TRIA: A Universal Gesture Symbol Language for Wearable Devices

1. Background

Wearable devices require simply and unified gesture coding for handling the complicated input and output. What would be the idea selection for encoding? It is suitable for human to grasp and at the same time easy for machines to recognize and process with low error rate. When communicating, language and symbols are the most important tools to facilitate the interaction with each other and to pass down culture and thoughts through generations.

There are various keyboards input solutions, but they are not able to replace QWERT keyboard. The major reason for this is not because that the keys are arranged reasonably in QWERT keyboard, because the arrangement of the QWERT keyboard makes it a "position language". When an entry system exists as a language, it has longer lifetime comparing to other technical solutions.

TRIA is a gesture symbol language designed for wearable devices. TRIA gesture symbol language is a universal, simple, unified language which is used for man-machine interaction and is also easy to learn. Features of TRIA make it an ideal solution for both PC and wearable devices. Furthermore, wearable devices are where TRIA can show its advantage and promised future.

2. TRIA Gesture Symbols Language Details

In the below section, the details of TRIA is introduced from the four aspects: major features for TRIA as a gesture symbol language, rules for TRIA's categorization, TRIA's phonogram & IAL, and character encoding for TRIA.

TRIA gesture Symbol Language Features: (Fig.1)

One symbol in TRIA is made up of 4 endpoints from the corners of a square and 1 stroke to connect the 4 endpoints.

- TRIA symbol set contains 76 coding symbols, including 53 1-stroke symbols, 7 2-stroke symbols, 15 points combinations and 1 non-point. With considering the different starting endpoints for the 53 1-stroke symbols, there will be 194 encoding symbols. The other 23(7+15+1) symbols are generated from special encoding.

  e.g.

  Latin letter "z" is presented as TRIA gesture symbol which is starting from left upper corner endpoint and motion route through (a, b, d, c). (As shown in Fig.1. a-b-d-c route. TRIA "z" shows the similar route as Latin letter "z".)

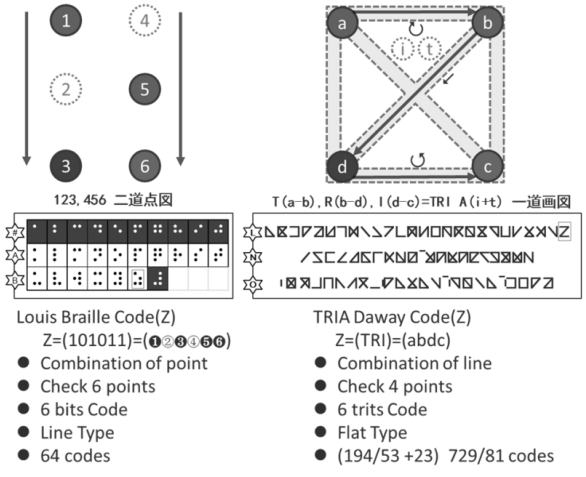


Fig.1 TRIA gesture symbol language Features

- Start from left upper corner endpoint has 30 TRIA symbols.

- "☒" which is completed by using two strokes is defined as R encode (or two code). R encode is generated using two points motion together, for example, index figure and thumb motion together.(Fig1.i+t)
- Each corner endpoint has three possible vector directions (triad), i.e. counterclockwise (T), diagonal(R), and clockwise (I). "TRI" within the word TRIA is used to describe the 4 endpoints from the corners (i.e. dcba) of the square. (Fig1. d-c-a-b)
  Alphabets can be designed from TRIA symbols with the designed rules. This is where the "A" in the word TRIA is coming from.

Rule for TRIA Gesture Symbol Language Categorization: (Fig.2)

TRIA symbols are categorized as alphabets, numbers, control and punctuation symbol according to the starting endpoint from upper left, upper right, lower left and lower right respectively.

