

**DESIGN  
DEPT.**

**Force**, 2023 UNIST Design 10th Graduation Show

# O-K Text

Hangul Input System in Head Mounted Display  
: Utilizing Gaze and Hand Gestures

Designer

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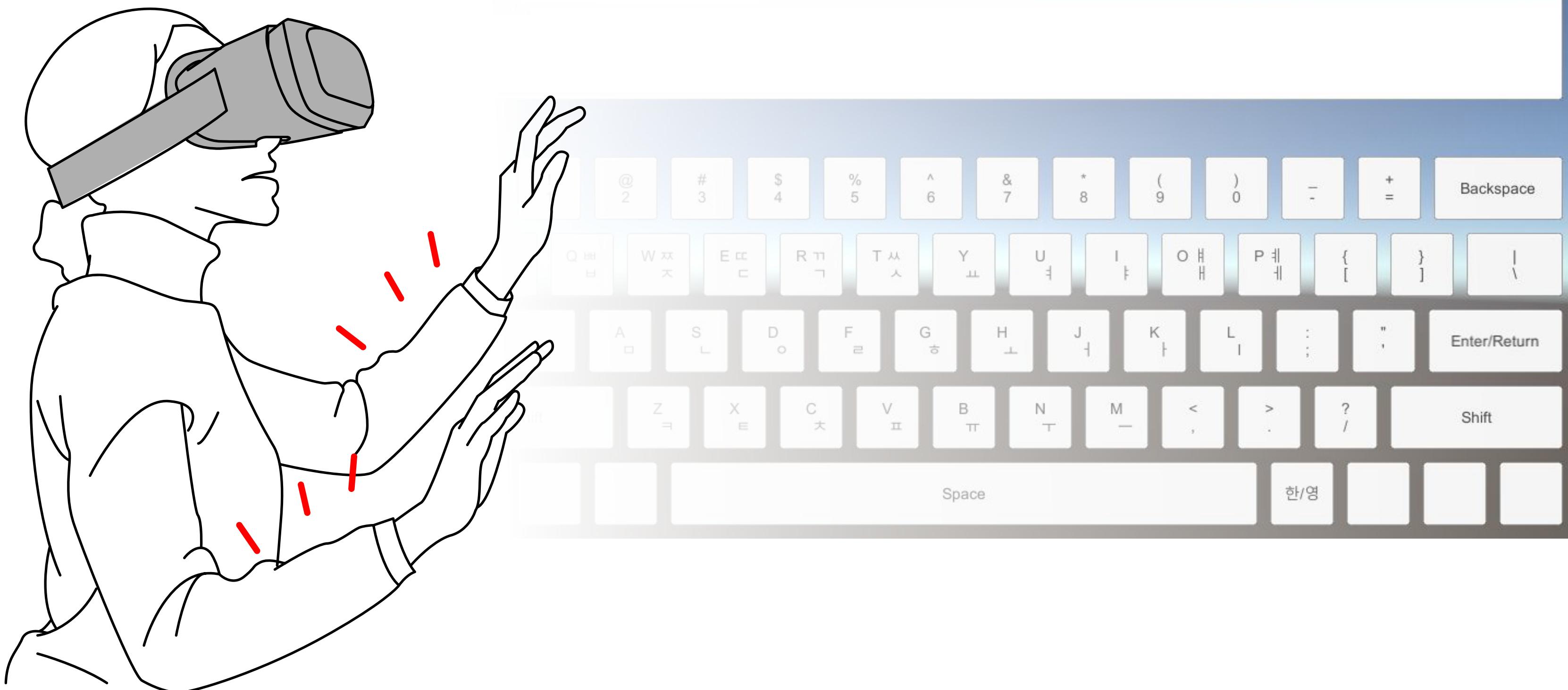
Supervisor

**Ian Oakley**

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# Problems

# Previous VR keyboards's problem



1. To Many Inputs
2. Lack of Haptic Feed back



**Significant  
Physical Fatigue**



## Solution with Gaze Interaction

HMD Internal Interactions

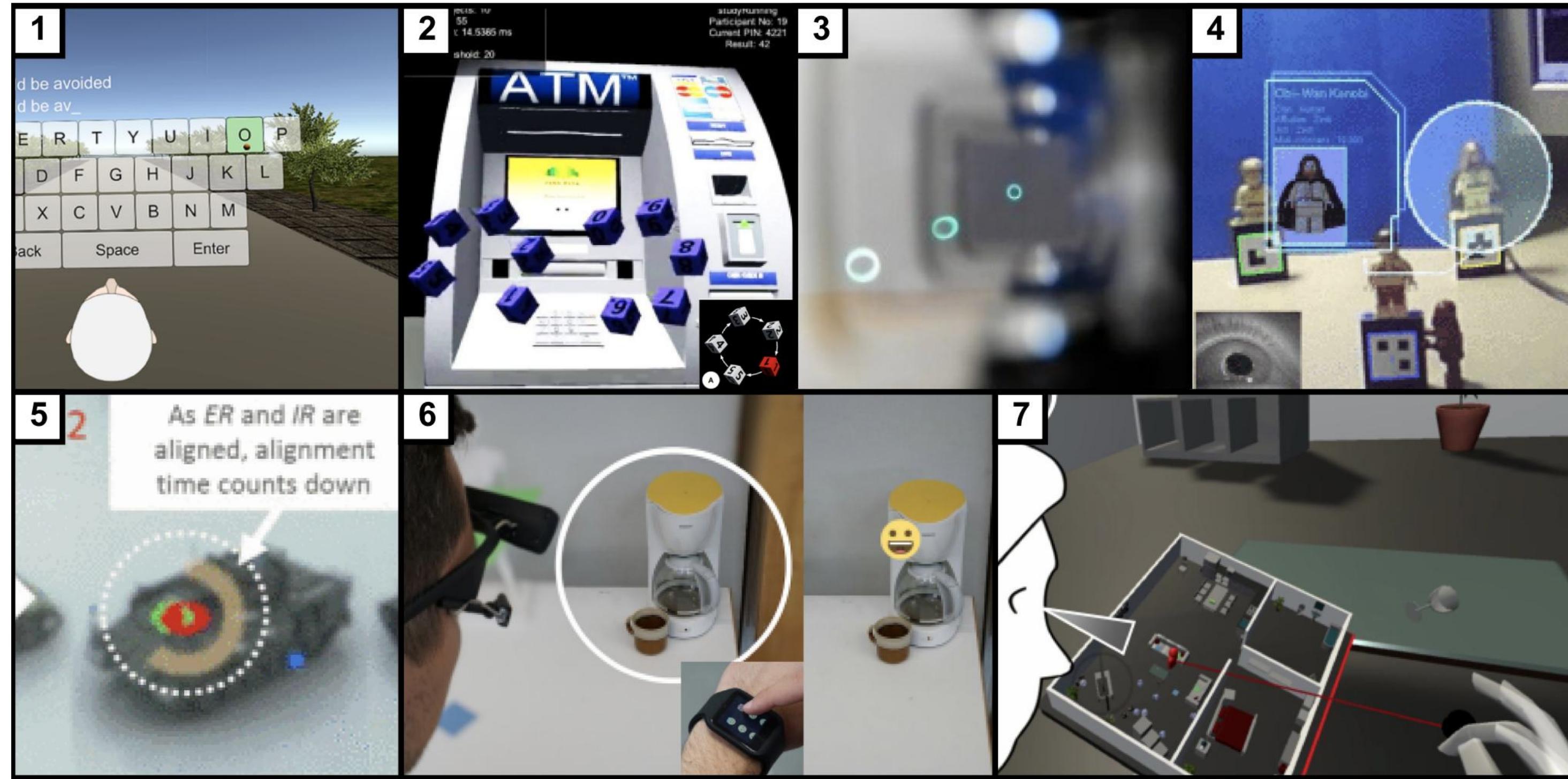
**No large gestural controls outside the machine**



**Reduce physical fatigue,  
Natural external user movement**

# Background Research

# Explicit Gaze Interaction



Use Gaze Interaction  
as Dominant Input

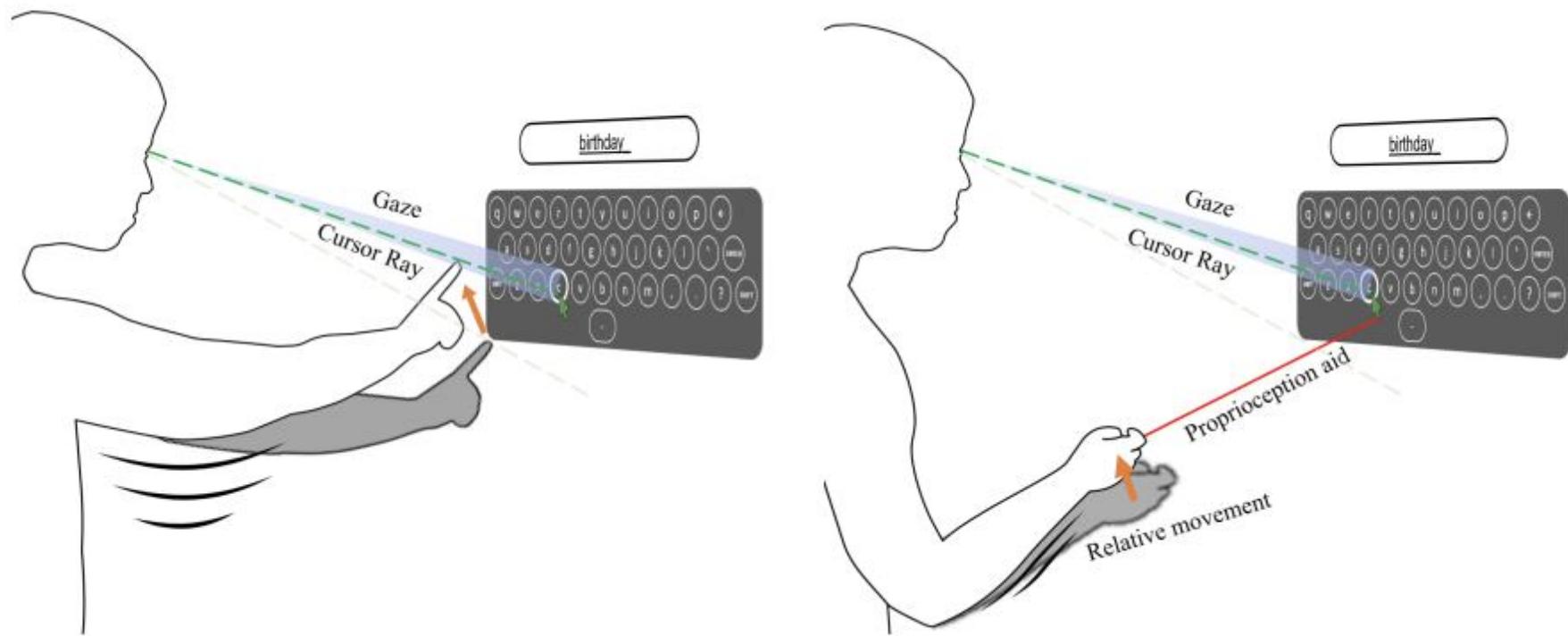
Dwell time  
Gaze behavior

Hover, Select

The eye in extended reality: A survey on gaze interaction and eye tracking in head-worn extended reality. Plopski, A. et al. (2022)

