

Unmasked: Lip Tracking and Animation

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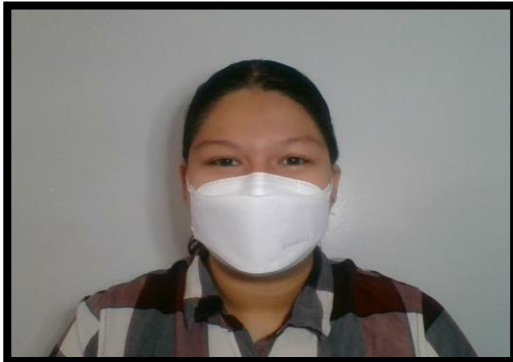


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Background



Due to the COVID-19 pandemic, wearing a mask to cover one's mouth is recommended in public.

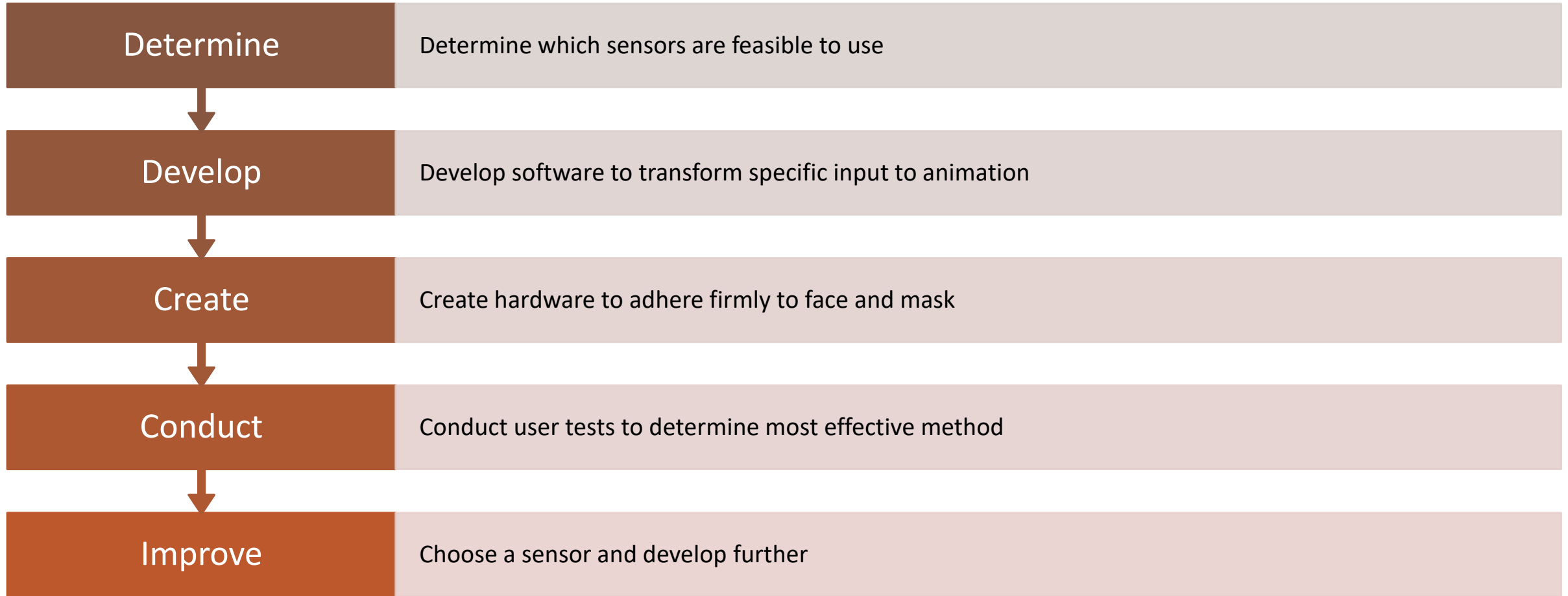
Wearing masks hinders our ability to express ourselves, as it is hard to read facial expressions much less lips behind a mask.

