Evaluating User Preferences for Augmented Reality Interactions for the Internet of Things

Shreya Chopra

Supervisor: Dr. Frank Maurer

Image Source: https://imaginahome.com/wp-content/uploads/2018/11/Smart-home.jpeg

AVI 2020

International Conference on Advanced Visual Interfaces
Ischia Island, Italy

Who We Are

Shreya Chopra, MSc.
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Dr. Frank Maurer

Agenda

- Introduction
- Background & Related Work
- User Elicitation Study for AR-IoT Controls
- Study Observations, User Comments, & Design Implications
- Limitations & Conclusion

Image source: https://www.cepro.com/wp-content/uploads/2019/08/ADT_data_large.jpg

Introduction

Image Source: Authors

How Will We Control Our Future Things?

Image Source: https://www.pinterest.ca/pin/419538521520759082/

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How Will We Control Our Future Things…Using Augmented Reality?

Image Source: https://docs.microsoft.com/en-us/windows/mixed-reality/gestures

Various Methods of Input

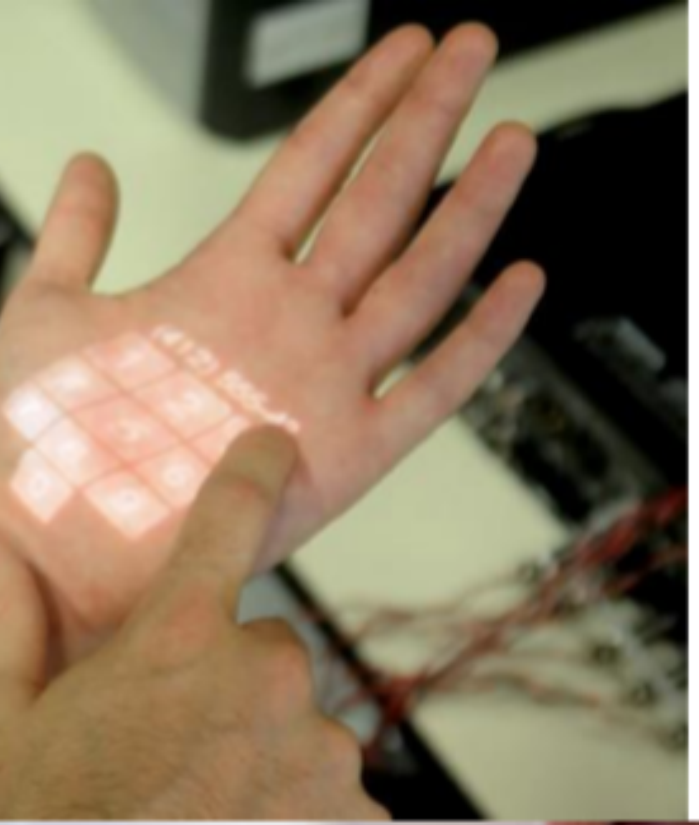

Image Sources: http://www.chrisharrison.net/index.php/Research/Skinput
https://ctl.net/products/ctl-chromebox-ctl22cbx1t-2-in-1-with-ip2154t-22-touch-display
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https://anymotion.com/en/wissensgrundlagen/ar-brillen/microsoft-hololens
https://www.youtube.com/watch?v=NfG63Ge3aQk

Voice Commands & Gestures

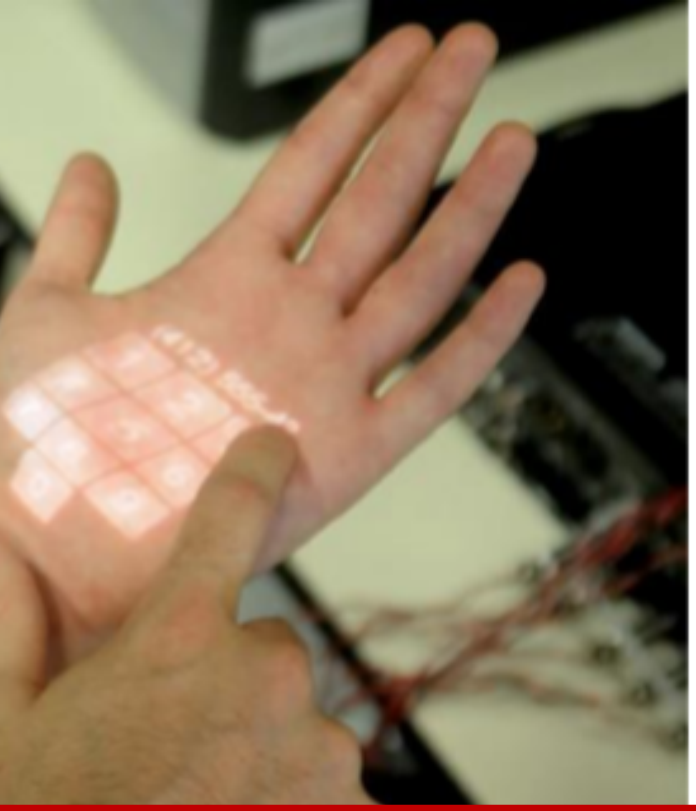

Image Sources: http://www.chrisharrison.net/index.php/Research/Skinput
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https://threatpost.com/skyping-and-typing-the-latest-threat-to-privacy/121387/
http://bwdisrupt.businessworld.in/article/Press-the-Mic-and-Trade-Your-Stock-with- Voice-Commands-from-this-App/24-05-2017-118838/
https://anymotion.com/en/wissensgrundlagen/ar-brillen/microsoft-hololens
https://www.youtube.com/watch?v=NfG63Ge3aQk

Research Questions

1. What is the current state of research?
2. How can gestures and voice commands be elicited?
3. What insights can be derived from the elicitation study?
4. Do users have a preference between voice vs gestures?

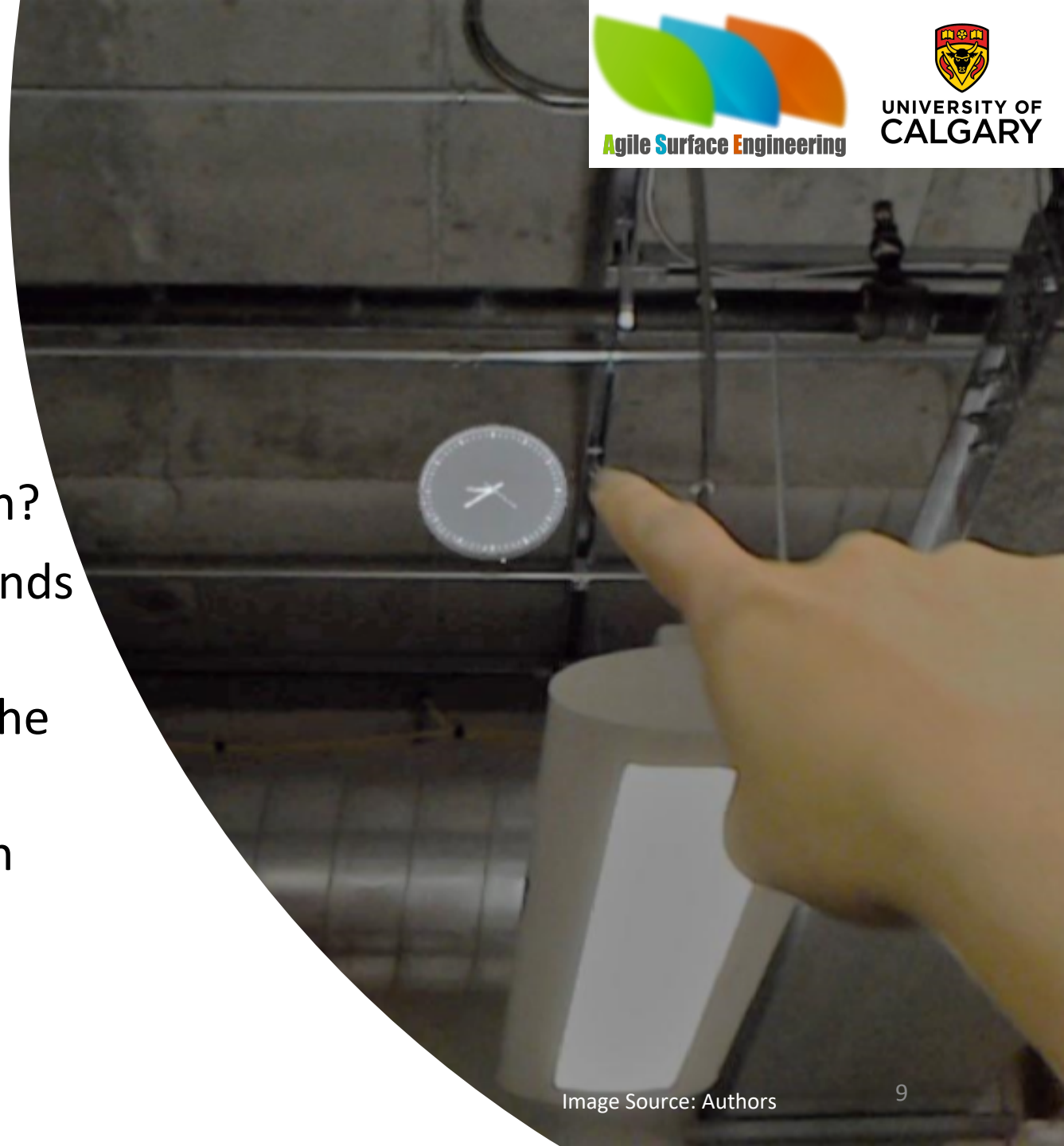

Image Source: Authors

Background & Related Work

Image Sources: https://www.bestbuy.ca/en-ca/product/click-and-grow-smart-indoor-garden-sgs8us-with-basil-seed-capsule-refill-3-pack-dark-grey/10660704?&cmp=knc-s-71700000055105959&gclid=EAIaIQobChMIgsHr6e254wIVBtRkCh1jWg8KEAYYBS ABEgKvBfD_BwE&gclsrc=aw.ds
https://www.pcmag.com/article/303814/the-best-smart-home-devices-for-2019
https://www.wayfair.com/furniture/pdx/sobro-smart- coffee-table-sobr1001.html
https://www.the-ambient.com/guides/best-smart-blinds-homekit-alexa-448

Background Research

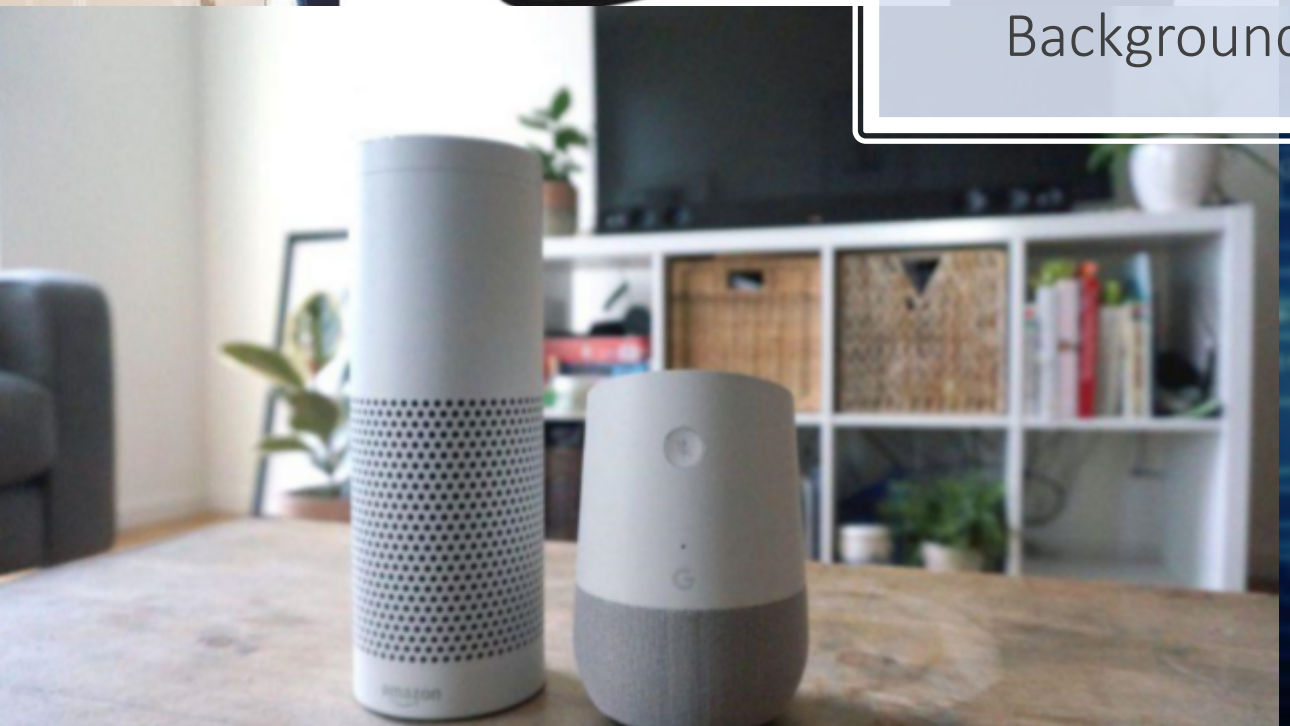

Image Sources: https://www.pcmag.com/article/303814/the-best-smart-home-devices-for-2019
https://www.irobot.com/roomba
https://www.currys.co.uk/gbuk/listing/332_3119_30206_xx_xx/xx-criteria.html
https://www.amazon.com/Bose-Speaker-Alexa-control- built/dp/B07FDF9B46
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https://pcper.com/2019/05/lenovo- thinkreality-a6/

Video Source (clipped from): Valentin Huen at https://www.media.mit.edu/projects/reality-editor/overview/

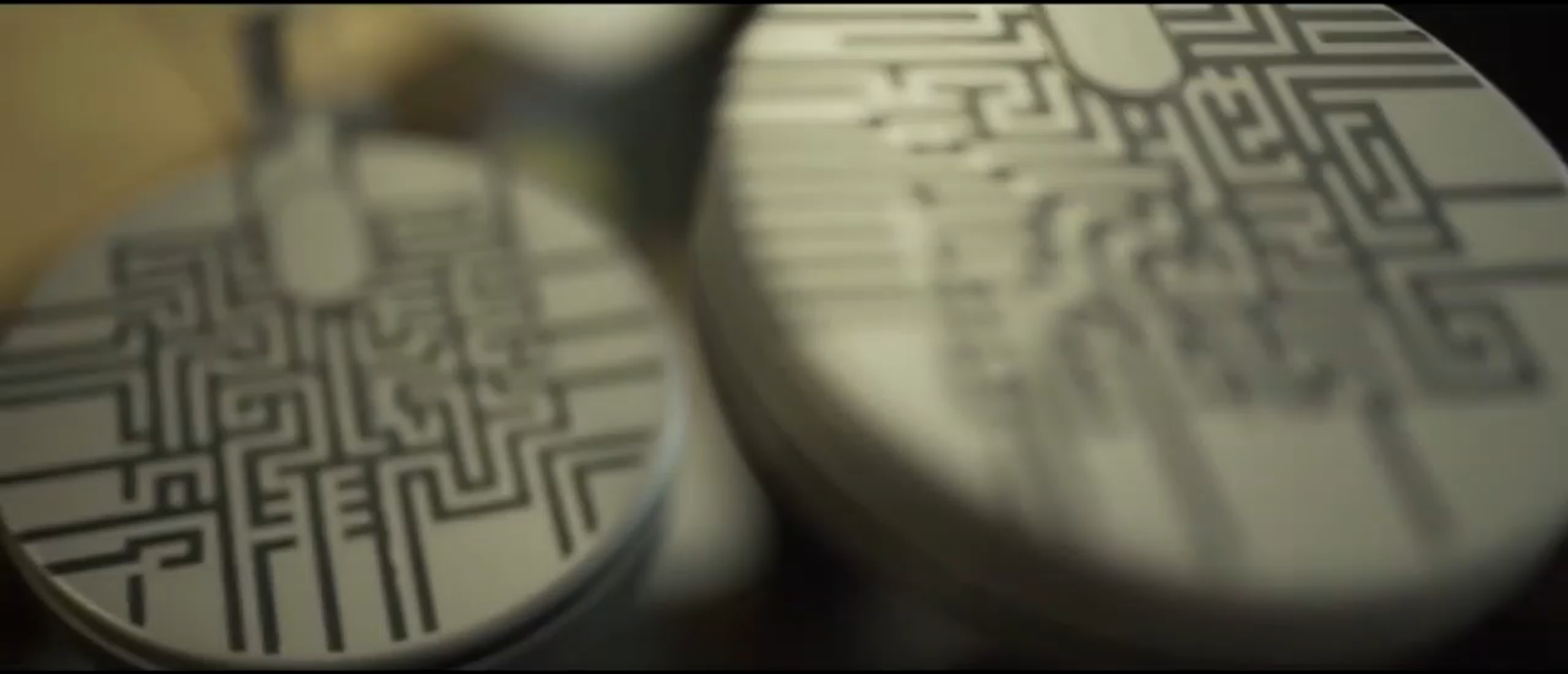


Image Source: Georgios Mylonas, Christos Triantafyllis, Dimitrios Amaxilatis.