# Gaze-based Text Entry Systems

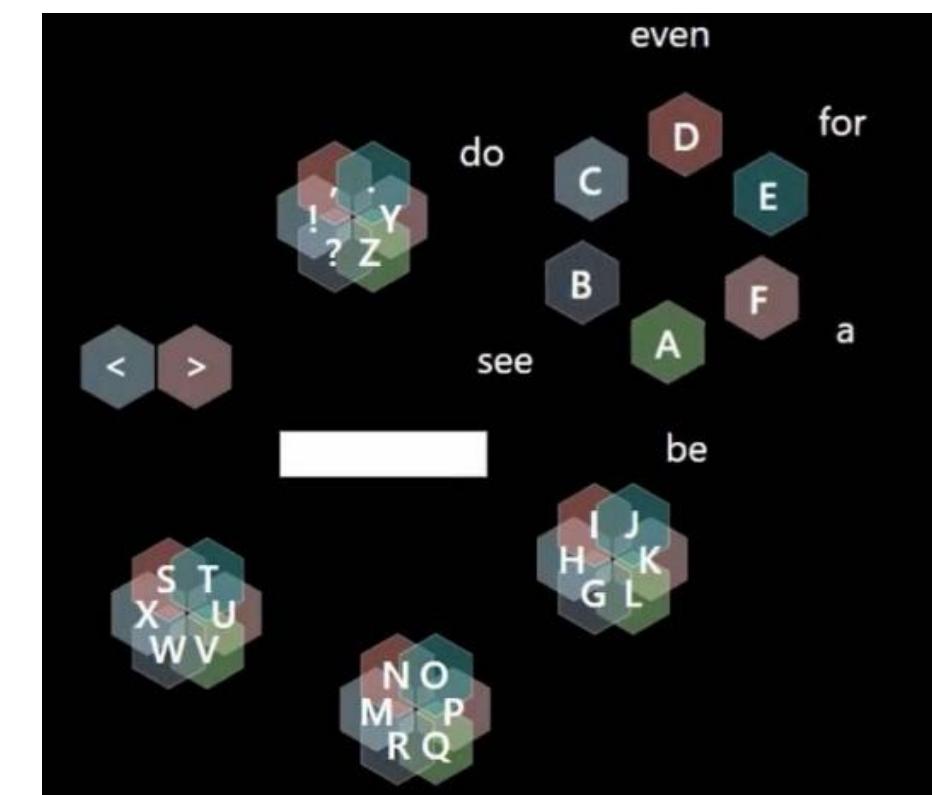
1



Exploring gaze for assisting freehand selection-based text entry in Ar. Lystbæk. et al. (2022)

Text entry using gaze hand alignment

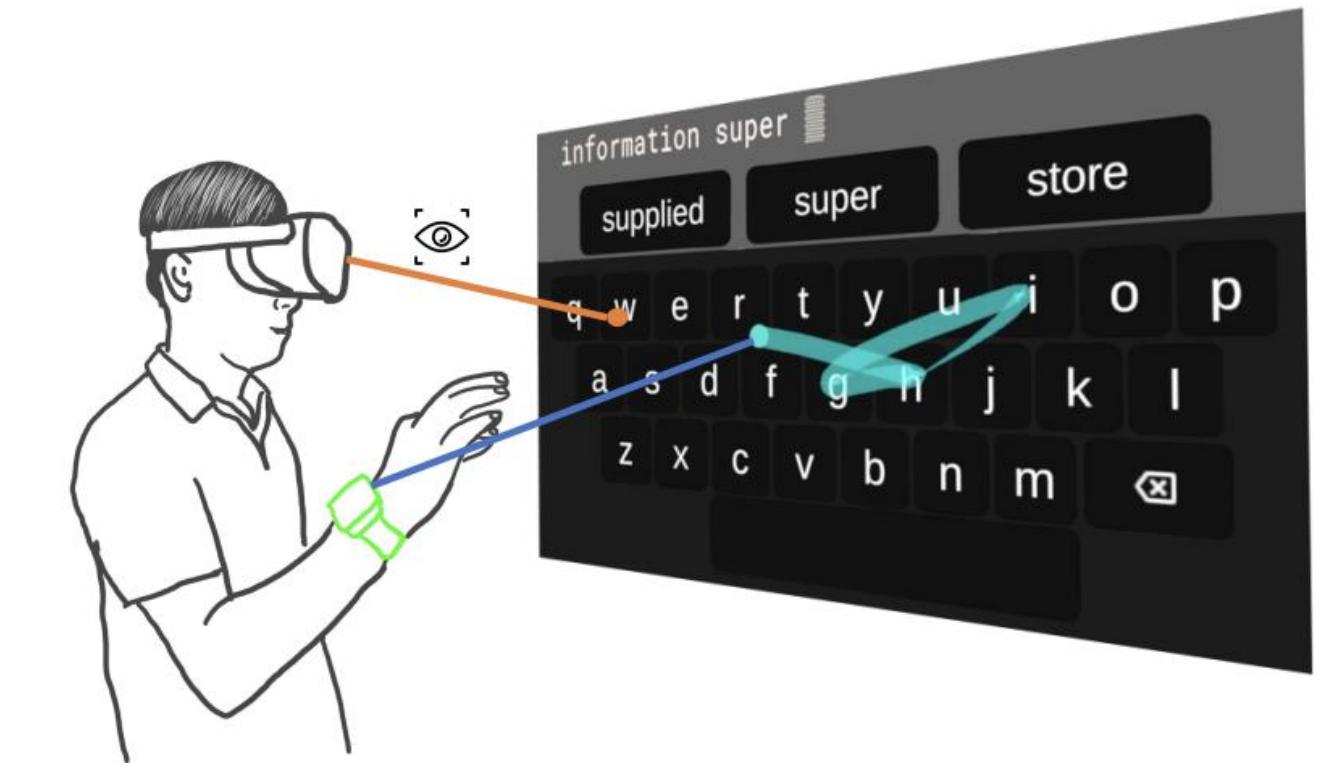
2



Calibration-free text entry using smooth pursuit eye movements. Abdabou, Y. et al. (2019).

Eye gaze only input, using motion correlation

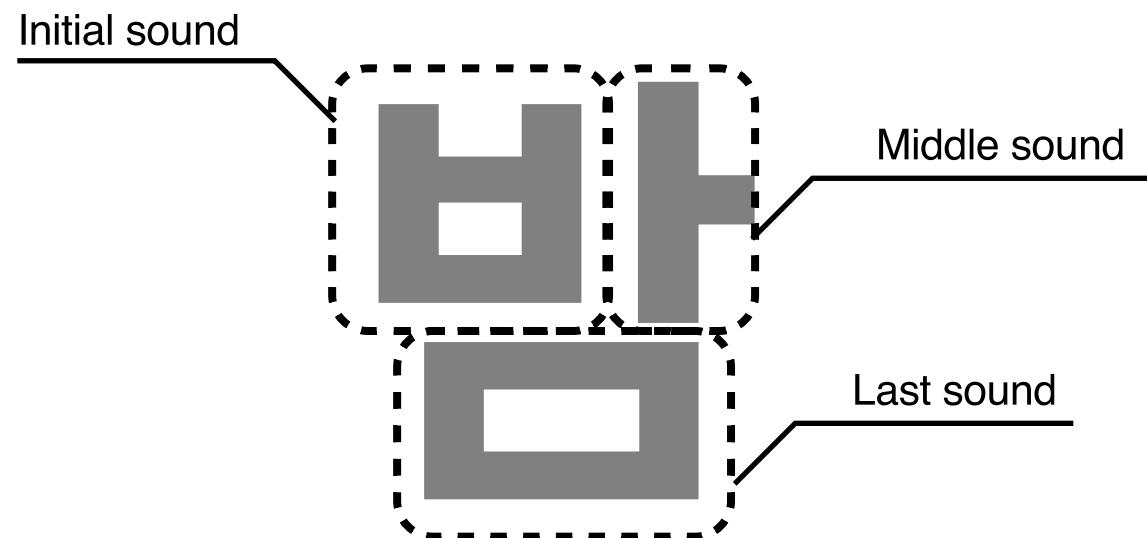
3



Gaze speedup: Eye gaze assisted gesture typing in virtual reality. Zhao, M. et al. (2023).

