# Emotion Recognition in VR

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Motivation

To study the complexity of emotions in human facial expressions, we created a software tool and a protocol for gathering "emotion data" from users to create a dataset of emotions. Not all facial expressions are created equal; however, and sometimes someone can be faking. To detect this, we trained our emotion recognition AI model on both "fake" and "genuine" emotion data we collected.

Gathering Emotions

To create our dataset of emotions, we recruited students from VCU to watch videos in VR while recording their avatars' facial expressions and weights.
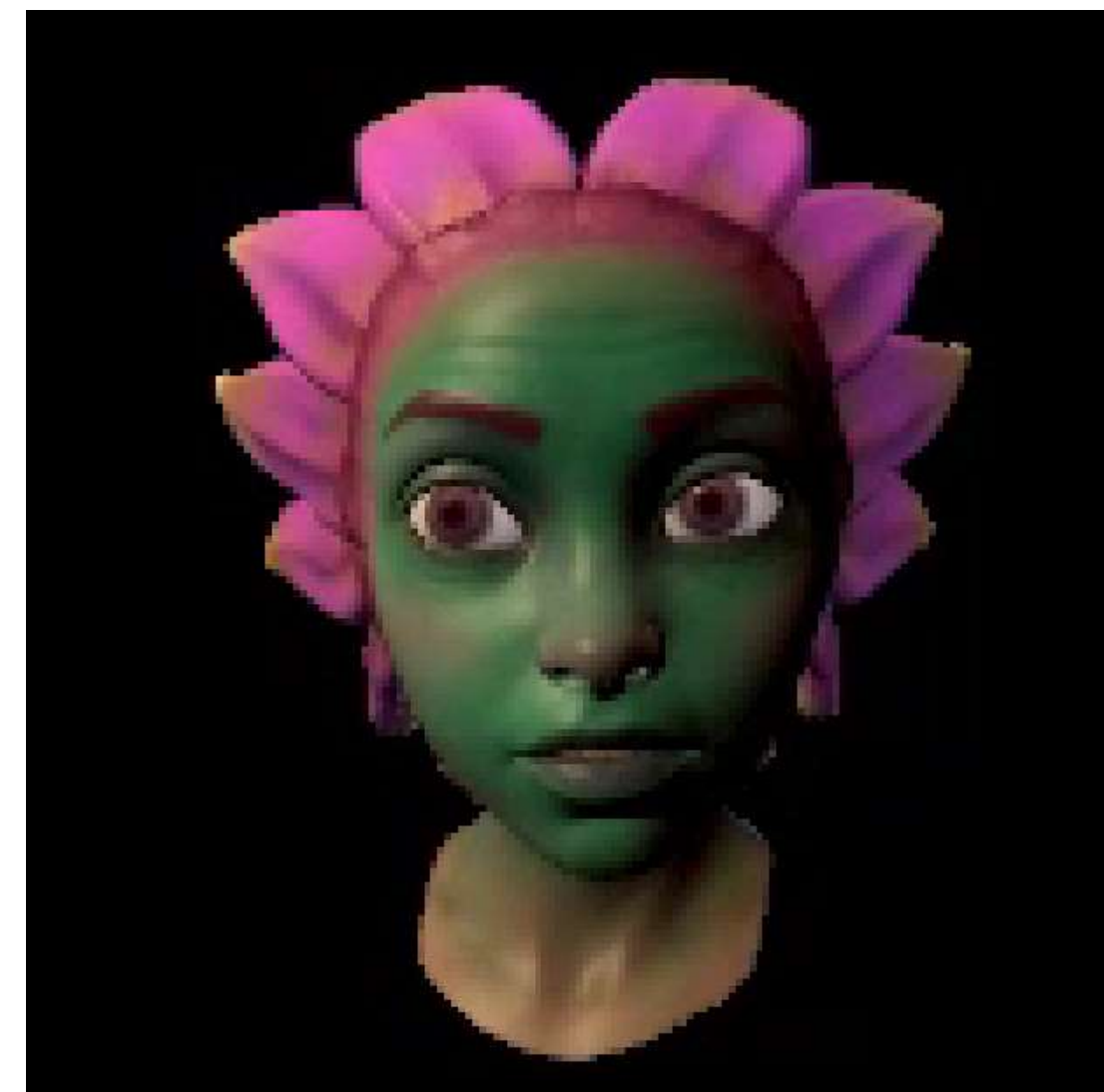
Action Units