AR & IoT Research

- Education
- Home
- Smart Cities
- User Interaction & Comfort
- Backend Solutions
- Industrial/ Market Based

Elicitations

- Gestures
- Voice
- Multimodal

Image Source: Ekaterina Peshkova, Martin Hitz, David Ahlström.

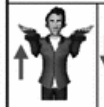
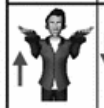
		Up & Down	*Left & Right*	*Rotate Left & Rotate Right*	*Forward & Backward*	*Takeoff & Land*
Survey	Voice	up (81) upward (8) down (83) downward (4)	left (82) west (6) right (84) east (6)	turn left (30) rotate left (26) rotate counter clockwise (17) turn right (31) rotate right (25) rotate clockwise (17)	forward (58) go (13) straight (8) north (6) back/backward (42) reverse/south (6)	up (28) takeoff (21) lift/start (17) land (56) down (23)
Experiment	Voice	up (88) higher (12) down (100)	left (80) turn left (12) right (92) turn right (8)	turn (48) turn left (12) turn (50) turn right (12)	forward (56) straight (32) back (76) backward (16)	up (42) start (32) land (40) stop (33) down (13)
	Gestures	 31 58	24 (left) and 26 (right)	35	23 35	-
Voice		*7*	*9*	*8*	*10*	*10*	*9*	*7*	*7*	*9*	*15*
Gesture		*9*	*10*	*9*	*9*	*8*	*9*	*9*	*9*	*2*	*3*
V+G		*17*	*14*	*16*	*14*	*15*	*15*	*17*	*17*	*22*	*15*
Interview	Gestures	 33 37	30	22	22 37	-

Image Source: Hüttenrauch et al.

Basic commands	
Confirm operation	Reject operation
Wake-up recognizer	Enter idle mode
Terminate service	Help
Transfer to human operator	Go to top level of service
List commands and/or functions	Cancel current operation
Go back to previous node/menu	Read prompt again
Digits	
Digits 0 to 9	Next digit repeated twice ("Double O")

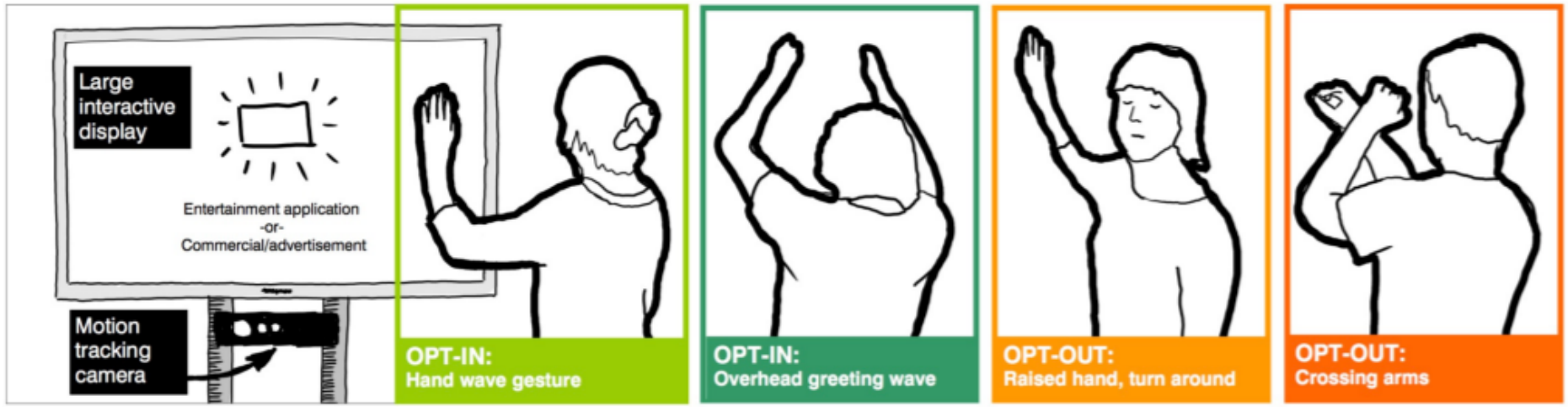


Image Source: Isabel Benavente Rodriguez.

User Elicitation Study for AR-IoT Controls

Image Source: Authors

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Task Combinations

Combo #	Scenario	Task (Context)	Control Method
1	Interact with a Menu System	Computer to Print Queue	gesture
2	Interact with a Menu System	Computer to Print Queue	voice
3	Interact with a Menu System	Lights Schedule	gesture
4	Interact with a Menu System	Lights Schedule	voice
5	Environmental Control	Blinds	gesture
6	Environmental Control	Blinds	voice
7	Environmental Control	Thermostat	gesture
8	Environmental Control	Thermostat	voice
9	Media Control	Speaker Control	gesture
10	Media Control	Speaker Control	voice
11	Media Control	Video Display	gesture
12	Media Control	Video Display	voice
13	Follow a Workflow	Cooking	gesture
14	Follow a Workflow	Cooking	voice
15	Follow a Workflow	Fixing a Boombox	gesture
16	Follow a Workflow	Fixing a Boombox	voice

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13	Follow a Workflow	Cooking	gesture
14	Follow a Workflow	Cooking	voice
15	Follow a Workflow	Fixing a Boombox	gesture
16	Follow a Workflow	Fixing a Boombox	voice

Task Combinations

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1	Interact with a Menu System	Computer to Print Queue	gesture
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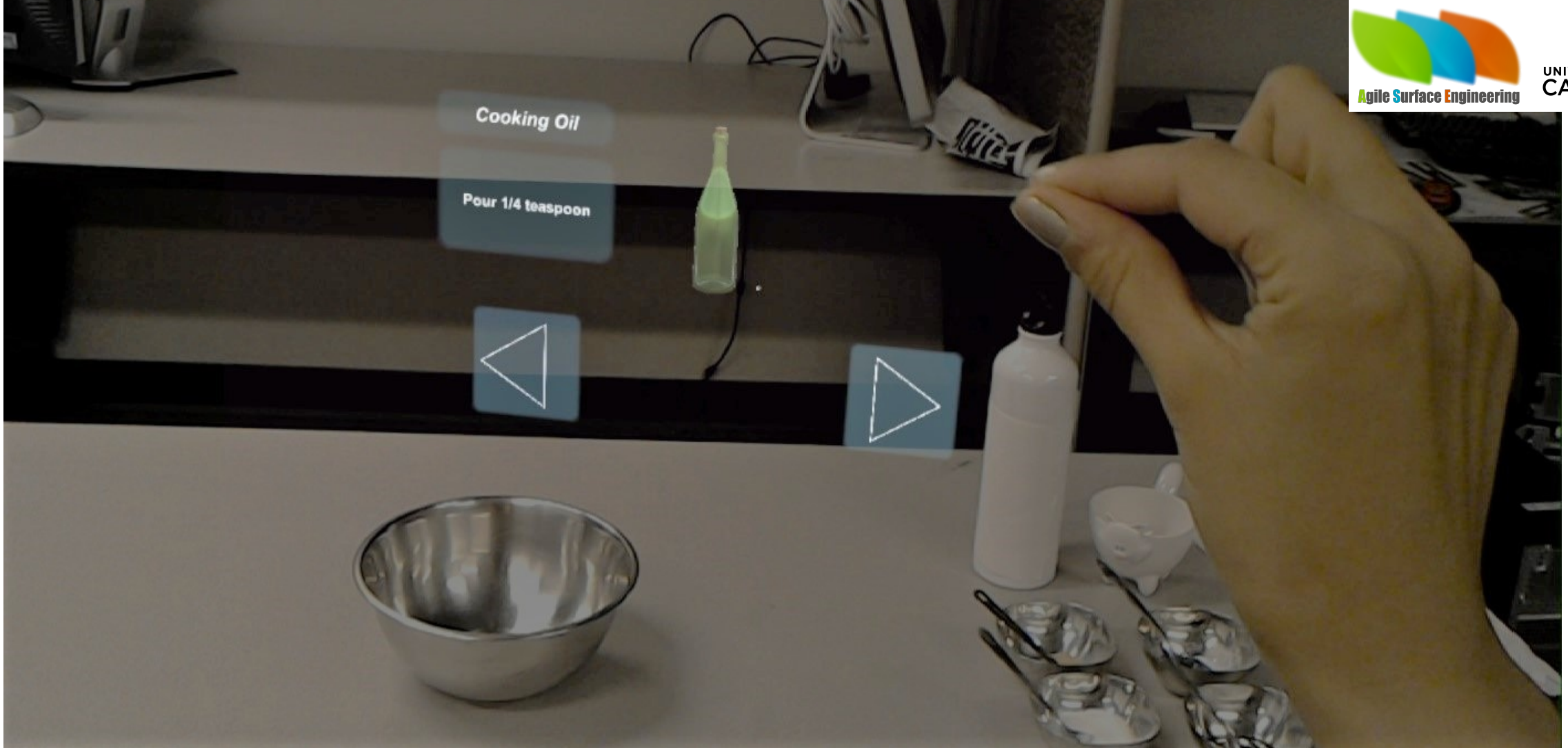
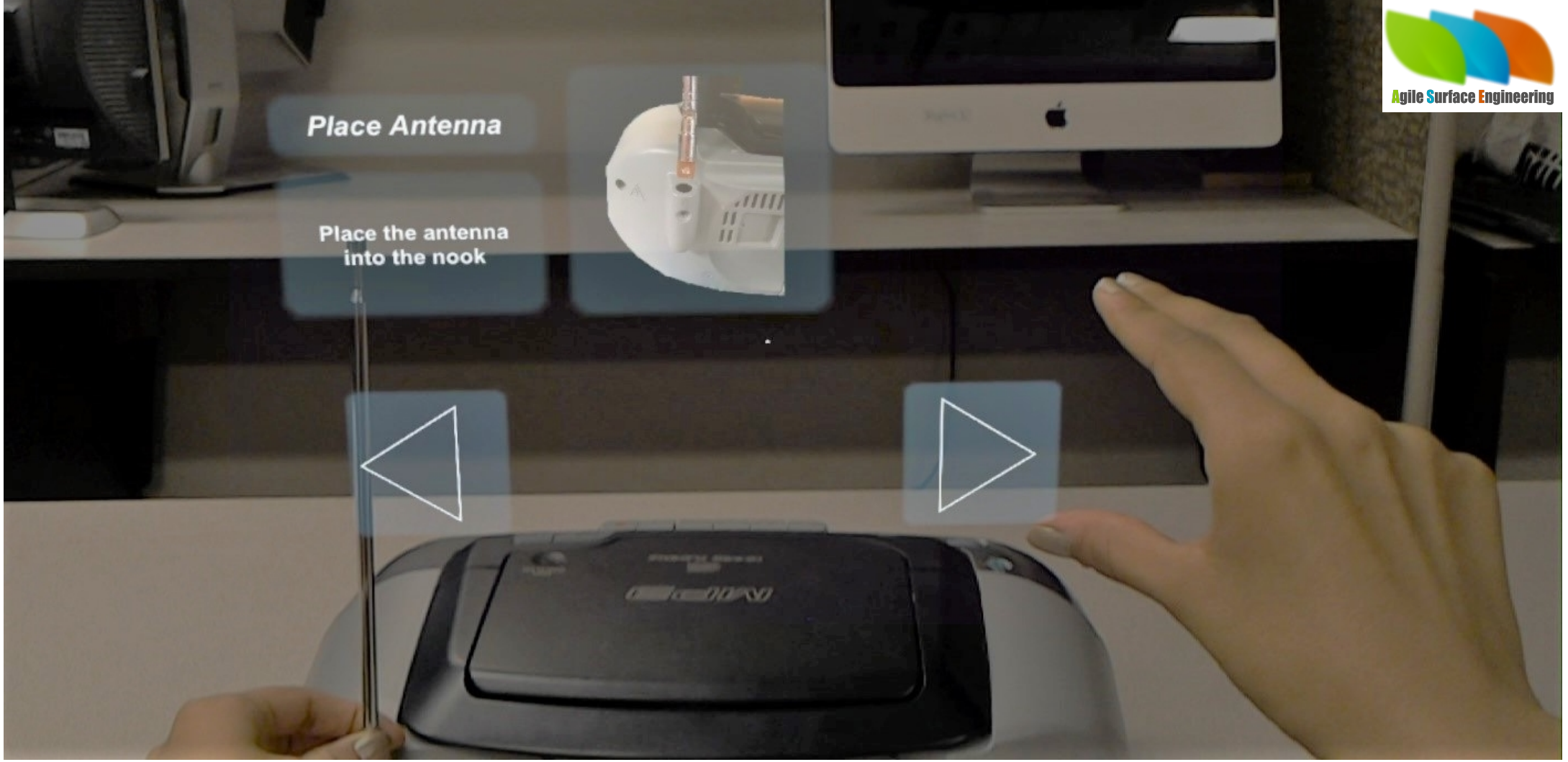
Task Combinations



Cooking a Recipe

(Following a Workflow)