Gesture tracking : eye + hand  
Using eye tracking to assist the wrist gesture tracking

# Hangul Structure



## Consonants

Regular consonants

ㄱ ㄴ ㄷ ㄹ ㅁ ㅂ ㅅ ㅇ ㅈ ㅎ  
ㄱ ㅋ ㄷ ㅌ ㅁ ㅂ ㅅ ㅆ ㅈ ㅉ  
ㄱ ㅌ ㅌ ㅍ ㅍ ㅍ ㅍ ㅍ ㅊ ㅊ

Double last sound

ㄹ → ㄹㄱ ㄹㅌ ㄱ → ㄱㅅ  
ㄹ → ㄹㅁ ㄹㅍ ㄴ → ㄴㅎ  
ㄹ → ㄹㅂ ㄹㅊ ㄴ → ㄴㅈ  
ㅂ → ㅂㅅ

## Vowels

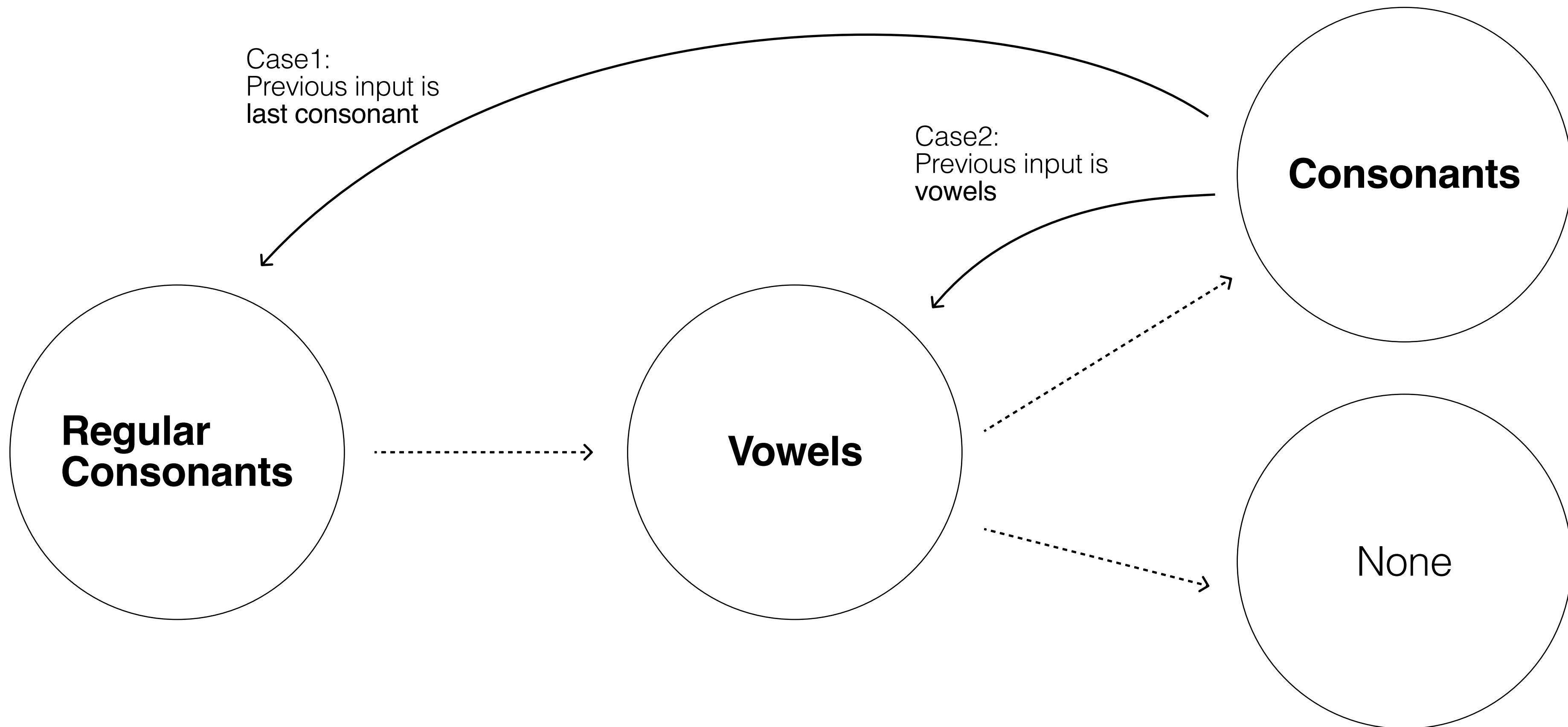
Regular vowels

ㅏ ㅓ ㅗ ㅜ ㅡ ㅣ  
ㅓ + dot(.)  
ㅑ ㅕ ㅛ ㅕ

Compound vowels

ㅣ → ㅐ ㅔ ㅚ ㅓ → ㅕ  
ㅔ ㅖ ㅖ ㅓ → ㅕ  
ㅚ ㅟ ㅟ ㅓ → ㅕ

# Korean text entry system

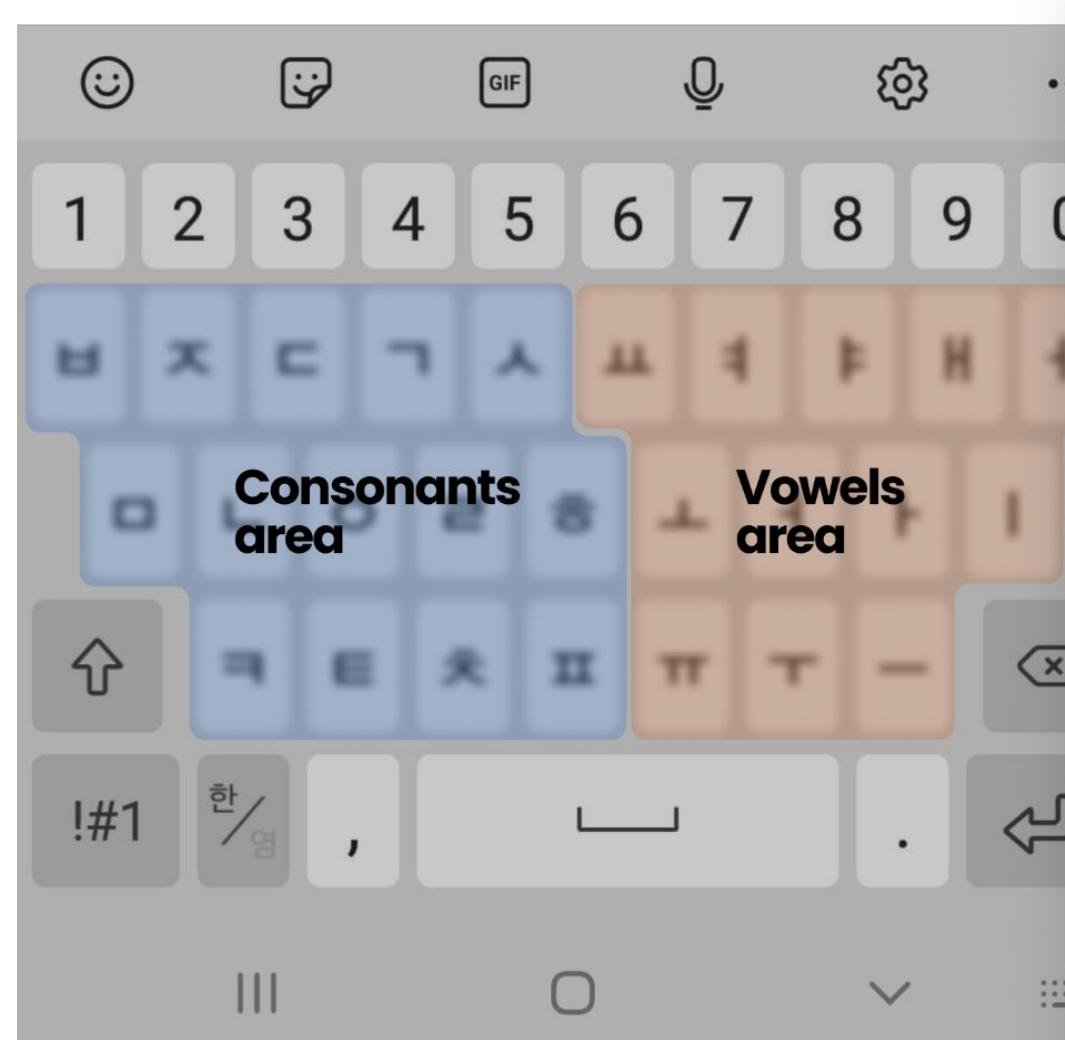


# Divided consonants and vowels area

Reduce typing time by alternating between two hands based on input sequence



Korean can be input with **different interactions** between **consonants** and **vowels**