Since the expression of many emotions rely heavily on subtle mouth movements, masks hinder our ability to understand each other's expressions and emotions.

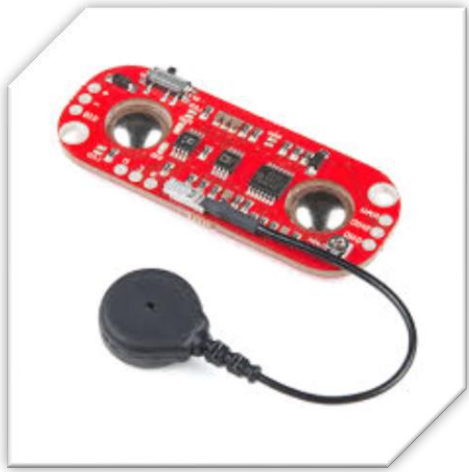
Research Question

What is the most efficient method for receiving and relaying mouth movements in order to clearly communicate human emotion with wearable technology amidst social distancing restrictions?

Process



All Sensors Considered



EMG Sensor



Soft Circuit



Accelerometer



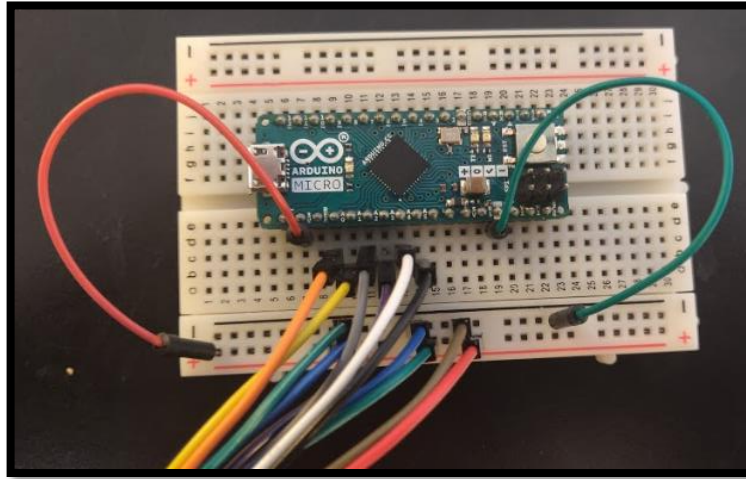
Camera



Flex Sensor

Accelerometer

- Arduino Microcontroller
- 3 x Accelerometers
- Breadboard
- LCD Screen
- P5.js Serial Controller