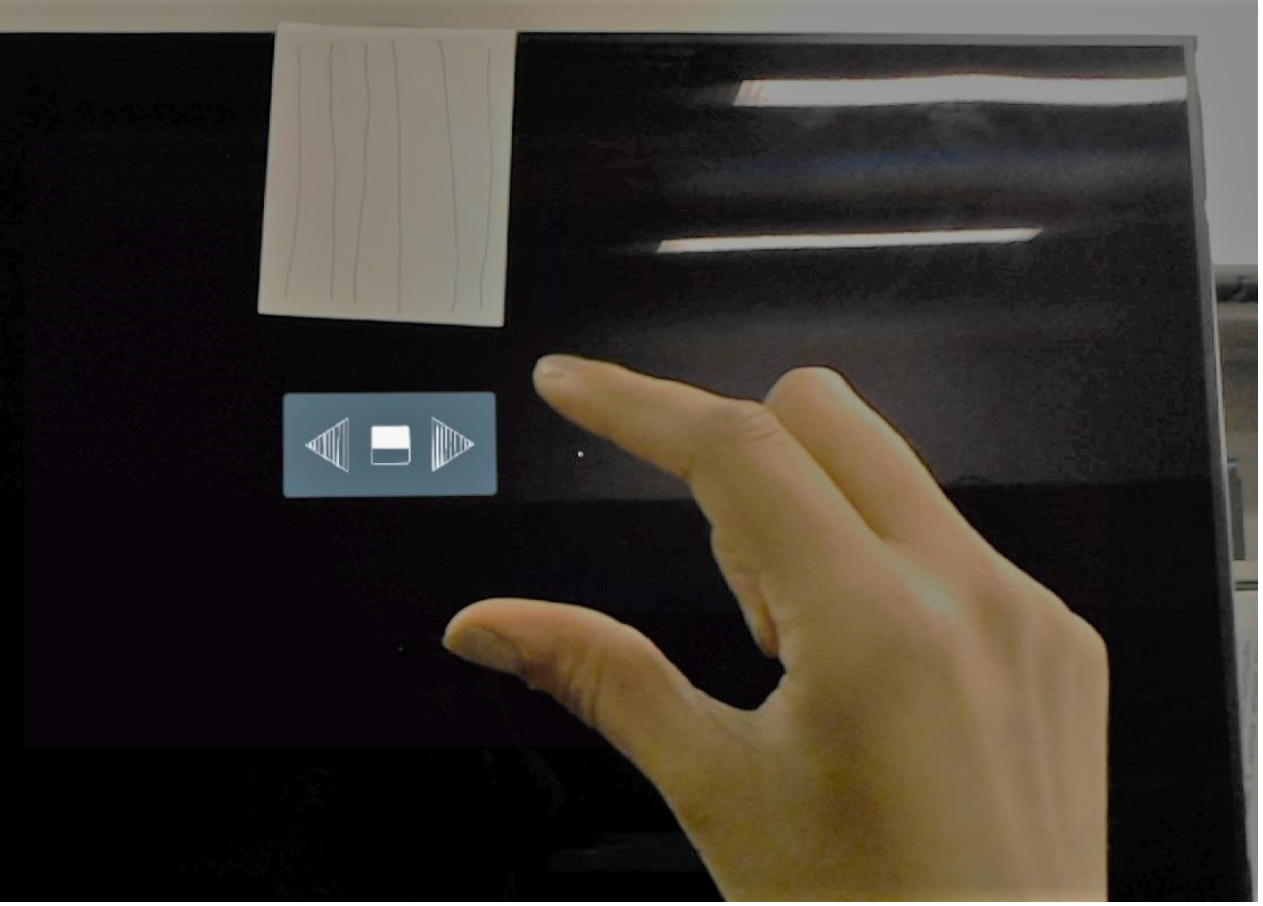
Image Source: Authors

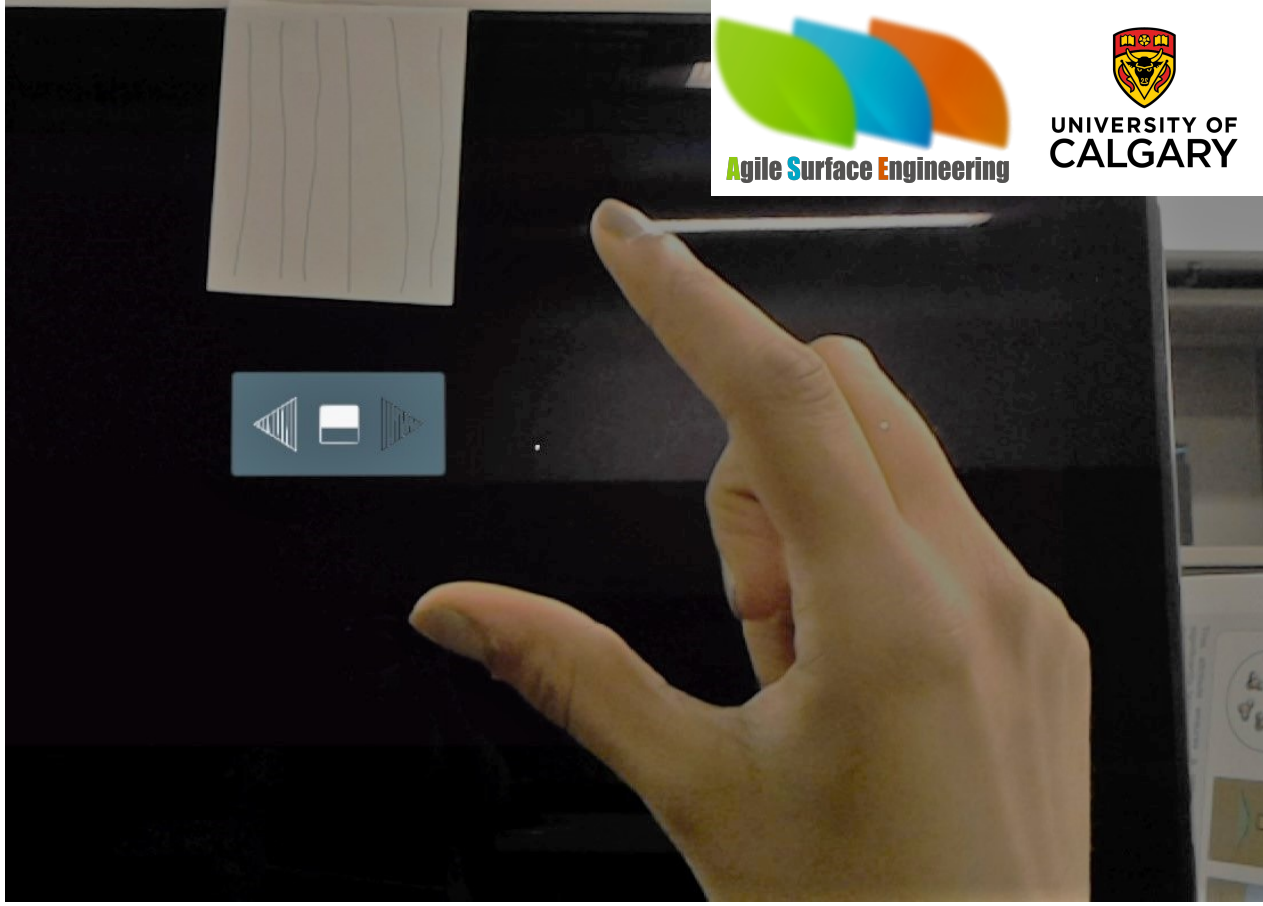


Fixing a Boombox

(Following a Workflow)

Image Source: Authors





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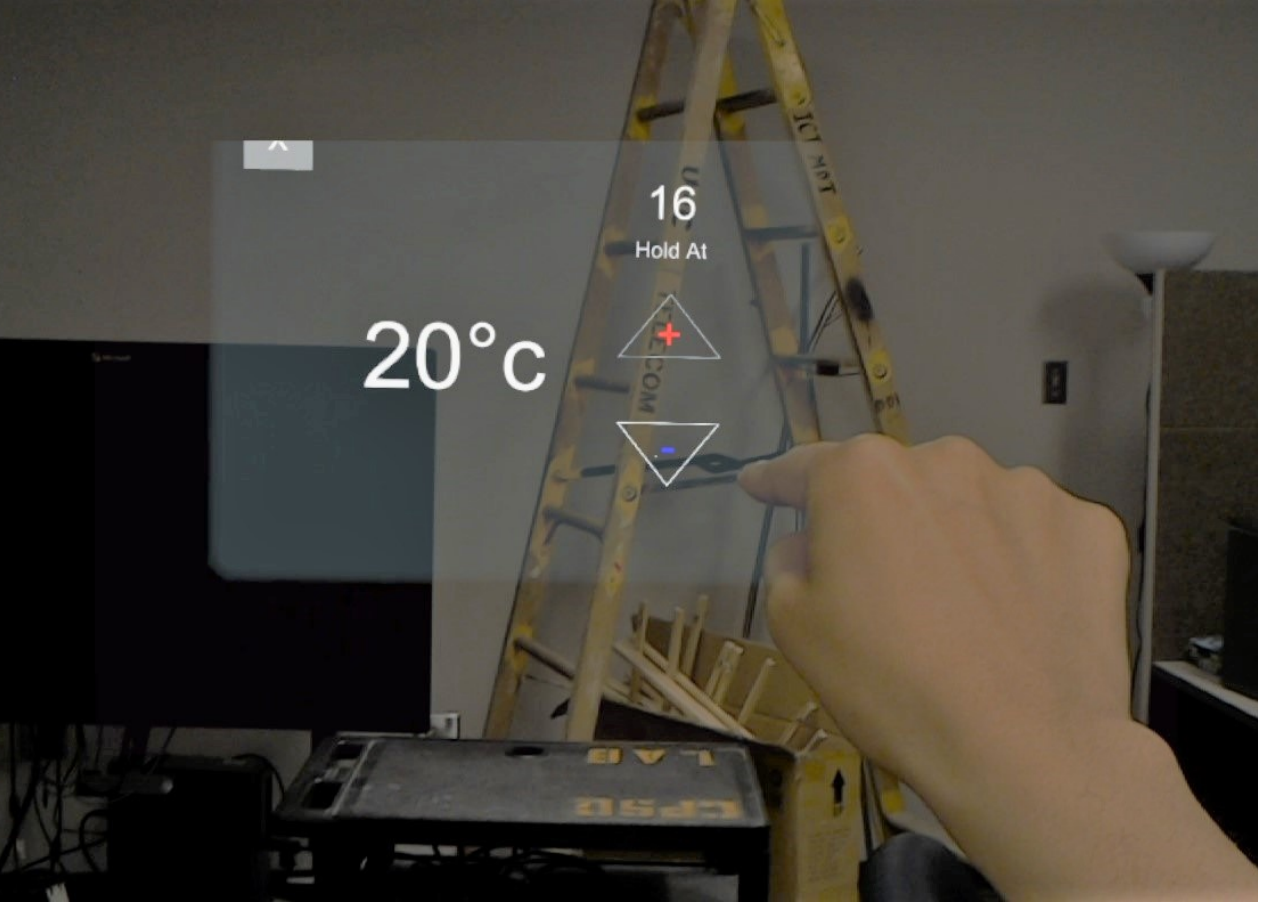
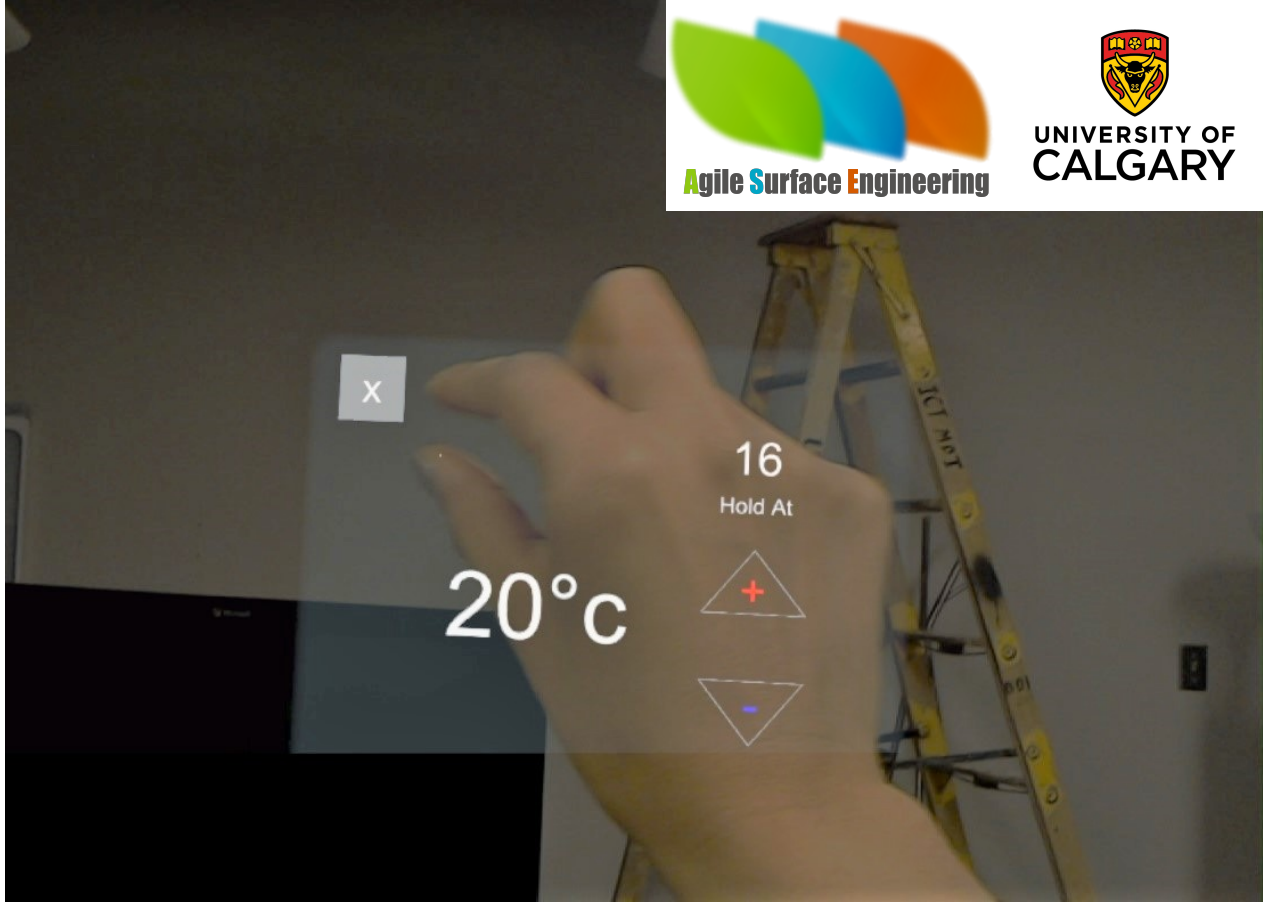
Blinds Control

(Environmental)

Images Source: Authors





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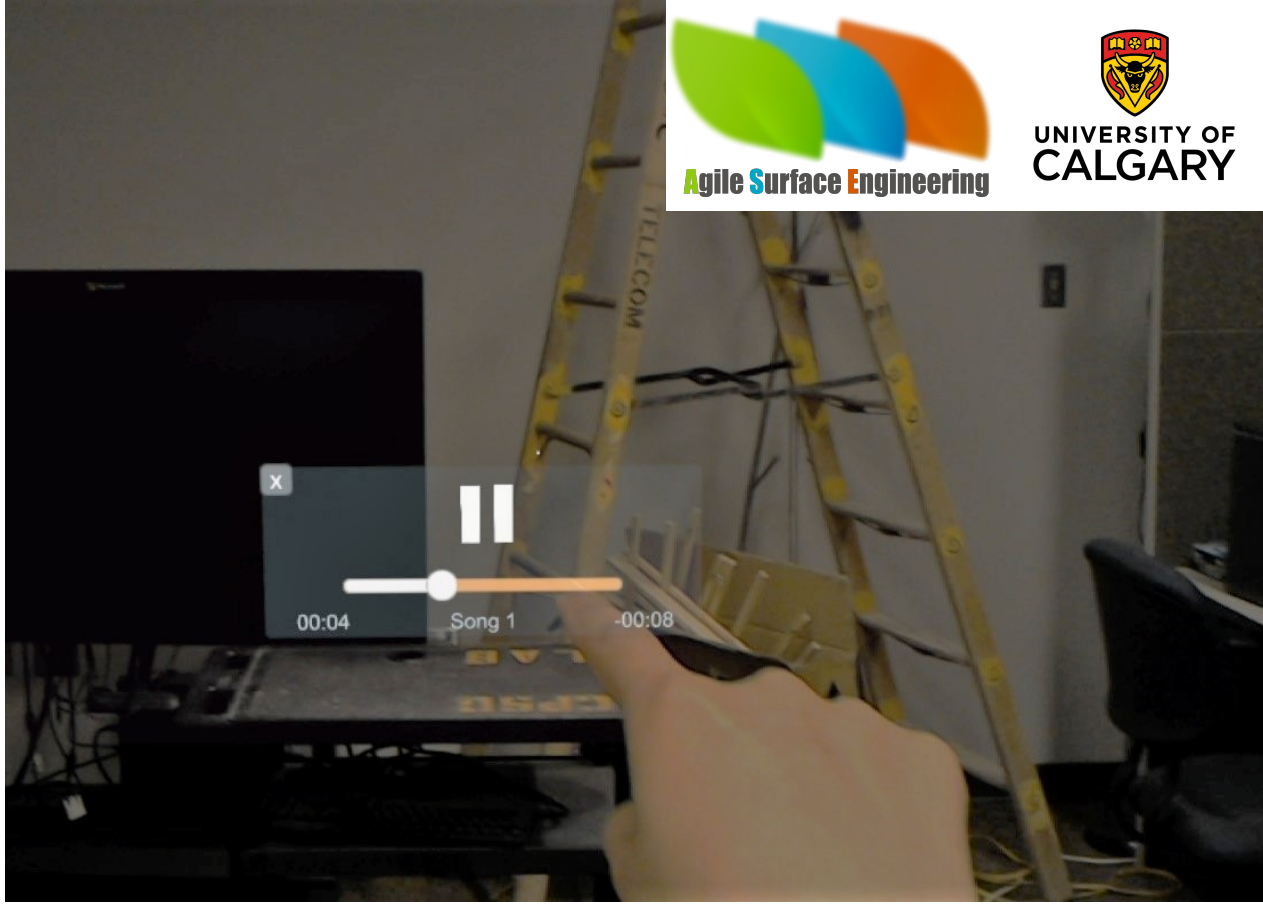
Thermostat Control