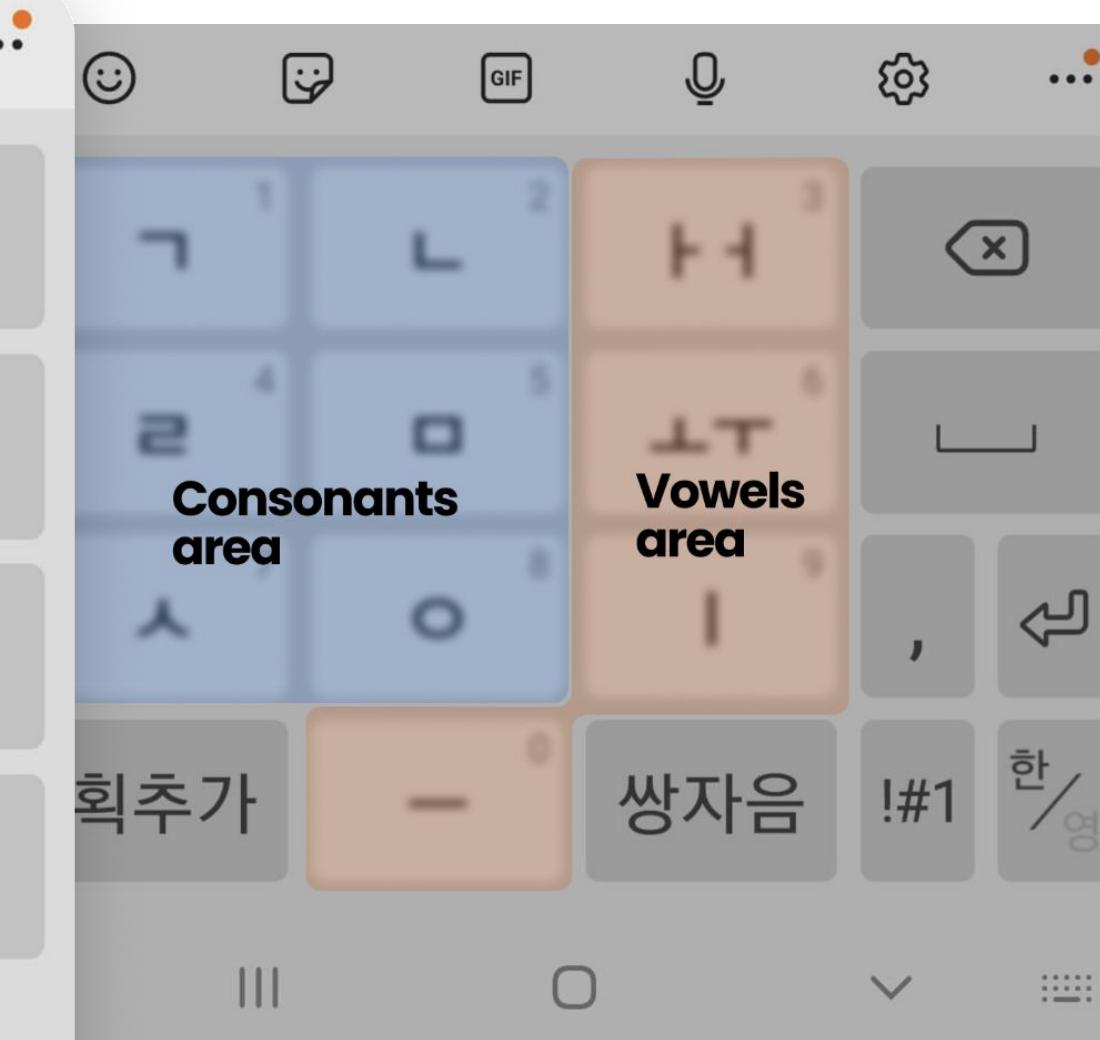
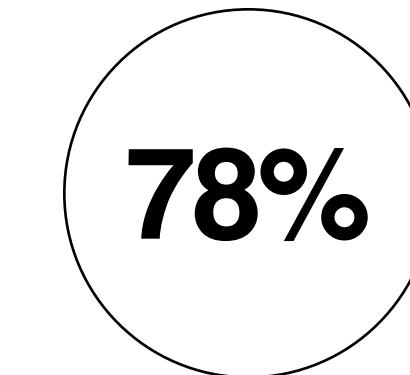


QWERTY

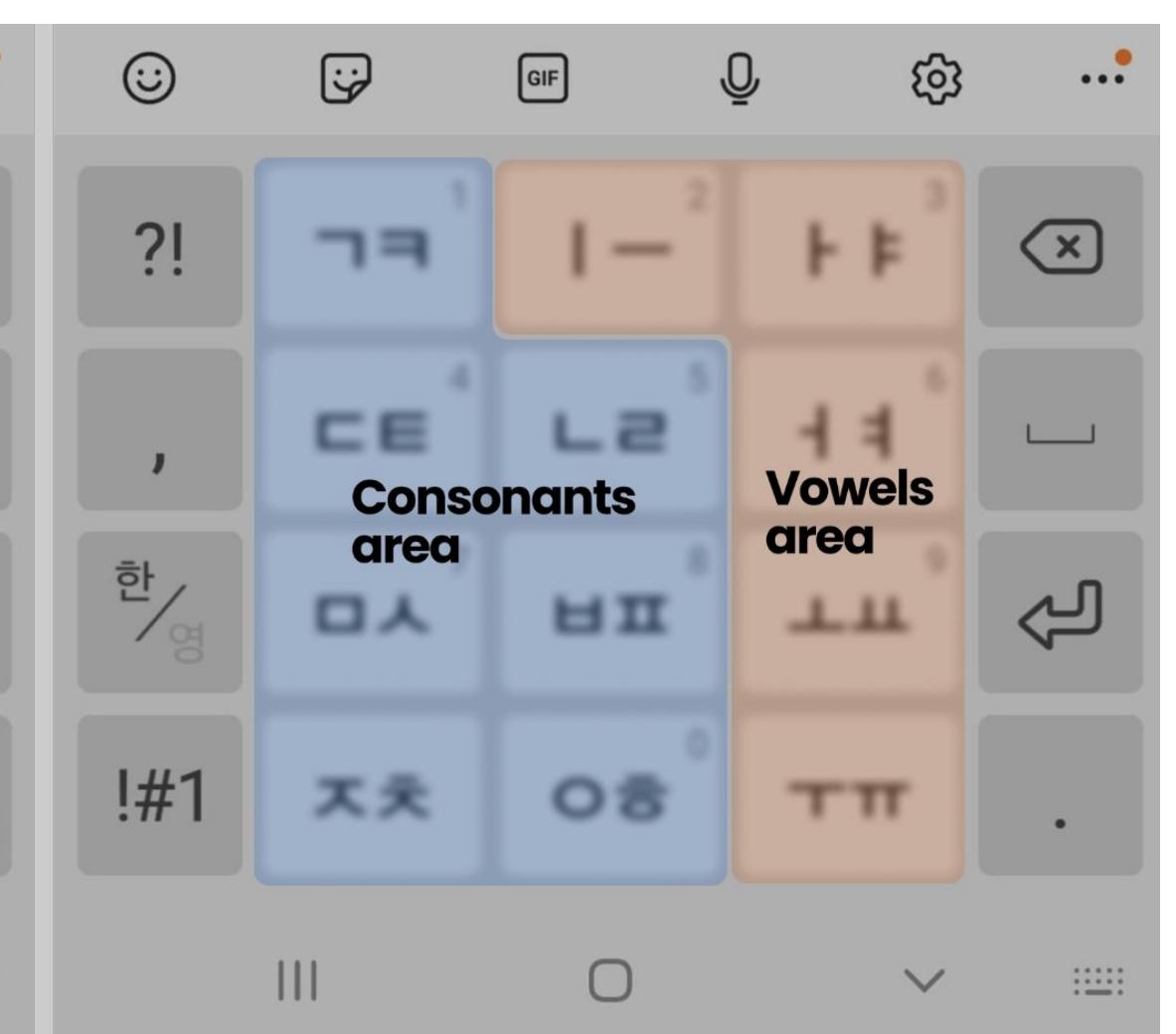


Cheonjiin

The first consonant typed on **Cheonjiin** is most likely to be an initial sound at



NaraGuel



Vega

# Project Goals

# Project Goals

**1**

Design a consonant Gaze tracking layout for input.

**2**

Design low effort finger taps vowel input interactions.

**3**

Design both interactions to be a natural experience.

