

# **FINAL PRESENTATION**

**GCT565  
AUGMENTED HUMANS**

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# RESEARCH OBJECTIVE



## AVATAR SMILE

TO INVESTIGATE THE IMPACT OF  
ENHANCED SMILE MEDIATED BY THE  
VIRTUAL AVATAR ON THE EMOTIONAL  
STATE OF THE USER

# LITERATURE REVIEW

## \*FACIAL EXPRESSIONS AND EMOTIONS

David Robson. 2010. Is laughter the best medicine? *New Sci.* 207, 2769 (2010), 35.

Barbara L. Fredrickson. 2001. The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *Am. Psychol.* 56, 3 (2001), 218–226.

## \*AVATAR EMBODIMENT AND VIRTUAL MIRROR

Mar González-Franco, Daniel Pérez-Marcos, Bernhard Spanlang, and Mel Slater. 2010. The contribution of real-time mirror reflections of motor actions on virtual body ownership in an immersive virtual environment.

## \*THE PROTEUS EFFECT

Nick Yee and Jeremy Bailenson. 2007. The proteus effect: The effect of transformed self-representation on behavior. *Hum. Commun. Res.* 33, 3 (2007), 271–290.

## \*EEG AND EMOTIONS

Gannouni, S., Aledaily, A., Belwafi, K. et al. Emotion detection using electroencephalography signals and a zero-time windowing-based epoch estimation and relevant electrode identification. *Sci Rep* 11, 7071 (2021).  
<https://doi.org/10.1038/s41598-021-86345-5>

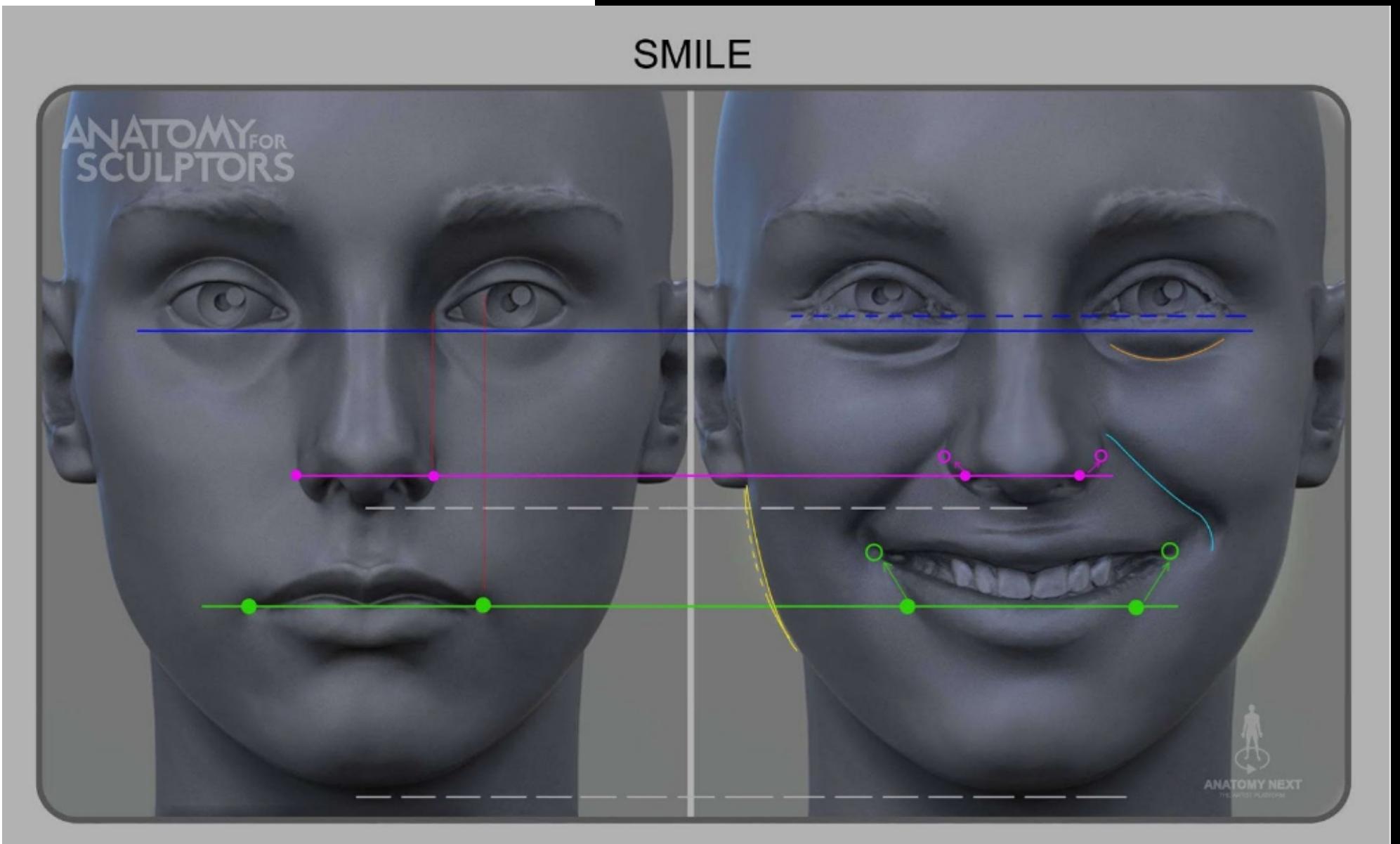
# FACIAL EXPRESSIONS AND EMOTIONS

## POSITIVE PSYCHOLOGY

Positive emotion has beneficial effects on physical health [1]

## JAMES-LANGE THEORY

James claimed that emotions occur because of physiological changes such as increased muscle tone [2]



