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SignWriting Text Input Interface for Myanmar Sign Language

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Outline of Presentation

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Abstract

- Deaf people are facing many difficulties in communicating with other hearing people and also in education.
- Most of them hard to understand the writing system that uses normal hearing people.
- Although sign languages do not have a traditional or formal written form, SignWriting can help hard of hearing people be able to read or write sign language.
- In the system, **two fingerspelling keyboard layouts** are implemented for typing Myanmar fingerspelling characters with SignWriting and **Myanmar SignWriting text input interface** that covers the whole Myanmar sign language.

Introduction

- Myanmar deaf people mainly use Myanmar Sign Language (MSL) as an essential communication language among them.
- They have difficulties in relation to written languages with orally spoken words.
- SignWriting is used for writing sign language in other countries for their deaf people.
- There is no Myanmar language specific SignWriting text editor for Myanmar Deaf society yet.

Introduction (Cont'd)

- In the system, two fingerspelling keyboard layouts were proposed, one is based on **pronunciation of Myanmar characters** and another is based on **the shapes of SignWriting symbols** for Myanmar fingerspelling characters.
- The SignWriting text input interface is also implemented for typing Myanmar sign language.
- A user study with both hearing-impaired and hearing users was conducted and the comparisons are made between two keyboard layouts in terms of **Character Per Minute** and **Likert scale feedbacks**.

Objectives

- To develop Myanmar SignWriting Dictionary for Myanmar Sign Language
- To implement Myanmar SignWriting Text Input Interface
- To provide a writing system for Myanmar Deaf people
- To improve the quality of Deaf Education in Myanmar

Myanmar Sign Language (MSL)

- Sign Language:
  - Not an international language
  - Based on their own culture and traditions
  - Different in every country and even from region to region
- MSL that Myanmar Deaf people use is also different with Myanmar language in grammatical structure.

Myanmar Sign Language (Cont'd)

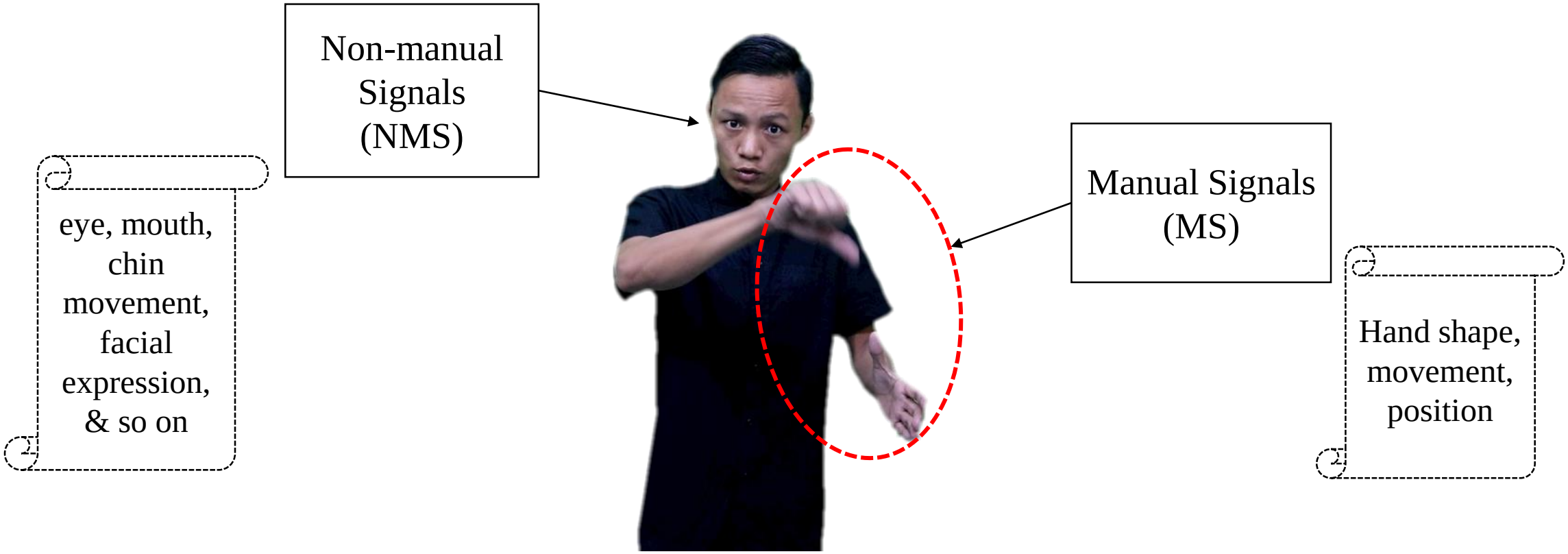


Figure 1: The Structure of Sign Language

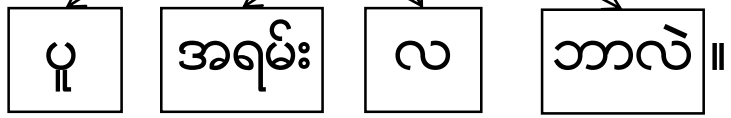
Myanmar Sign Language (Cont'd)

- MSL that Myanmar Deaf people use is also different with Myanmar language in grammatical structure.

  Example:

  Myanmar Written Language: ဘယ် လ က အပူ ဆုံး လ လဲ ။

  ("What is the hottest month ?" in English)

  Myanmar Sign Lanugae: 

Myanmar Fingerspelling

- It is the representation of Myanmar characters and numbers with hands in Myanmar sign language.
- It can be used to represent Myanmar consonant, vowel, and numbers with hands.
- It is used for signing names, city names and words that are not existing in sign language.
- In the system, fingerspelling character set recognized as a standard in 2007 is used for designing two SignWriting keyboard layouts.