- Symbols starting from upper left corner are designed for the 26 TRIA alphabets. These 26 TRIA alphabets are presenting the 26 English Alphabets. (Fig.2.R01)

	C01	C02	C03	C04	C05	C06	C07	C08	C09	C10	C11
R01	Tria(L)										
R02	alphabets	abcdefghijklmnopqrstuvwxyz									
R03	Tria(N)										
R04	Numeric	1	2	3	4	5	6	7	8	9	0
R05	Tria(P)										
R06	punctuation	!	@	#	$	%	^	&	*	(	)
R07	Tria(P)										
R08	punctuation	-	_	=	+	[	]	{	}	\	|
R09	Tria(P)										
R10	punctuation	;	:	'	"	,	.	/	<	>	?
R11	Tria(O)										
R12	control	`	~	ESC	Ctrl	Alt	Del	Shift	Enter	Fn	Space

Fig.2 Rule for TRIA Gesture Symbol Language Categorization

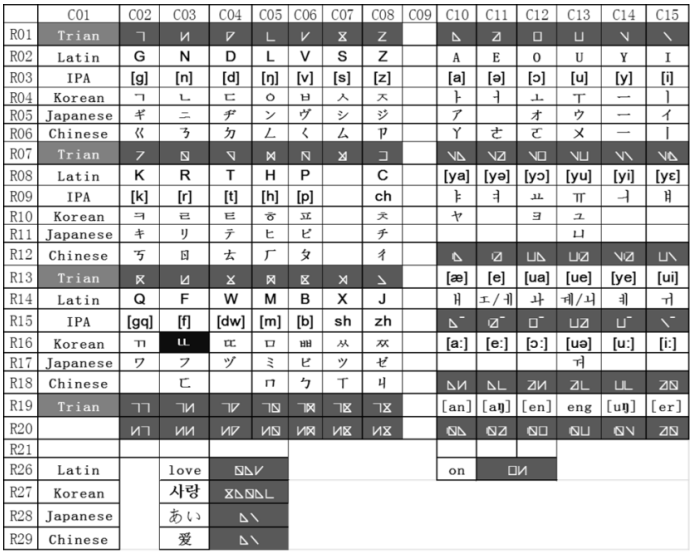
- Symbols starting from upper right corner are designed for the 10 number symbols in TRIA. (Fig.2.R03)
- Symbols starting from the lower left corner are designed for the control symbols. (Fig.2.R11)
- Symbols starting from the lower right corner are designed for punctuations. There are two sets of special cases: one set of punctuation symbols (Fig.2.R05) are using the combination of TRIA shift and TRIA numbers to generate the listed punctuations. This is to follow the arrangement of QWERT keyboard. The other exception is "." in TRIA (Fig.2.R09C07). Instead of designing it using a symbol starting from lower right corner, it is designed to use the mirror image of TRIA "," (Fig.2.R09C06). (Fig.2.R05, R07, R09)

TRIAN's Phonogram & IAL (International Auxiliary Language): (Fig.2)

TRIAN is a phonetic alphabet generated from TRIA symbols (Fig.2.R01). Pronunciation and spelling can be one to one match or vowel combinations.

- TRIAN alphabet set are mapping to the Latin alphabet set. (Fig.3.R01/R02)

- One alphabet in TRIA maps to one phonetic alphabet. TRIAN alphabets can be mapped to International Phonetic Alphabets set and North Asian language pronunciation, such as, Chinese (Fig.3.R06C02), Japanese (Fig.3.R05C02), Korean (Fig.3.R04C02) and IPA (Fig.3.R03C02).
  Fig.3. is a chart showing the TRIAN with the various languages. For example,