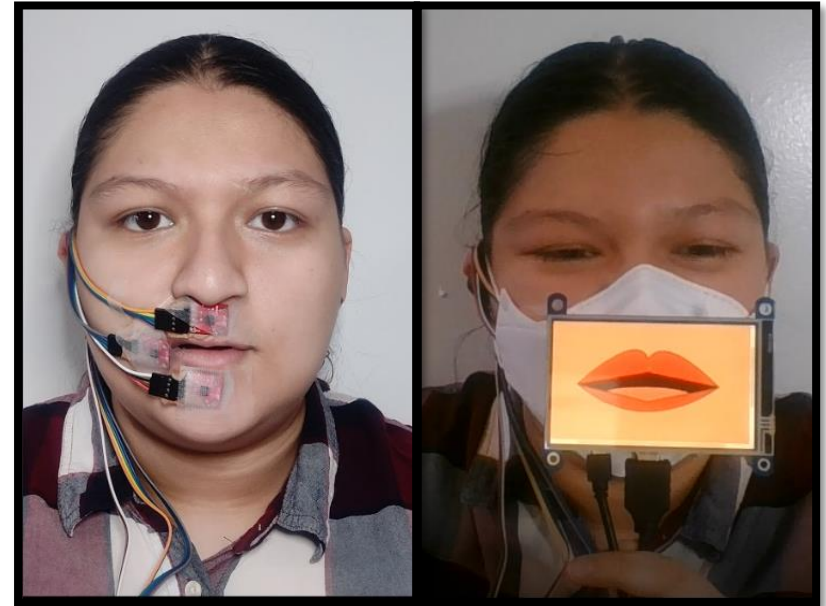
4 326, 343, 323, 285, 333, 325

2 326, 343, 323, 284, 333, 325

326, 343, 322, 285, 333, 325

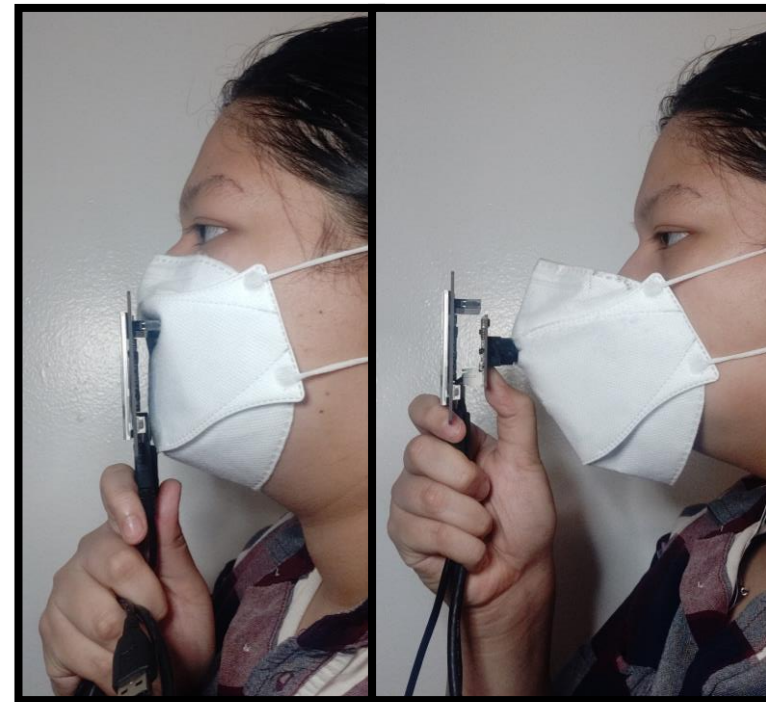
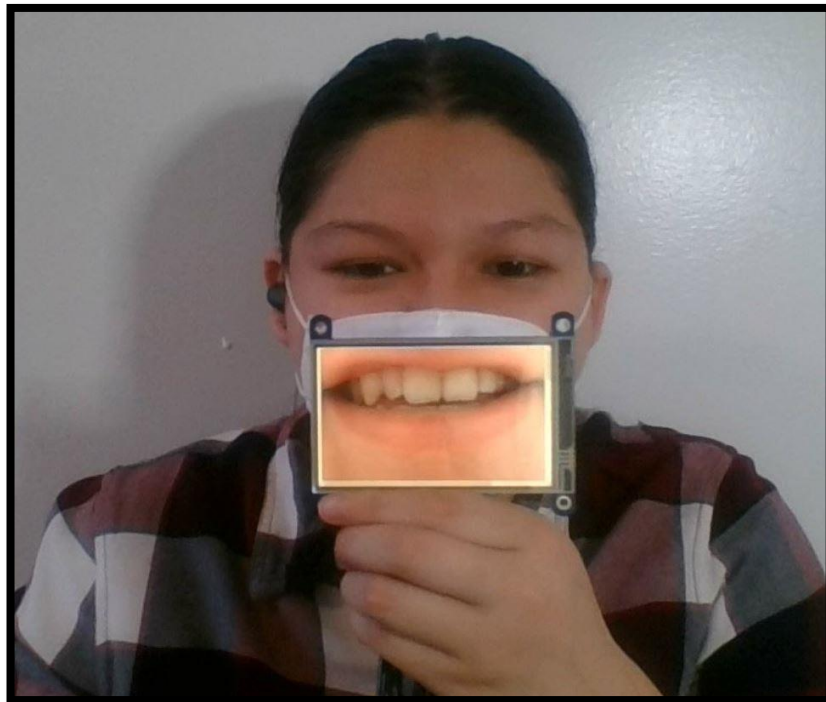
326, 343, 323, 285, 333, 325

```
//Determines values from calibration
let open = (y3 - normalH - y1) * 6;
let width;
if( (x2 - normalW - x1) > 0)
  width = (x2 - normalW - x1) * 4;
else
  width = (x2 - normalW - x1) * 6;
let top = open / 2;
```