(Environmental)

Images Source: Authors



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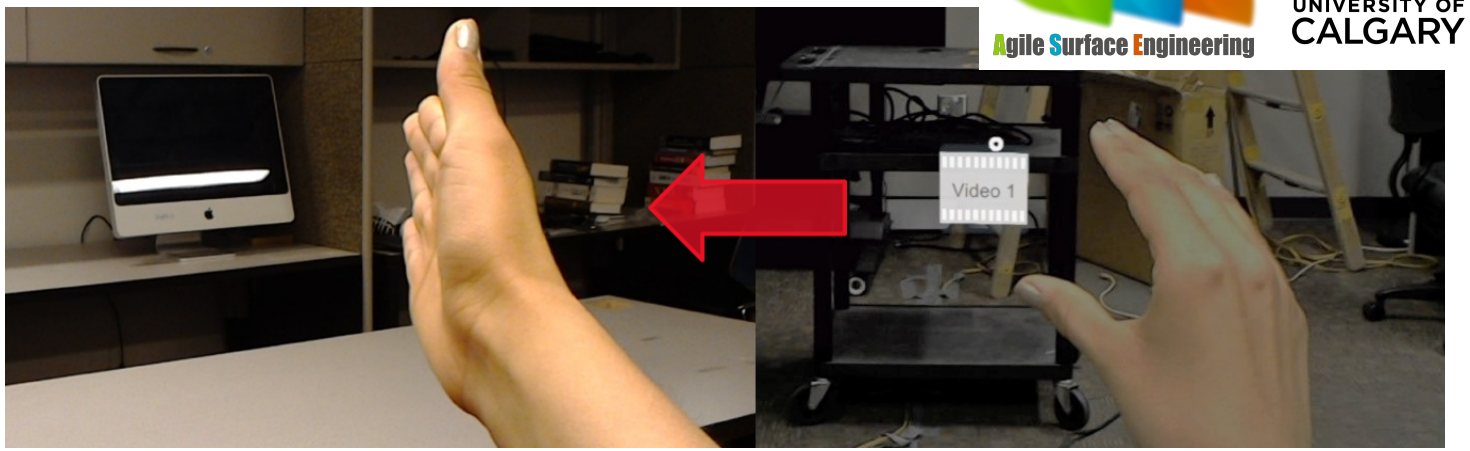
Speaker Control

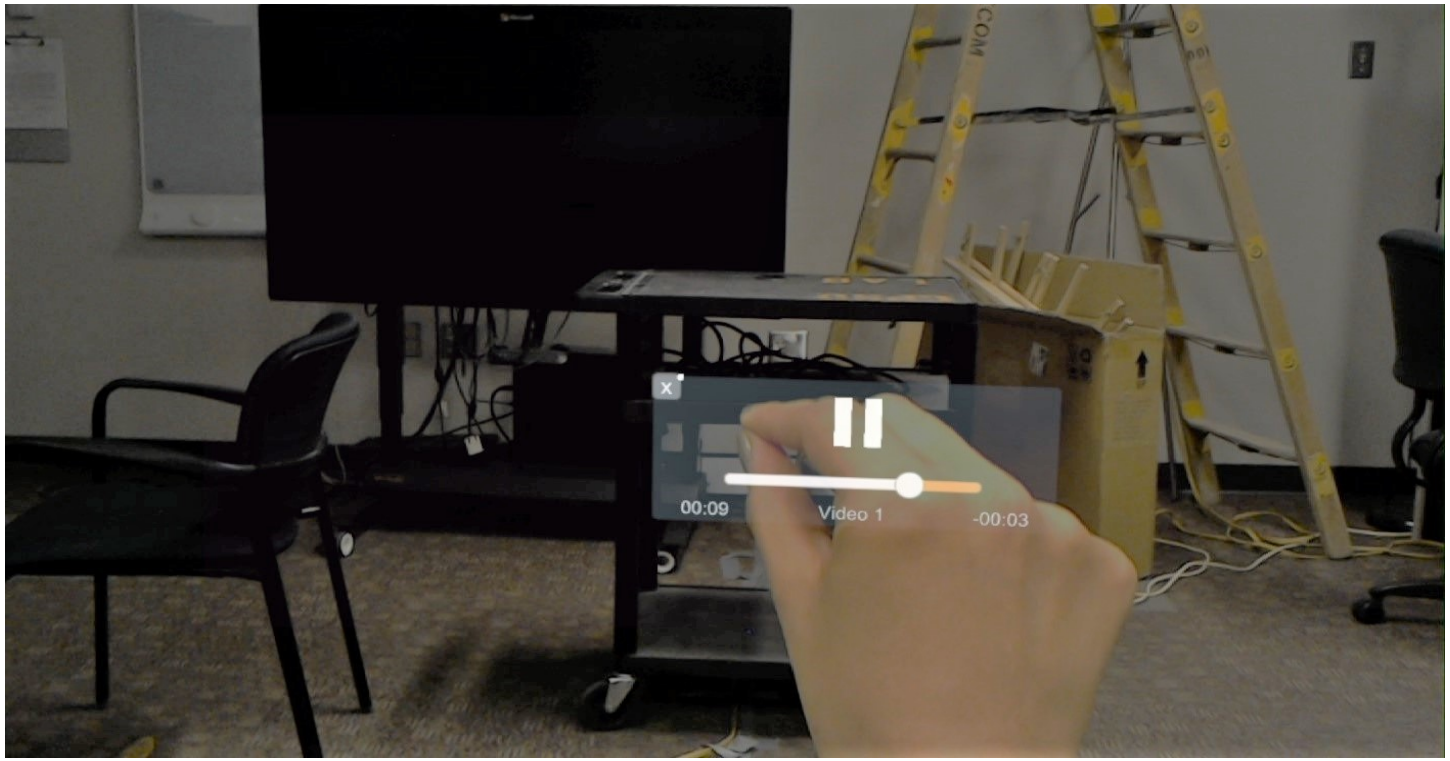
(Media)

Images Source: Authors

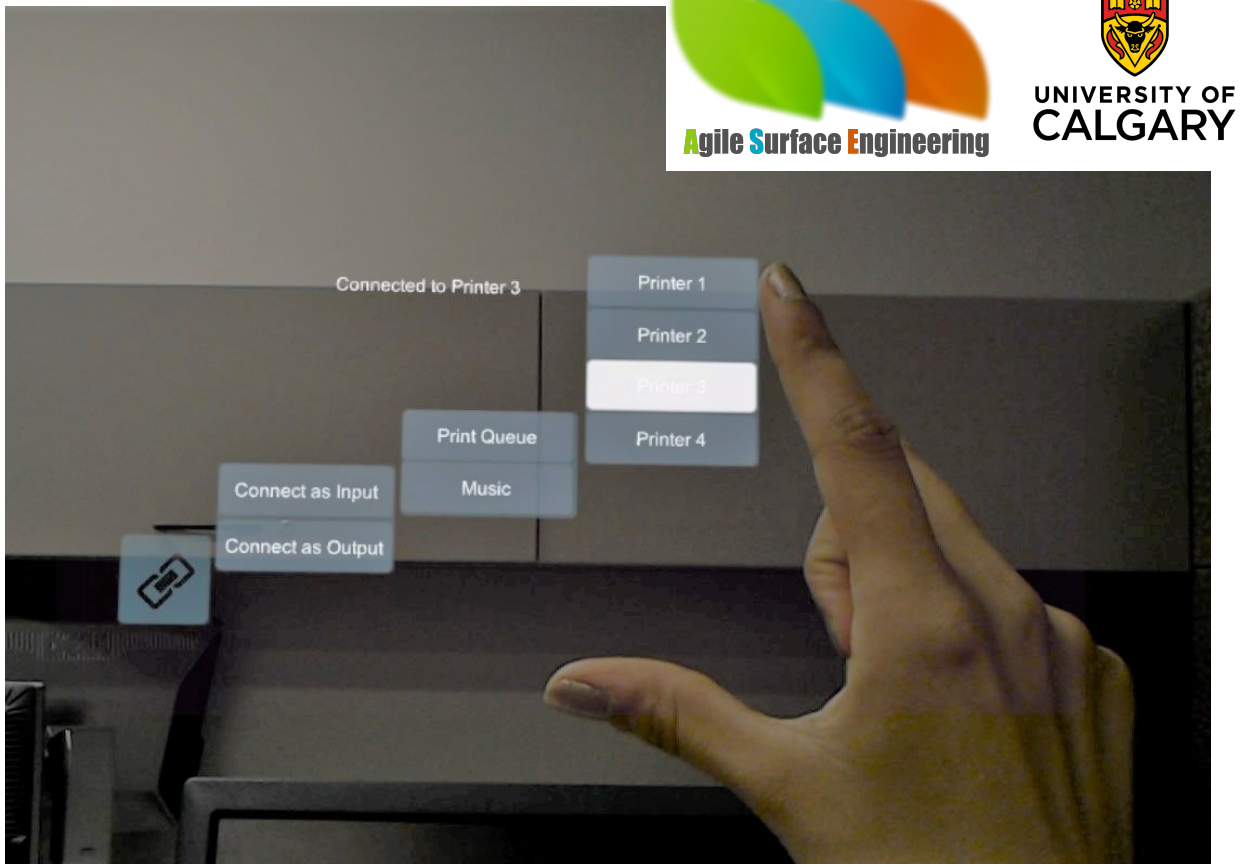
Video Display Control

(Media)





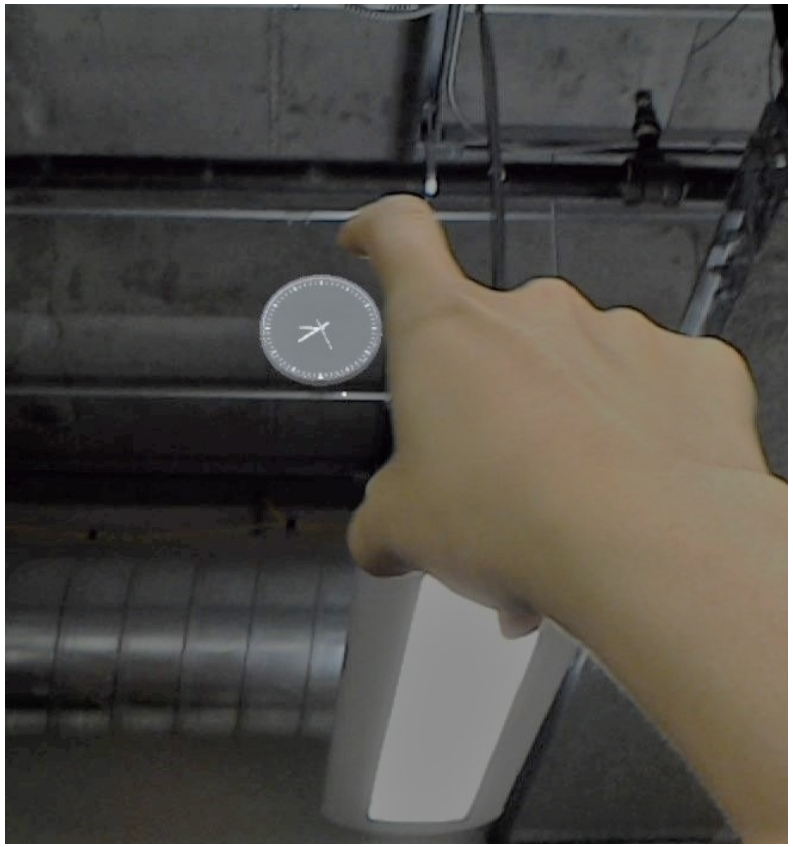
Images Source: Authors

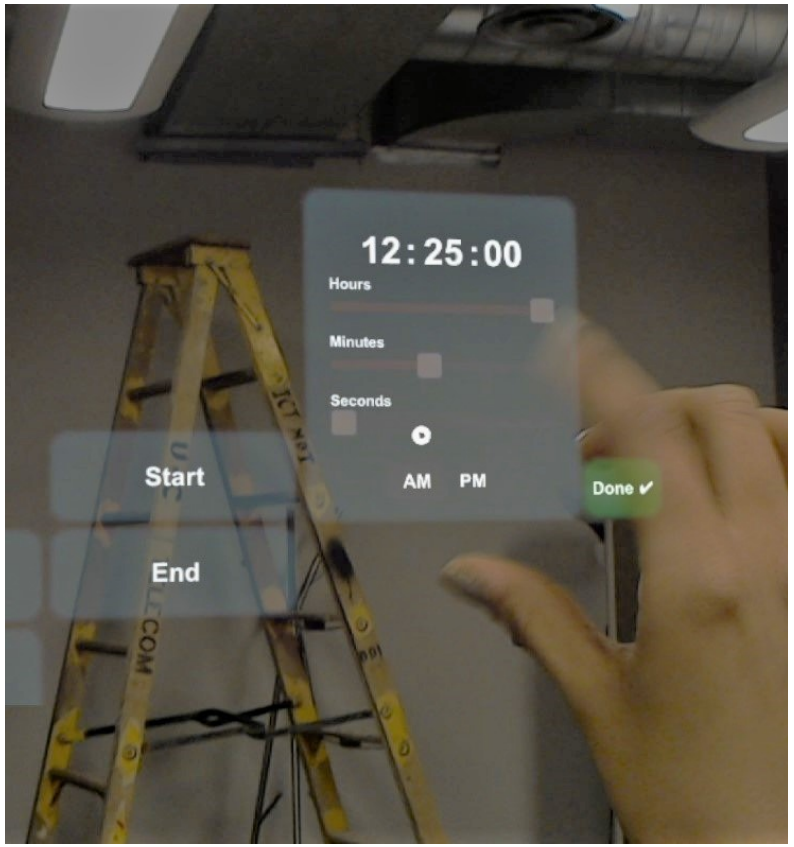


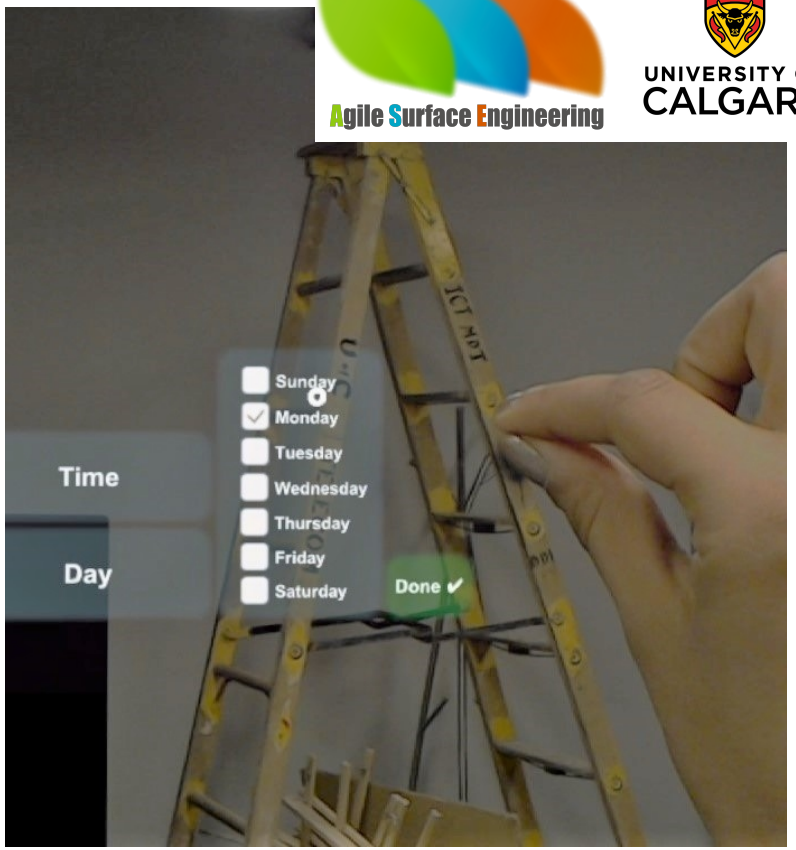
Connecting Computer to Print Queue

(Menus)

