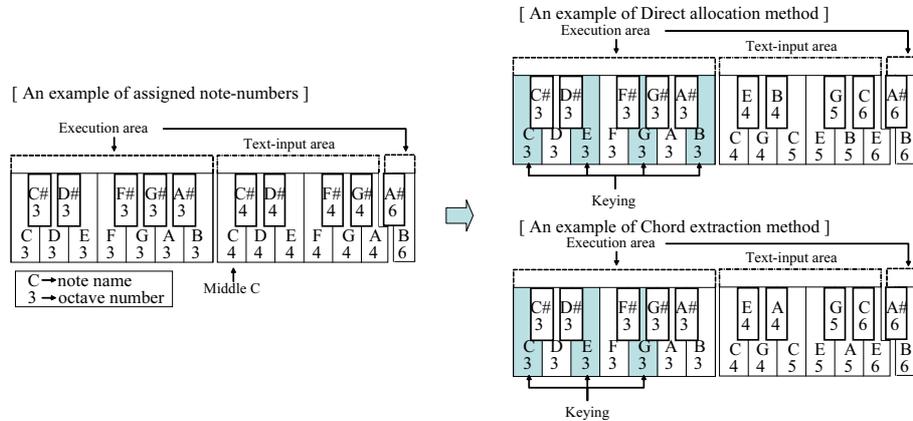


Fig. 1. The example of the note replacement algorithm

### 2. Direct allocation method

The system extracts note names played in Execution areas. Then, it allocates the extracted note names in order for Text-input keys. For example, in the situation as shown in the left of Figure 1, when C3, E3, G3 and B3 in Execution area are played, the system allocates C, E, G, B in order for Text-input keys as shown in the upper right of Figure 1.

### 3. Chord extraction method

The system extracts possible chords that include note names played in Execution areas and then it selects one of them randomly. Next, it replaces the note names of Text-input keys by constituents of the extracted chord in order of the key. For example, in the situation as shown in the left of Figure 1, when C3, E3, and G3 in Execution area are played, the possible chords extracted by the system are C (C major triad), CMaj7 (C major seventh), C7 (C dominant seventh), C6 (C major sixth), and the system randomly selects one of them. The lower right of Figure 1 show the case that C6 is selected.

In Random method, since the system replaces the note name of the key whenever a Text-input key is played, the user enjoys unpredictable sounds. On the other hand, he cannot control output sounds. In Direct allocation method, if the note names played in Execution area is same, all keys in Text-input area are assigned the same note names. Therefore, users can control output sounds, at the same time, performances tend to be monotonous. Moreover, in Random and Direct allocation method, in the case that the number of keys pressed in Execution areas is one or two, the system reluctantly allocates the same note name for each Text-input key. On the other hand, Chord extraction method extracts possible chords to resolve this problem. This method has the most unpredictable layout in the proposed three methods, because the system may replace the note names of Text-input keys by the note names not played in Execution areas. Since each method has advantages and disadvantages, users can select a method flexibly.

**Table 2.** Aggregate statistics of the questionnaire

Question	Not Applying	Applying
1. This performance has musical artistry.	2.12	4.35
2. I am impressed by input characters with musical artistry.	1.56	3.83

### Replacement methods of octave numbers

In general keyboards, the righter key has the higher pitch. According to this rule, the system allocates the octave number as shown in the right of Figure 1.

In concrete terms, the system allocates the octave numbers that the leftmost/rightmost key in the Text-input area is higher/lower than the rightmost/left-most key in the left/right side Execution area. For example, when the rightmost key in the left side Execution area is “B3”, and the leftmost key in the right side Execution area is “A#6”, the keys in a Text-input area are as shown in the right of Figure 1.

## 3 Evaluation

We have evaluated the effectiveness of the proposed algorithms by the subjective evaluation. In this evaluation, the first author of this paper entered “Osaka University” in applying the note replacement algorithm and not applying it. 48 examinees evaluated the system by ranking (1: worst, 5: best) the questions, and the average of scores are shown in Table 2. From the result, we prove the effectiveness of proposed algorithm for the improvement of the artistry.

## 4 Conclusions

In this study, we have constructed TEMPEST that a user can input texts with musical artistry. We propose the several text input methods to improve the artistry of the text input.

In future, we have a plan to evaluate our system from the point of player’s view. Moreover, we will construct text input interfaces using other instruments such as the guitar, the violin, and the maraca. Additionally, we will construct a musical performance chat system as an application.

## Reference

1. Y. Itoh, A. Miyajima, and T. Wanatabe.: ‘tsunagari’ communication: fostering a feeling of connection betweenfamily members. CHI 2002, pp. 810–811, April 2002.