#### **Importance of Visual Scene in Emotion Perception**







### **Presentation Outline**

(1) What is Emotion Recognition?

#### (2) EMOTIons in Context (EMOTIC) Dataset

(3) Modeling and Analysis

(4) Conclusions

### **Next Section**

(1) What is Emotion Recognition?

#### (2) EMOTIons in Context (EMOTIC) Dataset

(3) Modeling and Analysis

(4) Conclusions

# What is Emotion Recognition<sup>[1]</sup>





[1] Kosti, Ronak, Jose M. Alvarez, Adria Recasens, and Agata Lapedriza. "Emotic: Emotions in context dataset." In 2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), pp.2309-2317. IEEE, 2017

# What is Emotion Recognition<sup>[1]</sup>





#### "Relaxing"

[1] Kosti, Ronak, Jose M. Alvarez, Adria Recasens, and Agata Lapedriza. "Emotic: Emotions in context dataset." In 2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), pp.2309-2317. IEEE, 2017

# What is Emotion Recognition<sup>[1]</sup>





#### "Relaxing"

"Working"

[1] Kosti, Ronak, Jose M. Alvarez, Adria Recasens, and Agata Lapedriza. "Emotic: Emotions in context dataset." In 2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), pp.2309-2317. IEEE, 2017









Perceived Emotion changes: *Face* → *Visible Body* → *Scene Context* 

Body Posture, Scene Context, Surroundings<sup>[1]</sup>



Body Posture, Scene Context, Surroundings<sup>[1]</sup>



"Disgust"

Body Posture, Scene Context, Surroundings<sup>[1]</sup>



"Disgust"



"Anger"

Body Posture, Scene Context, Surroundings<sup>[1]</sup>



"Disgust"



"Anger"



"Sadness"

14

Body Posture, Scene Context, Surroundings<sup>[1]</sup>



"Disgust"



"Anger"





# **Approach for Emotion Recognition**

(1) Find the Visual Features responsible for the emotions



# **Approach for Emotion Recognition**

(1) Find the Visual Features responsible for the emotions







# **Approach for Emotion Recognition**

(1) Find the Visual Features responsible for the emotions







(3) Model using Features & Labels 🏾 🌋 📑



### **Next Section**

#### (1) What is Emotion Recognition?

(2) EMOTIons in Context (EMOTIC) Dataset

(3) Modeling and Analysis

(4) Conclusions

# **EMOTIC - Characteristics**

#### (1) Appearance of Subjects



Anticipation Excitement Engagement



# **EMOTIC - Characteristics**

(1) Appearance of Subjects

(2) Presence of Scene Context



Anticipation Excitement Engagement



# **EMOTIC - Characteristics**

(1) Appearance of Subjects

(2) Presence of Scene Context

(3) Extensive Emotion Labels



#### <u>Combined Emotion Labels</u><sup>[C]</sup>

#### (1) 26 Emotion Categories

6 "Basic" Emotions<sup>[1]</sup>

Anger Aversion Fear Sadness Surprise Happiness

#### Combined Emotion Labels<sup>[C]</sup>

#### (1) 26 Emotion Categories

#### 6 "Basic" Emotions<sup>[1]</sup>

Anger Aversion Fear Sadness Surprise Happiness

#### + 20 more Affective Categories

Peace Affection Esteem Anticipation Engagement Confidence Pleasure Excitement Sympathy Doubt/Confusion Suffering Disconnection Embarrassment Yearning Disapproval Annoyance Sensitivity Disquietment Pain Suffering

#### <u>Combined Emotion Labels</u><sup>[C]</sup>

(1) 3 Continuous Dimensions

#### <u>Combined Emotion Labels</u><sup>[C]</sup>

### Valence: Negative vs. Positive

Negative (unpleasant)