Images Source: Authors







Setting Up Lights Schedule

(Menus)

Images Source: Authors

Gestures

Image Source: Authors

P1	"move to left"
P2	"rotate to the left using the button"
P3	"rotate blinds to the left"
P4	"rotate the blinds to the left"
P5	"click"
P6	"spin left"
P7	"blinds rotate to the left"
P8	"rotate blinds to left"

P1	"move to left"
P2	"rotate to the left using the button"
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P5	"click"
P6	"spin left"
P7	"blinds rotate to the left"
P8	"rotate blinds to left"

“rotate”/other verb (“spin”/ “move”) + “blinds” + “left”/ “right”

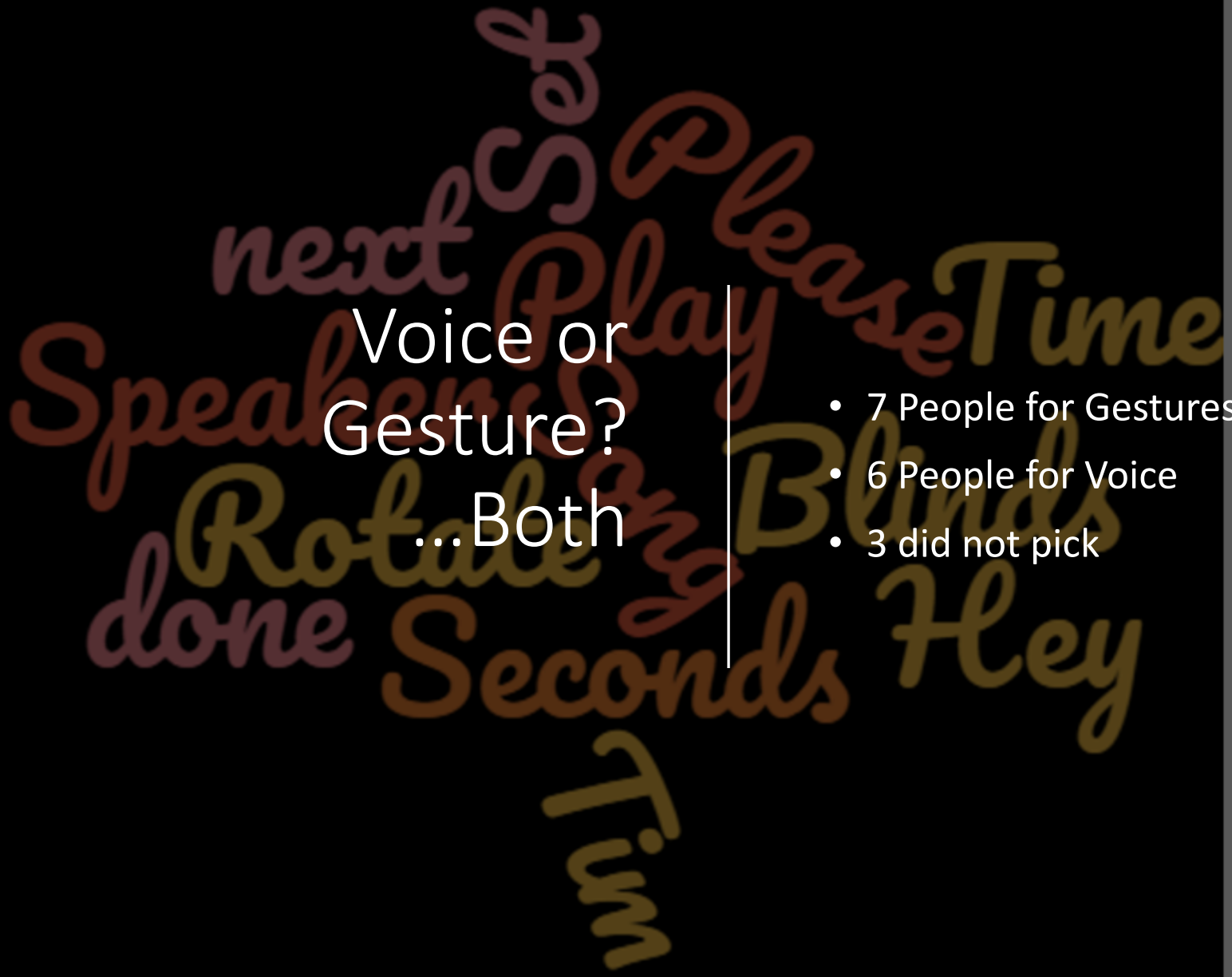
Voice Command Pattern Template

Final Results

784 inputs

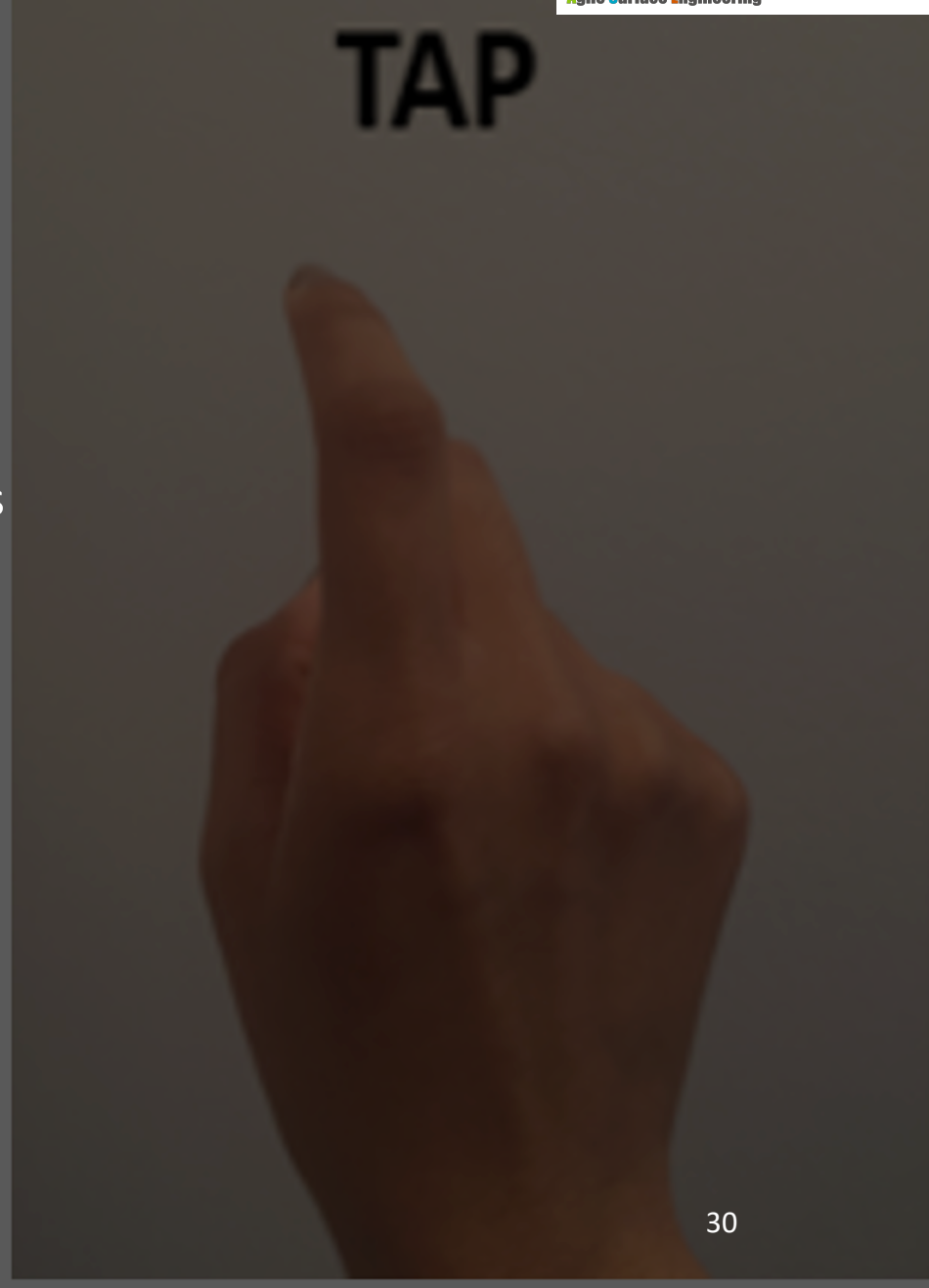
$$AR = \frac{\max_{P_i \subseteq P} |P_i| - 1}{|P| - 1}$$

Referent	Most Popular Gesture agreement rate	Voice Command Template for Each Referent (Order of Components Does Not Matter) agreement rate
Interacting with Menu System		
Expand Menu	tap 0.53	"click"/"set"/ other verb ("hit"/"open"/"select"/"program") + object ("button"/"timer") 0.67
Pick Button	tap 0.67	exact words on button 1
Set Slider	drag 1	slider name + value 1
Set Toggle	tap 0.71	toggle value 1
Collapse Menu	tap 0.29 **low agreement rate*	"collapse"/ other verb ("erase"/"click") + "menu" 0.86
Environmental Control		
Pick Directional Button/ Specify Direction	tap 0.53	"rotate"/"change"/ other verb ("spin"/"move"/"set"/"select") + object ("blinds"/ UI words for temperature) + value ("left"/"right"/numeric value) 0.87
Open Blinds Entirely	swipe 0.71	"open" + "blinds" 1
Close the Control Panel	tap 0.86	"close" + "menu"/"it" 0.57
Media Control		
Select Media to Play	tap 0.6	"play" + media file name 0.93
Select Button/Modify Playing Status	tap 0.67	"play"/"pause" / "stop" 0.80
Select Physical Display for Media	drag 0.57	"play" + media file name + "on" + display name 0.86
Following a Workflow		
Go to Next/ Previous Step *(not enough users used previous)*	tap 0.6	"next" 1



Voice or Gesture? ...Both

- 7 People for Gestures
- 6 People for Voice
- 3 did not pick



Images Source: Authors

Study Observations, User Comments, & Design Implications

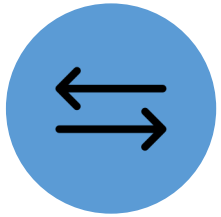
Image Source: Authors

Gesture Round Observations

6 GESTURE ORIENTATIONS

HAND-SWITCHING

PRIORITIZE POINTER & THUMB



VARIOUS DEGREES OF FREEDOM

ENTIRE ARM

PHYSICAL WORLD INFLUENCES

BRIDGING PHYSICAL GAPS

Voice Round Observations

minimalistic commands

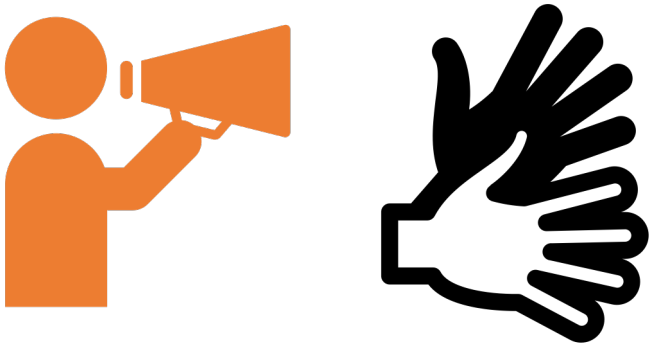
Commands align with UI & environment

previously learned command styles

natural conversation/intuition

“back” to go to previous step

Overall Observations



Technology should be receptive to multimodal input

Interaction may change based on affordances (i.e. hands not clean)

User Comments- Interaction & Strategy

Current technology influences

Visual cues (where to look)

Consistent Interaction (some want to interact spontaneously)

User Comments- Preferences

All would use non-preferred method

Some said combo would be best (together/not together)

Limitations & Conclusion

Image Sources: https://www.pinterest.ca/pin/424886546067479761/
https://images.squarespace-cdn.com/content/58090c87d1758ec5d1815f6f/1498243176372-70G2LZ7RMAWD67XG68ZU/Natural-Language-Processing-Definition-1.jpg?content-type=image%2Fjpeg

Scope

- 16 participants
- Demographic
- Scenarios, Hardware

Limitations

- Another Person in the Room
- Priming
- Words on the UI
- Proposal Structure

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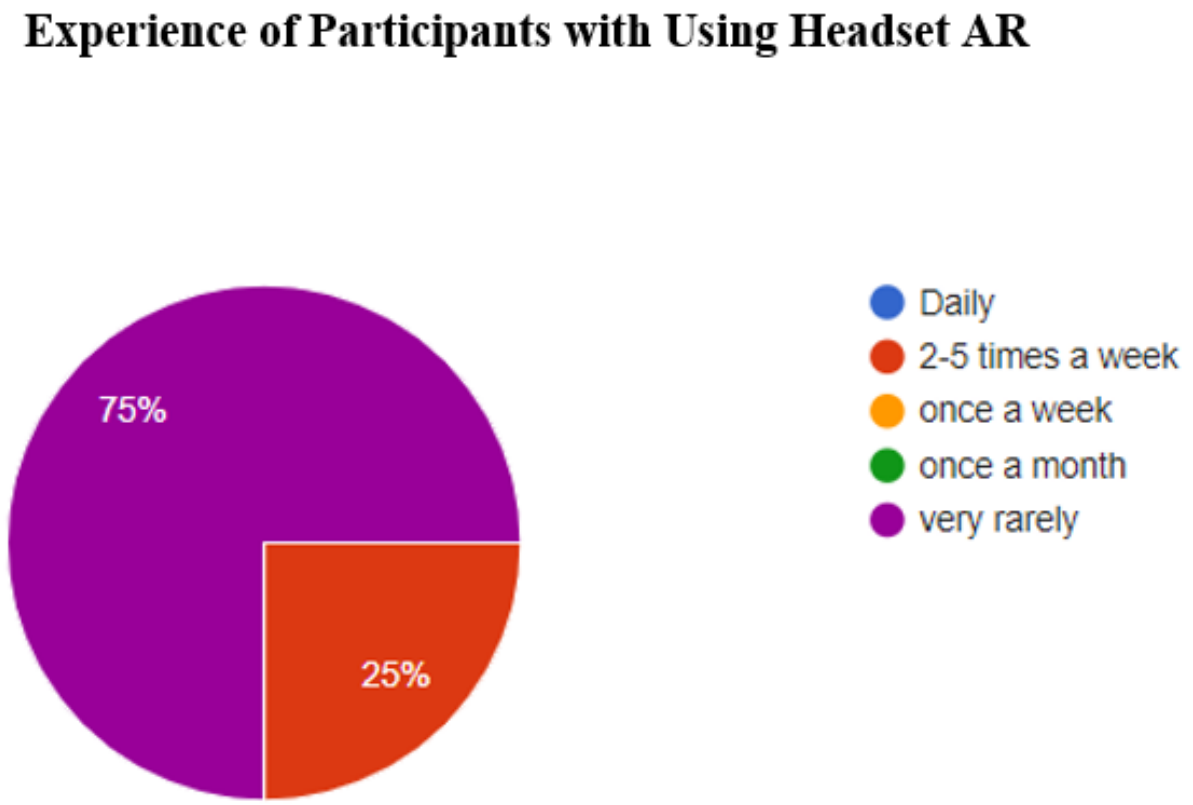