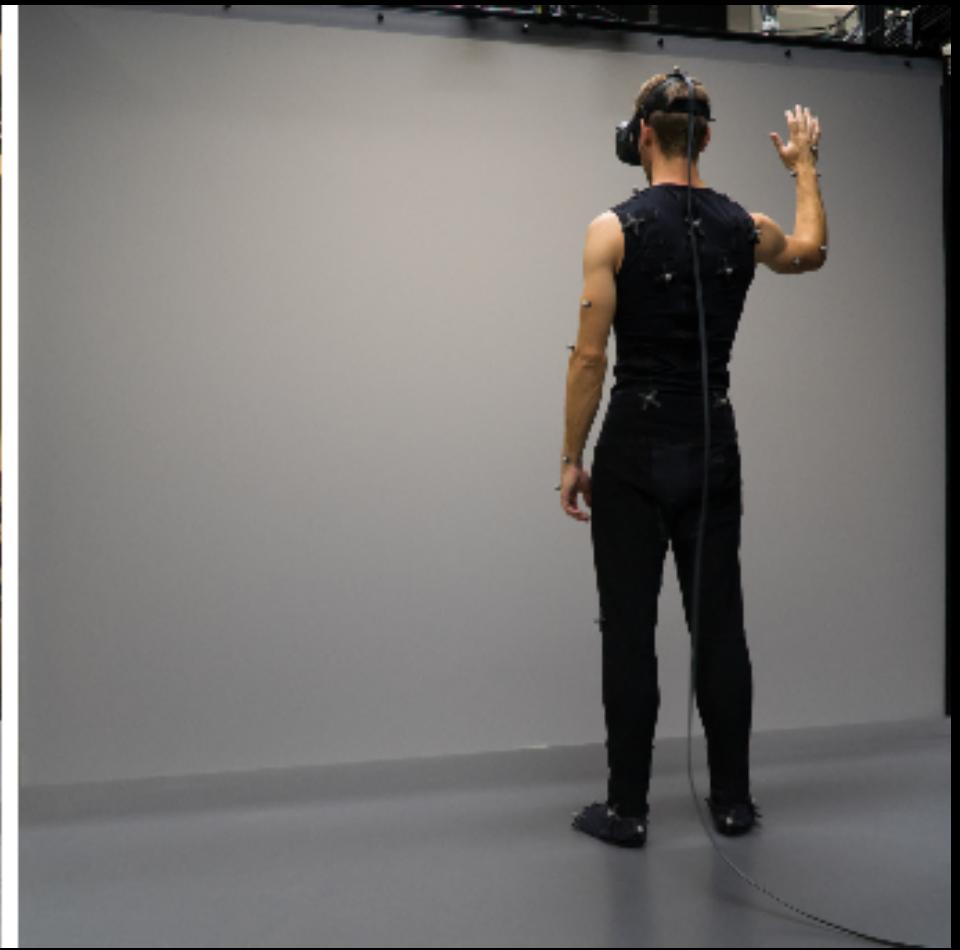
[1] David Robson. 2010. Is laughter the best medicine? *New Sci.* 207, 2769 (2010), 35.  
Barbara L. Fredrickson. 2001

[2] Cannon, W. B. (1927). The James-Lange Theory of Emotions: A Critical Examination and an Alternative Theory. *The American Journal of Psychology*, 39, 106-124.

# AVATAR EMBODIMENT AND VIRTUAL MIRROR

## MIRROR SELF-RECOGNITION

Mirror has been used to measure physiological and cognitive self-awareness [3]



## AVATAR EMBODIMENT

People's body ownership of an avatar can be observed in a virtual mirror. [3]

Mirror is important for body perception. [4]

[3] Mar González-Franco, The contribution of real-time mirror reflections of motor actions on virtual body ownership in an immersive virtual environment.

[4] Catherine Preston, Owning the body in the mirror: The effect of visual perspective and mirror view on the full-body illusion.

# THE PROTEUS EFFECT

## AVATAR APPEARANCE

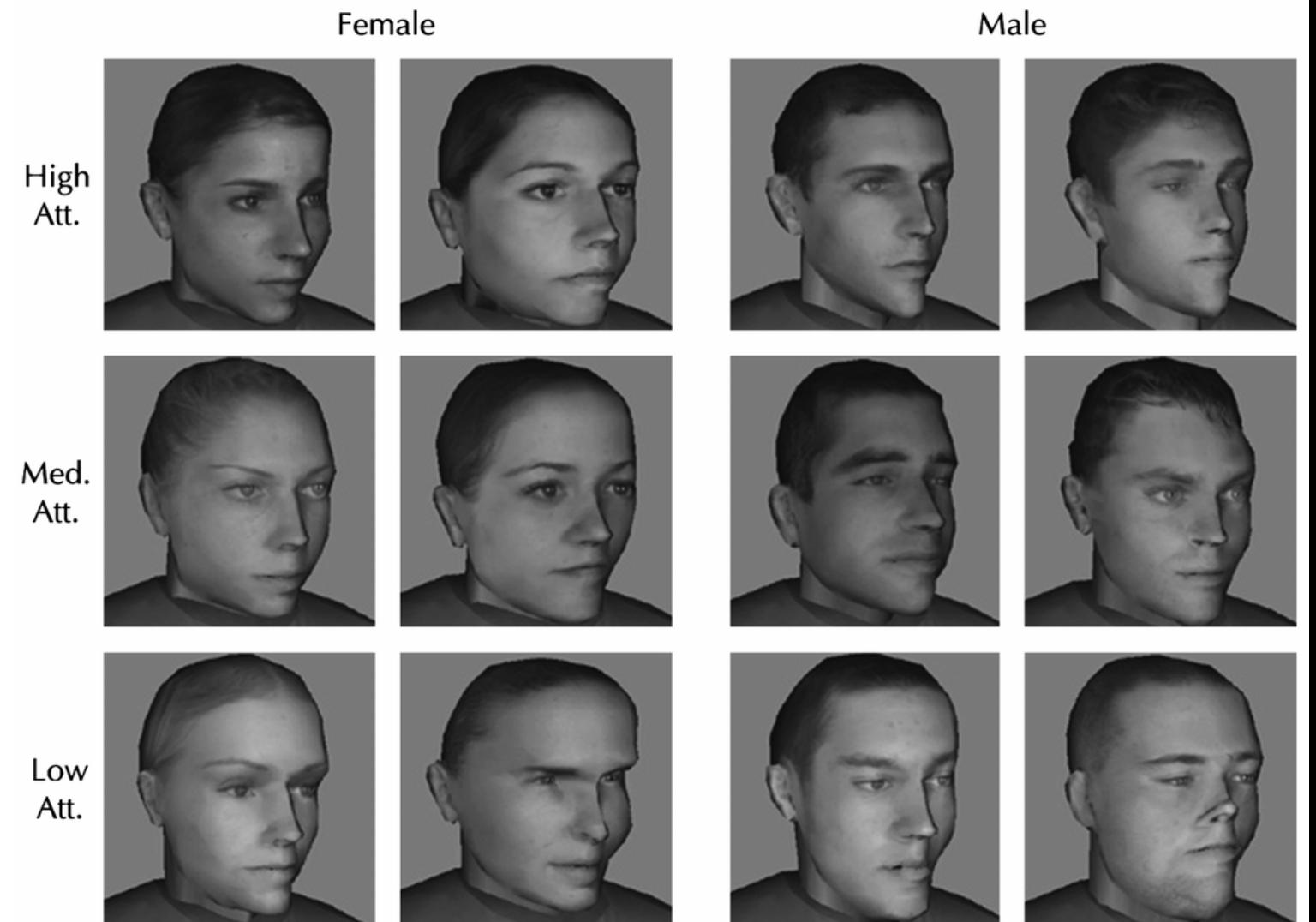
User behavior changes depending on the appearance of the avatar used [5]