Each emotion is linked to a set of facial muscle movements. These are called action units. When one of these muscle movements happens, the weight (a number between 0 and 1) of that action unit is greater.

Timestamp	BrowLowererL	BrowLowererR	CheekPuffL	CheekPuffR	CheekRaiserL	CheekRaiserR
0.1000366	0.06207505	0.06949779	3.12E-30	1.40E-45	0.3953057	0.3125336
0.2000122	0.07899861	0.1069079	1.09E-30	1.40E-45	0.4500144	0.3846061
0.3000488	0.07213124	0.08418108	3.83E-31	1.40E-45	0.4388835	0.3703746
0.4000244	0.06780364	0.05236345	1.34E-31	1.40E-45	0.4180134	0.3340471
0.5	0.04322878	0.040843	3.62E-32	1.40E-45	0.3724513	0.3053387
0.6000366	0.04822083	0.06022325	1.80E-32	1.40E-45	0.3306278	0.2660152
0.7000122	0.02320751	0.04684409	4.44E-33	1.40E-45	0.293691	0.2275666
0.8000488	0.02274489	0.04524497	1.55E-33	1.40E-45	0.2878709	0.2232278
0.9000244	0.01108328	0.03987769	7.72E-34	1.40E-45	0.2029628	0.1632841
1	0.0127206	0.04358269	1.90E-34	1.40E-45	0.2252252	0.179665

Key Action Unit Combinations by Emotion

Emotion	Key Action Unit Combinations
Neutral	AU5+7, AU10+25, AU5+7+10, AU4+7, AU5+26
Disgust	AU10+7, AU6+10, AU4+10, AU9+10, AU7+14, AU4+7+9+10
Anger	AU4+5+7+10+26, AU4+5+7+10+16+26, AU4+5+7+23, AU4+7+24, AU4+17+24
Happiness	AU6+12+7, AU6+12+26, AU1+2+6+12, AU5+6+12
Fear	AU4+5+7+20, AU1+2+5+26, AU1+2+4+5, AU1+2+5+20+26, AU5+7+10
Surprise	AU7+10, AU6+7+10, AU5+7+10, AU6+10+12, AU4+7+10
Sadness	AU7+4, AU7+4+6, AU4+15, AU1+4, AU7+10+15