Image Source: Authors

Future Work

- Variables
- Situational/Environmental
- User Interface
- Demographic

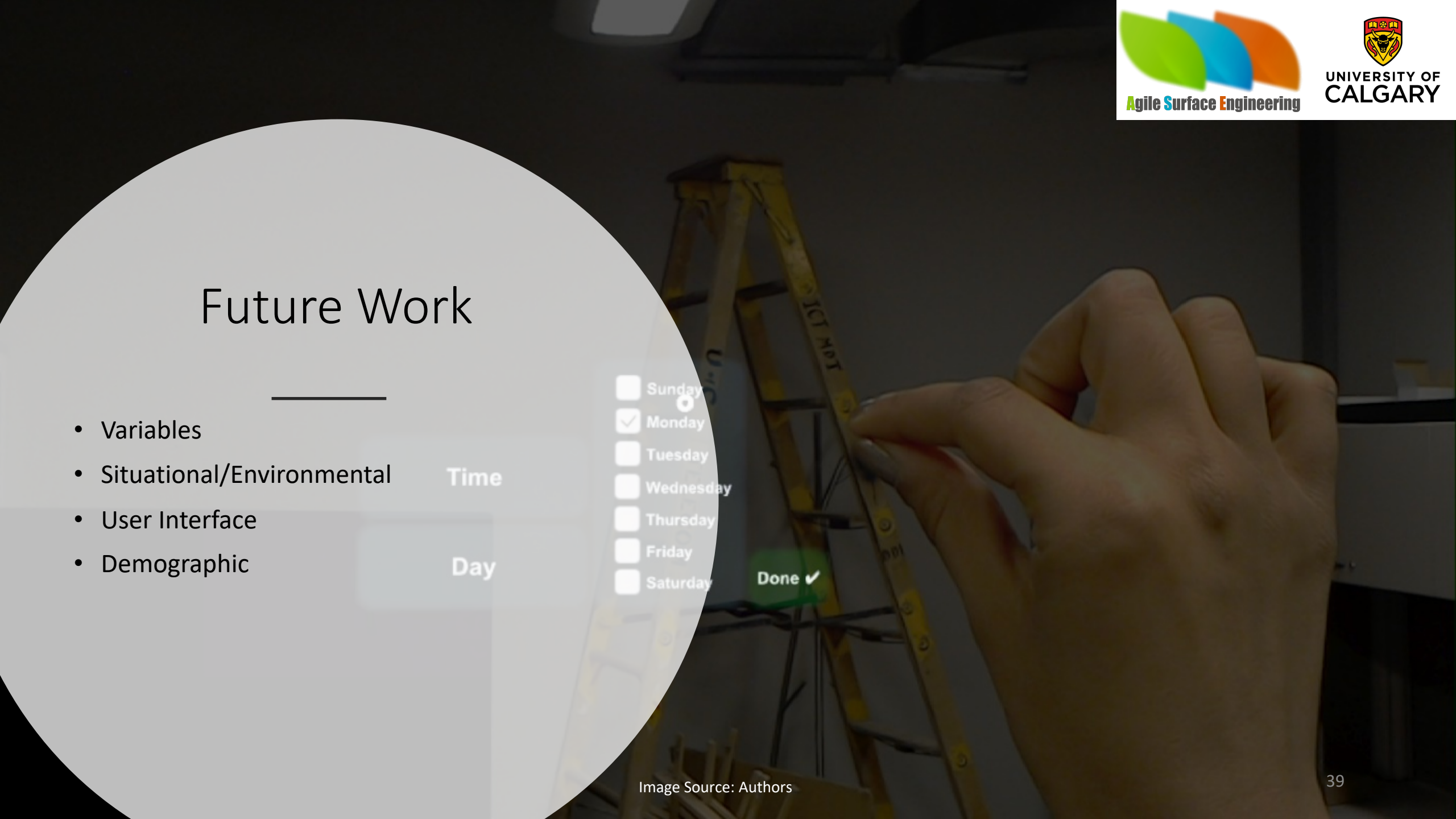


Image Source: Authors

Conclusion

- How users want to interact with IoT & headset AR at home
- Elicitation study
- voice command pattern template
- Gestures & Commands
- Preferences
- Design recommendations

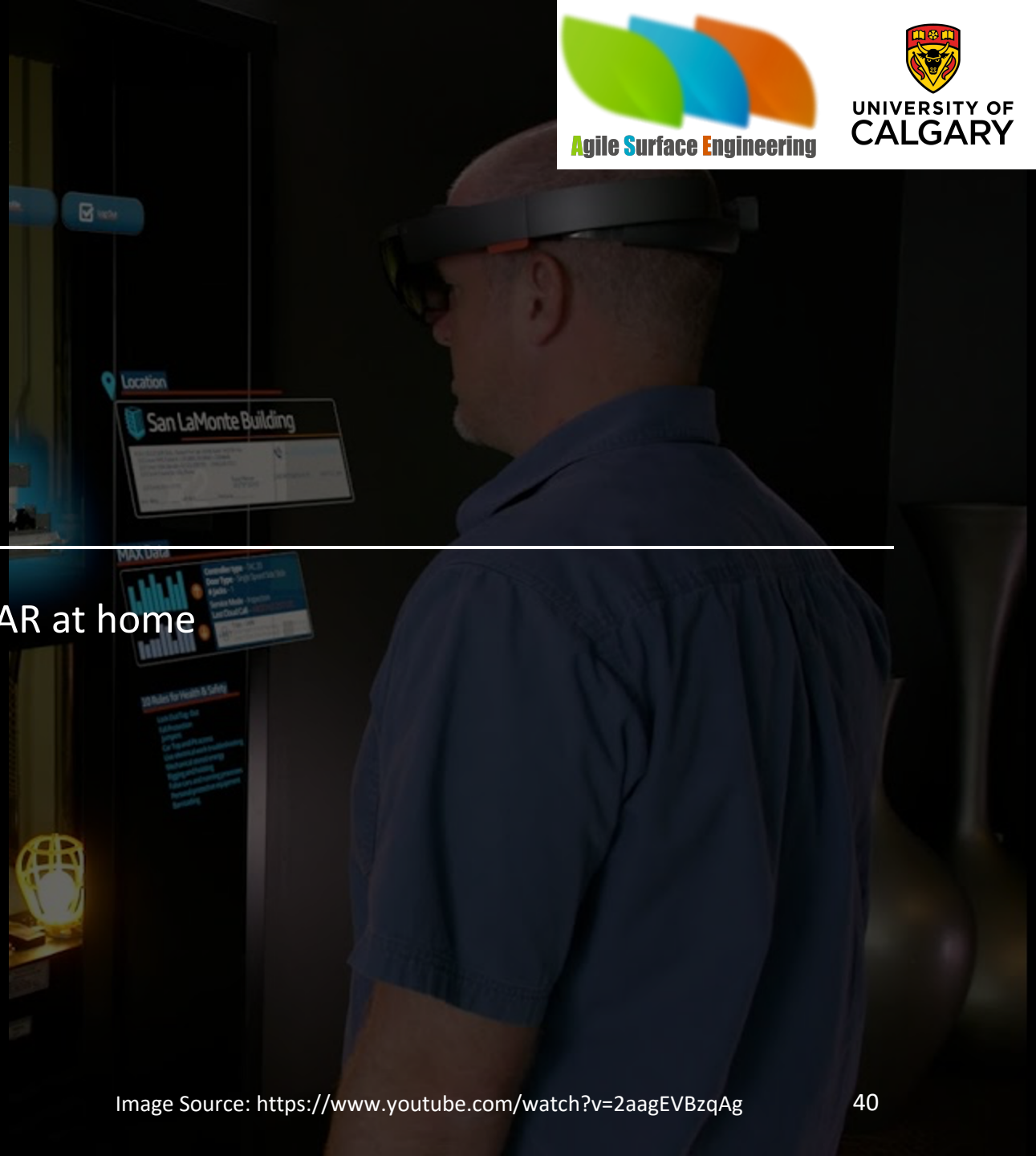
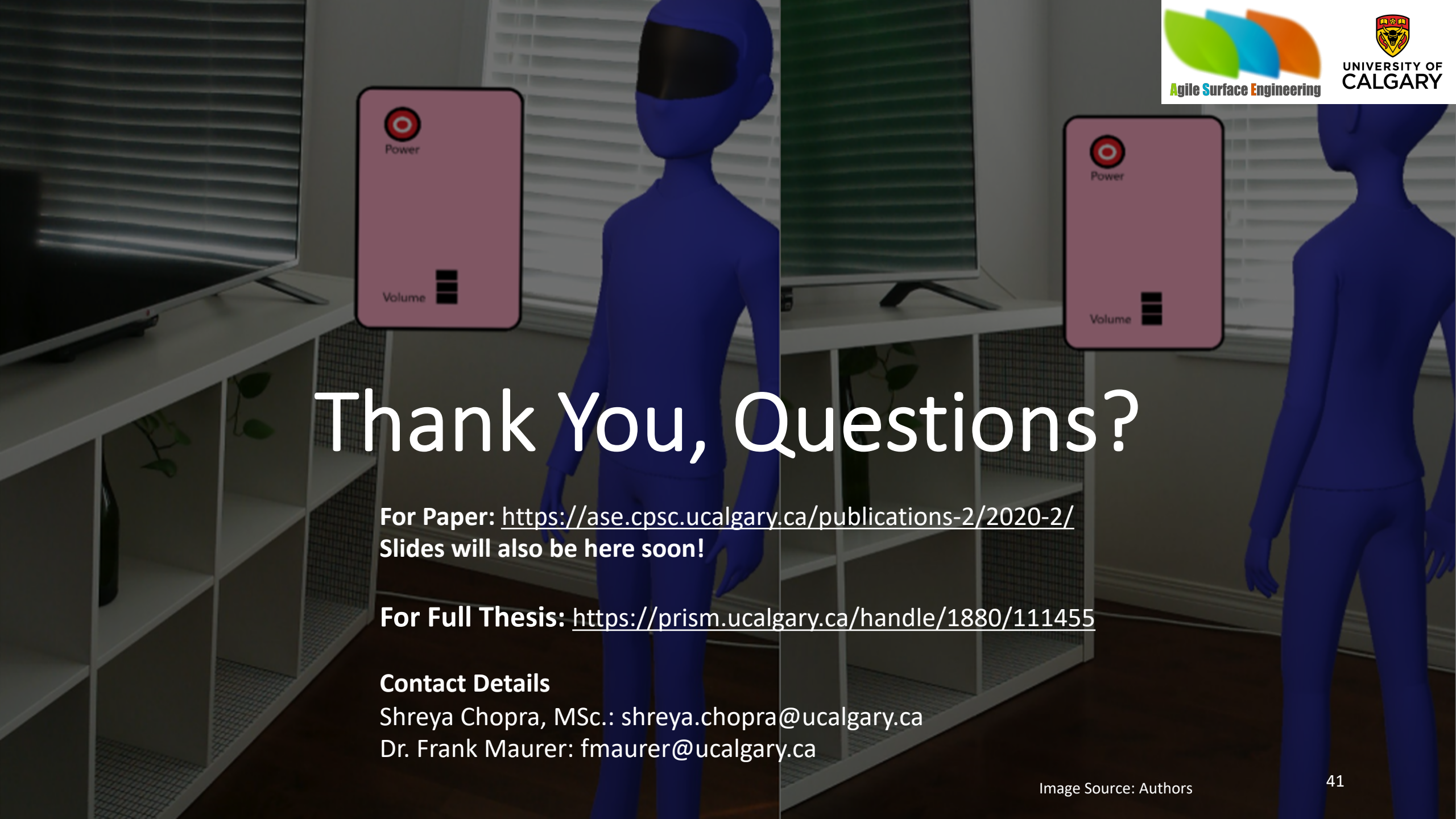


Image Source: https://www.youtube.com/watch?v=2aagEVBzqAg



Thank You, Questions?

For Paper: https://ase.cpsc.ucalgary.ca/publications-2/2020-2/
Slides will also be here soon!

For Full Thesis: https://prism.ucalgary.ca/handle/1880/111455

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Image Source: Authors

Backup Slides

Current Popular AR

Image Sources: https://www.youtube.com/watch?v=2aagEVBzqAg
https://junkee.com/pokemon-go-still-thriving/196317
https://digiday.com/marketing/ikea-using-augmented-reality/

Internet of Things

Image Sources: http://www.lgnewsroom.com/2014/01/lg-makes-smart-tv-simple-with-new-webos-smart-tv-platform/
https://betanews.com/2016/11/14/philips-hue-light-bulbs- worm-vulnerable/
https://www.cnet.com/news/how-the-nest-learning-thermostat-started-a-design-revolution/

IoT Control Points

Image Sources: https://www.macstories.net/reviews/philips-hue-app-update-enhances-light-management- and-adds-30-new-designer-scenes/
https://www.forbes.com/sites/jaymcgregor/2018/03/15/google-home-vs-amazon-echo-45- complex-questions-1-clear-winner/#79e9dab8f284

Procedure-Wizard of Oz

- We tell them what to achieve at each step
- They decide how to do it (using non-menu part of freedom)
- We know what output will be at each step
- Output is same regardless of input
- Consistency for everyone
- Each component (i.e. slider) mapped to our keyboard

Gulf of Execution

- Output the same regardless of input
- Consistency
- Keyboard mapping
- No technical problems with input recognition

Agreement Rates- Wobbrock

- r = referent in the set of all referents R
- Pr = set of proposals for referent r
- Pi = subset of identical symbols from Pr
- Range of equation: $1/|Pr| \cdot 100\% \leq A \leq 100\%$
- Lower bound is non-zero because even when all proposals disagree, each one trivially agrees with itself.
- i.e. if 15 out of 20 users proposed one gesture while 5 proposed another gesture for the same referent, r, [(15/20)^2 + (5/20)^2] / 1 · 100% = 62.5% is the agreement rate.
- few gaps in this calculation: i.e. trivial agreement even when all proposals were unique

$$A = \frac{\sum_{r \in R} \sum_{P_i \subseteq P_r} \left(\frac{|P_i|}{|P_r|} \right)^2}{|R|} \cdot 100\%$$

Agreement Rates- Vatavu

$$\mathcal{AR}(r) = \frac{\sum_{P_i \subseteq P} \frac{1}{2}|P_i|\,(|P_i| - 1)}{\frac{1}{2}|P|\,(|P| - 1)}$$

- i.e. 20 participants
- |P|=20 proposals were collected for a given referent r
- 15/20 proposed one gesture and 5/20 propose another, i.e., |P1|=15 and |P2|=5
- # of pairs of participants in agreement w/ each other: (15·14)/2 + (5·4)/2
- Total # of pairs that could have been in agreement: (20·19)/2
- Dividing 2 values: AR(r) = (115/190) = .605 is obtained
- By comparison, Wobbrock: (15/20)2 + (5/20)2 =.625
- Both Wobbrock, Vatavu assume each participant only proposes one gesture

Agreement Rates- max consensus

$$\frac{\max_{P_i \subseteq P} |P_i|}{|P|}$$

- For multiple proposals by one participant
- $|P|$= # of participants
- Pi = set of participants who made proposal i
- max $Pi \subseteq P$ $|Pi|$: # of participants who made the most popular proposal
- Drawback: case where there is no consensus among participants. Ie. 2 people each propose something different: ½ = 50% as the "max consensus" or "the percent of participants suggesting the most popular proposed interaction".

→This is unexpected since there is, in fact, 0 agreement amongst the 2 participants.

Agreement Rates-Chen

gap where there is no valid calculation for the case in which there are multiple proposals by the same participant as well as a 0 consensus amongst proposals of all participants

applicable study \ **min value**	**Never 0**	**0**
Single-proposal	Wobbrock *et al.*'s formula	Vatavu *et al.*'s formula
Multi-proposal	Morris' max-consensus	?