Myanmar Fingerspelling (Cont’d)

- Some of Myanmar fingerspelling characters can be seen as follows:

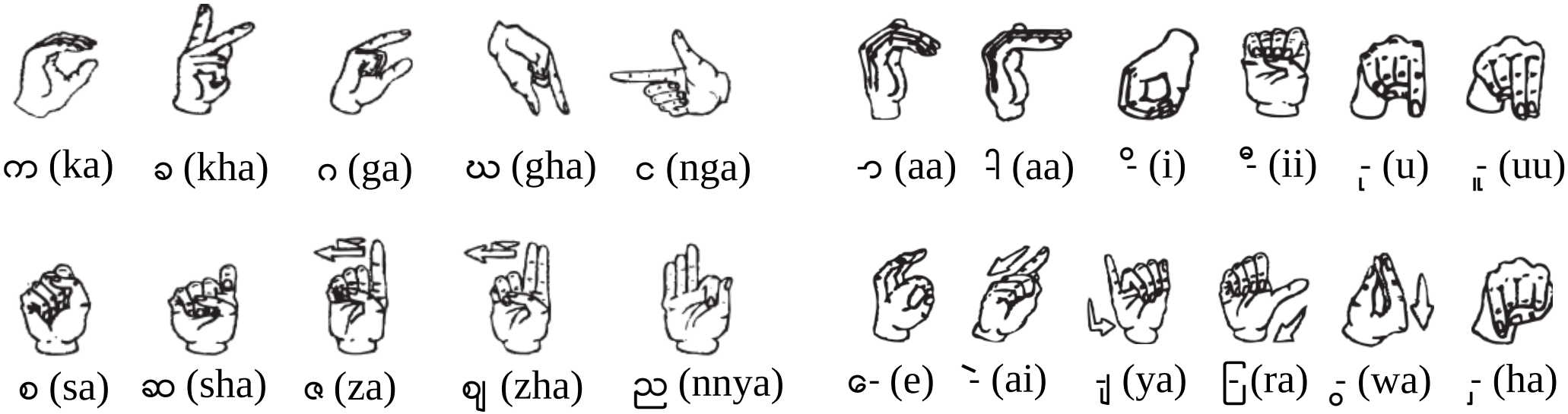


Figure 2. Some of MSL Fingerspelling Consonant and vowel

Myanmar Fingerspelling

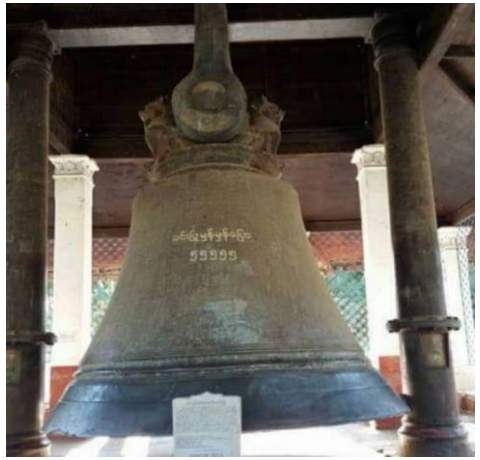
- It is the basic language of sign language for Myanmar deaf people.
- It can be used to represent Myanmar consonant, vowel, and numbers with hands.
- It is used for signing names, city names and words that are not existing in sign language.
- Example:

ဧ (e) န (na) တ (ta) ိ (i) ု (u) း (visarga)

ဧန (Nay) တိုး (Toe)

Classifier (CF)

- One of Myanmar sign language that expresses sign according to the figures of objects
- Example:

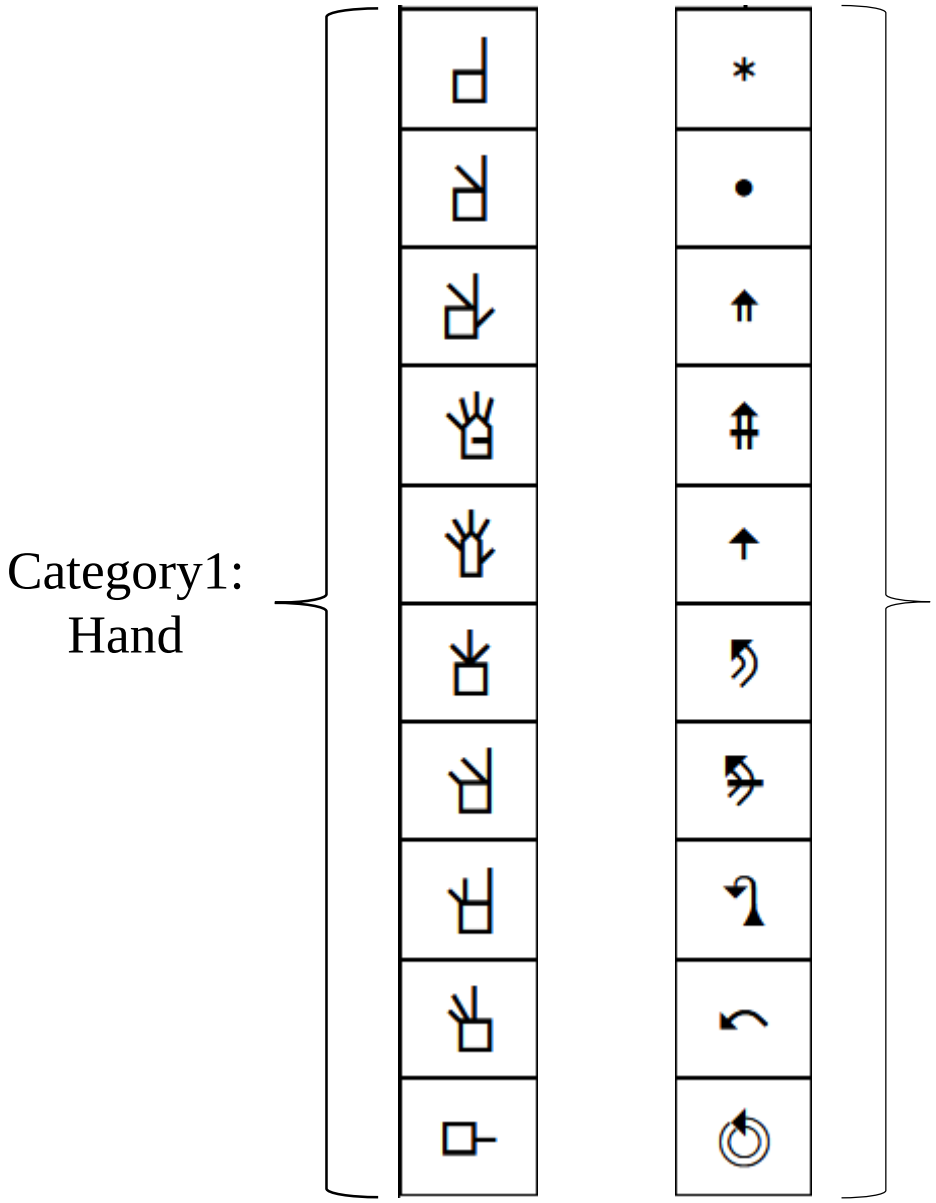
Min Guon		
Inn Lay		

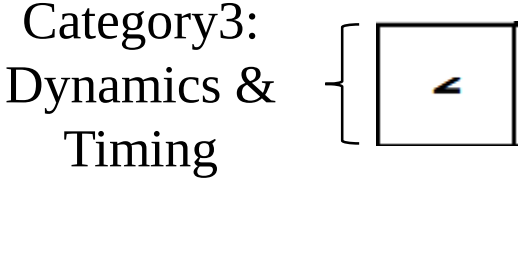
SignWriting

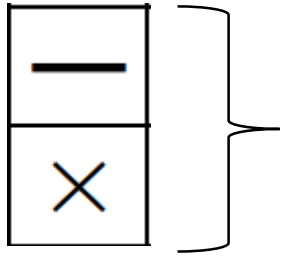
Valerie Sutton

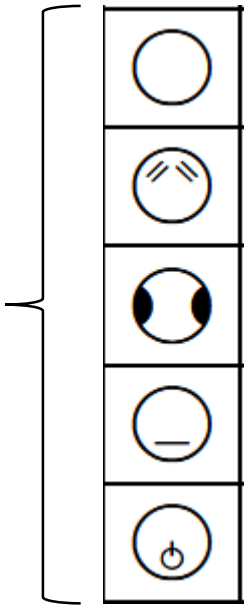
- In 1974, Valerie Sutton invented for deaf people to write and read sign languages.
- It is becoming the written form of a sign language in **over 40 countries**.
- **International SignWriting Alphabet (ISWA)** used in SignWriting includes all symbols used to write the handshapes, movements, facial expressions, and body movements.

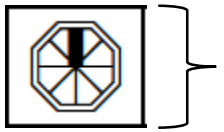
7 Categories and 30 groups of SignWriting Symbols

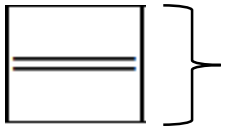








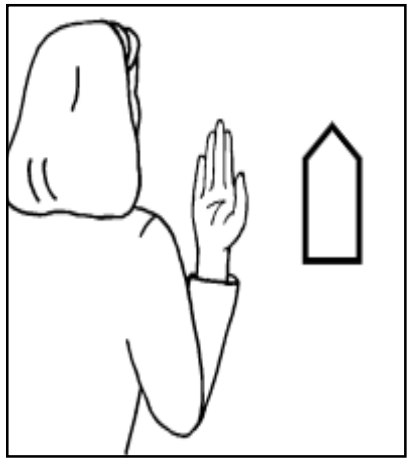




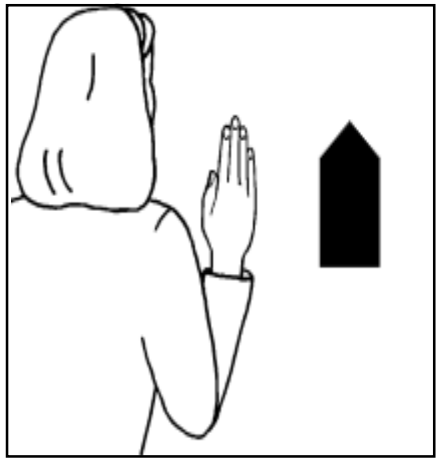
SignWriting (Cont’d)

- **Hand Orientation** is also important

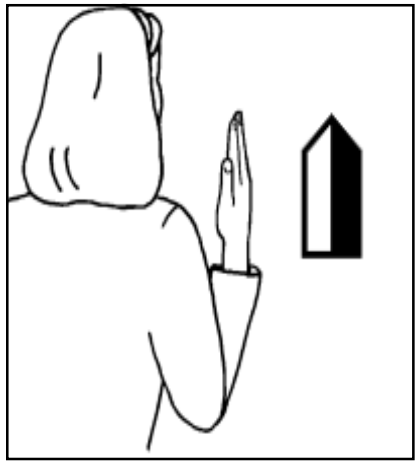
The Palm



The back of the hand

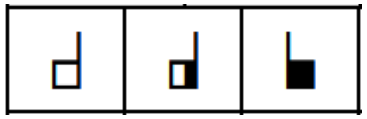


The side of the hand

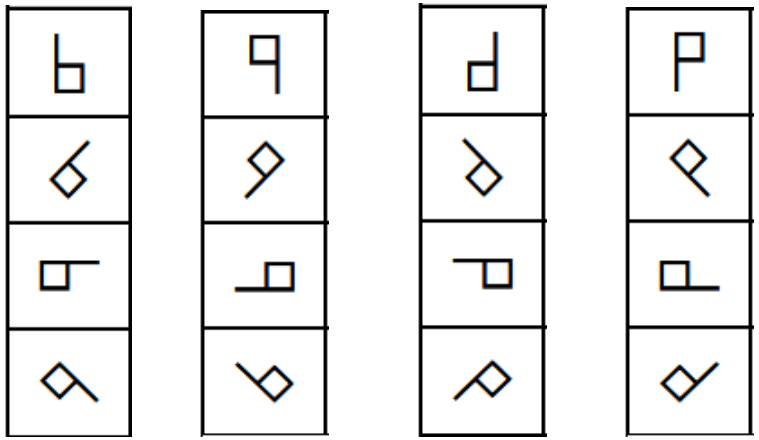


SignWriting (Cont'd)

- Each basic symbol can have
  - **3** different fillings



  - **16** different spatial rotations



- There are almost **35,023 symbols** for various conditions

SignWriting (Cont'd)

- Each symbol is defined with corresponding **Unicode** value.
- Sutton Unicode block is U+1D800 to U+1DAAF including Unicode value for **fill modifiers** and **rotation modifiers:**
  -  = U1D800
  -  = U1D801
  -  = U1D802, and so on…..