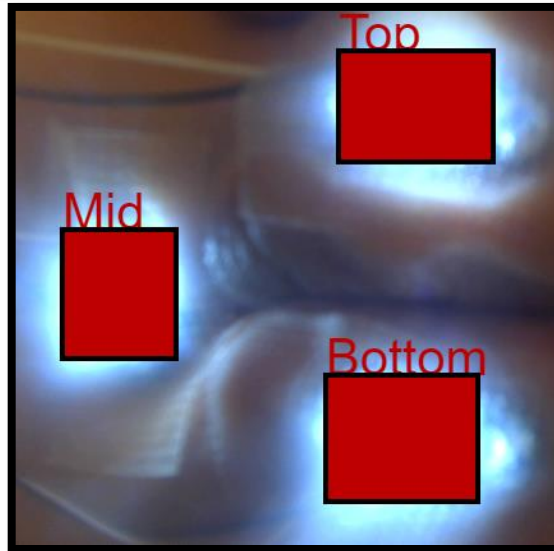
Camera

- Camera
- LCD Screen

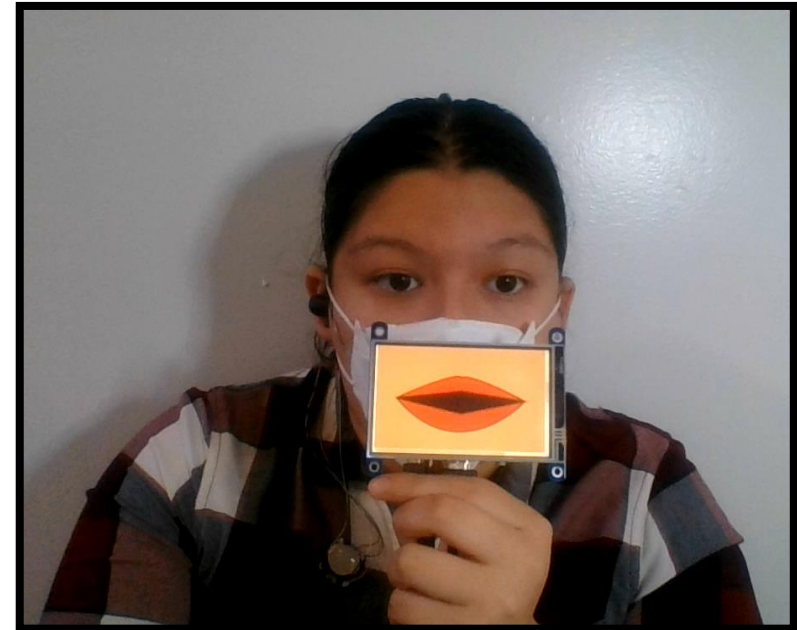


Camera + LED

- 3 x LED
- Camera
- LCD Screen



```
if(r.x > mid[0] && r.y < topL[1])  
{  
    topC[0] = r.x + r.width;  
    topC[1] = r.y + (r.height / 2) + down;  
    topC[2] = r.width;  
    topC[3] = r.height;  
}
```





Counter-Balance

Mask Only

Allows for the least emotion to be shown

Testing Method

1. Which emotion is expressed? (select all that apply)

- Happiness
- Fear
- Sadness
- Surprise
- Anger
- Disgust
- Other...