Agreement Rates- Chen

$$AR = \frac{\max_{P_i \subseteq P} |P_i| - 1}{|P| - 1}$$

- multiproposals by single participants in + consensus amongst all participants' proposal is o
- $|P|$: # of participants
- Pi = set of participants who made proposal i
- max $Pi \subseteq P$ $|Pi|$: # of participants who made the most popular proposal
- In this case, if 2 users proposed diverging inputs, the percentage would be (1-1)/(2-1) = 0%

Agreement Rates-Chen

Allows for different # of proposals from each participant

"id 1": "gesture A",
"id 2": ["gesture B", "gesture A"]

According to my formula, $P = \{\text{"id 1"}, \text{"}id\ 2\text{"}\}$, therefore $|P| = 2$; $P_{gesture\ A} = \{\text{"id 1"}, \text{"}id\ 2\text{"}\}$,

$P_{gesture\ B} = \{\text{"}id\ 2\text{"}\}$, thus $\max_{P_i \subseteq P} |P_i| = 2$. This results in an agreement rate of 1 which is justified

given that "id 2" does not discriminate between her two proposals. Another example is the "total

Legacy Bias

- What people know can influence their elicitation
- People usually force different interactions
- We allowed them to interact organically

→Same or different every time if they want

→Pros: organicness and whether they *choose* to use same or not

Interacting with Menu System

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Pick Button (Interacting with Menu System)	Pick Printer Menu Buttons	Proposal 1	air tap	tap	air tap	air tap	tap	tap	swipe	tap	Proposed Voice Commands							
		Proposal 2	air tap	tap	air tap	air tap	tap	tap	tap	tap								
		Proposal 3	air tap	tap	air tap	air tap	tap	tap	tap	tap								
	Pick Light Menu Buttons	Proposal 1	Proposed Voice Commands								tap	air tap	tap	tap	air tap	tap	tap	tap
		Proposal 2									tap	air tap	tap	tap	air tap	tap	tap	tap
		Proposal 3									swipe	air tap	tap	tap	air tap	tap	tap	tap
		Proposal 4									swipe	air tap	tap	tap	air tap	tap	tap	tap
		Proposal 5									tap	air tap	tap	tap	air tap	air hold & tap	tap	tap
		Proposal 6									air hold & tap	air tap	tap	tap	air tap	air hold & tap	tap	tap
	Participant's Set		air tap	tap	air tap	air tap	tap	tap	swipe, tap	tap	tap, swipe, air hold	air tap	tap	tap	air tap	tap, air hold	tap	tap
	Final Set		air tap, tap, swipe, air hold															
	Final Set By Number of People who ever proposed gesture		tap (11), air tap (5), swipe (2), air hold (2)															
	Gesture Proposed by most amount of People		tap (0.67 agreement rate)															

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Expand Menu (Interacting with Menu System)	Expand Computer	Proposal 1	air tap	tap	air tap	air tap	tap	spread apart	tap	tap	Proposed Voice Commands							
	Expand Light Options	Proposal 1	Proposed Voice Commands								swipe	air tap	tap	tap	swipe	tap	tap	tap
	Participant's Set		air tap	tap	air tap	air tap	tap	spread apart	tap	tap	swipe	air tap	tap	tap	swipe	tap	tap	tap
	Final Set		air tap, tap, spread apart, swipe															
	Final Set By Number of People who ever proposed gesture		tap (9), air tap (4), swipe (2), spread apart (1)															
	Gesture Proposed by most amount of People		tap (0.53 agreement rate)															

Interacting with Menu System

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Set Slider (Interacting with Menu System)	Set Lighting Time Sliders	Proposal 1	Proposed Voice Commands								drag & tap	pinch & drag	drag	tap	pinch & drag	air hold & tap & drag	tap	drag
		Proposal 2									drag & tap	air tap	drag	tap & drag & tap	pinch & drag	air hold & tap & drag	drag	drag
		Proposal 3									drag & tap	pinch & drag	drag	tap & drag & tap	pinch & drag	air hold & tap & drag	drag	drag
		Proposal 4									air hold & drag & tap	air hold & drag & air tap	drag	drag	pinch & drag	air hold & tap & drag	drag	drag
		Proposal 5									air hold & drag & tap	air hold & drag & air tap	drag	drag	pinch & drag	air hold & tap & drag	drag	drag
		Proposal 6									air hold	air tap	tap	tap	no gesture	air hold & tap & drag	tap	tap
	Participant's Set		N/A								drag, tap, air hold	pinch, drag, air tap, air hold	drag, tap	tap, drag	pinch, drag, no gesture	air hold, tap, drag	tap, drag	drag, tap
	Final Set		drag, tap, air hold, pinch, air tap, no gesture															
	Final Set By Number of People who ever proposed gesture		drag (8), tap (6), air hold (3), pinch (2), air tap (1), no gesture (1)															
	Gesture Proposed by most amount of People		drag (1 agreement rate)															

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Set Toggle (Interacting with Menu System)	Set Lighting Time Toggles	Proposal 1	Proposed Voice Commands								swipe	air tap	tap	tap	air tap	tap	tap	tap
		Proposal 2									air hold & tap	air tap	tap	tap	air tap	air hold & tap	tap	tap
		Proposal 3									tap	air tap	tap	tap	air tap	air hold & tap	tap	tap
		Proposal 4									tap	air tap	tap	tap	air tap	air hold & tap	tap	tap
	Participant's Set		N/A								swipe, air hold	air tap	tap	tap	air tap	tap, air hold	tap	tap
	Final Set		swipe, air hold, tap, air tap															
	Final Set By Number of People who ever proposed gesture		tap (6), air tap (2), air hold (2), swipe (1)															
	Gesture Proposed by most amount of People		tap (0.71 agreement rate)															

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Collapse Menu (Interacting with Menu System)	Collapse Computer Options	Proposal 1	swipe	tap	air tap	bloom	tap	bring together	swipe	tap	Proposed Voice Commands							
	Participant's Set		swipe	tap	air tap	bloom	tap	bring together	swipe	tap	N/A							
	Final Set		swipe, tap, air tap, bloom, bring together															
	Final Set By Number of People who ever proposed gesture		tap (3), swipe (2), air tap (1), bloom (1), bring together (1)															
	Gesture Proposed by most amount of People		tap (0.29 agreement rate) NOTE: LOW AGREEMENT RATE															

Environmental Control

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Pick Directional Button / Specify Direction (Environmental Control)	rotate blinds	Proposal 1	tap, air tap	rotate, pinch & rotate	air tap	air tap	air hold & rotate	tap, tap and hold	air hold & rotate	tap, pinch & rotate	Proposed Voice Commands							
		Proposal 2	air tap	pinch & rotate	air tap	air tap	air hold & rotate	tap and hold, tap	air hold & rotate	tap, pinch & rotate								
	change thermostat temperature	Proposal 1	Proposed Voice Commands								tap	air tap	tap, air hold & rotate	tap	tap	air hold & tap	tap	tap and hold
		Proposal 2									tap	air tap	tap	tap	tap	air hold & tap	tap	tap and hold
	Participant's Set		tap, air tap	rotate, pinch	air tap	air tap	air hold, rotate	tap, tap and hold	air hold, rotate	tap, pinch, rotate	tap	air tap	tap, air hold, rotate	tap	tap	air hold, tap	tap	tap and hold
	Final Set		tap, air tap, rotate, pinch, air hold, tap and hold															
	Final Set By Number of People who ever proposed gesture		tap (9), rotate (5), air tap (4), air hold (4), pinch (2), tap and hold (2)															
	Gesture Proposed by most amount of People		tap (0.53 agreement rate)															

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Open Blinds Entirely (Environmental Control)	Open Blinds	Proposal 1	swipe	tap and hold	swipe (both hands simultaneously)	air tap	pinch & swipe	swipe (both hands simultaneously)	swipe	pinch & swipe (both hands simultaneously)	Proposed Voice Commands							
	Participant's Set		swipe	tap and hold	swipe	air tap	pinch, swipe	swipe	swipe	pinch, swipe	N/A							
	Final Set		swipe, tap and hold, air tap, pinch															
	Final Set By Number of People who ever proposed gesture		swipe (6), pinch (2), air tap (1), tap and hold (1)															
	Gesture Proposed by most amount of People		swipe (0.71 agreement rate)															

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Close the Control Panel (Environmental Control)	Close Thermostat Control	Proposal 1	Proposed Voice Commands								tap	air tap	tap	tap	tap	tap	tap	tap
	Participant's Set		N/A								tap	air tap	tap	tap	tap	tap	tap	tap
	Final Set		tap, air tap															
	Final Set By Number of People who ever proposed gesture		tap (7), air tap (1)															
	Gesture Proposed by most amount of People		tap (0.86 agreement rate)															

Media Control

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Select Media to Play (Media Control)	Select Song	Proposal 1	air tap	tap	air tap	air tap	tap	tap	tap	air tap	Proposed Voice Commands							
	Select Video	Proposal 1	Proposed Voice Commands								tap	air tap	tap	air tap	tap	air hold & tap	tap	tap
	Participant's Set		air tap	tap	air tap	air tap	tap	tap	tap	air tap	tap	air tap	tap	air tap	tap	air hold, tap	tap	tap
	Final Set		air tap, tap, air hold															
	Final Set By Number of People who ever proposed gesture		tap (10), air tap (6), air hold (1)															
	Gesture Proposed by most amount of People		tap (0.60 agreement rate)															

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Select Button / Modify Playing Status (Media Control)	Pause/ Play Song	Proposal 1	air tap	tap	air tap	air tap	tap	swipe	tap	air tap	Proposed Voice Commands							
		Proposal 2	air tap	tap	air tap	air tap	tap	swipe	tap	air tap, tap								
	Stop Video	Proposal 1	Proposed Voice Commands								tap	air tap	tap	tap	tap	air hold & tap	tap	tap
	Participant's Set		air tap	tap	air tap	air tap	tap	swipe	tap	air tap, tap	tap	air tap	tap	tap	tap	air hold, tap	tap	tap
	Final Set		air tap, tap, swipe, air hold															
	Final Set By Number of People who ever proposed gesture		tap (11), air tap (5), air hold (1), swipe (1)															
	Gesture Proposed by most amount of People		tap (0.67 agreement rate)															

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Select Physical Display for	Select Video Display	Proposal 1	Proposed Voice Commands								swipe	tap & drag & release	tap & drag	tap & drag & release	swipe	swipe	air hold & drag & release	air hold & drag
	Participant's Set		N/A								swipe	tap, drag, release	tap, drag	tap, drag, release	swipe	swipe	air hold, drag, release	air hold, drag
	Final Set		swipe, tap, drag, release, air hold															
	Final Set By Number of People who ever proposed gesture		drag (5), tap (3), swipe (3), release (3), air hold (2)															
	Gesture Proposed by most amount of People		drag (0.57 agreement rate)															

Following a Workflow

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Go to Next / Previous Step (Following a Workflow) ***Note: Not enough usage of previous***	**Cooking a Recipe**	**Proposal 1**	air tap	air tap	air tap	air tap	tap	rotate	tap	tap	Proposed Voice Commands							
		Proposal 2	air tap	tap	air tap	air tap	tap	rotate	tap	tap								
		Proposal 3	air tap	tap	air tap	air tap	tap	rotate	tap	tap								
		Proposal 4	air tap	tap	air tap	air tap	tap	rotate	tap	tap								
		Proposal 5	air tap	tap	air tap	air tap	tap	rotate	swipe	tap								
		Proposal 6	air tap	rotate & tap	air tap	air tap	tap	rotate	swipe	tap								
		Proposal 7	air tap	tap	air tap	air tap	tap	rotate	swipe	tap								
	Fixing a Boombox	**Proposal 1**	Proposed Voice Commands								tap	air tap	tap	tap	swipe	tap	tap	tap
		Proposal 2									tap	air tap	tap	tap	swipe	tap	tap	tap
		Proposal 3									tap	air tap	tap	tap	swipe	tap	tap	tap
		Proposal 4									tap	air tap	tap	tap	swipe	tap	tap	tap
		Proposal 5									tap	air tap	tap	tap	swipe	tap	tap	tap
		Proposal 6									tap	air tap	tap	tap	swipe	tap	tap	tap
		Proposal 7									tap	air tap	tap	tap	swipe	tap	tap	tap
		Proposal 8									tap	air tap	tap	tap	swipe	tap	tap	tap
	Participant's Set		air tap	air tap, tap, rotate	air tap	air tap	tap	rotate	tap, swipe	tap	tap	air tap	tap	tap	swipe	tap	tap	tap
	Final Set		**air tap, tap, rotate, swipe**															
	Final Set By Number of People who ever proposed gesture		**tap (10), air tap (5), rotate (2), swipe (2)**															
	Gesture Proposed by most amount of People		**tap (0.60 agreement rate)**															

Interacting with Menu System

Referent	Generic Participant Number		P9	P10	P11	P12	P13	P14	P15	P16	Emerging Command	Number of Users
Expand Menu (Interacting with Menu System)	Expand Computer Options	Proposal 1	"hit the button"	"right click the button"	"open menu"	"click button"	"click"	"printer open"	"switch button"	"show options"	"Click"/ "Hit"/ "Open" + "Button"/ "Menu"/ "Printer"	7 out of 8
			P1	P2	P3	P4	P5	P6	P7	P8		
	Expand Light Options	Proposal 1	"hello computer... please program light time"	"select"	"show more options"	"next"	"hey siri set a timer"	"next"	"set the alarm (timer)"	"settings"	"Set"/"Select"/"Program" + "Time"/"Timer"	4 out of 8
	Final Command - based on all proposals (& Number of Users Who Ever Proposed It)										**"Click"/"Set"/ Other Verb ("Hit"/"Open"/"Select"/"Program") + Object ("Button"/"Timer")**	**11 out of 16**
	Agreement Rate										**0.67**	

Referent	Generic Participant Number		P9	P10	P11	P12	P13	P14	P15	P16	Emerging Command	Number of Users
Pick Button (Interacting with Menu System)	Pick Printer Menu Buttons	Proposal 1	"connect as input"	"connect as input"	"select connect as input"	"connect as input"	"click"	"connect as input"	"connect as input"	"connect as input"	"Connect as input"	7 out of 8
		Proposal 2	"connect as input print queue"	"print queue"	"select print queue"	"print queue"	"click"	"print queue"	"print queue"	"print queue"	"Print Queue"	7 out of 8
		Proposal 3	"printer 3"	"printer 3"	"select printer 3"	"printer 3"	"select printer 3"	"printer 3"	"printer 3"	"printer 3"	"Printer 3"	8 out of 8
	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8		
	Pick Light Menu Buttons	Proposal 1	"hey Tim set time"	"time"	"time"	"time"	"time"	"time"	"set the alarm (timer)"	"set time"	"Time"	7 out of 8
		Proposal 2	"start time tim"	"start"	"start"	"start"	"start"	"start"	"start"	"start"	"Start"	8 out of 8
		Proposal 3	"done"	"done"	"done"	"done"	"that's it"	"done"	"turn off"	"done"	"Done"	6 out of 8
		Proposal 4	"end"	"end"	"end"	"end"	"end time"	"end"	"turn off at: "	"set up end time"	"End"	7 out of 8
		Proposal 5	"day tim"	"done"	"done" "day"	"done" "day"	"and we're done" "day"	"done" "day"	"turn it off"	"done" "set up day"	"Day"	6 out of 8
		Proposal 6	"done"	"done"	"done"	"done"	"that's it"	"done"	"go to time"	"done"	"Done"	6 out of 8
	Final Command - based on all proposals (& Number of Users Who Ever Proposed It)										**Exact words on Button**	**16 out of 16**
	Agreement Rate										**1**	

Interacting with Menu System

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	Emerging Command	Number of Users
Set Slider (Interacting with Menu System)	Set Lighting Time Sliders	Proposal 1	"hours 7"	"hours 7"	"7 hours"	"hours 7"	"set time for 7 hours"	"7 hours"	"7"	"7"	"Hours" + "7"	8 out of 8
		Proposal 2	"minutes 25"	"minutes 25"	"25 minutes"	"25"	"25 minutes"	"25 minutes"	"25"	"25"	"Minutes" + "25"	8 out of 8
		Proposal 3	"and seconds to 30"	"seconds 30"	"30 seconds"	"30"	"and 30 seconds"	"30 seconds"	"30 seconds"	"and 30 seconds"	"Seconds" + "30"	8 out of 8
		Proposal 4	"hours to 4"	"hours 4"	"4 hours"	"4"	"4 hours"	"4 hours"	"16"	"hour to 4"	"Hours" + "4"	8 out of 8
		Proposal 5	"minutes to 15"	"minutes 15"	"15 minutes"	"15"	"15 minutes"	"15 minutes"	"15"	"15 minutes"	"Minutes" + "15"	8 out of 8
		Proposal 6	"seconds are good"	"seconds 0"	"0 seconds"	"0"	"and 0 seconds"	"0 seconds"	"0 seconds"	"0 seconds"	"Seconds" + "0"	8 out of 8
	Final Command - based on all proposals (& Number of Users Who Ever Proposed It)										Slider Name + Value	8 out of 8
	Agreement Rate										1	