## ARTIFICIAL SMILE

Reinforcing the smile of the virtual avatar has a positive impact on the user experience [5]



Appearance - matters!



[5] Nick Yee and Jeremy Bailenson. 2007. The proteus effect: The effect of transformed self-representation on behavior. *Hum. Commun. Res.* 33, 3 (2007), 271–290.

# EEG AND EMOTIONS

EEG analysis will be used to support the measurements obtained by the questionnaire method

## ACCURACY

The newest implemented method using QDC and RNN showed an average accuracy level of over 89%. Compared with existing algorithms dealing with 9 emotions, the proposed method enhanced the accuracy rate by 8% [6]

Emotion ( $\eta$ )	RNN (scheme 2)		
	$DFT_{Exp}$	$NGD_{Exp}$	Proposed method
Happy	86.79	88.98	92.04
Depressed	94.46	91.01	93.21
Neutral	87.10	93.44	93.49

[6]Gannouni, S., Aledaily, A., Belwafi, K. et al. Emotion detection using electroencephalography signals and a zero-time windowing-based epoch estimation and relevant electrode identification. Sci Rep 11, 7071 (2021).  
<https://doi.org/10.1038/s41598-021-86345-5>

# IMPLEMENTATION DETAIL



HTC VIVE



UNITY 3D

**Ready Player Me**

Personal 3D avatars for games and VR  
from a single selfie.