Implementations

- In this system, a user-friendly Myanmar SignWriting text input interface is mainly considering to propose for Myanmar sign language
- The main challenge is how to organize or grouping many SignWriting symbols for Myanmar SignWriting
- As a first step, typing Myanmar fingerspelling characters with SignWriting is only focused because it is the basic language of sign language for deaf people.

Two Fingerspelling Keyboard Layouts for MSW

- In the system, two Myanmar fingerspelling keyboard layouts for Myanmar SignWriting were implemented.

Myanmar Words	ကလေးယ်	က	ဖ	လ	း		ဂ	ဃ	၎
Myanmar Fingerspelling	-								
Myanmar SignWriting	Symbol								
	Filling					-			
	Rotation	-	-	-				-	-

Table1. Example of typing Myanmar word ‘ကလေးယ်’ with SignWriting

Two Fingerspelling Keyboard Layouts for MSW (Cont’d)

- These keyboard layouts were implemented for Linux operating system computers using X Keyboard Extension (XKB).
- In this system, a TrueType font of Sutton SignWriting built with the SignWriting 2010 Tools was used to display Myanmar fingerspelling characters with SignWriting.
- In this implementation, the main concept is how to map the symbols on which keys to be usability for the user.

Phonetic-based Keyboard Layout for Myanmar SignWriting

- The mapping of Myanmar characters on English QWERTY keyboard based on their phonetic similarities with English characters such as
  - Symbol of “က” (Ka) on k key
  - Symbol of “ဂ” (Ga) on g key
  - Symbol of “စ” (Ca) on s key
  - Symbol of “ဆ” (Cha) on S (Shift + s) key and so on
- The concept is same with the kKg (ကခဂ) Myanmar keyboard.

Phonetic-based Keyboard Layout for Myanmar SignWriting (Cont’d)

- Every fingerspelling character are not needed to map on the keyboard because most of the SignWriting symbols for fingerspelling characters are same shapes such as “  ” (Ga) and “  ” (Gha), “  ” (Nga) and “  ” (La) etc.
- Some Myanmar fingerspelling characters are mapped on English keys based on the similar shape of characters
  - Example: Myanmar consonant "c" (Nga) is mapping to English small c-key

Phonetic-based Keyboard Layout for Myanmar SignWriting (Cont'd)

- The phonetic-based keyboard layout for MSW can be seen as follows:

Symbol-based Keyboard Layout for Myanmar SignWriting

- The mapping is based on the shape similarities of SignWriting symbols.
- MSW symbols are grouped by the shape of the symbols.
- Example: the same shape  and  are mapped on s key and S (shift + s) key,  and  symbols are on d key and D (shift + d) key, respectively and so on.
- Thumb group of SignWriting symbols such as “  ” (Le gaung), “  ” (Ca), “  ” (a) are mapped on the bottom row keys of QWERTY keyboard layout.
- This keyboard mapping concept might be difficult for the first-time users who are unfamiliar with Myanmar fingerspelling and SignWriting symbols.

Symbol-based Keyboard Layout for Myanmar SignWriting (Cont'd)

- The symbol-based keyboard layout for MSW can be seen as follows:

Methodology

- For User study,
  - Participants → **19** volunteer participants (9 males and 10 female)
  - Two types of users → **Eight Hearing-impaired users** and **Eleven Hearing users**
  - Location → School for the Deaf, Mandalay
- None of them had prior experience with SignWriting symbols for Myanmar fingerspelling characters.
- Three poems from Myanmar language Primary School textbook were selected for user study.
- They cover most combination patterns of vowels and medials with a consonant.

Methodology (Cont'd)

- The printouts of the two keyboard layouts and three SignWriting poems (parallel sentences with Myanmar language) was provided.

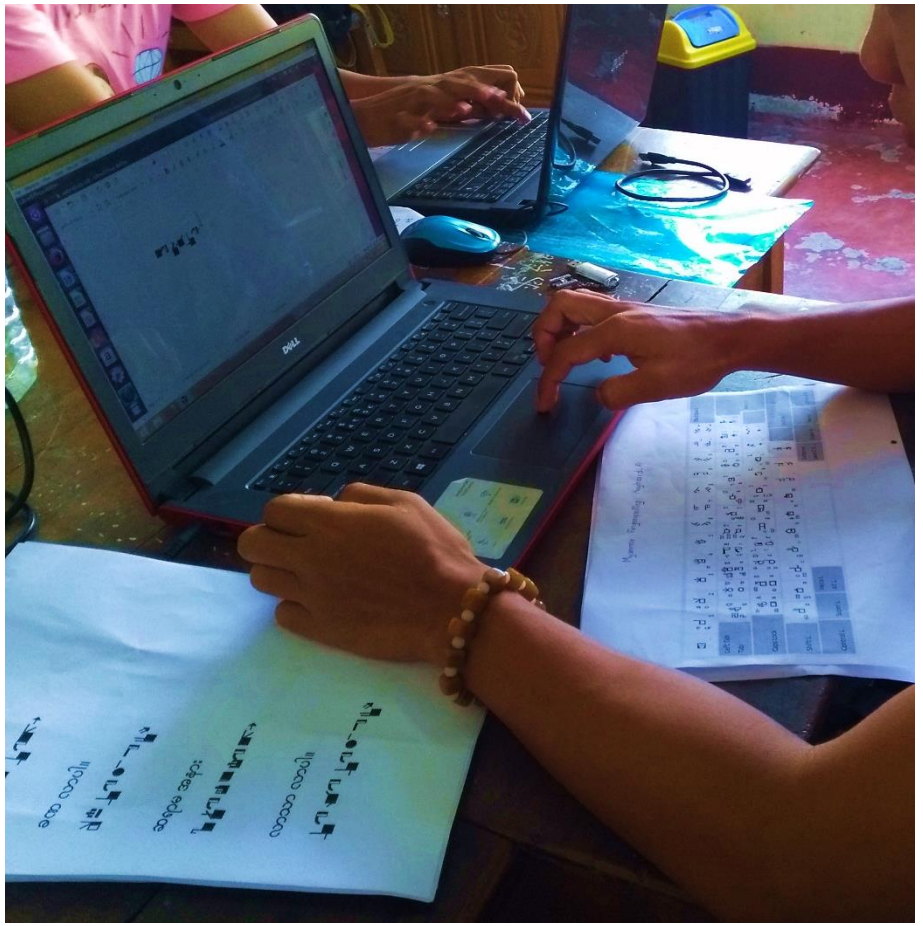
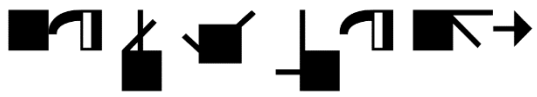