5. Rate each device. (choose one for each

mask only

- Strongly Like
- Like
- Neutral
- Dislike
- Strongly Dislike

This mode of communication is clear and legible. *

- 1 2 3 4 5 6 7
- Strongly Disagree ○ ○ ○ ○ ○ ○ ○ Strongly Agree

- 18 volunteers recruited and separated in 2 groups (n=10, n=8, 6 female, 12 male, avg. age 21.8)
- 6 basic emotions per sensor
- Lorem ipsum placeholder text for 15 seconds per emotion in random order.
- Asked to select which emotion they thought was being expressed
- Ranked each sensor from 1-7 for
 - Clarity
 - Playfulness
 - Expression
 - Disturbance
 - Preference

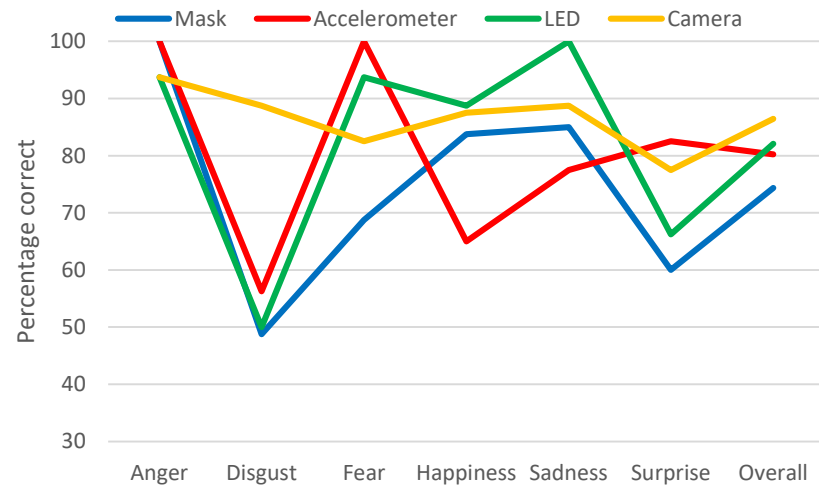
Results

Baseline
 Neutral
 Significant - Good
 Significant - Bad

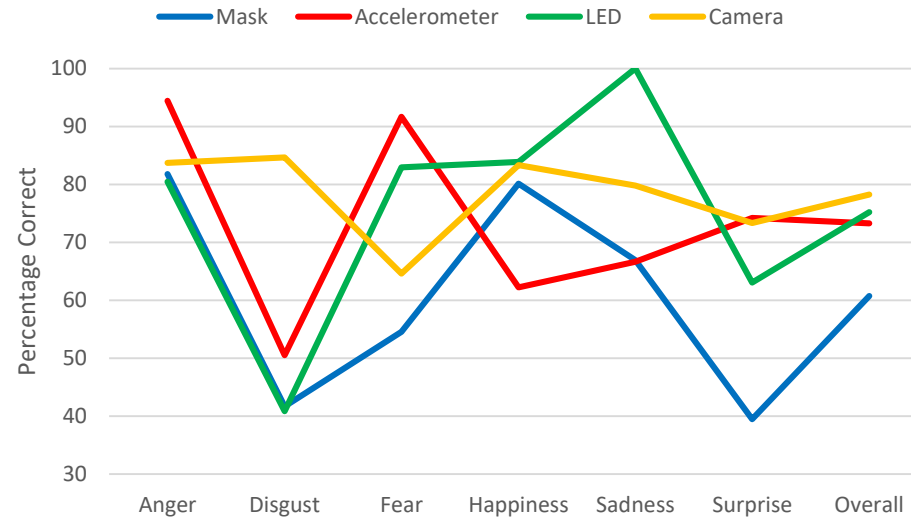
Category	Population Averages									
	Mask Only				Accelerometer		Camera + LED		Camera Only	
	At least 1 guess correct	St.dev	Overall Guesses	St.dev	At least 1 guess correct	Overall Guesses	At least 1 guess correct	Overall Guesses	At least 1 guess correct	Overall Guesses
Anger	100.00	0.00	81.81	9.09	100.00	94.44	93.75	80.45	93.75	83.75
Disgust	48.75	11.25	41.67	8.34	56.25	50.51	50.00	40.84	88.75	84.66
Fear	68.75	18.75	54.54	9.09	100.00	91.67	93.75	82.95	82.50	64.62
Happy	83.75	3.75	80.11	7.39	65.00	62.22	88.75	83.89	87.50	83.34
Sadness	85.00	15.00	66.93	13.08	77.50	66.67	100.00	100.00	88.75	79.80
Surprise	60.00	10.00	39.45	0.56	82.50	74.24	66.25	63.07	77.50	73.34
Overall	74.38	2.71	60.75	2.11	80.21	73.29	82.08	75.20	86.46	78.25
Clear			3.6	0.65		4.2		4.0		5.7
Fun			2.9	0.40		5.2		4.7		5.3
Expressive			3.1	0.60		4.7		5.4		5.9
Disturbing			1.6	0.05		3.0		2.8		3.7
Preferred			3.5	0.49		5.2		4.6		5.9

