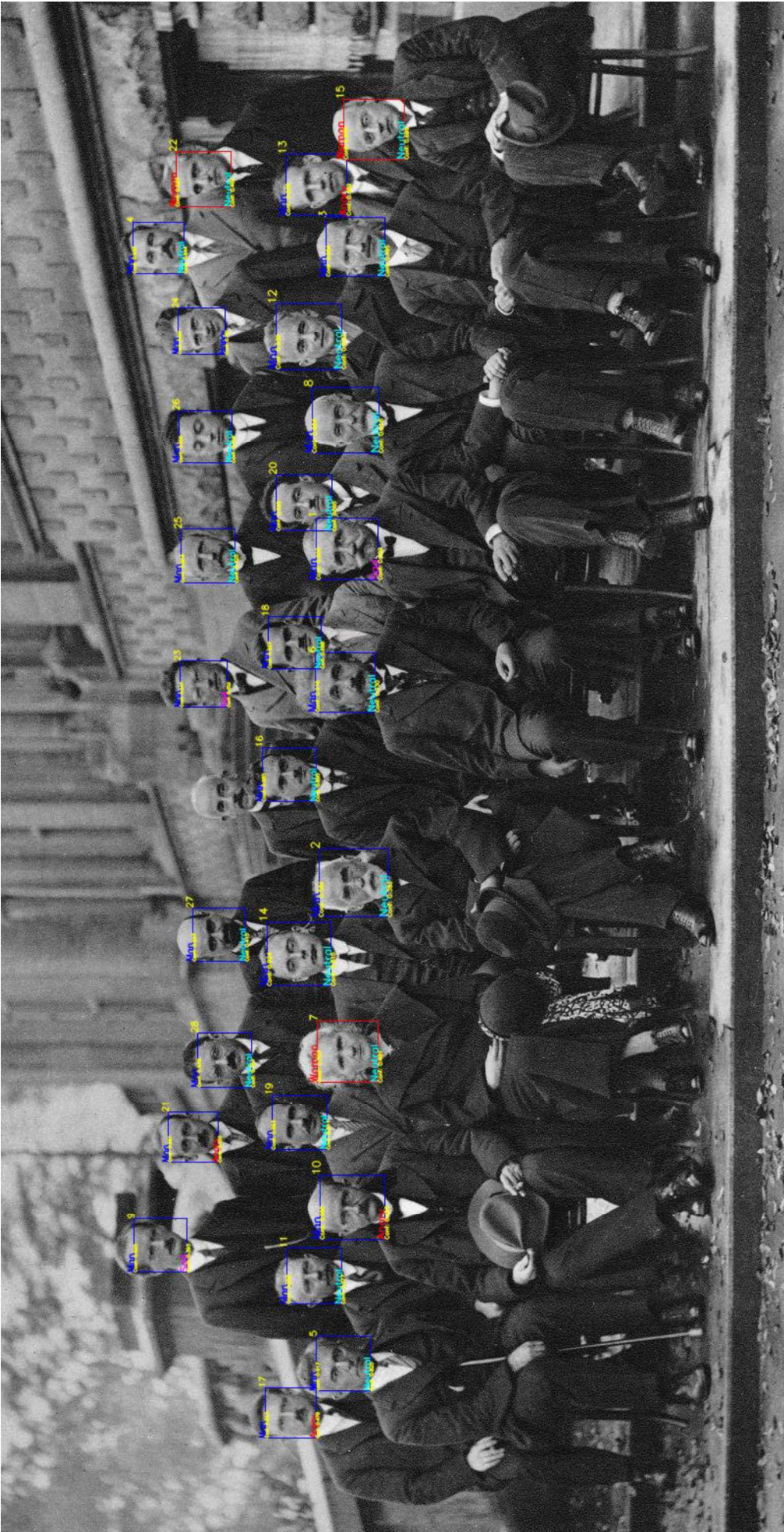


APPENDIX I: Solvay Test Image and Results

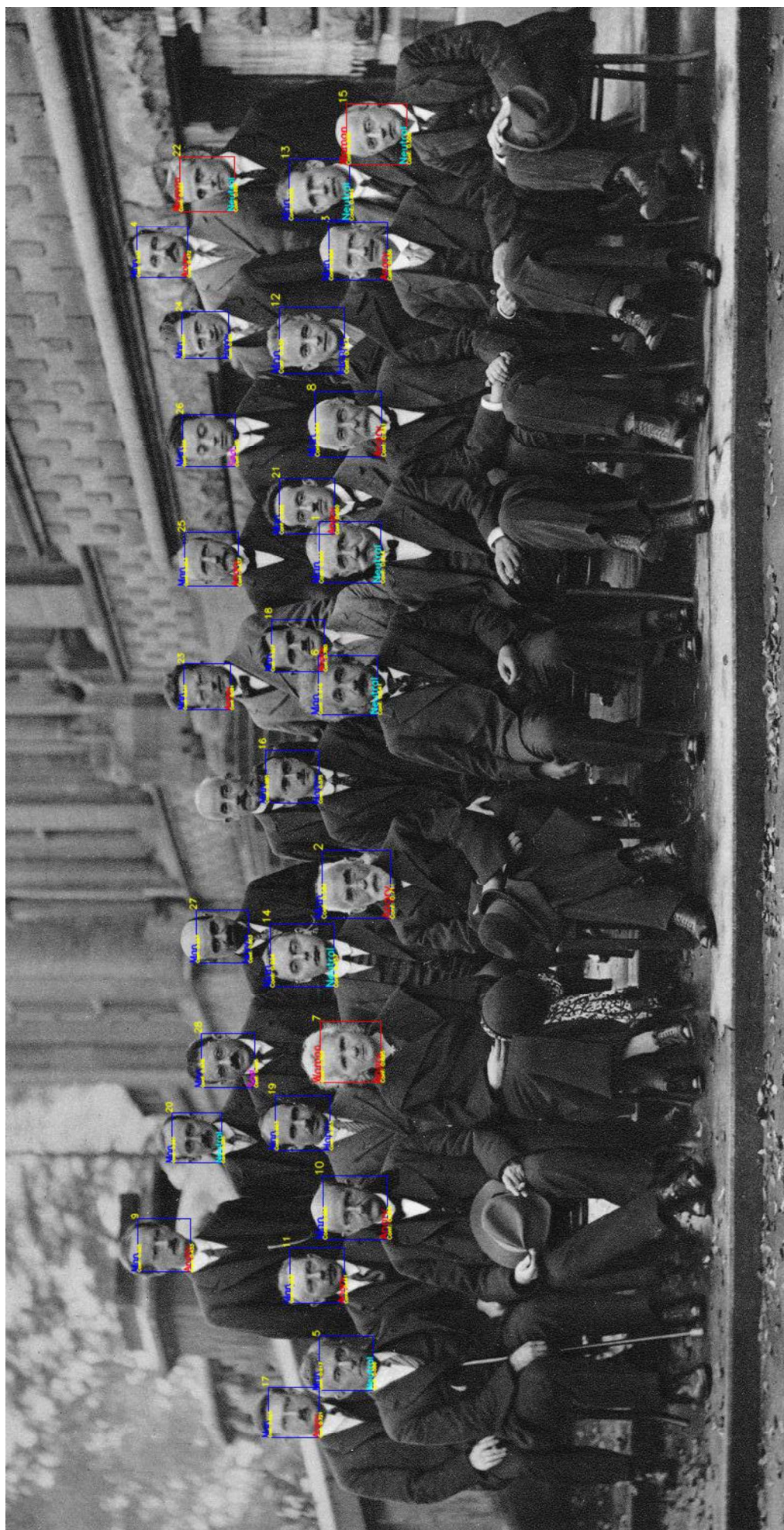
Each expression model was tested on this famous picture from the 1927 Solvay International Conference on Electrons and Photons.