#### <u>Combined Emotion Labels</u><sup>[C]</sup>

### Arousal (awakeness): Calm vs. Ready to act



#### <u>Combined Emotion Labels</u><sup>[C]</sup>

### **Dominance**: *Dominated* vs. *In control*



## EMOTIC - Examples<sup>[C]</sup>



#### Yearning Disquitement Annoyance



### EMOTIC - Examples<sup>[C]</sup>



#### Yearning Disquitement Annoyance





Peace Esteem Happiness



#### **Cooccurence of Categories**

in	100.00	0.05	0.00	12.35	0.26	17.11	0.16	1.00	0.42	0.90	0.58	33.74	17.48	27.19	0.37	0.32	65.42	0.21	14.52	42.61	0.95	3.01	0.48	2.69	22.97	1.69
Affectio	0.28	100.00	46.05	5.65	20.34	5.65	31.36	5.65	21.47	12.99	4.52	15.82	0.56	3.11	3.95	6.50	0.56	6.78	0.00	0.28	9.60	4.24	11.58	3.95	0.85	3.39
1.r.Ange	0.00	24.18	100.00	9.20	16.32	5.64	37.54	13.35	24.48	18.69	4.45	19.14	0.30	3.26	12.61	5.64	0.89	5.93	0.59	0.30	10.24	5.64	12.17	4.30	0.89	4.45
novation	2.85	0.24	0.75	100.00	0.34	23.04	0.77	1.84	1.49	3.96	0.45	62.34	5.40	25.16	1.11	0.82	19.29	0.30	3.81	6.82	0.29	0.79	0.26	1.50	2.88	1.80
3. Ariicipation	1.57	22.64	34.59	8.81	100.00	4.09	35.22	15.41	22.01	17.30	5.66	13.21	1.26	3.46	7.55	7.55	0.63	4.40	1.26	6.29	13.84	6.29	14.15	5.66	4.40	3.77
4. Anni Aversice	4.93	0.30	0.58	28.80	0.20	100.00	0.53	1.52	0.91	0.70	0.26	57.58	9.36	43.13	0.87	0.41	28.97	0.18	8.40	14.39	0.06	0.35	0.08	1.28	3.19	0.85
5. fiderial	0.48	17.70	40.35	10.05	17.86	5.58	100.00	12.60	21.05	30.46	6.06	23.29	0.32	2.23	15.31	4.94	1.59	11.80	1.28	1.28	14.04	5.58	17.86	13.56	2.23	9.73
6 conprovion	0.85	0.90	4.04	6.77	2.20	4.48	3.54	100.00	6.77	7.35	1.17	17.04	1.75	2.15	9.28	0.81	4.75	0.81	8.43	1.93	2.96	1.30	1.66	0.99	0.76	1.43
7. Discherent	0.95	9.06	19.67	14.54	8.34	7.15	15.73	18.00	100.00	19.55	5.84	21.33	1.19	6.44	16.33	7.27	1.19	4.77	1.19	0.72	18.95	7.39	15.02	4.41	4.17	3.58
a Discouletnicon	1.51	4.09	11.20	28.89	4.89	4.09	16.98	14.58	14.58	100.00	3.91	32.89	1.51	5.69	12.09	7.91	3.20	6.84	3.29	3.02	8.18	4.62	9.51	12.09	2.13	8.00
9. Discontus.	4.45	6.48	12.15	14.98	7.29	6.88	15.38	10.53	19.84	17.81	100.00	11.74	3.24	7.69	9.72	9.72	7.29	8.91	1.62	4.05	14.98	6.88	14.98	7.29	2.83	1.21
oublyrassment	3.36	0.29	0.68	26.96	0.22	19.93	0.77	2.00	0.94	1.95	0.15	100.00	3.61	20.37	1.09	0.31	18.66	0.21	6.13	8.02	0.55	0.45	0.22	1.17	1.72	0.84
10. Embariageniem	21.07	0.13	0.13	28.26	0.25	39.15	0.13	2.48	0.64	1.08	0.51	43.67	100.00	29.66	0.38	0.57	45.77	0.19	9.61	22.28	0.70	1.21	0.25	1.65	20.88	2.04
11. L.Eng Estent	7.10	0.15	0.30	28.51	0.15	39.11	0.19	0.66	0.74	0.88	0.26	53.37	6.43	100.00	0.39	0.65	45.33	0.06	4.66	18.43	0.03	0.36	0.06	2.66	2.94	0.79
rxciterinue	0.80	1.60	9.70	10.39	2.74	6.51	10.96	23.63	15.64	15.53	2.74	23.63	0.68	3.20	100.00	3.08	3.77	11.07	8.90	2.85	8.33	2.74	14.04	6.96	1.48	7.88
14.5.Fallear	1.82	6.99	11.55	20.36	7.29	8.21	9.42	5.47	18.54	27.05	7.29	17.63	2.74	14.29	8.21	100.00	1.22	11.85	3.65	2.13	21.88	9.73	20.36	12.77	2.74	4.86
16.1055	13.59	0.02	0.07	17.38	0.02	20.88	0.11	1.16	0.11	0.39	0.20	38.87	7.88	36.03	0.36	0.04	100.00	80.0	10.75	24.86	0.01	0.67	0.10	2.19	6.47	0.84
Happingin	1.26	7.55	12.58	7.86	4.40	3.77	23.27	5.66	12.58	24.21	6.92	12.58	0.94	1.26	30.50	12.26	2.20	100.00	1.57	2.20	31.45	10.69	53.14	16.67	6.29	15.09
17. 18. 2ce	10.21	0.00	0.15	11.62	0.15	20.50	0.30	6.98	0.37	1.37	0.15	43.26	5.61	12.55	2.90	0.45	36.39	0.19	100.00	20.16	0.82	5.05	0.33	1.49	4.94	4.23
19. Foure	22.12	0.03	0.05	15.35	0.55	25.92	10.00	1.18	01.04	0.93	0.27	41.76	9.59	30.01	0.69	0.19	02.13	0.19	14.88	100.00	100.00	1.07	0.14	3.51	0.09	1.04
on Pleases	2.47	4.07	9.48	3.30	0.04	0.00	5.01	9.07	21.84	9.64	0.08	14.42	1.01	4.22	2 00	5.09	10.12	5.65	3.02	0.00	17.04	14.04	12.46	0.16	9.64	4.03
of Sautivity	9.47	2.49 8.22	16.43	4 21	9.02	1 00	22 44	4.02	25.25	0.04	7.02	8.42	0.80	4.52	24.65	13.32	1 80	33.87	1.80	1.00	50.90	16.23	100.00	10.22	7.82	10.62
Sensing	7.30	2 00	4 15	17.60	2.58	12.02	12.44	3.15	5 29	19.46	2.58	31.76	3.72	27.61	8 73	6.01	28.61	7.58	5.72	18.31	2.00	1 86	7.30	100.00	3 29	7.87
22. Sumprise	32.85	0.23	0.45	17 90	1.06	15.86	1.06	1 28	2.64	1.81	0.53	24.62	24 77	16.09	0.98	0.68	44.56	1.51	10.05	18.43	6.80	3.93	2.95	1 74	100.00	1 74
24.Sunathy	3.26	1.22	3.05	15.06	1.22	5.70	6.21	3.26	3.05	9.16	0.31	16.17	3.26	5.80	7.02	1.63	7.83	4.88	11.60	6.10	3.36	8 75	5.39	5.60	2.34	100.00
5.Syniphing	0.20		0.00	10.00		0.70	<u> </u>	0.20	*	0.10	*		0.20		7.02		1.00		11.00	0.10	0.00		0.00	0.00	2.01	
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#### **Cooccurence of Categories**