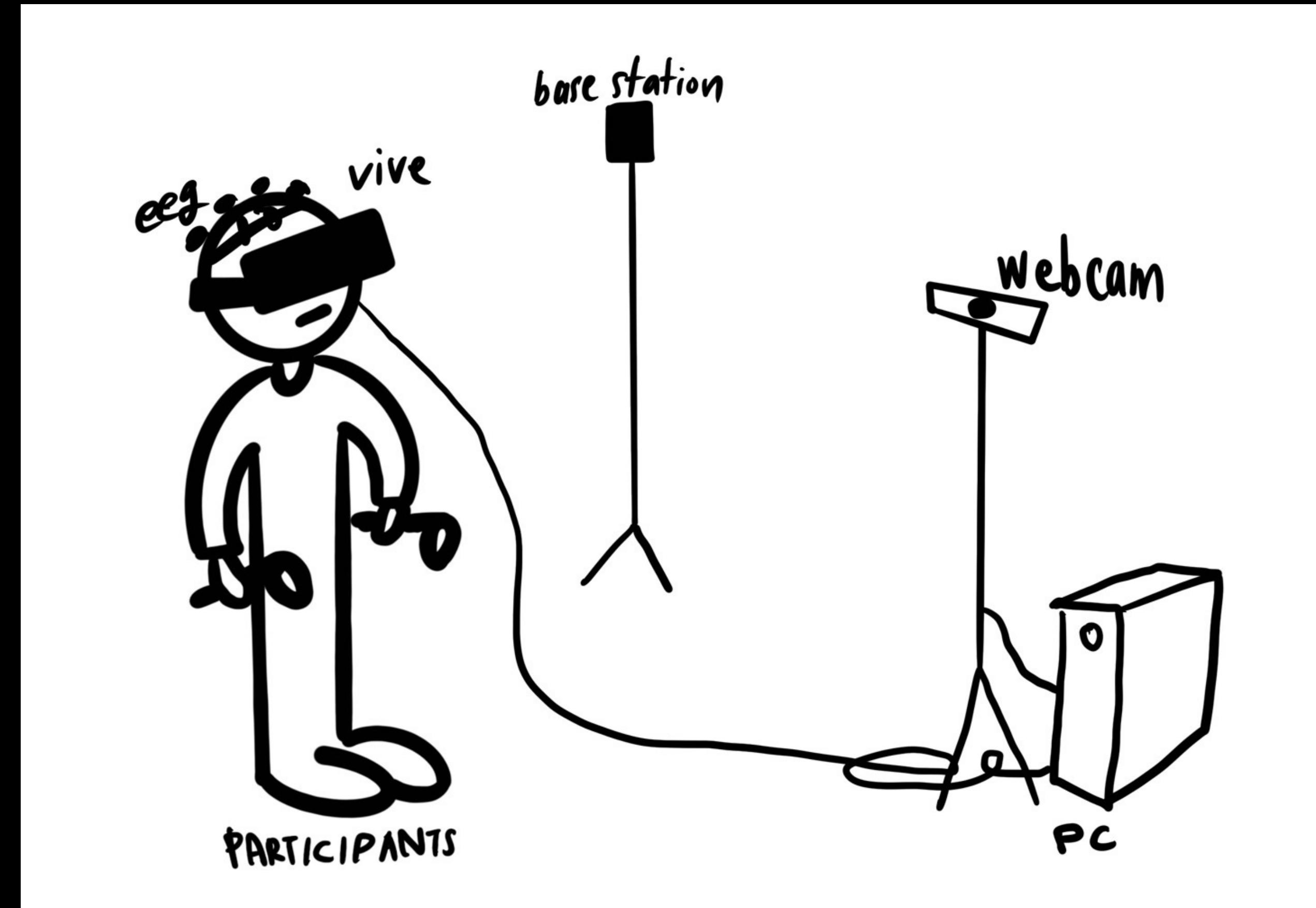


READY  
PLAY ME



EMOTIVE  
PRO

# SETTING

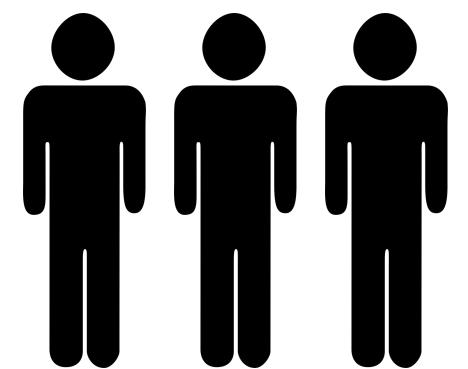


# USER STUDY PLAN

N=40

HEALTHY  
(MENTAL DISORDER X)

F = 20  
M = 20



PARTICIPANTS

# PROCEDURE

1



## BEFORE EXPERIMENT

1. AVATAR MAKING
2. QUESTIONNAIRE

2



## DURING EXPERIMENT

1. VR MIRROR (PRE, MAIN)
2. SMILE DETECTION
3. EEG DATA COLLECT

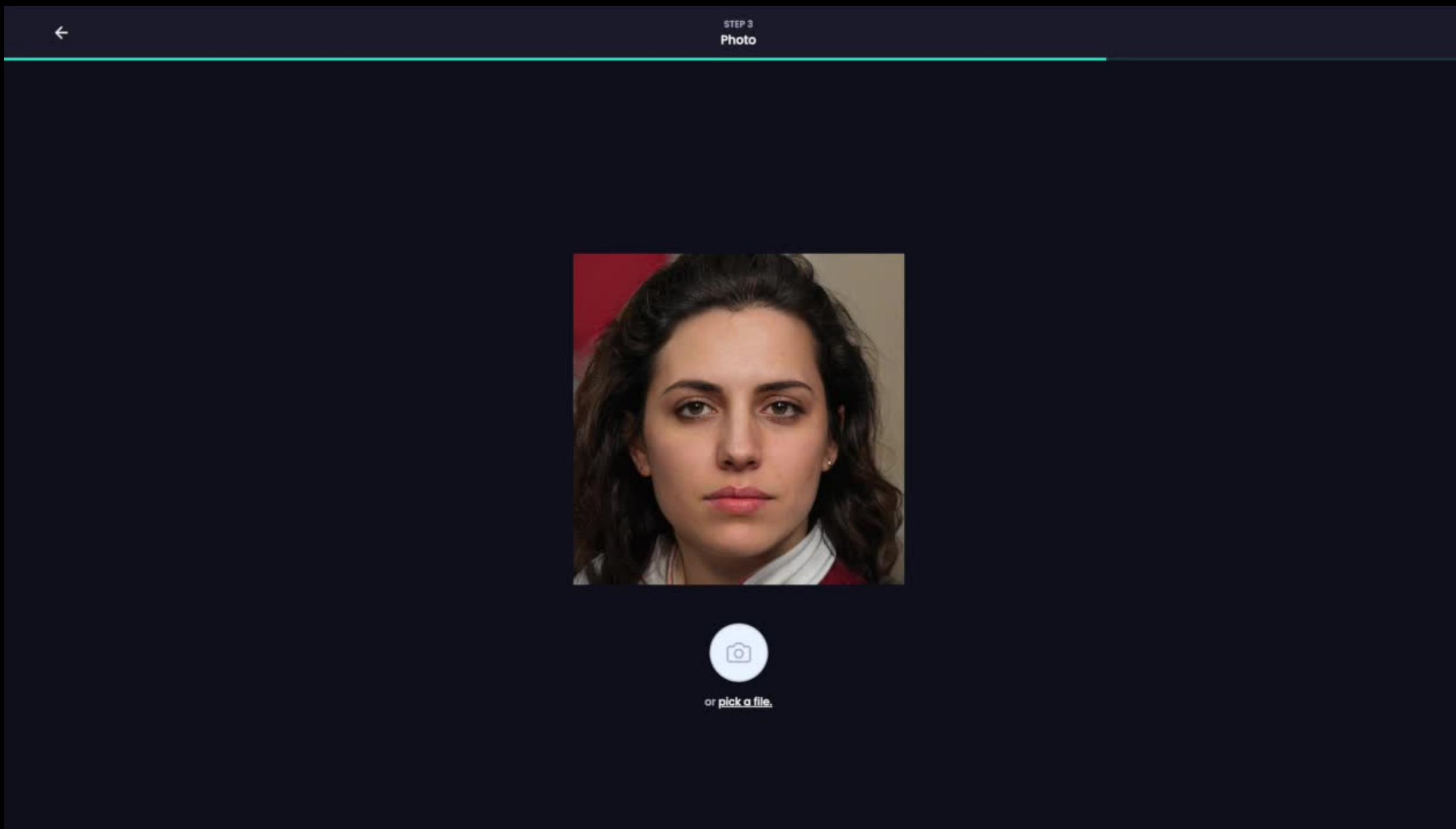
3



## AFTER EXPERIMENT

1. QUESTIONNAIRE

# 1 AVATAR CREATION



[<https://readyplayer.me/avatar>

# 2 PRE QUESTIONNAIRE

**2.1**

## VR EXPERIENCE

1. I have experiences of VR

- |        |       |
|--------|-------|
| a. Yes | b. No |
|--------|-------|

**2.2**

## AVATAR

1. I think the avatar is representing myself

2. I like the appearance of my avatar

- |                      |                      |                              |                   |
|----------------------|----------------------|------------------------------|-------------------|
| 1. Strongly disagree | 2. Somewhat disagree | 3. Neither agree or disagree | 4. Somewhat agree |
|----------------------|----------------------|------------------------------|-------------------|