	C01	C02	C03	C04	C05	C06	C07	C08	C09	C10	C11	C12	C13	C14	C15
R01	Trian	ㄱ	ㅂ	ㄷ	ㄴ	ㅅ	ㅈ	ㅈ		ㅏ	ㅓ	ㅁ	ㅜ	ㅛ	ㅗ
R02	Latin	G	N	D	L	V	S	Z		A	E	O	U	Y	I
R03	IPA	[g]	[n]	[d]	[ŋ]	[v]	[s]	[z]		[a]	[ə]	[ɔ]	[u]	[y]	[i]
R04	Korean	ㄱ	ㄴ	ㄷ	ㅇ	ㅂ	ㅅ	ㅈ		ㅏ	ㅓ	ㅗ	ㅜ	ㅡ	ㅣ
R05	Japanese	ギ	ニ	ヂ	ン	ヴ	シ	ジ		ア		オ	ウ	ー	イ
R06	Chinese	ㄍ	ㄋ	ㄉ	ㄥ	ㄑ	ㄙ	ㄗ		ㄚ	ㄛ	ㄛ	ㄨ	ㄧ	ㄧ
R07	Trian	ㄱ	ㅀ	ㅋ	ㅐ	ㅀ	ㅒ	ㄱ		ㅑㅏ	ㅑㅓ	ㅑㅁ	ㅑㅜ	ㅑㅡ	ㅑㅣ
R08	Latin	K	R	T	H	P		C		[ya]	[yə]	[yɔ]	[yu]	[yi]	[yɛ]
R09	IPA	[k]	[r]	[t]	[h]	[p]		ch		ㅏ	ㅕ	ㅛ	ㅠ	ㅢ	ㅐ
R10	Korean	ㅋ	ㄹ	ㅌ	ㅎ	ㅍ		ㅊ		ㅑ		ㅒ	ㅠ		
R11	Japanese	キ	リ	テ	ヒ	ピ		チ					ュ		
R12	Chinese	ㄎ	ㅀ	ㄊ	ㄏ	ㄆ		ㄔ		ㅀ	ㅀ	ㅁㅀ	ㅜㅀ	ㅘㅀ	ㅁㅅ
R13	Trian	ㅒ	ㅐ	ㅒ	ㅒ	ㅒ	ㅒ	ㅘ		[æ]	[e]	[ua]	[ue]	[ye]	[ui]
R14	Latin	Q	F	W	M	B	X	J		ㅐ	ㅔ/ㅖ	ㅘ	ㅞ/ㅙ	ㅞ	ㅟ
R15	IPA	[gq]	[f]	[dw]	[m]	[b]	sh	zh		ㅀ	ㅀ	ㅁ	ㅜㅀ	ㅁ	ㅅ
R16	Korean	ㄲ	ㅛ	ㄸ	ㅁ	ㅃ	ㅆ	ㅉ		[a:]	[e:]	[ɔ:]	[uə]	[u:]	[i:]
R17	Japanese	ワ	フ	ヅ	ミ	ピ	ッ	ゼ						ヶ	
R18	Chinese		ㄈ		ㅁ	ㄅ	ㅜ	ㅐ		ㅀㅂ	ㅀㄴ	ㅀㅂ	ㅀㄴ	ㅛㄴ	ㅀㅀ
R19	Trian	ㄱㄱ	ㄱㅂ	ㄱㅂ	ㄱㅀ	ㄱㅒ	ㄱㅒ	ㄱㅘ		[an]	[aŋ]	[en]	eng	[uŋ]	[er]
R20		ㅂㄱ	ㅂㅂ	ㅂㅂ	ㅂㅀ	ㅂㅒ	ㅂㅒ	ㅂㅘ		ㅀㅀ	ㅀㅀ	ㅀㅁ	ㅀㅜ	ㅀㅅ	ㅀㅀ
R21															
R26	Latin		love	ㅀㅀㅂ						on	ㅁㅂ				
R27	Korean		사랑	ㅘㅀㅀㄴ											
R28	Japanese		あい	ㅀㅅ											
R29	Chinese		爱	ㅀㅅ											