O-K Text

# Eye-tracking system

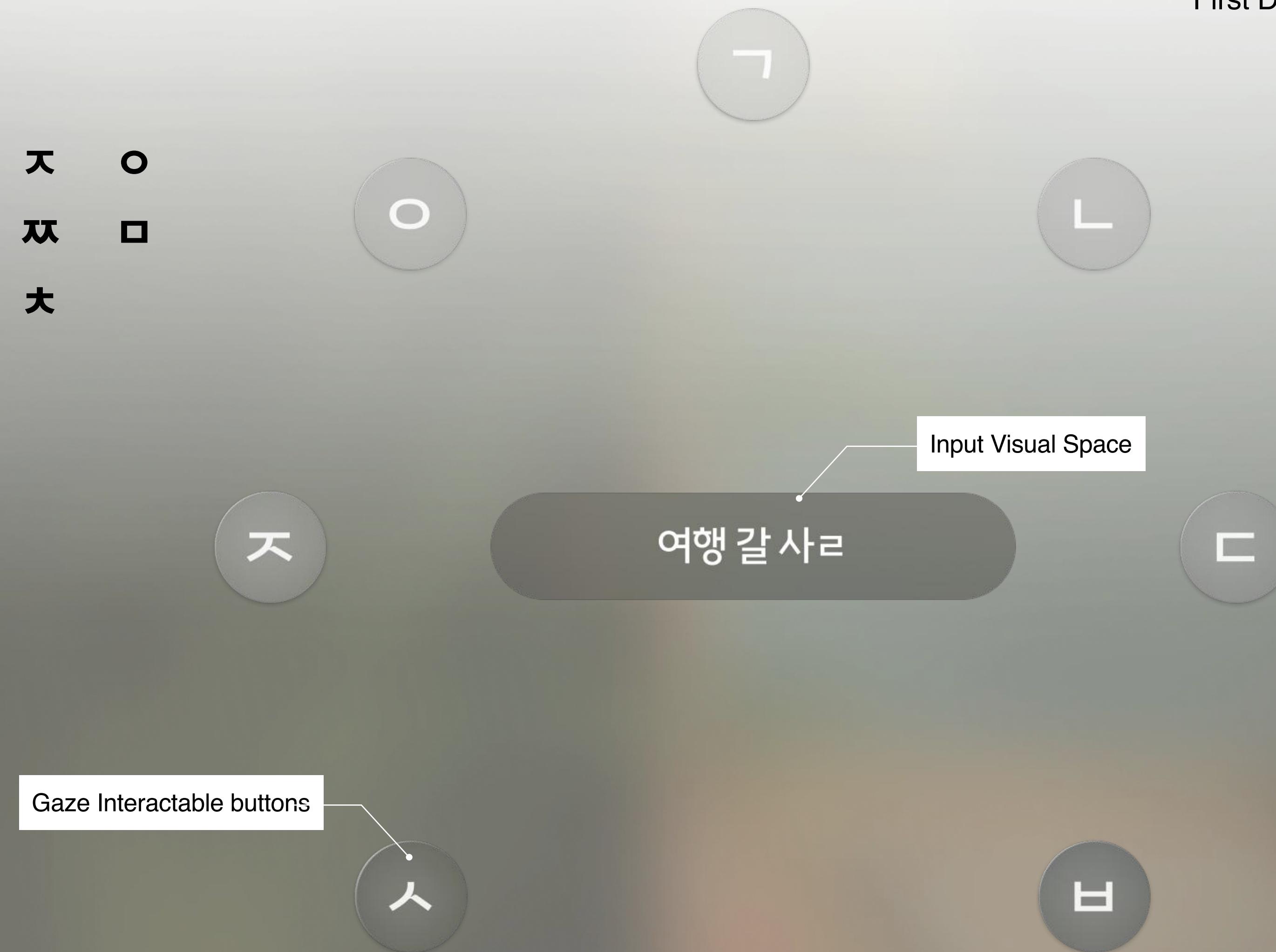
First Depth Scene

Consonants groups

Depth 1 → ㄱ ㄴ ㄷ ㅂ ㅅ ㅈ ㅇ

Depth 2 → ㅋ ㄹ ㅌ ㅍ ㅎ ㅊ ㅁ

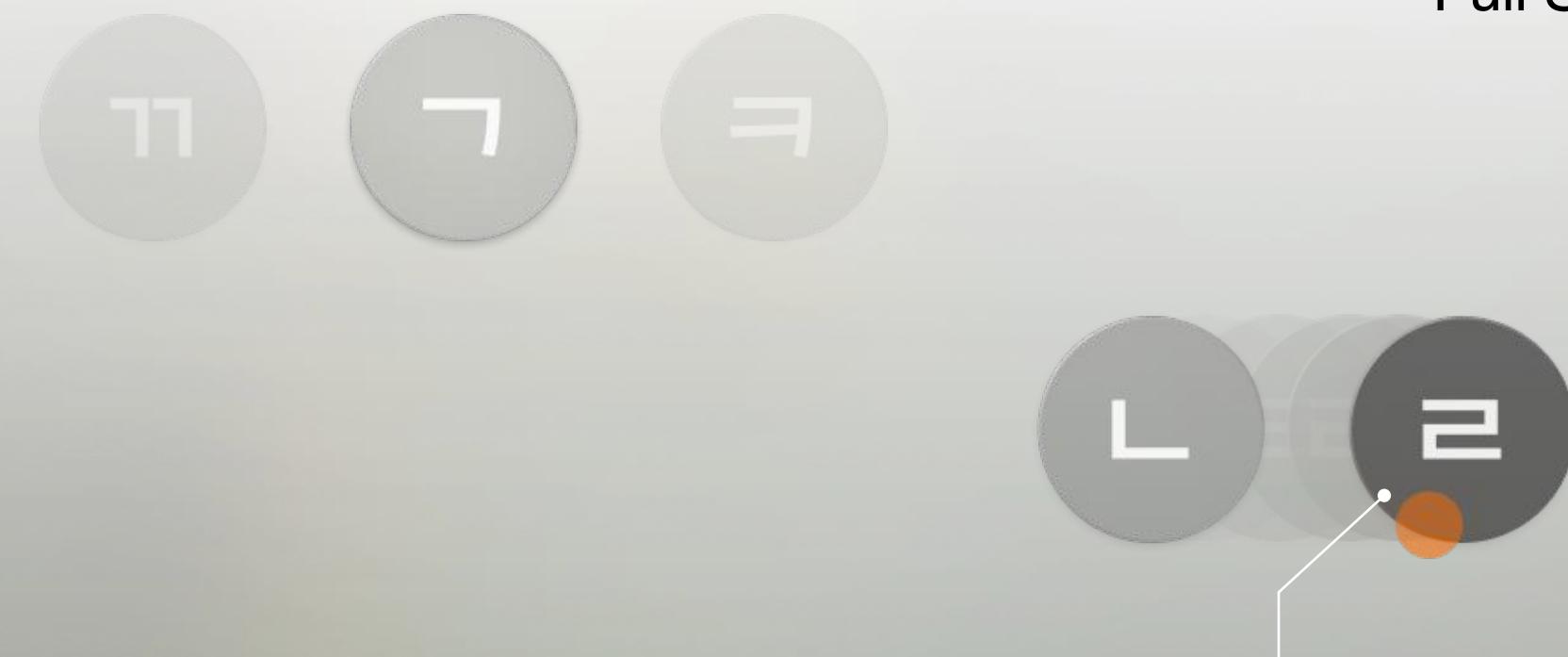
Depth 3 → ㄲ ㄸ ㅃ ㅆ ㅉ ㅊ ㅏ



# Gaze interactions

Full Sets Scene

Depth 1 → ㄱ ㄴ ㄷ ㅂ ㅅ ㅅ ㅈ ㅇ  
Depth 2 → ㅋ ㄹ ㅌ ㅃ ㅎ ㅎ ㅉ ㅁ  
Depth 3 → ㄲ ㄸ ㅃ ㅍ ㅆ ㅆ ㅈ ㅊ

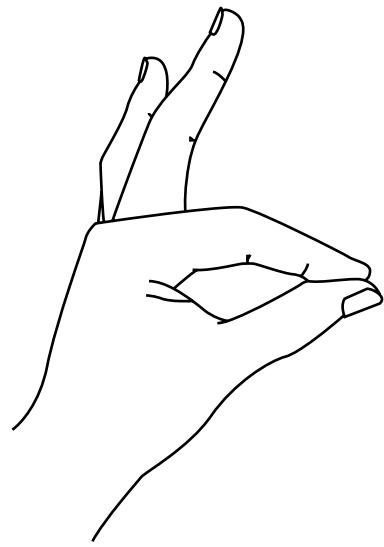


여행 갈 사로

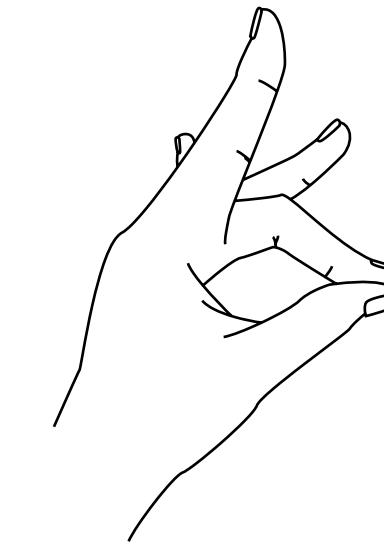
Gazing at a consonant  
shows full hierarchy