Figure 3. Experimental Environment with hearing-impaired users

Three Fingerspelling Poems with SignWriting for User Study

Poem1:

- စာရသလား 
- ခကလာပါ။ 
- ဆရာမအနား 
- လာ သာ လာပါ။ 

Three Fingerspelling Poems with SignWriting for User Study

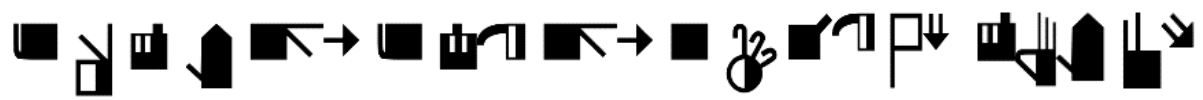
Poem2:

- အလံတော် တလူလူ။

- တေးသံ သာယာ၏။

- စီးတန်း၍ လာနေသည်။

- အခမ်းအနား စတော့မည်။



Three Fingerspelling Poems with SignWriting for User Study (Cont’d)

Poem3:

- လယ်သမား လူငယ်

- စပါး နယ်နေသည်။

- မမ စပါးသယ်၏။

- မေမေစားစရာ ဝယ်လာသည်။

- ဖရဲသီးပါသလား။

Experimental Procedures

Figure 4. Experimental Environment with hearing-impaired users

Evaluation

- To measure the typing speed of participants, **Character per Minute (CPM)** is used.
- The formula of CPM is as follows:

$$CPM = \frac{|\mathrm{T}|-1}{\mathrm{S}} \times 60 \qquad \text{.....[7]}$$

where,

- |T| = length of string
- T may contain SignWriting Symbols
- S = seconds spent from the entry of the first character to the last

Evaluation (Cont'd)

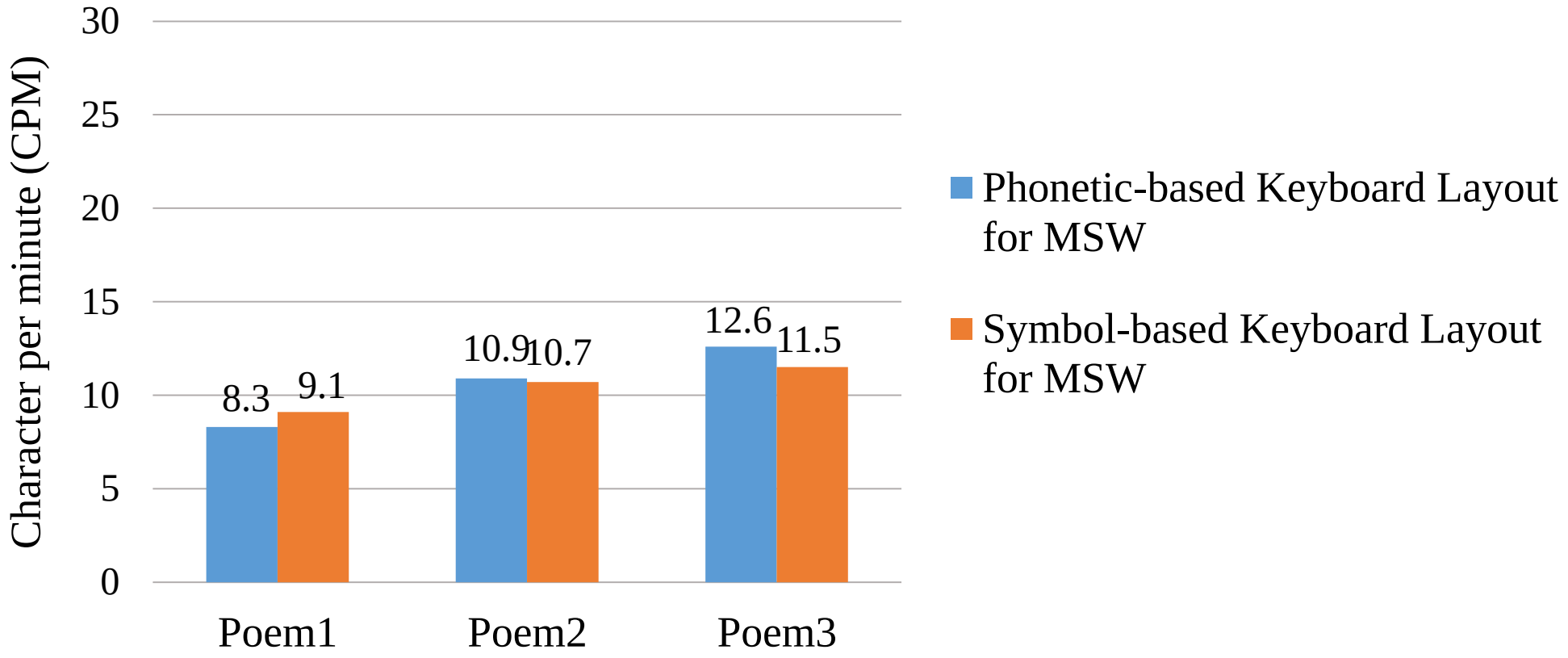


Figure 5. Average CPM of hearing-impaired participants' typing for three poems with both two fingerspelling keyboard layouts for MSW

Evaluation (Cont'd)