Based on facial expression analysis from participants within VCU

Intense Feelings

Participants in our study watched seven different videos, each corresponding to one of seven basic emotions. We analyzed the weight of specific facial action units corresponding to each emotion and determine the intensity of those emotions throughout the duration of their related videos.
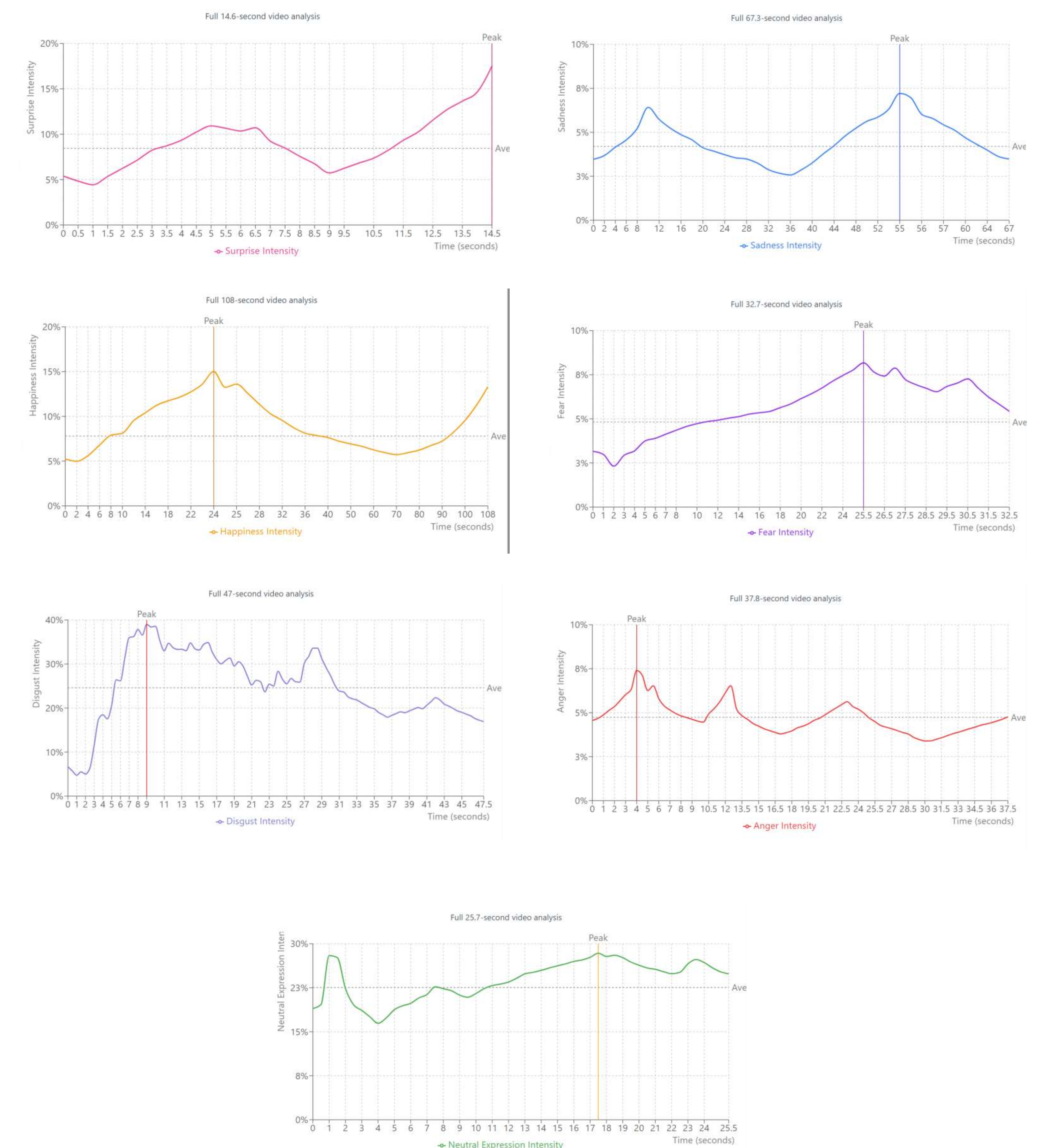
AU1 (Inner Brow Raiser)	**AU2** (Outer Brow Raiser)	**AU4** (Brow Lowerer)	**AU5** (Upper Lid Raiser)	**AU6** (Cheek Raiser)	**AU7** (Lid Tightener)	**AU9** (Nose Wrinkler)	**AU10** (Upper Lip Raiser)	**AU12** (Lip Corner Pull)	**AU14** (Dimpler)
AU15 (Lip Corner Depressor)	**AU16** (Lower Lip Depressor)	**AU17** (Chin Raiser)	**AU20** (Lip Stretcher)	**AU23** (Lip Tightener)	**AU24** (Lip Pressor)	**AU25** (Lips Part)	**AU26** (Jaw Drop)		

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