- |                   |
|-------------------|
| 5. Strongly agree |
|-------------------|

# 2 PRE QUESTIONNAIRE

2.3

## EMOTIONAL STATE

1.I am currently feeling the emotion of

- |            |              |            |         |          |             |
|------------|--------------|------------|---------|----------|-------------|
| a. Sadness | b. Happiness | c. Disgust | d. Fear | e. Anger | f. Surprise |
|------------|--------------|------------|---------|----------|-------------|

2.The intensity of my current emotional state is as follows

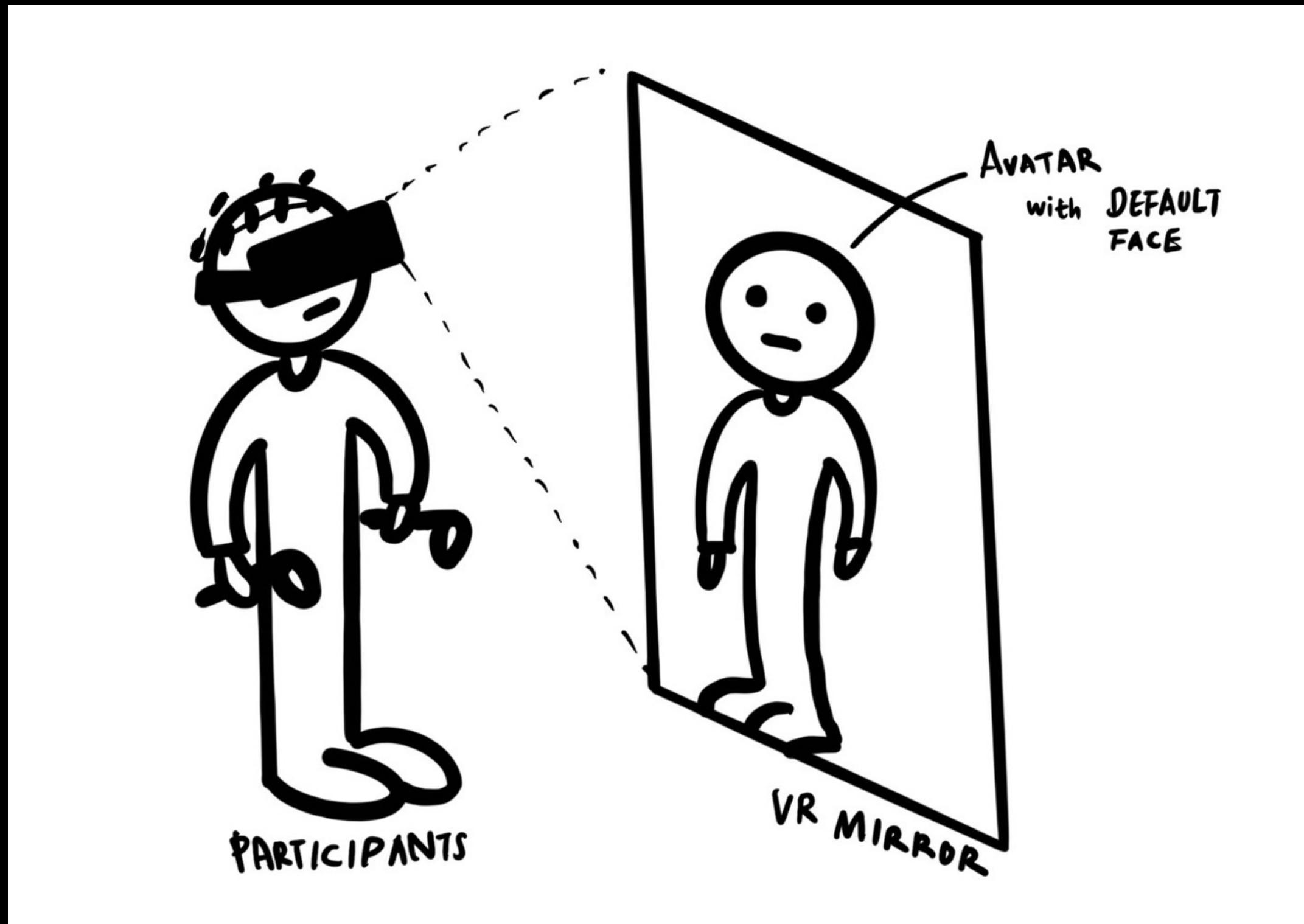
- |              |                  |                           |                    |                |
|--------------|------------------|---------------------------|--------------------|----------------|
| 1. Very weak | 2. Somewhat weak | 3. Neither weak or strong | 4. Somewhat strong | 5. Very strong |
|--------------|------------------|---------------------------|--------------------|----------------|

3. I think myself as a smiley person. (I smile a lot.)

- |                      |                      |                              |                   |
|----------------------|----------------------|------------------------------|-------------------|
| 1. Strongly disagree | 2. Somewhat disagree | 3. Neither agree or disagree | 4. Somewhat agree |
|----------------------|----------------------|------------------------------|-------------------|