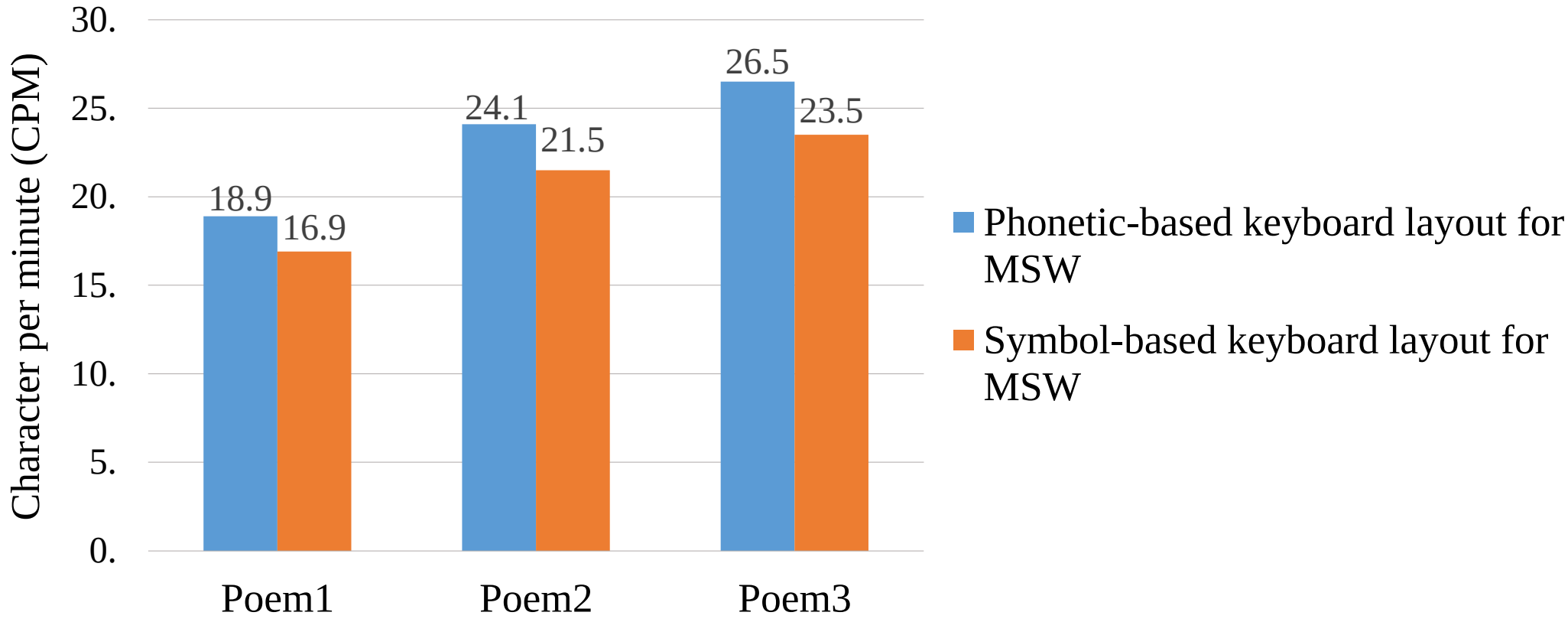


Figure 6. Average CPM of hearing participants' typing for three poems with both two fingerspelling keyboard layouts for MSW

Evaluation (Cont'd)

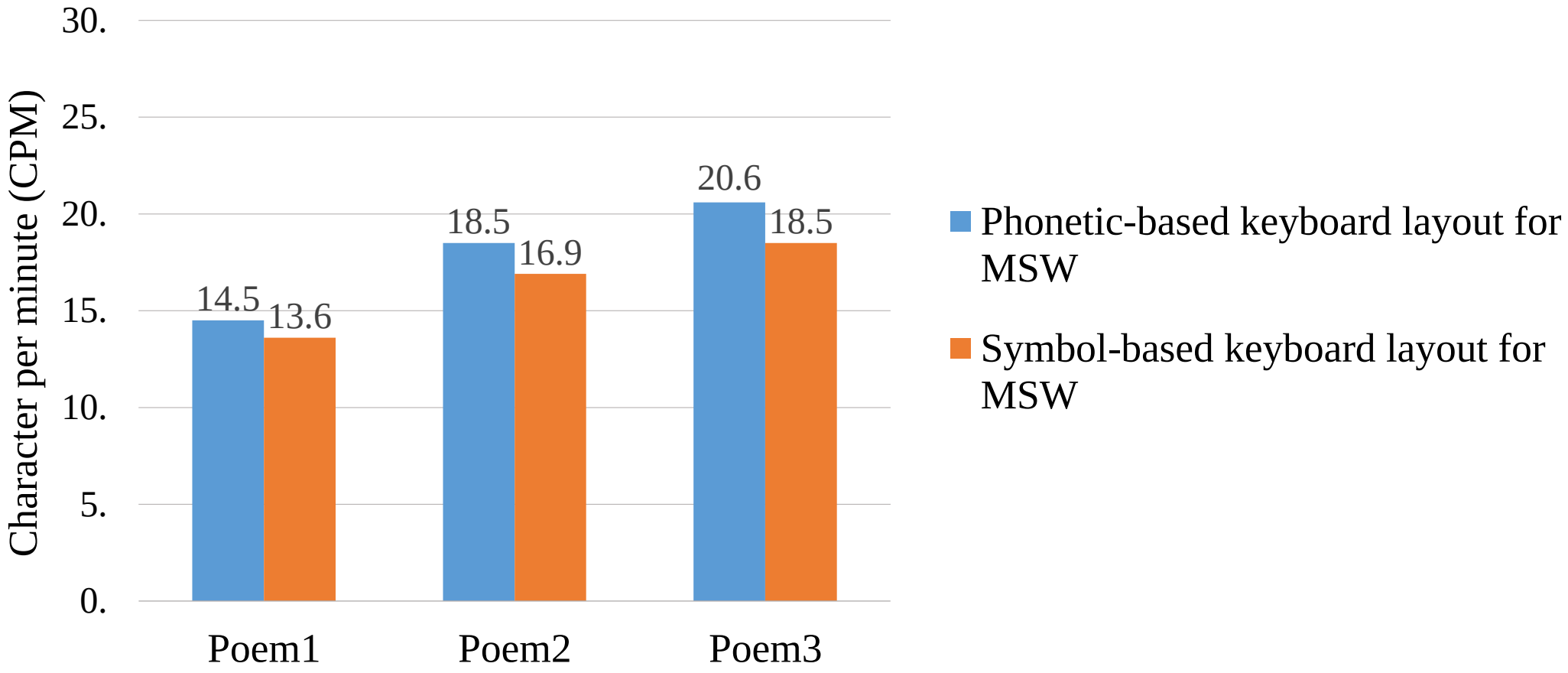


Figure 7. Average CPM typing speed of two types of participants: hearing-impaired and hearing participants for three poems with both two fingerspelling keyboard layouts

Evaluations (Cont’d)

- Questionnaires were taken to the participants in order to get their comments and suggestions on that keyboard layout after the typing experiments with one keyboard layout .
- Four Likert scales (1 to 5) are made to rate the user-friendliness of two fingerspelling keyboard layouts for Myanmar SignWriting.
- The scales are: Difficult-easy, Slow-fast, Dislike-like and Impossible-possible
- Likert scales value 1 is the most negative, 3 is neutral and 5 is the most positive.