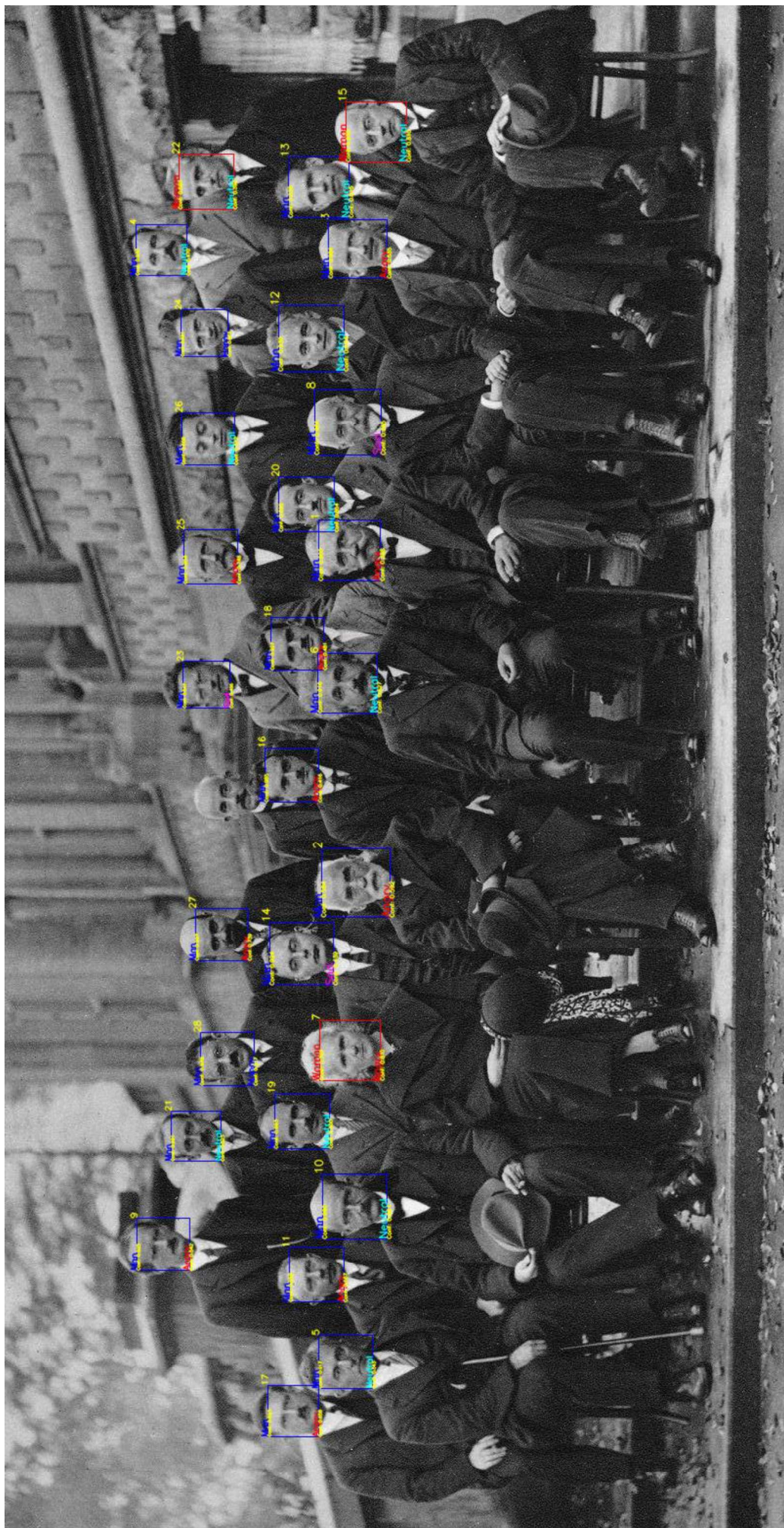
The gender model correctly identified the lone woman in attendance, Marie Curie (third from left, first row). However, it incorrectly classified two men on the far right as women. The Haar cascade failed to recognize the man 5th from the left in the back row. On the following pages are larger versions of the above picture with gender and emotion predictions written on the image. Model 2, the “Angry Model” seems to believe a majority of these physicists are angry, while Model 3 shows a wider variation than Model 1. Of course, most faces in this image would be, by a human observer, likely classified as “Neutral”. To this end, it appears Model 1 performs the best.