5. Strongly agree
-------------------

### 3.1 PRE TASK



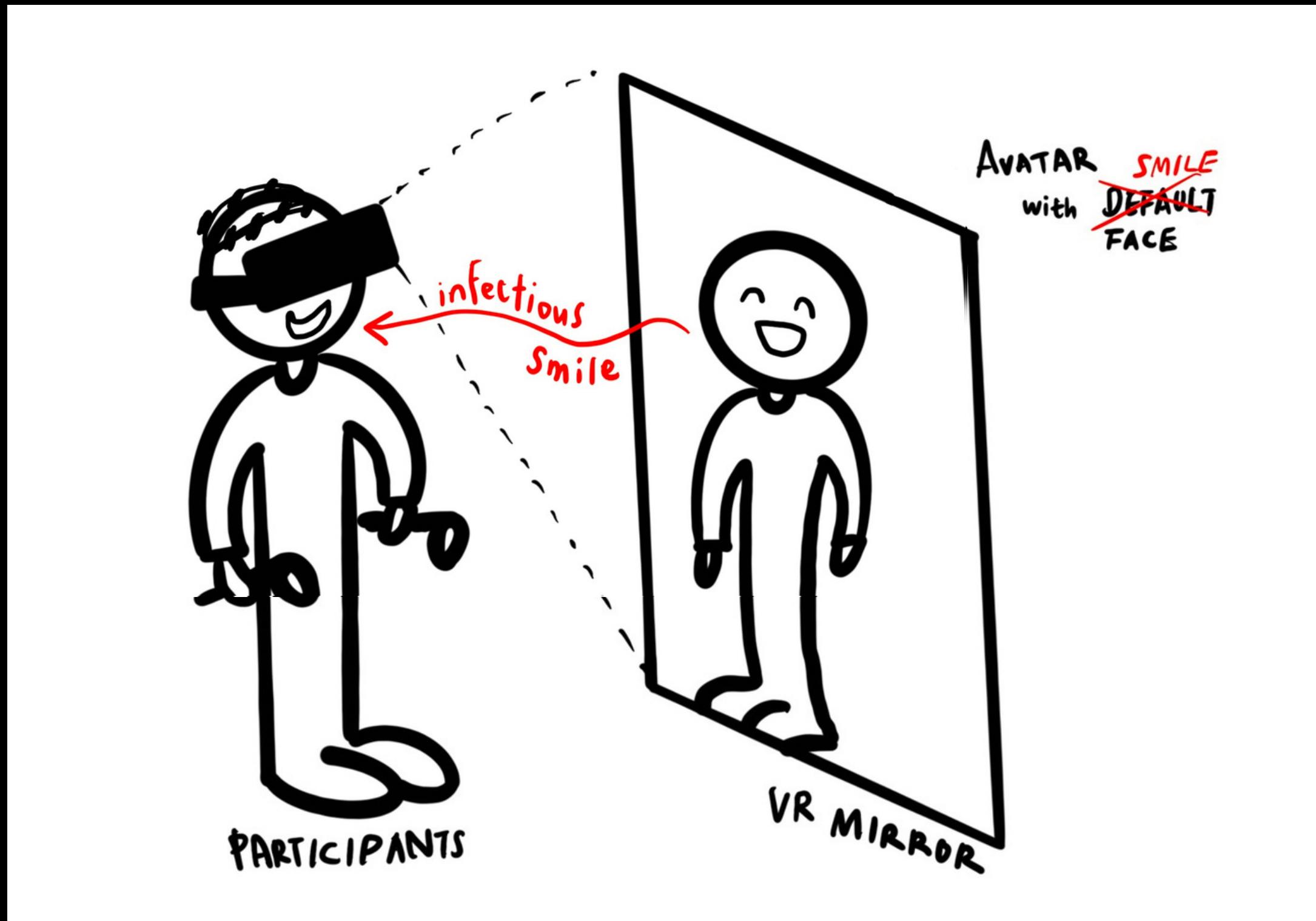
#### ADJUSTMENT

Try various posture for 30s  
looking at VR mirror

#### AVATAR CONDITION

Avatar has no facial  
expression ; default face

## 3.2 MAIN TASK



### SMILE DETECTION

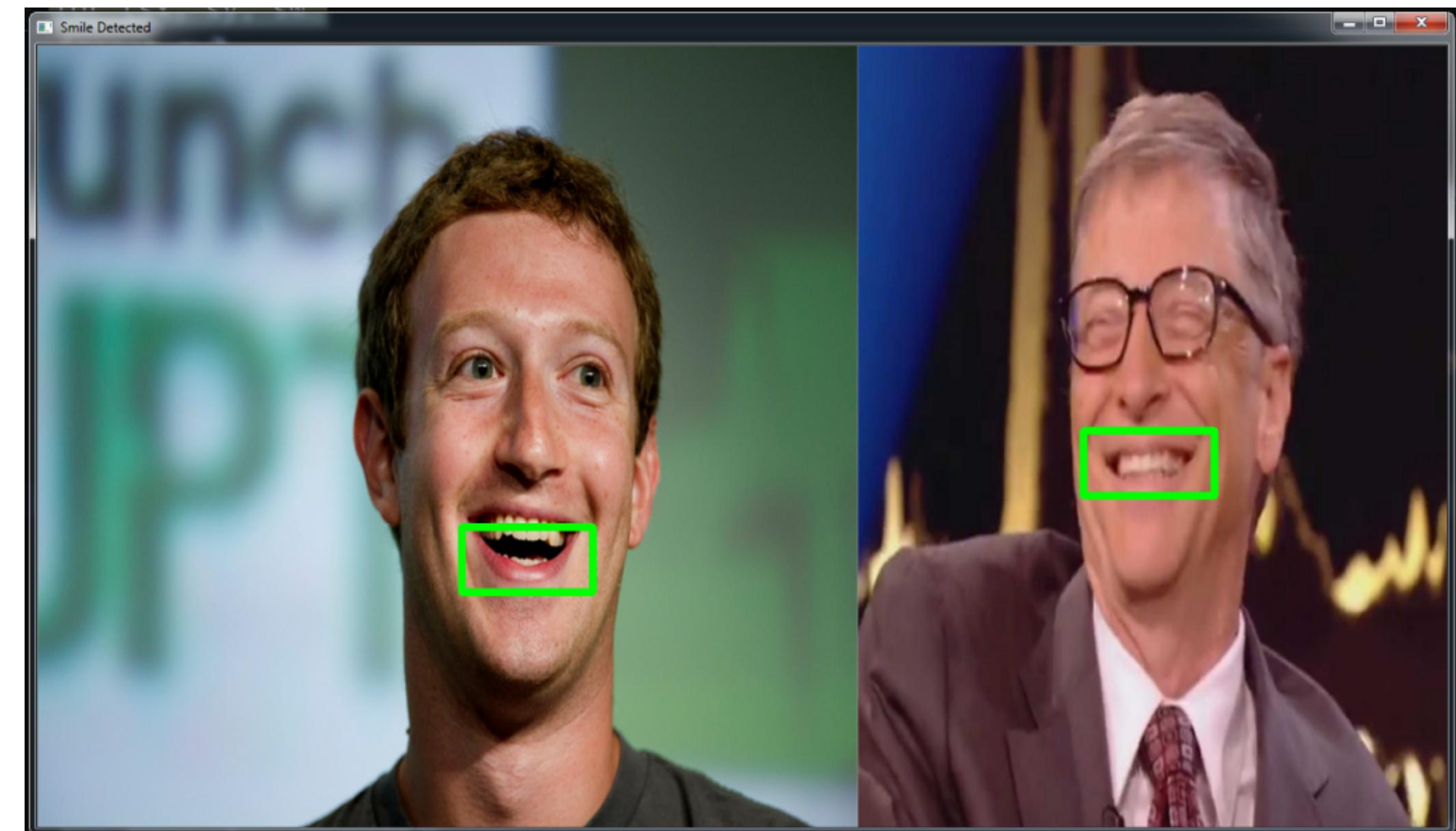
- 1) Step forward to the VR mirror
- 2) Look at avatar's face closely
- 3) Ask user to investigate any differences
- 4) Record user's mouth muscle movement