# Hand Interactions

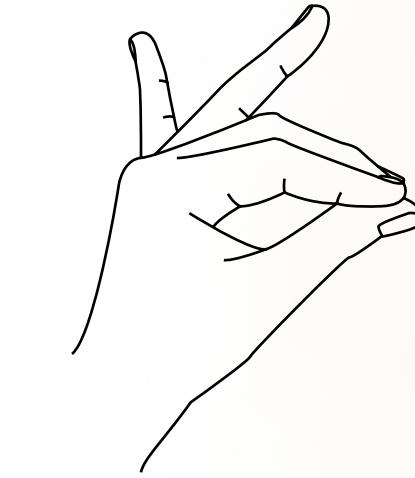
Left Hand



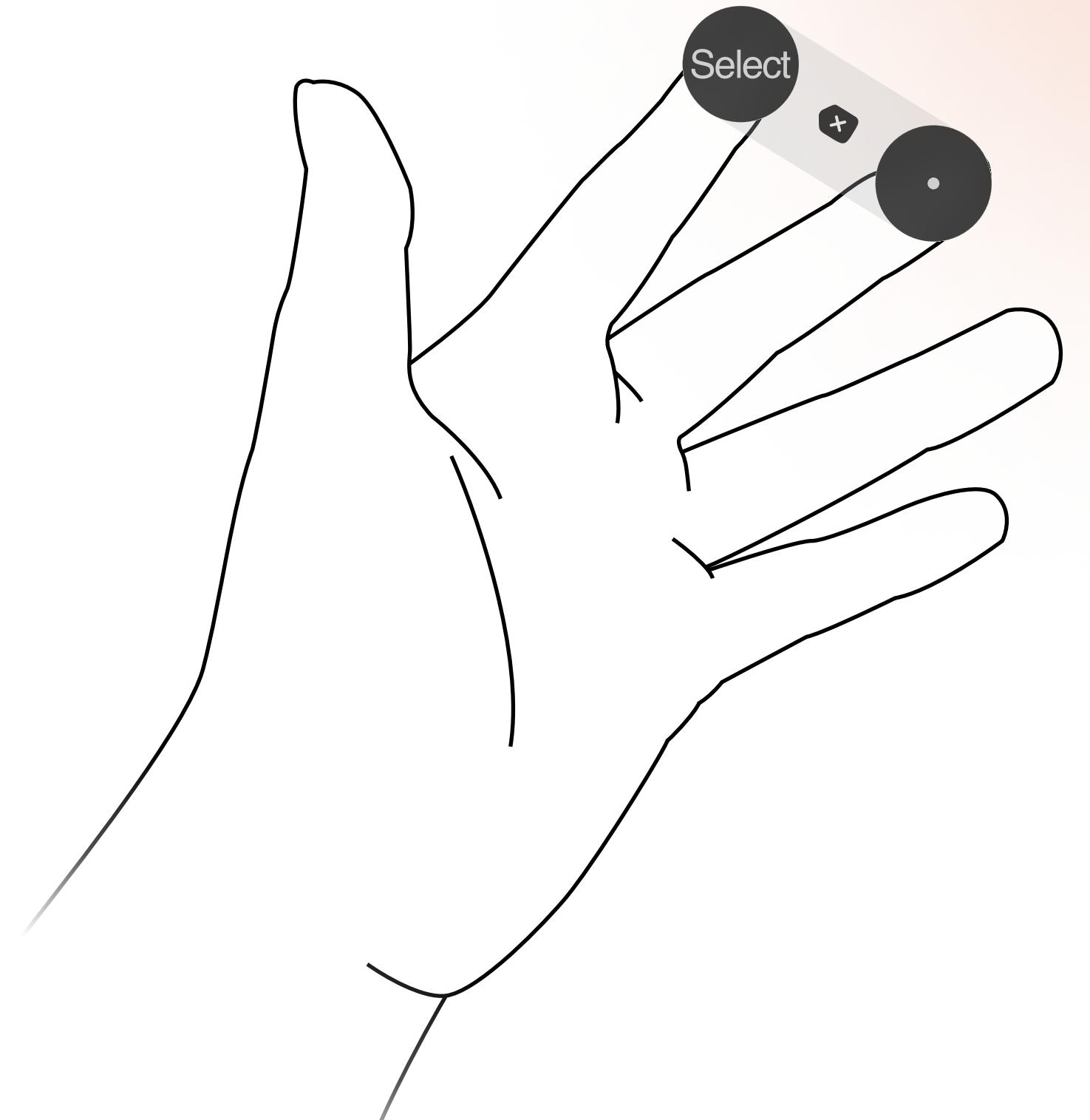
Select Consonants



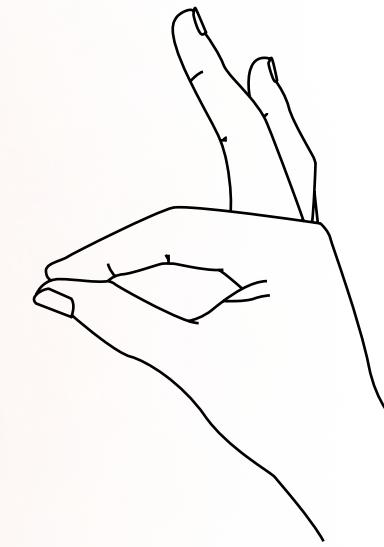
Add Vowels Stroke



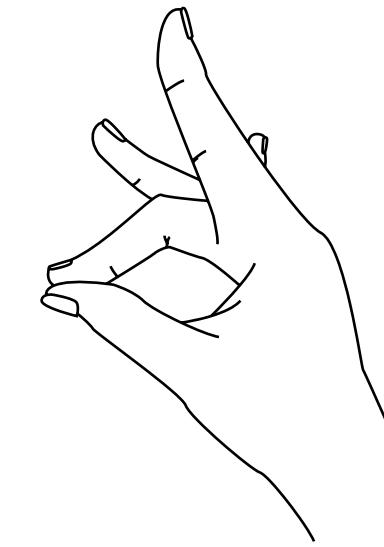
BackSpace



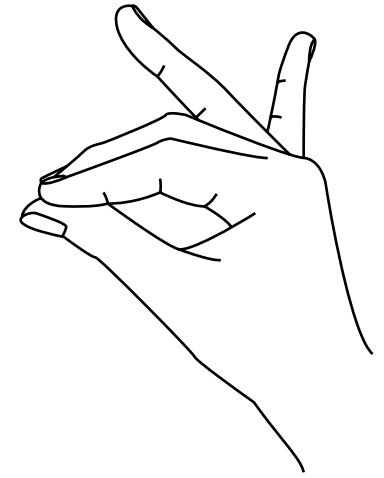
Right Hand



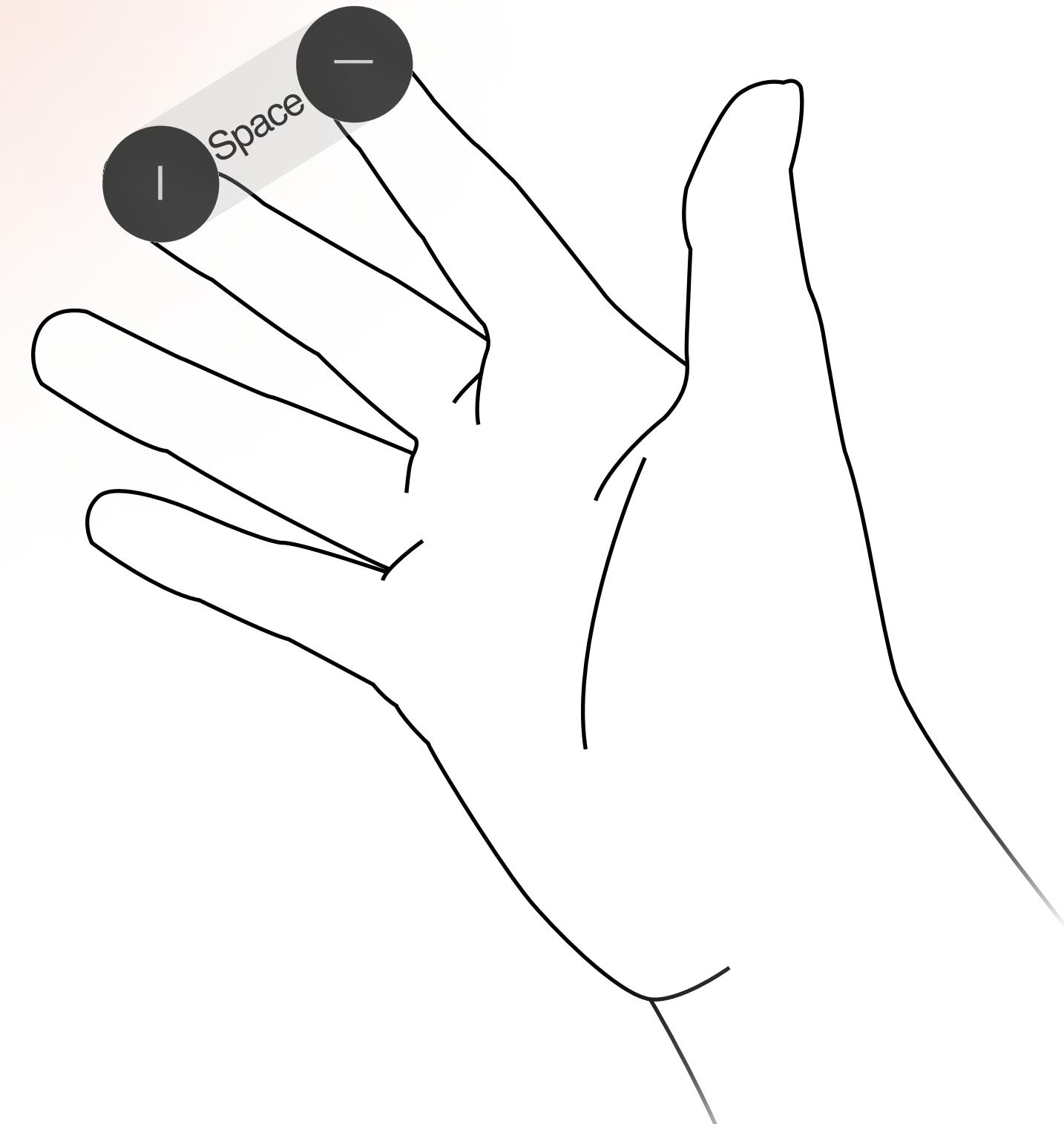
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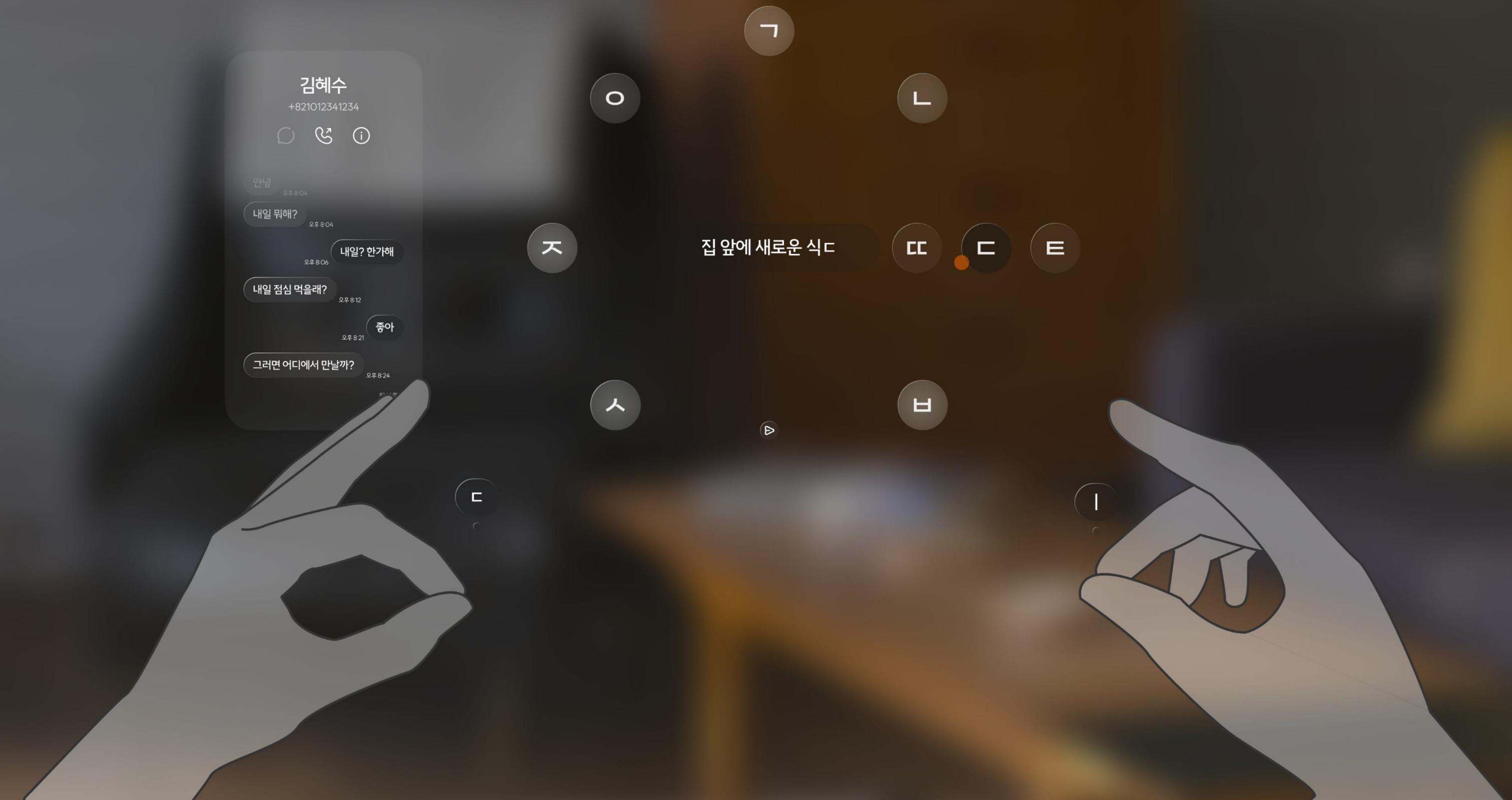
I