Evaluation (Cont'd)
Likert Scale Evaluations Results

- The average or arithmetic mean results of Likert scale questions to hearing-impaired users and hearing users can be seen as follows:

Likert scales	Phonetic-based keyboard layout for MSW	Symbol-based keyboard layout for MSW
Difficult-Easy	4.3	4.1
Slow-Fast	4.3	3.9
Dislike-Like	4.5	4.3
Impossible-Possible	4.4	4

Table 2. Evaluation by hearing-impaired users

Likert scales	Phonetic-based keyboard layout for MSW	Symbol-based keyboard layout for MSW
Difficult-Easy	4.5	3.7
Slow-Fast	4.1	4.1
Dislike-Like	4.4	4.5
Impossible-Possible	4.8	4.6

Table 3. Evaluation by hearing users

Evaluation (Cont'd)

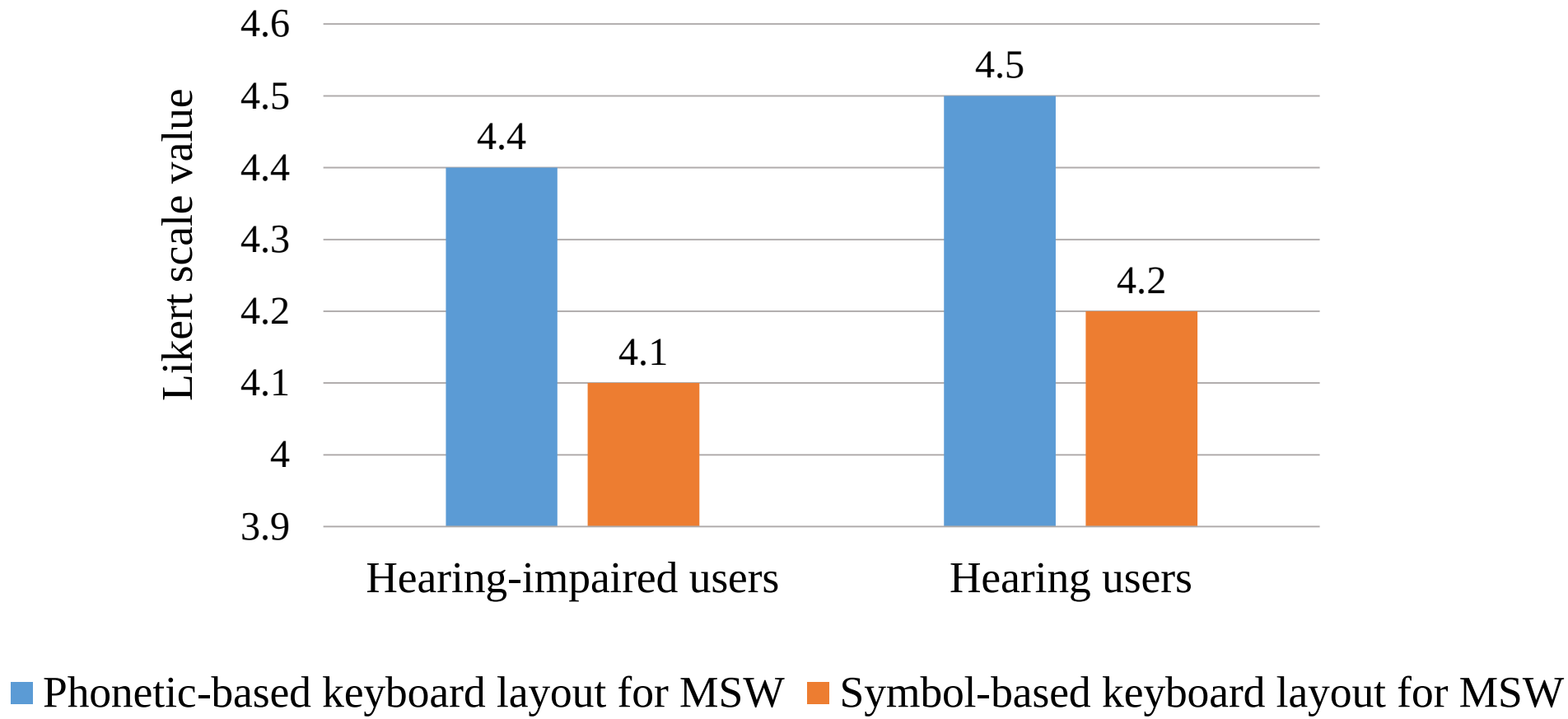


Figure 8. Comparison of Likert scale evaluation results for both two fingerspelling keyboard layouts for MSW

Discussion

CPM Value	Phonetic-based keyboard layout for MSW	Symbol-based keyboard layout for MSW
Hearing-impaired Users	**26.5**	23.5
Hearing Users	**12.6**	11.5

Likert Scale Value	Phonetic-based keyboard layout for MSW	Symbol-based keyboard layout for MSW
Hearing-impaired Users	**4.4**	4.1
Hearing Users	**4.5**	4.2

- From the evaluations in terms of typing speed, **both of the keyboard layouts** are applicable for typing Myanmar fingerspelling SignWriting.
- Based on users' comments, suggestions and Likert scale values, **phonetic-based keyboard layout** is more flexible to use for both users.

Myanmar SignWriting Text Input Interface

- The second work is the implementation of SignWriting Text Input Interface for Myanmar Deaf people to write Myanmar sign language.
- The implementation of this input interface is set up on Ubuntu desktop computers running Ubuntu 16.04 LTS Linux OS.
- The graphical user interface is implemented with Python programming language.
- In this interface system, users can write symbols for all hand shape, movement, head and face, body, location, timing and punctuation to represent all Myanmar sign language words.