### DETECT USER'S SMILE

Using Python open CV, collect user's mouth muscle movement data and analyze, how often s/he smiled

# 4 SMILE DETECTION

Upper Face Action Units					
AU1	AU2	AU4	AU5	AU6	AU7
Inner Brow Raiser	Outer Brow Raiser	Brow Lowerer	Upper Lid Raiser	Cheek Raiser	Lid Tightener
*AU41	*AU42	*AU43	AU44	AU45	AU46
Lip Droop	Slit	Eyes Closed	Squint	Blink	Wink
Lower Face Action Units					
AU9	AU10	AU11	AU12	AU13	AU14
Nose Wrinkler	Upper Lip Raiser	Nasolabial Deepener	Lip Corner Puller	Cheek Puffer	Dimpler
AU15	AU16	AU17	AU18	AU20	AU22
Lip Corner Depressor	Lower Lip Depressor	Chin Raiser	Lip Puckerer	Lip Stretcher	Lip Funneler
AU23	AU24	*AU25	*AU26	*AU27	AU28



Stewart, Patrick & Bucy, Erik & Mehu, Marc. (2015). Strengthening bonds and connecting with followers: A biobehavioral inventory of political smiles. Politics and the Life Sciences. 34. 1-20.  
10.1017/pls.2015.5.

Python open CV

# EEG + VR



EMOTIV EPOC+ 14-Channel Wireless EEG Headset + VR

<https://youtu.be/QCrBDm7fIpo?t=178>

# 5 POST QUESTIONNAIRE

**5.1**

## FACIAL EXPRESSIONS

1.I think avatar's facial expression has been changed

- |        |       |
|--------|-------|
| a. Yes | b. No |
|--------|-------|

2.I think I smiled during the experiment

- |        |       |
|--------|-------|
| a. Yes | b. No |
|--------|-------|

**5.2**

## SYSTEM USABILITY

1.I think that the system is easy to use

2.I feel very confident using the system

- |                      |                      |                             |                   |
|----------------------|----------------------|-----------------------------|-------------------|
| 1. Strongly disagree | 2. Somewhat disagree | 3.Neither agree or disagree | 4. Somewhat agree |
|----------------------|----------------------|-----------------------------|-------------------|

- |                  |
|------------------|
| 5.Strongly agree |
|------------------|

# 5 POST QUESTIONNAIRE

**5.3**

## EMOTIONAL STATE

1.I am currently feeling the emotion of

- |            |              |            |         |          |             |
|------------|--------------|------------|---------|----------|-------------|
| a. Sadness | b. Happiness | c. Disgust | d. Fear | e. Anger | f. Surprise |
|------------|--------------|------------|---------|----------|-------------|

2.The intensity of my current emotional state is as follows

- |              |                  |                           |                    |                |
|--------------|------------------|---------------------------|--------------------|----------------|
| 1. Very weak | 2. Somewhat weak | 3. Neither weak or strong | 4. Somewhat strong | 5. Very strong |
|--------------|------------------|---------------------------|--------------------|----------------|

3. I think avatar's facial expression has affected on my mood

- |                      |                      |                              |                   |
|----------------------|----------------------|------------------------------|-------------------|
| 1. Strongly disagree | 2. Somewhat disagree | 3. Neither agree or disagree | 4. Somewhat agree |
|----------------------|----------------------|------------------------------|-------------------|

5. Strongly agree
-------------------

## **ANALYSIS METHOD:**

For short-term: One-way ANOVA with F-test

For long-term: Repeated Measures ANOVA with Aligned Rank Transform

## **NULL HYPOTHESIS:**

"An artificially created smile avatar will boost a user's mood"

## **VARIABLES**

Independent variables: avatar's smile, time points(only for long-term).