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	Emerging Command	Number of Users
Set Toggle (Interacting with Menu System)	Set Lighting Time Toggles	Proposal 1	"AM"	"AM"	"AM"	"AM"	"AM"	"AM"	"IN THE MORNING"	"and AM"	"AM"	7 out of 8
		Proposal 2	"PM"	"PM"	"PM"	"PM"	"PM"	"PM"	"IN THE AFTERNOON"	"PM"	"PM"	7 out of 8
		Proposal 3	"lets set Monday"	"Monday"	"Monday"	"Monday"	"Monday"	"Monday"	"today" instead of "Monday"	"Monday"	"Monday"	7 out of 8
		Proposal 4	"and Saturday"	"Saturday"	"Saturday"	"Saturday"	"Saturday"	"Saturday"	"and Saturday"	"and Saturday"	"Saturday"	8 out of 8
	Final Command - based on all proposals (& Number of Users Who Ever Proposed It)										Toggle Value	8 out of 8
	Agreement Rate										1	

Referent	Generic Participant Number		P9	P10	P11	P12	P13	P14	P15	P16	Emerging Command	Number of Users
Collapse Menu (Interacting with Menu System)	Collapse Computer Options	Proposal 1	"collapse the print queue"	"collapse the far right menu"	"collapse all menus"	"erase"	"click"	"collapse"	"home"	"collapse menu"	"Collapse"/"Erase"/"Click" + "Menu"	7 out of 8
	Final Command - based on all proposals (& Number of Users Who Ever Proposed It)										"Collapse"/Other Verb ("Click"/"Erase") + "Menu"	7 out of 8
	Agreement Rate										0.86	

Environmental Control

Referent	Generic Participant Number		P9	P10	P11	P12	P13	P14	P15	P16	Emerging Command	Number of Users
Pick Directional Button / Specify Direction (Environmental Control)	rotate blinds	Proposal 1	"move to left"	"rotate to the left using the button"	"rotate blinds to the left"	"rotate the blinds to the left"	"click"	"spin left"	"blinds rotate to the left"	"rotate blinds to left"	"rotate"/other verb ("spin"/ "move") + "blinds" + "left"	7 out of 8
		Proposal 2	"move right"	"rotate to the right using the button"	"rotate blinds to the right"	"rotate the blinds to the right"	"click"	"spin right"	"blinds rotate to the right"	"rotate blinds to right"	"rotate"/other verb ("spin"/ "move") + "blinds" + "right"	7 out of 8
			P1	P2	P3	P4	P5	P6	P7	P8		
	change thermostat temperature	Proposal 1	"Hey tim I'm cold can we change the hold at tempreature to 24?"	"select hold at 24"	"hold at 24 degrees celsius"	repeatedly saying "plus"	"hey Siri change the hold at temperature to 24"	"change hold at 19 to 24"	"set the temperature to 24"	"set up hold at 24 celsius"	"change"/ other verb ("set"/ "select") + words on UI for temperature value ("hold at") + "temperature" + "24"	7 out of 8
		Proposal 2	"hey tim actually I'm way too hot now set it to 18"	"select hold at 18"	"hold at 18 degrees celsius"	repeatedly saying "minus" and at one point just said "minus 3"	"hey Siri change the hold at to 18"	"change hold at 24 to 18"	"set the temperature to 18"	"set up temperature to 18"	"change"/ other verb ("set"/ "select") + words on UI for temperature value ("hold at") + "18"	7 out of 8
	Final Command - based on all proposals (& Number of Users Who Ever Proposed It)										**"rotate"/"change"/ other verb ("spin"/"move"/"set"/"select") + object ("blinds"/ UI words for temperature) + value ("left"/"right"/numeric value)**	**14 out of 16**
	Agreement Rate										0.87	

Referent	Generic Participant Number		P9	P10	P11	P12	P13	P14	P15	P16	Emerging Command	Number of Users
Open Blinds Entirely (Environmental Control)	Open Blinds	Proposal 1	"open them to right"	"open the blinds using the button"	"open blinds 100%"	"open all the blinds and move them all away"	"open"	"open window"	"blinds open"	"open blinds"	"open" + "blinds"	8 out of 8
	Final Command - based on all proposals (& Number of Users Who Ever Proposed It)										**"open" + "blinds"**	**8 out of 8**
	Agreement Rate										1	

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	Emerging Command	Number of Users
Close the Control Panel (Environmental Control)	Close Thermostat Control	Proposal 1	"hey tim close out of that menu"	"exit"	"that's it"	"close it"	"hey siri close the menu"	"close the thermostat control"	it should understand that it should close based on silence	"k done close it"	"Close" + "It" / "Menu"	5 out of 8
	Final Command - based on all proposals (& Number of Users Who Ever Proposed It)										"Close" + "It" / "Menu"	5 out of 8
	Agreement Rate										0.57	

Media Control

Referent	Generic Participant Number		P9	P10	P11	P12	P13	P14	P15	P16	Emerging Command	Number of Users
Select Media to Play (Media Control)	Select Song	Proposal 1	"play everywhere"	"speaker please play song 1"	"play song 1"	"play song 1"	"play song 1"	"play song 1"	"play my favourite song"	"play song 1"	"Play" + "Song 1"	8 out of 8
	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8		
	Select Video	Proposal 1	"play it"	"play video 1"	"play video on display 1"	"play"	"hey siri play video on display 1"	"play video 1"	it should automatically play from first prompt	"play it"	"Play" + "Video 1"/"Video"/"It"	7 out of 8
	Final Command - based on all proposals (& Number of Users Who Ever Proposed It)										"Play" + Media File Name	**15 out of 16**
	Agreement Rate										**0.93**	

Referent	Generic Participant Number		P9	P10	P11	P12	P13	P14	P15	P16	Emerging Command	Number of Users
Select Button / Modify Playing Status (Media Control)	Pause/ Play Song	Proposal 1	"pause"	"pause the song"	"pause song"	"pause"	"pause"	"pause"	"pause"	"pause song"	"Pause" + "Song"	8 out of 8
		Proposal 2	"play"	"play song one"	"play song"	"play"	"play"	"resume"	"play music"	"play"	"Play"	7 out of 8
	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8		
	Stop Video	Proposal 1	"Hey Tim stop the video"	"pause. Stop"	"exit video player"	"close it"	"hey siri pause the video"	"exit from video 1"	"pause" "close the video" "shut it off"	"stop playing"	"Stop" / "Pause" + "Video"	5 out of 8
	Final Command - based on all proposals (& Number of Users Who Ever Proposed It)										**"Play"/"Pause"/"Stop"**	**13 out of 16**
	Agreement Rate										**0.8**	

Referent	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8	Emerging Command	Number of Users
Select Physical Display for Media (Media Control)	Select Video Display	Proposal 1	"hey tim play video 1 on display 1"	"play video 1 on display 1"	"place video 1 on display 1"	"go to screen 1"	"hey siri play video 1 on display 1"	"play video 1 on display 1"	"play this video on display 1"	"play on display 1"	"Play" + Media File Name + "on" + Hardware Name	7 out of 8
	Final Command - based on all proposals (& Number of Users Who Ever Proposed It)										**"Play" + Media File Name + "on" + Hardware Name**	**7 out of 8**
	Agreement Rate										**0.86**	

Environmental Control

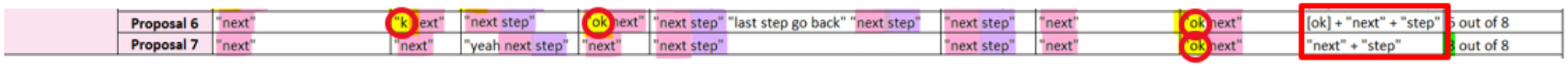
Referent	Generic Participant Number		P9	P10	P11	P12	P13	P14	P15	P16	Emerging Command	Number of Users
Go to Next / Previous Step (Following a Workflow) ***Note: Not enough usage of previous***	Cooking a Recipe	Proposal 1	"ok next"	"next"	"ok next step"	"ok next"	"k next step"	"next step"	"next"	"uh next"	[ok] + "next" + "step"	5 out of 8
		Proposal 2	"next"	"next"	"next step"	"next"	"next step"	"next step"	"next"	"uh next"	"next" + "step"	8 out of 8
		Proposal 3	"ok next"	"next"	"ok next step"	"ok next"	"next step"	"next step"	"next"	"uh next"	[ok] + "next" + "step"	5 out of 8
		Proposal 4	"ok next"	"next"	"k next step"	"next"	"next step"	"next step"	"next"	"uh next"	"next" + "step"	8 out of 8
		Proposal 5	"k next"	"k next"	"k next step"	"next"	"next step"	"next step"	"next"	"uh next"	[ok] + "next" + "step"	5 out of 8
		Proposal 6	"next"	"k next"	"next step"	"ok next"	"next step" "last step go back" "next step"	"next step"	"next"	"ok next"	[ok] + "next" + "step"	6 out of 8
		Proposal 7	"next"	"next"	"yeah next step"	"next"	"next step"	"next step"	"next"	"ok next"	"next" + "step"	8 out of 8
		Task's Emerging Command									*"next" + "step"*	

Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8		
Fixing a Boombox	Proposal 1	"k tim go to the next step"	"uh next"	"k next step"	"next"	"hey google I wanna fix this boombox" "whats the next step"	"next"	"go to the next one"	"next"	"next" + "step"	8 out of 8
	Proposal 2	"next step tim"	"next"	"next step"	"next"	"ok next step whats next"	"next"	"go to the next one"	"next"	"next" + "step"	8 out of 8
	Proposal 3	"next step"	"next"	"next step"	"next"	"whats the next step"	"next"	"go to the next one"	"k next"	"next" + "step"	8 out of 8
	Proposal 4	"next step tim"	"next"	"next step"	"next"	"whats next"	"next"	"go to the next one"	"done next"	"next"	8 out of 8
	Proposal 5	"tim can you go back" "next step tim"	"next"	"next step"	"next"	"whats next"	"next"	"next"	"next"	"next"	8 out of 8
	Proposal 6	"next step tim"	"next"	"next step"	"next"	"ok whats next"	"next"	"next"	"ok next"	"next"	8 out of 8
	Proposal 7	"next step tim"	"next"	"next step"	"next"	"done that whats next"	"back" "next"	"next"	"yeah next"	"next"	8 out of 8
	Proposal 8	"next"	"next"	"next step"	"next"	"whats next"	"next"	"next"	"yeah done next"	"next"	8 out of 8
	Task's Emerging Command									*"next"*	
	Final Command - based on all proposals (& Number of Users Who Ever Proposed It)									"next"	16 out of 16
	Agreement Rate									1	

NOTE: "ok" was not meant as a part of the command, but since it emerged amongst multiple participants, it was analyzed as well. This is further discussed in chapter 4

Voice Rules

1) Arbitrarily, more than 25% of users have to propose something in the same proposal round for it to be considered (at least 3 out of 8 in this case).



	Proposal 6	"next"	"k ext"	"next step"	"ok next"	"next step" "last step go back" "next step"	"next step"	"next"	"ok next"	[ok] + "next" + "step"	5 out of 8
	Proposal 7	"next"	"next"	"yeah next step"	"next"	"next step"	"next step"	"next"	"ok next"	"next" + "step"	3 out of 8

Figure 73: "Ok" is used at least 3 times in proposal 6, so it appears as a part of the emerging command. It is only used once in proposal 7, so it does not appear there.

2) If there are uncommon factors amongst the emerging command proposals of one task, those factors are removed from the emerging command of that task.

Referent	Generic Participant Number		P9	P10	P11	P12	P13	P14	P15	P16	Emerging Command	Number of Users
Go to Next /	Cooking a Recipe	Proposal 1	"ok next"	"next"	"ok next step"	"ok next"	"k next step"	"next step"	"next"	"uh next"	[ok] + "next" + "step"	5 out of 8
		Proposal 2	"next"	"next"	"next step"	"next"	"next step"	"next step"	"next"	"uh next"	"next" + "step"	3 out of 8
		Proposal 3	"ok next"	"next"	"ok next step"	"ok next"	"next step"	"next step"	"next"	"uh next"	[ok] + "next" + "step"	5 out of 8
		Proposal 4	"ok next"	"next"	"k next step"	"next"	"next step"	"next step"	"next"	"uh next"	"next" + "step"	3 out of 8
		Proposal 5	"k next"	"k next"	"k next step"	"next"	"next step"	"next step"	"next"	"uh next"	[ok] + "next" + "step"	5 out of 8
		Proposal 6	"next"	"k next"	"next step"	"ok next"	"next step" "last step go back" "next step"	"next step"	"next"	"ok next"	[ok] + "next" + "step"	5 out of 8
		Proposal 7	"next"	"next"	"yeah next step"	"next"	"next step"	"next step"	"next"	"ok next"	"next" + "step"	3 out of 8
	Task's Emerging Command										*"next" + "step"*	

Figure 74: "Ok" is not used as a part of emerging command for all proposals. However, "next" + "step" is a common factor throughout. Thus, "ok" is removed from the task's emerging command.

Voice Rules

3) Furthermore, if there are uncommon factors amongst the emerging command of the two tasks, those factors are removed from the final command.

Referent	Generic Participant Number		P9	P10	P11	P12	P13	P14	P15	P16	Emerging Command	Number of Users
Go to Next / Previous Step (Following a Workflow) *Note: Not enough usage of previous*	Cooking a Recipe	Proposal 1	"ok next"	"next"	"ok next step"	"ok next"	"k next step"	"next step"	"next"	"uh next"	[ok] + "next" + "step"	5 out of 8
		Proposal 2	"next"	"next"	"next step"	"next"	"next step"	"next step"	"next"	"uh next"	"next" + "step"	8 out of 8
		Proposal 3	"ok next"	"next"	"ok next step"	"ok next"	"next step"	"next step"	"next"	"uh next"	[ok] + "next" + "step"	5 out of 8
		Proposal 4	"ok next"	"next"	"k next step"	"next"	"next step"	"next step"	"next"	"uh next"	"next" + "step"	8 out of 8
		Proposal 5	"k next"	"k next"	"k next step"	"next"	"next step"	"next step"	"next"	"uh next"	[ok] + "next" + "step"	5 out of 8
		Proposal 6	"next"	"k next"	"next step"	"ok next"	"next step" "last step go back" "next step"	"next step"	"next"	"ok next"	[ok] + "next" + "step"	6 out of 8
		Proposal 7	"next"	"next"	"yeah next step"	"next"	"next step"	"next step"	"next"	"ok next"	"next" + "step"	8 out of 8
		Task's Emerging Command									*"next" + "step"*	
	Generic Participant Number		P1	P2	P3	P4	P5	P6	P7	P8		
	Fixing a Boombox	Proposal 1	"k tim go to the next step"	"uh next"	"k next step"	"next"	"hey google I wanna fix this boombox" "whats the next step"	"next"	"go to the next one"	"next"	"next" + "step"	8 out of 8
		Proposal 2	"next step tim"	"next"	"next step"	"next"	"ok next step whats next"	"next"	"go to the next one"	"next"	"next" + "step"	8 out of 8
		Proposal 3	"next step"	"next"	"next step"	"next"	"whats the next step"	"next"	"go to the next one"	"k next"	"next" + "step"	8 out of 8
		Proposal 4	"next step tim"	"next"	"next step"	"next"	"whats next"	"next"	"go to the next one"	"done next"	"next"	8 out of 8
		Proposal 5	"tim can you go back" "next step tim"	"next"	"next step"	"next"	"whats next"	"next"	"next"	"next"	"next"	8 out of 8
		Proposal 6	"next step tim"	"next"	"next step"	"next"	"ok whats next"	"next"	"next"	"ok next"	"next"	8 out of 8
		Proposal 7	"next step tim"	"next"	"next step"	"next"	"done that whats next"	"back" "next"	"next"	"yeah next"	"next"	8 out of 8
		Proposal 8	"next"	"next"	"next step"	"next"	"whats next"	"next"	"next"	"yeah done next"	"next"	8 out of 8
		Task's Emerging Command									*"next"*	
		Final Command - based on all proposals (& Number of Users Who Ever Proposed It)									**"next"**	**16 out of 16**
		Agreement Rate									1	

NOTE: "ok" was not meant as a part of the command, but since it emerged amongst multiple participants, it was analyzed as well. This is further discussed in chapter 4

Figure 75: "step" is used as a part of the cooking a recipe task's emerging command. However, it is not used as a part of the fixing a boombox task's emerging command. Nonetheless, "next" is a common factor in both. Thus, "step" is removed from the final command, and "next is considered as the final command.