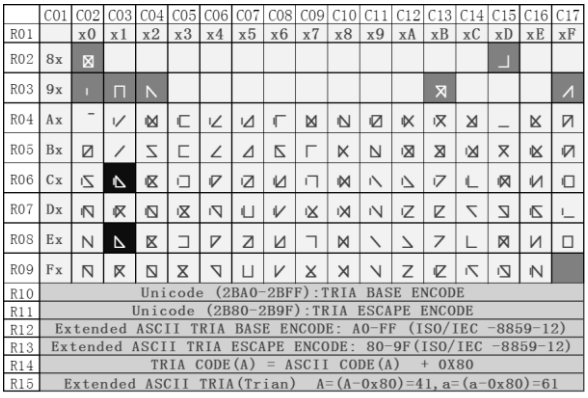
Fig.3 TRIAN's Phonogram & IAL

  using TRIAN to present the English word "Love" in English, Korean, Japanese and Chinese, the below codes will be generated:
  English / TRIAN (Fig.3.R26C03 / Fig.3.R26C04)
  Korean / TRIAN (Fig.3.R27C03 / Fig.3.R27C04)
  Japanese / TRIAN (Fig.3.R28C03 / Fig.3.R28C04)
  Chinese / TRIAN (Fig.3.R29C03 / Fig.3.R29C04)
- An international auxiliary language can be created based on TRIA alphabets. It can be used to exchange information via wearable devices which can process TRIA symbols.

TRIA Symbols Encoding and Character Encoding: (Fig.4)

To serve the purpose to input, edit, process, store, transfer, and output, display using PC, TRIA symbol encoding and character sets are required.

- When designing TRIAN character set, TRIAN encoding is ASCII alphabets plus 128 (x80), e.g. ASCII(z) + 128 = TRIA(z). This design is to facilitate the existing applications and programs. With the minimum modification in the programs, the programs created based on English ASCII can be modified to be TRIA adaptable.



	C01	C02	C03	C04	C05	C06	C07	C08	C09	C10	C11	C12	C13	C14	C15	C16	C17
R01		x0	x1	x2	x3	x4	x5	x6	x7	x8	x9	xA	xB	xC	xD	xE	xF
R02	8x																
R03	9x																
R04	Ax																
R05	Bx																
R06	Cx																
R07	Dx																
R08	Ex																
R09	Fx																
R10	Unicode (2BA0-2BFF):TRIA BASE ENCODE																
R11	Unicode (2B80-2B9F):TRIA ESCAPE ENCODE																
R12	Extended ASCII TRIA BASE ENCODE: A0-FF (ISO/IEC -8859-12)																
R13	Extended ASCII TRIA ESCAPE ENCODE: 80-9F(ISO/IEC -8859-12)																
R14	TRIA CODE(A) = ASCII CODE(A) + 0X80																
R15	Extended ASCII TRIA(Trian) A=(A-0x80)=41, a=(a-0x80)=61																

Fig.4 TRIA Symbols and Character Encoding

- The TRIAN character sets can occupy (0xA0 - FF) extended ASCII zone. TRIA alphabets (Upper and Lower case), numbers and punctuations occupy ASCII zone (0xA0 - FF); TRIA control symbols occupy the ASCII Zone (0x80 – 0x9F).
- TRIAN character encoding can also be projected to ISO8859-12 character set encoding zone. This is for the reference and the zone is currently unused.

- TRIAN character encoding can also be projected to the Unicode zone (2B80 – 2BFF). This is for the reference and the zone is currently unused.

3. TRIA Implementation: (Fig.5)

TRIA Entry System:

TRIA entry system is to input and generate the localization characters (Fig.3.R26C10) and symbol via TRIA motion symbols (Fig.3.R26C11) with following certain input rules.