Space



# Overall Design

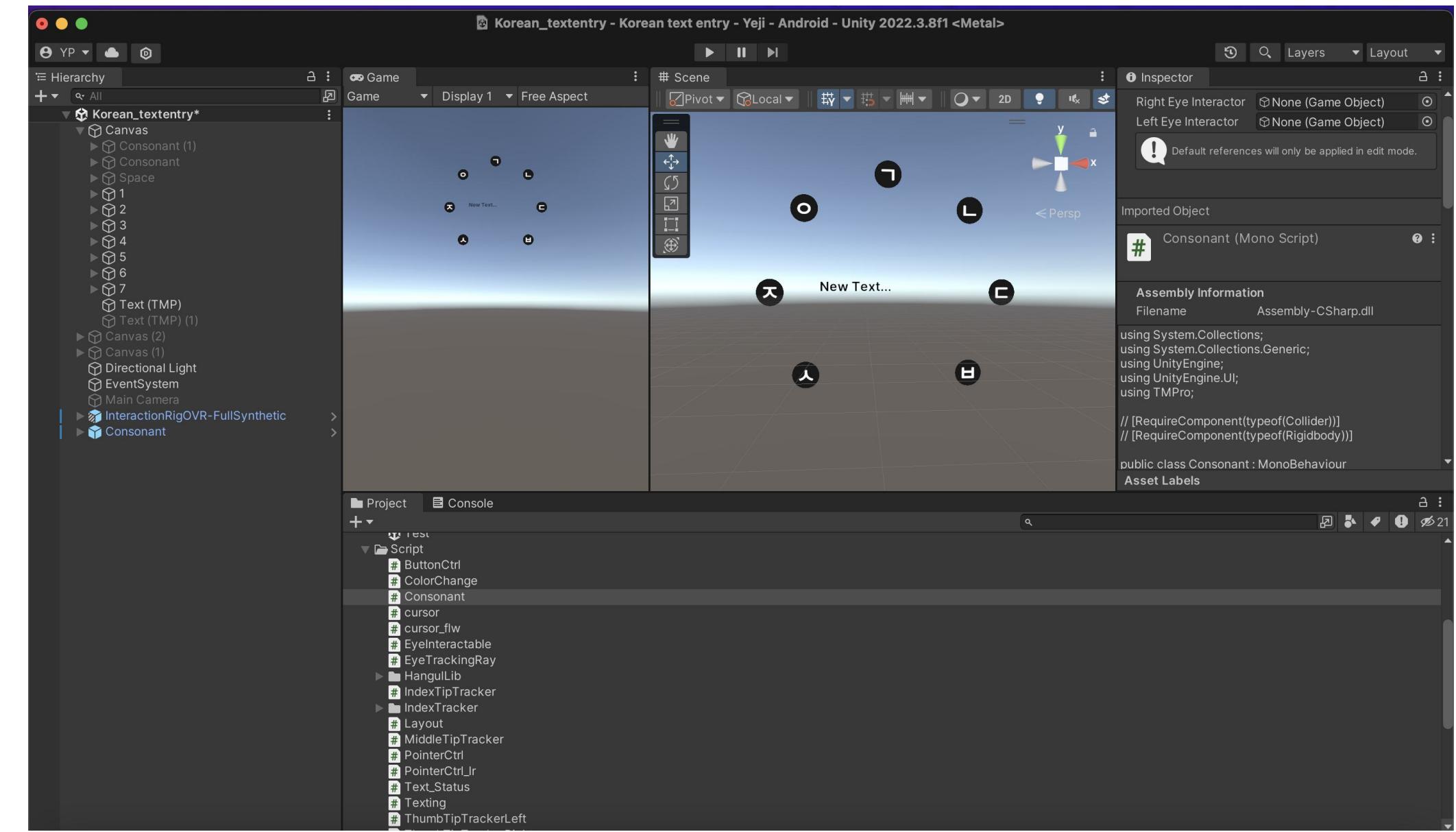


# Prototype

# Equipment & Tools

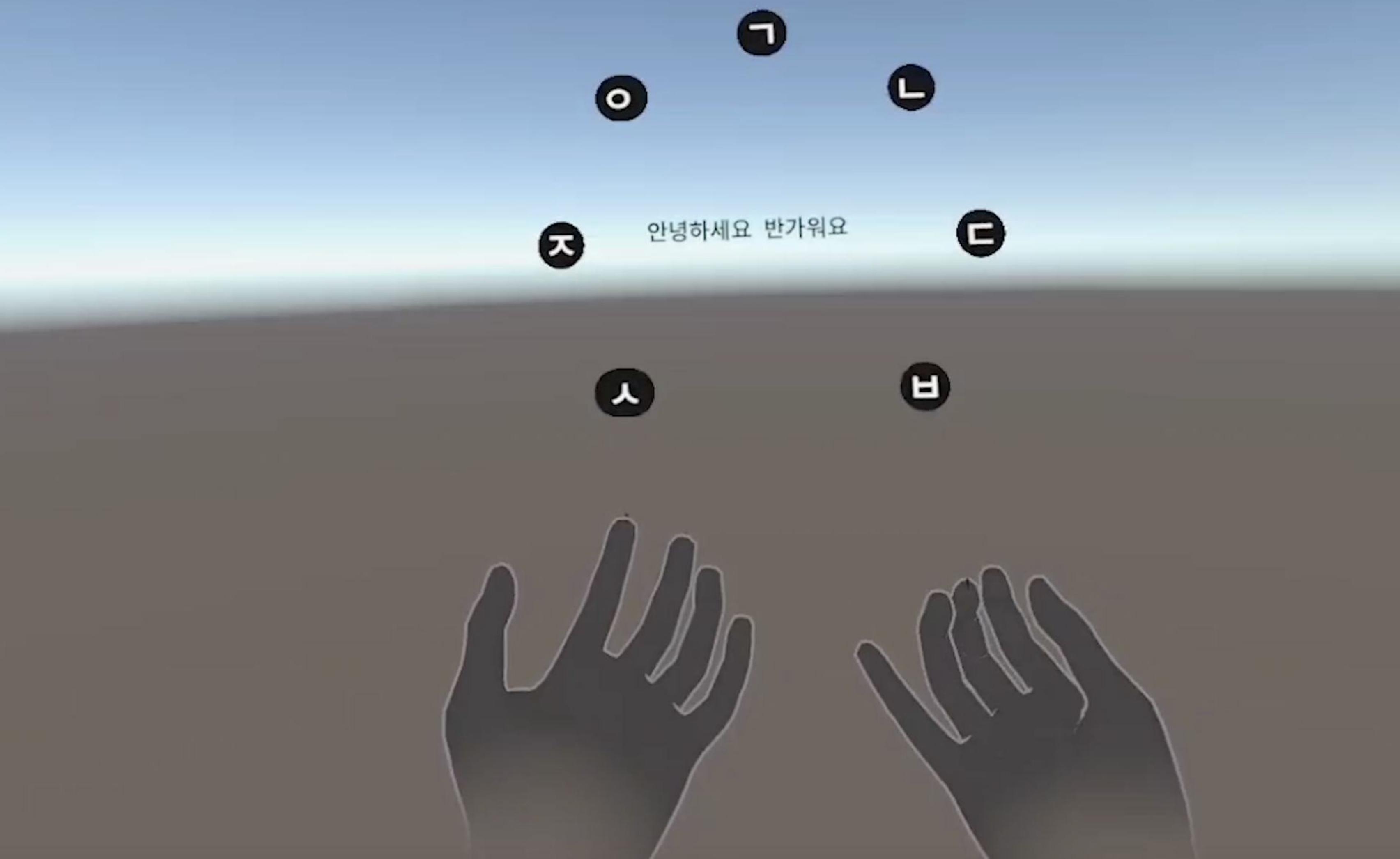


Meta Quest Pro



UNITY Engine 2022.3.8f

# Video



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# Usability Evaluation



# Usability Evaluation Method

## Word Representation Test

5 Words, 7times



Measure Word Per Minute (WPM)  
and Word Error Rate (WER)

### Word Information

Word	Total Key Stroke	Character	Letter	KeyStroke Per Character	KeyStroke Per Letter
더위	7	2	4	3.5	1.75
단감	8	2	6	4	1.33
샘	5	1	3	5	1.67
연필	8	2	6	4	1.33
감사	7	2	5	3.5	1.4
<b>Average</b>	<b>7</b>	<b>1.8</b>	<b>4.8</b>	<b>4</b>	<b>1.50</b>

학교

Character → 학, 교

Letters → ㅎ, ㅏ, ㄱ, ㅓ, ㅍ

# Usability Evaluation Method

## Procedure

Introduce  
O-K Text

Calibrate  
VR Equipment

Training  
Session

Start  
Usability Test

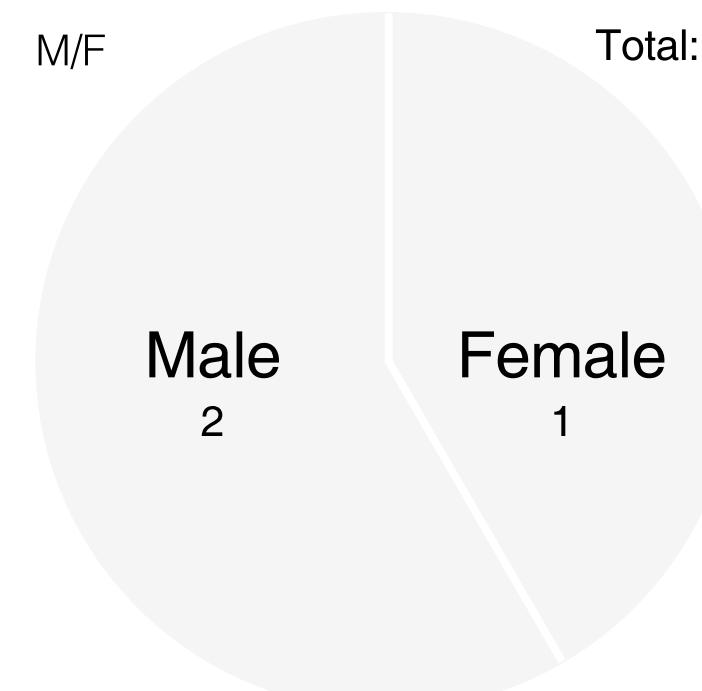
Discussion  
Session

1. Start to write a word
  - Press First Consonant → Start
  - After enter all characters and press Space → End
  - Reset
2. Repeat 7times
3. Break