NON	100.00	0.05	0.00	12.35	0.26	17.11	0.16	1.00	0.42	0.90	0.58	33.74	17.48	27.19	0.37	0.32	65.42	0.21	14.52	42.61	0.95	3.01	0.48	2.69	22.97	1.69
Affection	0.28	100.00	46.05	5.65	20.34	5.65	31.36	5.65	21.47	12.99	4.52	15.82	0.56	3.11	3.95	6.50	0.56	6.78	0.00	0.28	9.60	4.24	11.58	3.95	0.85	3.39
1.r.Ange	0.00	24.18	100.00	9.20	16.32	5.64	37.54	13.35	24.48	18.69	4.45	19.14	0.30	3.26	12.61	5.64	0.89	5.93	0.59	0.30	10.24	5.64	12.17	4.30	0.89	4.45
novation	2.85	0.24	0.75	100.00	0.34	23.04	0.77	1.84	1.49	3.96	0.45	62.34	5.40	25.16	1.11	0.82	19.29	0.30	3.81	6.82	0.29	0.79	0.26	1.50	2.88	1.80
3. Anicipation	1.57	22.64	34.59	8.81	100.00	4.09	35.22	15.41	22.01	17.30	5.66	13.21	1.26	3.46	7.55	7.55	0.63	4.40	1.26	6.29	13.84	6.29	14.15	5.66	4.40	3.77
4. Anaversice	4.93	0.30	0.58	28.80	0.20	100.00	0.53	1.52	0.91	0.70	0.26	57.58	9.36	43.13	0.87	0.41	28.97	0.18	8.40	14.39	0.06	0.35	0.08	1.28	3.19	0.85
5. fiderval	0.48	17.70	40.35	10.05	17.86	5.58	100.00	12.60	21.05	30.46	6.06	23.29	0.32	2.23	15.31	4.94	1.59	11.80	1.28	1.28	14.04	5.58	17.86	13.56	2.23	9.73
6. co. approv	0.85	0.90	4.04	6.77	2.20	4.48	3.54	100.00	6.77	7.35	1.17	17.04	1.75	2.15	9.28	0.81	4.75	0.81	8.43	1.93	2.96	1.30	1.66	0.99	0.76	1.43
7. Disneetent	0.95	9.06	19.67	14.54	8.34	7.15	15.73	18.00	100.00	19.55	5.84	21.33	1.19	6.44	16.33	7.27	1.19	4.77	1.19	0.72	18.95	7.39	15.02	4.41	4.17	3.58
a Discoulettion	1.51	4.09	11.20	28.89	4.89	4.09	16.98	14.58	14.58	100.00	3.91	32.89	1.51	5.69	12.09	7.91	3.20	6.84	3.29	3.02	8.18	4.62	9.51	12.09	2.13	8.00
9.Discontusent	4.45	6.48	12.15	14.98	7.29	6.88	15.38	10.53	19.84	17.81	100.00	11.74	3.24	7.69	9.72	9.72	7.29	8.91	1.62	4.05	14.98	6.88	14.98	7.29	2.83	1.21
noubverassment	3.36	0.29	0.68	26.96	0.22	19.93	0.77	2.00	0.94	1.95	0.15	100.00	3.61	20.37	1.09	0.31	18.66	0.21	6.13	8.02	0.55	0.45	0.22	1.17	1.72	0.84
10. Embargereem	7.10	0.13	0.13	28.20	0.25	39.15	0.13	2.48	0.64	1.08	0.51	43.07	6.42	29.66	0.38	0.57	45.77	0.19	9.01	19.42	0.70	0.26	0.25	0.66	20.88	2.04
17.12.En3.Estment	0.80	1.60	9.70	10.20	2.74	6.51	10.19	23.63	15.64	15 52	2.20	23.63	0.45	3 20	100.00	3.08	3 77	11.07	4.00 8.00	2.85	9.03	2.74	14.04	2.00	1 / 9	7.99