Results Continued

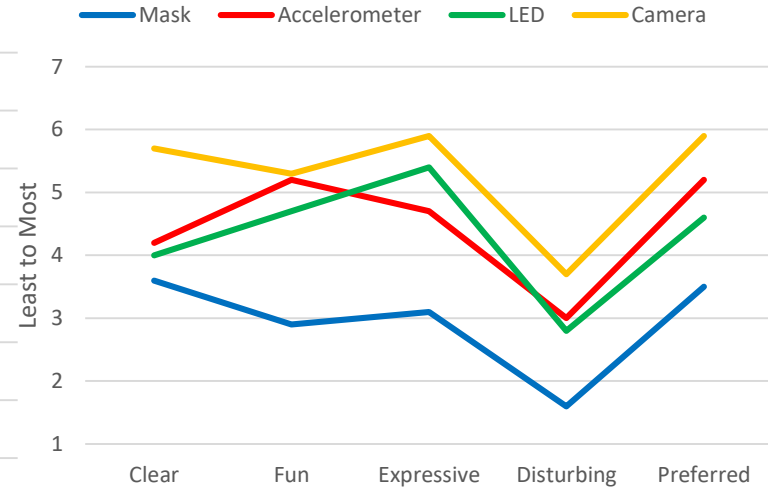
Accuracy



Precision



Preference



All versions of Unmasked significantly increase the ability of participants to recognize the emotions of the users

Moving Forward

Changes to Hardware

- Smaller Screen
- Less Space
- Improved Portability

Changes to Software

- Fluid Movements
- Real-Time
- Better Calibration

Future Directions



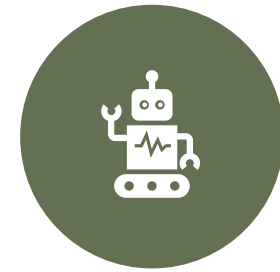
IN-CLASSROOM
DEVELOPMENT



FULL-FACE
ANIMATION



HEARING
IMPAIRMENT



ROBOTIC
APPLICATION

Sources

Alexander Goldin, Barbara E. Weinstein, and Nimrod Shiman. 2020. How do medical masks degrade speech perception? *Hearing Review*, 27, 5 (2020), 8–9.

Martin Wegrzyn, Maria Vogt, Berna Kireclioglu, Julia Schneider, and Johanna Kissler. 2017. Mapping the emotional face. How individual face parts contribute to successful emotion recognition. *PLoS ONE* 12, 5 (2017).

Paul Ekman. 1992. Are there basic emotions? *Psychological Review* 99, 3 (1992), 550–553.