Myanmar SignWriting Text Input Interface (Cont'd)

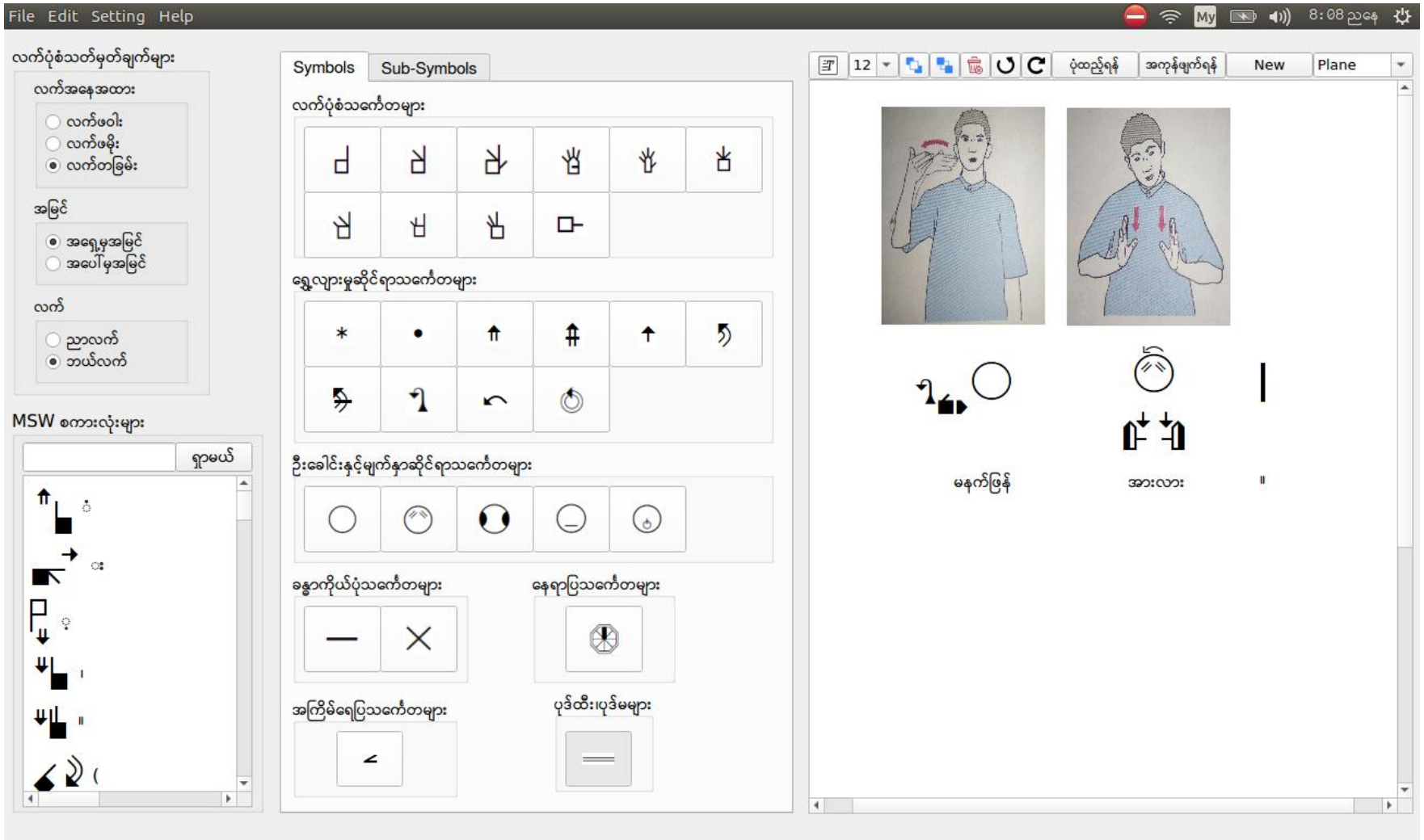


Figure 9. Myanmar SignWriting Text Input Interface Prototype for Myanmar Sign Language

Myanmar SignWriting Text Input Interface

- This is the first SignWriting text input interface for Myanmar sign language.
- MSW dictionary is needed to build because there is no predefined Myanmar SignWriting word for MSL.
- Currently, almost **1,900 MSW words** are built for Myanmar sign language words that cover 888 emergency sentences and about 2,000 general domain sentences.
- The future work is to continue building MSW words for other MSL words.

Conclusion

- This research introduced the first study of Myanmar SignWriting and the Myanmar SignWriting text input interface system of Myanmar sign language for Myanmar deaf society.
- Reading and writing Myanmar sign languages with SignWriting are effective in Deaf Education and communicating with each other.
- In this system, two fingerspelling keyboard layouts for Myanmar SignWriting: **phonetic-based and symbol-based keyboard layouts, and Myanmar SignWriting text input interface** for Myanmar sign languages have been proposed.

Conclusion (Cont'd)

- Among two fingerspelling keyboard layouts, the **phonetic-based keyboard layout** is more flexible to use for both hearing-impaired users and hearing users based on the results of experiments.
- Two-fingerspelling keyboard layouts were shared with the public via GitHub, and can be downloaded and used on your Ubuntu desktop computer. (https://github.com/ye-kyawthu/MyanmarSignWriting-Fingerspelling-Keyboards)
- In the near future, current Myanmar SignWriting text input interface have to be updated for Myanmar sign language to be more usability for the deaf people.

References

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3. “Text book of Primary Myanmar”, Mandalay School for the Deaf
4. MacKenzie, I. S. and Aleks Oniszczak, “A Comparison of Two Input Methods for Keypads on Mobile Devices”
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10. https://en.wikipedia.org/wiki/SignLanguage
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List of Publications

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- Swe Zin Moe, Ye Kyaw Thu, **Hlaing Myat Nwe**, Hnin Wai Wai Hlaing, Ni Htwe Aung, Hnin Aye Thant, Nandar Win Min, “Corpus Building for Machine Translation between Myanmar Sign Language and Myanmar Written Text”, World Deaf Day 2017, 14th Sept. 2017, Mandalay Community Center, Chan Aye Tharzan Township, Mandalay, Myanmar. (Poster)
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Thank You