Excitetique	1.82	6.99	11 55	20.36	7 20	8.01	9.42	5.47	18.54	27.05	7 20	17.63	2.00	14 29	8 21	100.00	1.22	11.07	3.65	2.00	21.88	9.73	20.36	12 77	2 74	4.86
14.15.Farear	13.59	0.02	0.07	17.38	0.02	20.88	0.11	1.16	0.11	0.39	0.20	38.87	7.88	36.03	0.36	0.04	100.00	0.08	10.75	24.86	0.01	0.67	0.10	2.19	6.47	0.84
10. ess	1.26	7.55	12.58	7.86	4.40	3.77	23.27	5.66	12.58	24.21	6.92	12.58	0.94	1.26	30.50	12.26	2.20	100.00	1.57	2.20	31.45	10.69	53.14	16.67	6.29	15.09
THAPPPAIN	10.21	0.00	0.15	11.62	0.15	20.50	0.30	6.98	0.37	1.37	0.15	43.26	5.61	12.55	2.90	0.45	36 39	0.19	100.00	20.16	0.82	5.05	0.33	1.49	4.94	4.23
11. 10	22.	0.03	0.05	15.35	0.55	25.92	0.22	1.10	0.10	0.93	0.27	41.70	9.59	30.01	0.69	0.15	62.13	0.19	14.88	100.00	0.00	1.07	0.14	3.51	6.69	1.64
aleasure	2.47	4.67	9.48	3.30	6.04	0.55	12.09	9.07	21.84	12.64	5.08	14.42	1.51	0.27	10.03	9.89	U.1 +	13.74	3.02	0.00	100.00	14.84	34.89	1.92	12.36	4.53
20.P10 1000	9.47	2.49	6.31	10.80	3.32	3.82	5.81	4.82	10.30	8.64	2.82	14.12	3.16	4.32	3.99	5.32	10. 3	5.65	22.59	6.48	17.94	100.00	13.46	2.16	8.64	14.29
21.Se tivits	1.80	8.22	16.43	4.21	9.02	1.00	22.44	7.41	25.25	21.44	7.41	8.42	0.80	0.80	24.65	13.43	1.8D	33.87	1.80	1.00	50.90	16.23	100.00	10.22	7.82	10.62
22. Selfering	7.30	2.00	4.15	17.60	2.58	12.02	12.16	3.15	5.29	19.46	2.58	31.76	3.72	27.61	8.73	6.01	28. 1	7.58	5.72	18.31	2.00	1.86	7.30	100.00	3.29	7.87
23. SUIPHIN	32.85	0.23	0.45	17.90	1.06	15.86	1.06	1.28	2.64	1.81	0.53	24.62	24.77	16.09	0.98	0.68	44	1.51	10.05	18.43	6.80	3.93	2.95	1.74	100.00	1.74
24. umpaing	3.26	1.22	3.05	15.06	1.22	5.70	6.21	3.26	3.05	9.16	0.31	16.17	3.26	5.80	7.02	1.63	7.82	4.88	11.60	6.10	3.36	8.75	5.39	5.60	2.34	100.00
25. Vearning	5	Å	~0	5	5	~®	à	Ś	ň.	5	Ň	Ň	8	Ň	,©	Ŕ	S	8	çõ	.0	Ś	Pr:	~		1	~
26.	1 1/3	Inge N	and in	allo a	io's	eru c	10 <sup>N</sup> e	c <sup>ilo</sup> x	mer Hi	Silv s	ner .	mer 2	6 <sup>0</sup>	mer a	Man S	40°	nes 2	200	en al	5 <sup>011</sup> .8	Nes st	IN A	SIII I	2/1°S	all a	CIII
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	0	5.r A		ଁ ତ	$\sim$ $^{\circ}$	, Ó	<sup>وي</sup> رو	NS AN	31 M	So X		~0	,×		$\langle \langle \rangle$			0	$\mathcal{V}$	1 2	Ų		i v	р. с	$\mathcal{V}$	
						<i>.</i> .	-5	, <sup>00</sup>	,×	~~					$\sim$											