Solvay Conference Test, Model 1



Solvay Conference Test, Model 2



Solvay Conference Test, Model 3

APPENDIX I (CONTINUED)

Below are stats for each face in the Solvay image for each model. Refer to the number in the upper righthand corner of each face in the image to determine the person to whom each stat refers. Numbers are consistent across images.

Model 1:

Predicted number of people
feeling each emotion:

Angry: 4
Disgusted: 0
Fearful: 0
Happy: 1
Neutral: 20
Sad: 3
Surprised: 0

Predicted number of men
and women:

Women: 3
Men: 25

Specific predictions for
faces

Person 1:

Predicted emotion: Sad
Confidence: 0.82911897
Predicted gender: Man
Confidence: 0.89965886

Person 2:

Predicted emotion: Neutral
Confidence: 0.38324463
Predicted gender: Man
Confidence: 0.583637

Person 3:

Predicted emotion: Neutral
Confidence: 0.49475875
Predicted gender: Man
Confidence: 0.98371613

Person 4:

Predicted emotion: Neutral
Confidence: 0.64418554
Predicted gender: Man
Confidence: 0.93730545

Person 5:

Predicted emotion: Neutral
Confidence: 0.8252429
Predicted gender: Man
Confidence: 0.9166301

Person 6:

Predicted emotion: Neutral
Confidence: 0.7299552
Predicted gender: Man
Confidence: 0.9157927

Person 7:

Predicted emotion: Neutral
Confidence: 0.49055684
Predicted gender: Woman
Confidence: 0.7069004

Person 8:

Predicted emotion: Neutral
Confidence: 0.6157285
Predicted gender: Man
Confidence: 0.9635548

Person 9:

Predicted emotion: Sad
Confidence: 0.39347428
Predicted gender: Man
Confidence: 0.9247081

Person 10:

Predicted emotion: Angry
Confidence: 0.45591182
Predicted gender: Man
Confidence: 0.98968554

Person 11:

Predicted emotion: Neutral
Confidence: 0.37726206
Predicted gender: Man
Confidence: 0.858431

Person 12:

Predicted emotion: Neutral
Confidence: 0.97203237
Predicted gender: Man
Confidence: 0.9391995

Person 13:

Predicted emotion: Angry
Confidence: 0.38168204
Predicted gender: Man
Confidence: 0.6382759

Person 14:

Predicted emotion: Neutral
Confidence: 0.81468445
Predicted gender: Man
Confidence: 0.9243938

Person 15:

Predicted emotion: Neutral
Confidence: 0.6989118
Predicted gender: Woman
Confidence: 0.97021514

Person 16:

Predicted emotion: Neutral
Confidence: 0.8950767
Predicted gender: Man
Confidence: 0.9850332

Person 17:

Predicted emotion: Angry
Confidence: 0.47764555
Predicted gender: Man
Confidence: 0.8227861

Person 18:

Predicted emotion: Neutral
Confidence: 0.688051
Predicted gender: Man
Confidence: 0.9274997

Person 19:

Predicted emotion: Neutral
Confidence: 0.81104493
Predicted gender: Man
Confidence: 0.99322414

Person 20:

Predicted emotion: Neutral
Confidence: 0.56490093
Predicted gender: Man
Confidence: 0.8976347

Person 21:

Predicted emotion: Angry
Confidence: 0.30943057
Predicted gender: Man
Confidence: 0.9910091

Person 22:

Predicted emotion: Neutral
Confidence: 0.46732026
Predicted gender: Woman
Confidence: 0.52345

Person 23:

Predicted emotion: Sad
Confidence: 0.35242328
Predicted gender: Man
Confidence: 0.54669917

Person 24:

Predicted emotion: Happy
Confidence: 0.7816232
Predicted gender: Man
Confidence: 0.89115417

Person 25:

Predicted emotion: Neutral
Confidence: 0.42531762
Predicted gender: Man
Confidence: 0.9539334

Person 26:

Predicted emotion: Neutral
Confidence: 0.6040195
Predicted gender: Man
Confidence: 0.6660698

Person 27:

Predicted emotion: Neutral
Confidence: 0.41532916
Predicted gender: Man
Confidence: 0.99652475

Person 28:

Predicted emotion: Neutral
Confidence: 0.7511657
Predicted gender: Man
Confidence: 0.9777784

Model 2

Predicted number of people
feeling each emotion:

Angry: 11
Fearful: 0
Happy: 2
Neutral: 12
Sad: 3
Surprised: 0

Predicted number of men and
women:

Women: 3
Men: 25

Specific predictions for faces

Person 1:

Predicted emotion: Angry
Confidence: 0.38781524
Predicted gender: Man
Confidence: 0.89965886

Person 2:

Predicted emotion: Angry
Confidence: 0.59197474
Predicted gender: Man
Confidence: 0.583637

Person 3:

Predicted emotion: Angry
Confidence: 0.53505373
Predicted gender: Man
Confidence: 0.98371613

Person 4:

Predicted emotion: Neutral
Confidence: 0.47026512
Predicted gender: Man
Confidence: 0.93730545

Person 5:

Predicted emotion: Neutral
Confidence: 0.5431332
Predicted gender: Man
Confidence: 0.9166301

Person 6:

Predicted emotion: Neutral
Confidence: 0.62726665
Predicted gender: Man
Confidence: 0.9157927

Person 7:

Predicted emotion: Angry
Confidence: 0.809524
Predicted gender: Woman
Confidence: 0.7069004

Person 8:

Predicted emotion: Sad
Confidence: 0.36460364
Predicted gender: Man
Confidence: 0.9635548

Person 9:

Predicted emotion: Angry
Confidence: 0.54171216
Predicted gender: Man
Confidence: 0.9247081

Person 10:

Predicted emotion: Neutral
Confidence: 0.66110986
Predicted gender: Man
Confidence: 0.98968554

Person 11:

Predicted emotion: Angry
Confidence: 0.5665451
Predicted gender: Man
Confidence: 0.858431

Person 12:

Predicted emotion: Neutral
Confidence: 0.57359236
Predicted gender: Man
Confidence: 0.9391995

Person 13:

Predicted emotion: Neutral
Confidence: 0.81499916
Predicted gender: Man
Confidence: 0.6382759

Person 14:

Predicted emotion: Sad
Confidence: 0.43899855
Predicted gender: Man
Confidence: 0.9243938

Person 15:

Predicted emotion: Neutral
Confidence: 0.8102385
Predicted gender: Woman
Confidence: 0.97021514

Person 16:

Predicted emotion: Angry
Confidence: 0.41582084
Predicted gender: Man
Confidence: 0.9850332

Person 17:

Predicted emotion: Angry
Confidence: 0.6579678
Predicted gender: Man
Confidence: 0.8227861

Person 18:

Predicted emotion: Angry
Confidence: 0.4810425
Predicted gender: Man
Confidence: 0.9274997

Person 19:

Predicted emotion: Neutral
Confidence: 0.39979565
Predicted gender: Man
Confidence: 0.99322414

Person 20:

Predicted emotion: Neutral
Confidence: 0.8537583
Predicted gender: Man
Confidence: 0.8976347

Person 21:

Predicted emotion: Neutral
Confidence: 0.5233646
Predicted gender: Man
Confidence: 0.9910091

Person 22:

Predicted emotion: Neutral
Confidence: 0.39326963
Predicted gender: Woman
Confidence: 0.52345

Person 23:

Predicted emotion: Sad
Confidence: 0.4656638
Predicted gender: Man
Confidence: 0.54669917

Person 24:

Predicted emotion: Happy
Confidence: 0.8730227
Predicted gender: Man
Confidence: 0.89115417

Person 25:

Predicted emotion: Angry
Confidence: 0.7477751
Predicted gender: Man
Confidence: 0.9539334

Person 26:

Predicted emotion: Neutral
Confidence: 0.57193285
Predicted gender: Man
Confidence: 0.6660698

Person 27:

Predicted emotion: Angry
Confidence: 0.73949254
Predicted gender: Man
Confidence: 0.99652475

Person 28:

Predicted emotion: Happy
Confidence: 0.81667113
Predicted gender: Man
Confidence: 0.9777784

Model 3

Predicted number of people
feeling each emotion:

Angry: 13

Fearful: 0

Happy: 5

Neutral: 8

Sad: 2

Surprised: 0

Predicted number of men and
women:

Women: 3

Men: 25

Specific predictions for faces
(see image for who's who):

Person 1:

Predicted emotion: Neutral

Confidence: 0.51354426

Predicted gender: Man

Confidence: 0.89965886

Person 2:

Predicted emotion: Angry

Confidence: 0.7105728

Predicted gender: Man

Confidence: 0.583637

Person 3:

Predicted emotion: Angry

Confidence: 0.5356694

Predicted gender: Man

Confidence: 0.98371613

Person 4:

Predicted emotion: Angry

Confidence: 0.47228456

Predicted gender: Man

Confidence: 0.93730545

Person 5:

Predicted emotion: Neutral

Confidence: 0.585604

Predicted gender: Man

Confidence: 0.9166301

Person 6:

Predicted emotion: Neutral

Confidence: 0.54098326

Predicted gender: Man

Confidence: 0.9157927

Person 7:

Predicted emotion: Angry

Confidence: 0.89503795

Predicted gender: Woman

Confidence: 0.7069004

Person 8:

Predicted emotion: Angry

Confidence: 0.33088726

Predicted gender: Man

Confidence: 0.9635548

Person 9:

Predicted emotion: Angry

Confidence: 0.4325108

Predicted gender: Man

Confidence: 0.9247081

Person 10:

Predicted emotion: Angry

Confidence: 0.65919614

Predicted gender: Man

Confidence: 0.98968554

Person 11:

Predicted emotion: Angry

Confidence: 0.4412918

Predicted gender: Man

Confidence: 0.858431

Person 12:

Predicted emotion: Happy

Confidence: 0.7466409

Predicted gender: Man

Confidence: 0.9391995

Person 13:

Predicted emotion: Neutral

Confidence: 0.44051

Predicted gender: Man

Confidence: 0.6382759

Person 14:

Predicted emotion: Neutral

Confidence: 0.45741487

Predicted gender: Man

Confidence: 0.9243938

Person 15:

Predicted emotion: Neutral

Confidence: 0.50813097

Predicted gender: Woman

Confidence: 0.97021514

Person 16:

Predicted emotion: Happy

Confidence: 0.57549417

Predicted gender: Man

Confidence: 0.9850332

Person 17:

Predicted emotion: Angry

Confidence: 0.7212262

Predicted gender: Man

Confidence: 0.8227861

Person 18:

Predicted emotion: Angry

Confidence: 0.7804631

Predicted gender: Man

Confidence: 0.9274997

Person 19:

Predicted emotion: Happy

Confidence: 0.9530914

Predicted gender: Man

Confidence: 0.99322414

Person 20:

Predicted emotion: Neutral

Confidence: 0.38575017

Predicted gender: Man

Confidence: 0.9910091

Person 21:

Predicted emotion: Angry

Confidence: 0.6504943

Predicted gender: Man

Confidence: 0.8976347

Person 22:

Predicted emotion: Neutral

Confidence: 0.68698674

Predicted gender: Woman

Confidence: 0.52345

Person 23:

Predicted emotion: Angry

Confidence: 0.5809791

Predicted gender: Man

Confidence: 0.54669917

Person 24:

Predicted emotion: Happy

Confidence: 0.90888524

Predicted gender: Man

Confidence: 0.89115417

Person 25:

Predicted emotion: Angry

Confidence: 0.43731076

Predicted gender: Man

Confidence: 0.9539334

Person 26:

Predicted emotion: Sad

Confidence: 0.43455607

Predicted gender: Man

Confidence: 0.6660698

Person 27:

Predicted emotion: Happy

Confidence: 0.8627667

Predicted gender: Man

Confidence: 0.99652475

Person 28:

Predicted emotion: Sad

Confidence: 0.29490697

Predicted gender: Man

Confidence: 0.9777784

APPENDIX II: Compiled Classwise Confusion Matrices

All of the following information is present in percentage confusion matrices for each of the three expression recognition models. It is compiled here so that it is easier to view the difference in percentage classifications across the three expression models without having to refer to all three confusion matrices at once. Each of these matrices demonstrates the percentage of images in their respective label that is classified as belonging to each of the 7 classifications.

Classification of Angry Images

(% of Images Labeled)

Predicted Classification		Model 1	Model 2	Model 3
	Angry	64.75	64.85	67.2
	Disgust	0.46	0	0
	Fear	4.03	6.93	8.44
	Happy	4.49	2.52	3.1
	Neutral	12.42	7.78	9.21
	Sad	13.08	16.68	21.87
	Surprise	0.77	1.25	3.17

Classification of Disgust Images

(% of Images Labeled)

Predicted Classification		Model 1	Model 2	Model 3
	Angry	28.92	36.33	38.62
	Disgust	44.8	0	0
	Fear	3.7	17.64	23.28
	Happy	4.41	5.82	7.58
	Neutral	4.59	5.82	5.47
	Sad	12.35	31.75	21.87
	Surprise	1.23	2.65	3.17

Classification of Fear Images

(% of Images Labeled)

Predicted Classification		Model 1	Model 2	Model 3
	Angry	8.12	10.96	11.75
	Disgust	0.24	0	0
	Fear	49.15	43.47	48.01
	Happy	4.01	2.57	3.05
	Neutral	9.75	6.11	8.37
	Sad	21.63	28.67	19.47
	Surprise	7.11	8.21	9.35

Classification of Happy Images

(% of Images Labeled)

Predicted Classification		Model 1	Model 2	Model 3
	Angry	0.99	1.17	3.55
	Disgust	0.05	0	0
	Fear	0.7	1.22	3.58
	Happy	92.24	91.48	80.95
	Neutral	3.85	2.22	4.65
	Sad	1.71	2.95	5.13
	Surprise	0.46	0.97	2.15

Classification of Neutral Images

(% of Images Labeled)

Predicted Classification		Model 1	Model 2	Model 3
	Angry	2.42	5.07	7.22
	Disgust	0.07	0	0
	Fear	1.61	2.62	5.39
	Happy	3.23	3.08	4.4
	Neutral	81.83	68.11	66.41
	Sad	10.28	20.54	15.52
	Surprise	0.57	0.57	1.07

Classification of Sad Images

(% of Images Labeled)

Predicted Classification		Model 1	Model 2	Model 3
	Angry	4.29	7.29	10.77
	Disgust	0.08	0	0
	Fear	4.6	5.69	11.34
	Happy	3.24	2.77	4.15
	Neutral	15.73	11.09	15.42
	Sad	71.67	72.68	57.45
	Surprise	0.39	0.49	0.87

Classification of Surprise Images

(% of Images Labeled)

Predicted Classification

	Model 1	Model 2	Model 3
Angry	1.47	1.49	1.57
Disgust	0.02	0	0
Fear	5.26	6.6	7.72
Happy	5.01	3.41	2.52
Neutral	3.29	1.89	1.17
Sad	1.07	1.27	0.47
Surprise	83.89	85.33	86.55