## Participants

Age

23.7

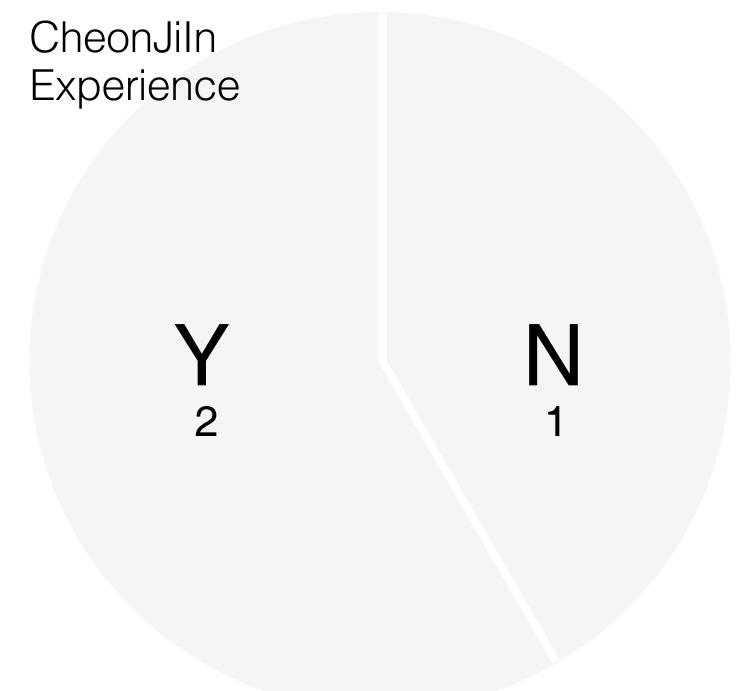


Dominant Hand

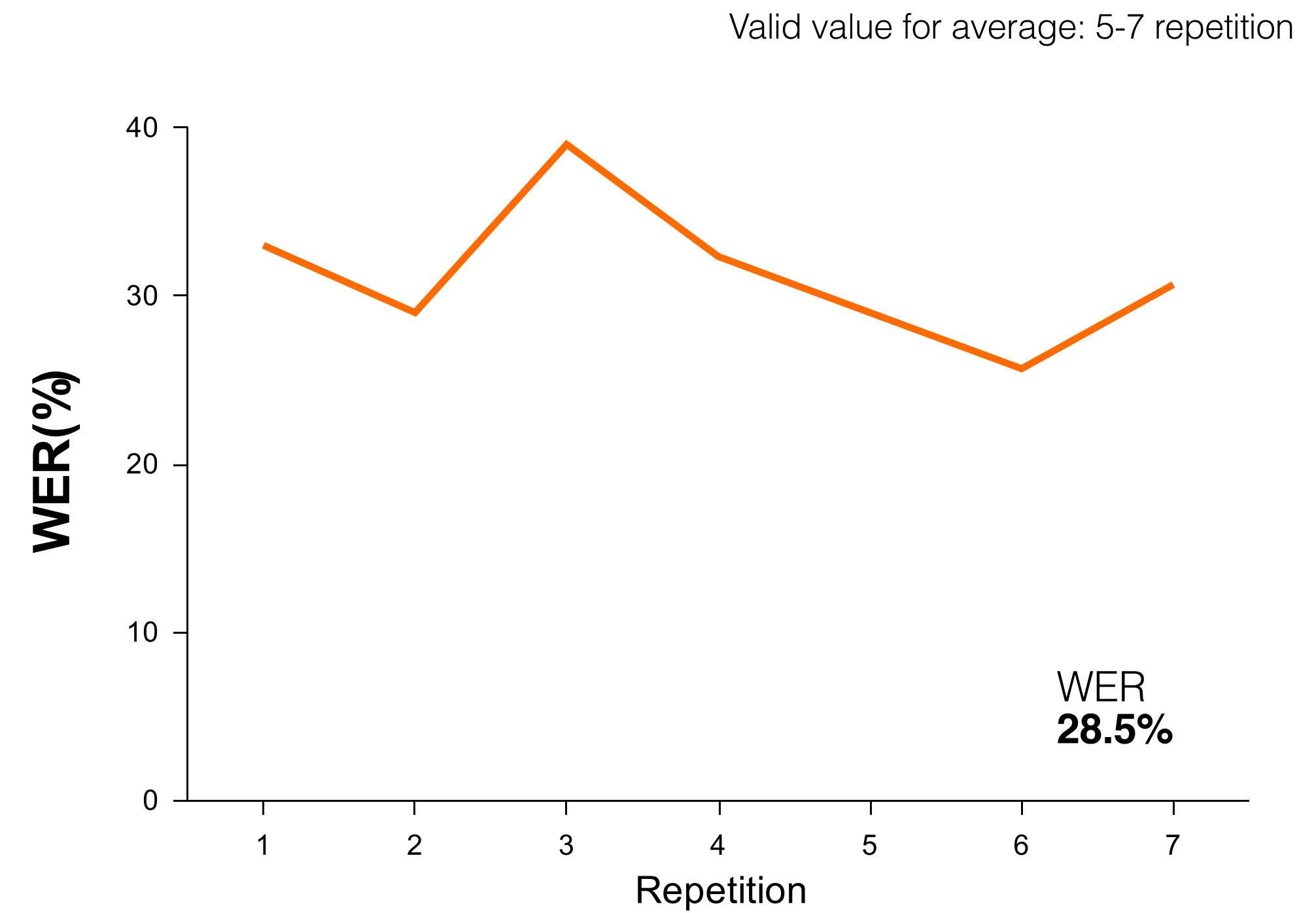
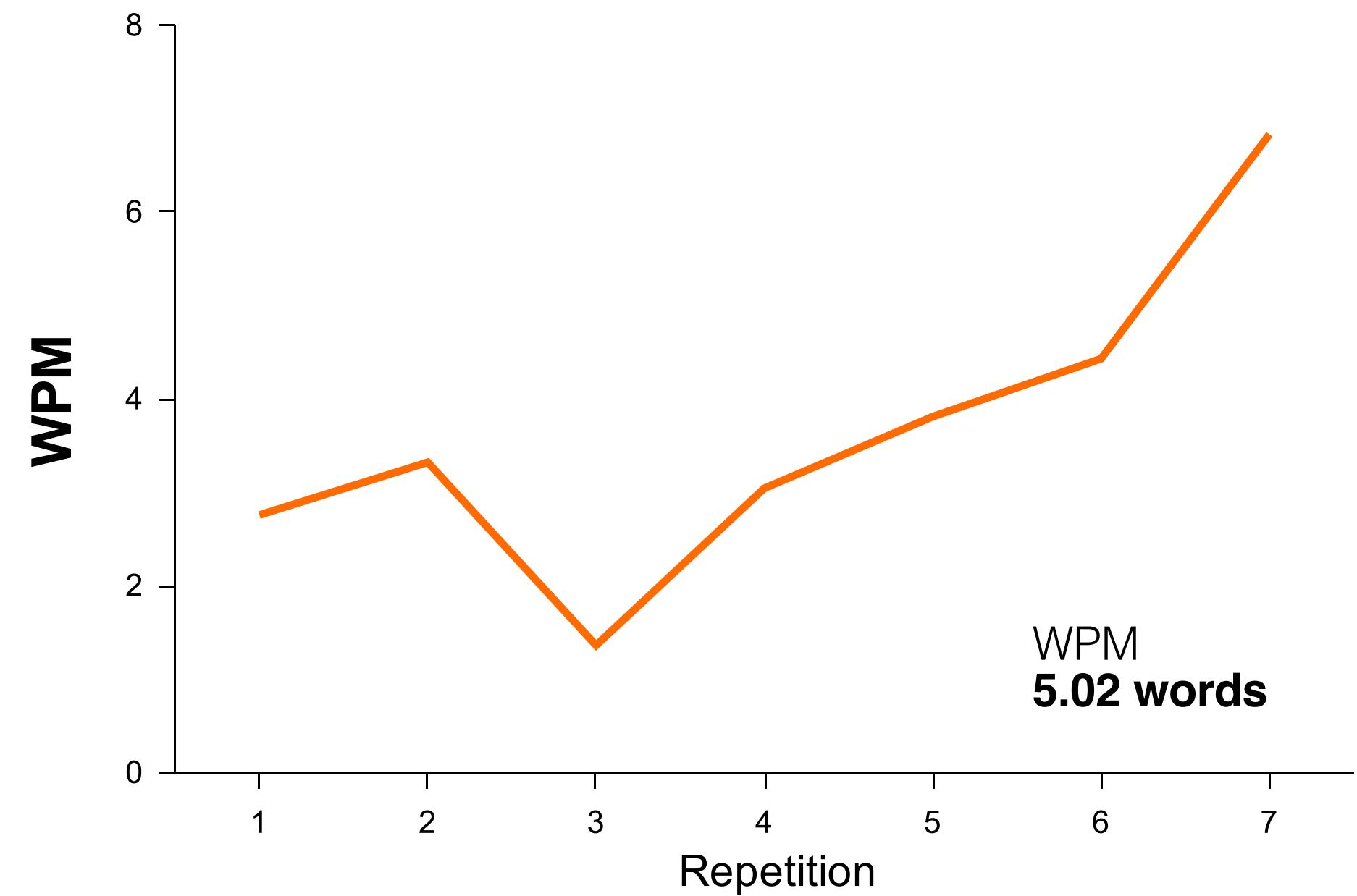
Right

Dominant Eye

Right



# Result



# Discussion

1

**Difficulty recognizing**  
consonants and hand input  
who has never used Cheonjiin.

2

Since the select button is in the  
hand, it feels like vowels and  
consonants are **not separated**.

3

Inaccuracy in hand input  
break the flow of writing

# Future Work

# Future Work

**1**

Redesigning the input visibility method.

**2**

Need to restructure input methods for vowel and consonant input

**3**

Functional workarounds for hand input accuracy

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Designer      Supervisor  
Yejji Park      Ian Oakley