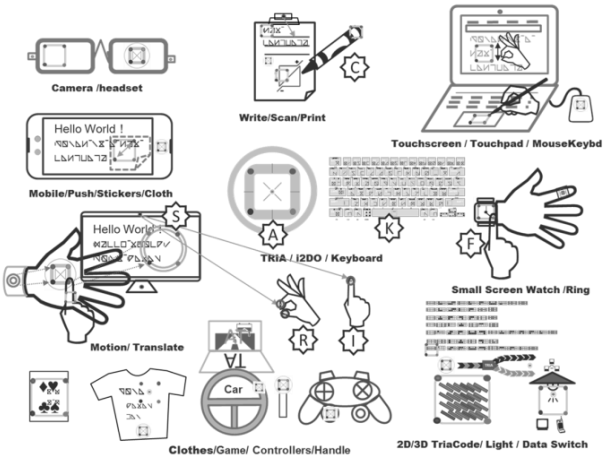


Fig.5 TRIA gesture symbols implementation in wearable device

- Using one figure via one stroke to input the TRIA symbols and it is processed to the respective localization characters, including alphabets, numbers, punctuations and control symbols. (Fig.5.I)
- TRIA shift control symbols (|) is applied together with TRIA alphabets and TRIA numbers to generate the uppercase letters and punctuations.
- TRIA has the flexibility to use two fingers together (R encode) to assist the configuring self-defined accelerators and special operations. (Fig.5.R)
- TRIA motion symbols facilitate cursive handwriting recognition according to the lines, angles and trend to make the judgment. (Fig.5.C)
- The accelerators in TRIA entry system is generated via the combination of TRIA symbols. (Fig.5.R+I)
- In traditional QWERTY keyboard, entry methods can be used to input the TRIA symbols. (Fig.5.K)

TRIA Input in Flat Surface: (Fig.5.F)

When implementing TRIA encoding in flat surface, tap the input box first; four endpoints appears in the screen. Four endpoints and two diagonals generate the "☒" shaped auxiliary frame. Users can use the auxiliary frame to motion input using TRIA gesture symbols. (Fig.5.A)

When implementing TRIA encoding in touch pad, four raised dots are designed in the touch pad. Users will use the four dots to facilitate to motion the TRIA gesture symbols.

TRIA Input in 3D Space: (Fig.5.S)

The uniqueness of TRIA symbols makes it possible to motion TRIA symbols on virtual screen in the air. User can use gesture recognition technology to remote control TV's or other devices.

Index finger is normally to motion the input and in certain conditions index finger and thumb can be used together to facilitate input and control the remote devices.

TRIA Symbols for data inputting, storing, editing, computing and transferring:

In computer systems, TRIA symbols code can be implemented for data inputting, storing, editing, computing and transferring.

TRIA can be implemented in various areas using its gesture, symbols, language and encoding aspects. Once TRIA is learned, it can be used to facilitate the information exchange between human & human and human & machine.

4. TRIA's Advantage

Language symbols are categorized as line symbols and dot symbols according to the shape.

Dot symbolic languages are binary encoding as the language symbol. Braille is a typical dots symbolic language to have 64 codes that were made up of three rows and two columns of six different convex and concave dots. (Fig.1. dot symbols on the left). The other set of natural languages are line symbolic. e.g. Latin, Arabic, Chinese and Korean language etc.

TRIA symbol language is one of the line symbolic languages. Comparing to the other natural languages, TRIA is a geometrical symbolic system which is more mathematic oriented. It is a simplified and geometric figure evolution of natural language symbols. Comparing to the typical dot symbolic language braille which is a binary encoding system, but TRIA is a ternary encoding system. And TRIA is also easier to learn and input comparing to Braille. A portable coin sized TRIA keyboard with 3 or 4 touch endpoints can be designed. It can be used to replace the traditional 101 QWERT keyboard keys.

5. Summary

TRIA can be used as a wearable device gesture language, with the flat surface input and 3D input to facilitate the information exchange. With the 4 endpoints routes and unified encoding rules, it is easy to learn and understanding. It can be used in different TRIA adaptable devices.