Dependent variables: user's emotional state, EEG data

## **USER STUDY PLAN. ANALYSIS**

## OUTCOME

For immediate short-term: change of UES(User's emotional state) values per each trial

For long-term: mean value of the UES per each time point

Result: comparing the variables of the "Before", "During" and "After" experiment UES changes

ID	UES1	UES2	UES3
SP1	3	4	5
SP2	3	3	3
SP3	4	5	5
SP4	2	1	4
SP5	2	3	4
SP6	4	5	4

UES=user's emotional state

Table 1. Example of the data pattern for the variable User's emotional state

## USER STUDY PLAN. ANALYSIS

# DETAILED ANALYSIS VARIABLES FOR IMMEDIATE SHORT-TERM IMPACT

Element	Variable
1) Domain	Emotional State
2) Specific measure	OpenCV Python Smile detection
3) Specific metric	Change from baseline
4) Method of aggregation	Categorical variable
5) Time point	3 times per each trial
6) Analysis population	All participants who fully finished a trial
7) Method for handling missing data	If at least 80% of the questionnaire is completed per trial, the average score will be used for the missing item(s). If the questionnaire is less than 80% complete, the questionnaire will be treated as missing.
8) Analysis method	One-way ANOVA using F-test

# USER STUDY PLAN. ANALYSIS

## DETAILED ANALYSIS VARIABLES FOR LONG-TERM IMPACT

<b>Element</b>	<b>Variable</b>
1) Domain	Emotional State
2) Specific measure	OpenCV Python Smile detection
3) Specific metric	Value at a time point, time-to-event
4) Method of aggregation	Categorical variable, time-to-event variable
5) Time point	Analyzed at 2 weeks, outcome for each day
6) Analysis population	All participants taking part in at least 1 week of the study experiment
7) Method for handling missing data	If at least 80% of the questionnaire is complete at 2 weeks, the average score will be used for the missing item(s). If the questionnaire is less than 80% complete, the questionnaire will be treated as missing.
8) Analysis method	Repeated Measures ANOVA with Aligned Rank Transform

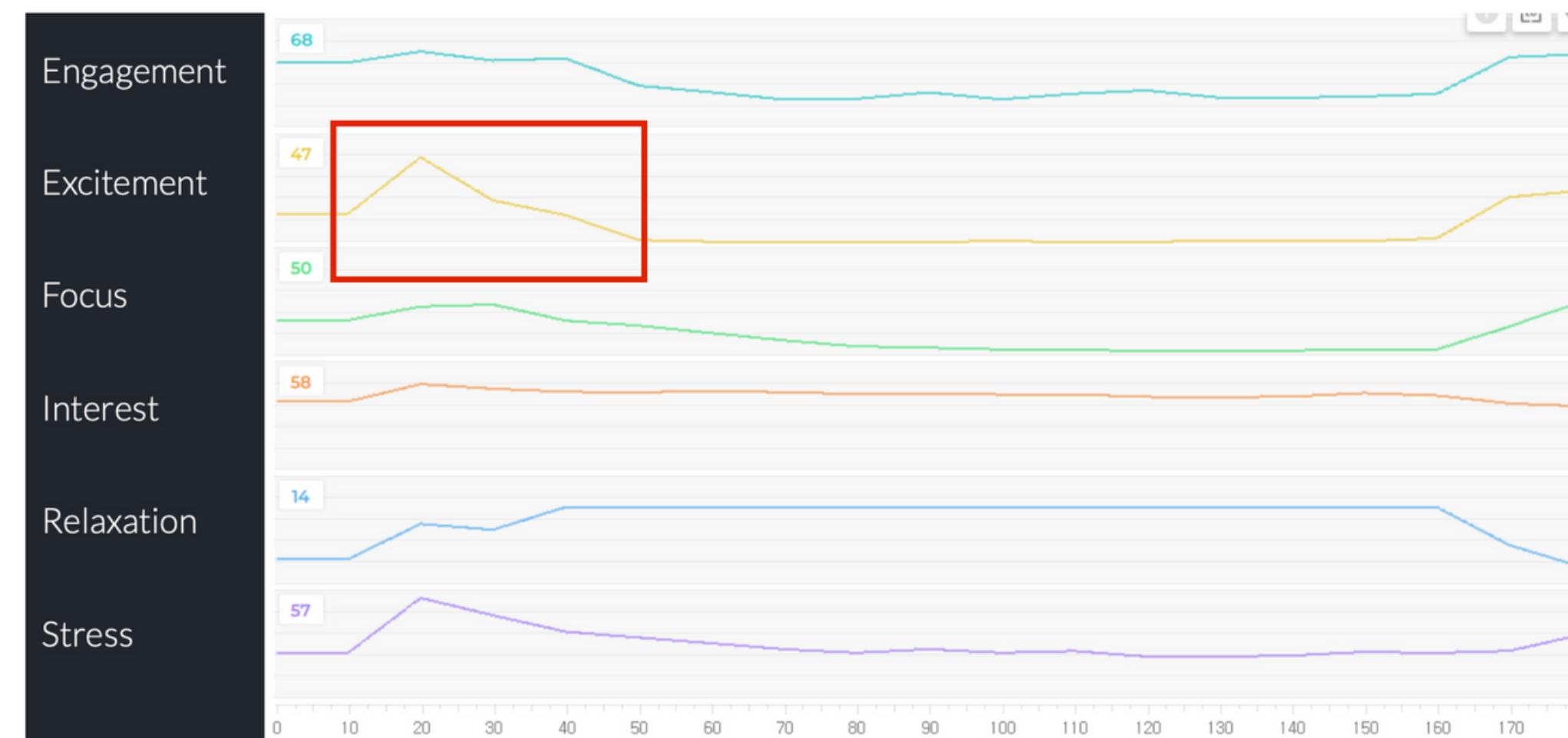
## USER STUDY PLAN. ANALYSIS

## EEG ANALYSIS

Data: raw data of "Excitement" metric

Frequency: each 10 seconds from the moment of entering the experiment VR environment

Outcome: mean value of "Excitement" metric



## USER STUDY PLAN. ANALYSIS

# POTENTIAL APPLICATION

## INTERPERSONAL COMMUNICATION

For multiplayer mode, user could apply a smiling avatar to increase the average atmosphere in virtual environment

## ADDITIONAL TOOL FOR DEPRESSION TREATMENT

During a depression treatment session conducted in VR, you can use the avatar's enlarged smile to achieve a greater effect of the treatment technique used

## ANTI-BULLYING PLUGIN

Cyberbullying is one of the most problematic issues in the virtual world. Implementing our system as a plugin can reduce the negative emotions that cyberbullying causes.

THANK YOU FOR  
ATTENTION!

# Q&A