#### **Cooccurence of Categories**

Marchards Marchards 100	2.69 <b>22.97</b> 1.69	2.69	0.48	3.01	0.95	42.61	14.52	0.21	65.42	0.32	0.37	27.19	17.48	33.74	0.58	0.90	0.42	1.00	0.16	17.11	0.26	12.35	0.00	0.05	100.00	Sion
Marcial conditione in the second sec	3.95 0.85 3.39	3.95	11.58	4.24	9.60	0.28	0.00	6.78	0.56	6.50	3.95	3.11	0.56	15.82	4.52	12.99	21.47	5.65	31.36	5.65	20.34	5.65	46.05	100.00	0.28	Attecher
Normal in the series of the series of the series of the series in the series of the	4.30 0.89 4.45	4.30	12.17	5.64	10.24	0.30	0.59	5.93	0.89	5.64	12.61	3.26	0.30	19.14	4.45	18.69	24.48	13.35	37.54	5.64	16.32	9.20	100.00	24.18	0.00	1.r. Ang.
A. B. Color       1.00 <td>1.50 2.88 1.80</td> <th>1.50</th> <td>0.26</td> <td>0.79</td> <td>0.29</td> <td>6.82</td> <td>3.81</td> <td>0.30</td> <td>19.29</td> <td>0.82</td> <td>1.11</td> <td>25.16</td> <td>5.40</td> <td>62.34</td> <td>0.45</td> <td>3.96</td> <td>1.49</td> <td>1.84</td> <td>0.77</td> <td>23.04</td> <td>0.34</td> <td>100.00</td> <td>0.75</td> <td>0.24</td> <td>2.85</td> <td>novation</td>	1.50 2.88 1.80	1.50	0.26	0.79	0.29	6.82	3.81	0.30	19.29	0.82	1.11	25.16	5.40	62.34	0.45	3.96	1.49	1.84	0.77	23.04	0.34	100.00	0.75	0.24	2.85	novation
All of the properties       9.8       9.	5.66 4.40 3.77	5.66	14.15	6.29	13.84	6.29	1.26	4.40	0.63	7.55	7.55	3.46	1.26	13.21	5.66	17.30	22.01	15.41	35.22	4.09	100.00	8.81	34.59	22.64	1.57	3. Anicipation
Sinder in the set of the set o	1.28 3.19 0.85	1.28	0.08	0.35	0.06	14.39	8.40	0.18	28.97	0.41	0.87	43.13	9.36	57.58	0.26	0.70	0.91	1.52	0.53	100.00	0.20	28.80	0.58	0.30	4.93	4. Anu Aversice
CC-0         CO-0         CO-0     CO-0         CO-	13.56 2.23 9.73	13.56	17.86	5.58	14.04	1.28	1.28	11.80	1.59	4.94	15.31	2.23	0.32	23.29	6.06	30.46	21.05	12.60	100.00	5.58	17.86	10.05	40.35	17.70	0.48	5. fiderial
Description       100       100       110	0.99 0.76 1.43	0.99	1.66	1.30	2.96	1.93	8.43	0.81	4.75	0.81	9.28	2.15	1.75	17.04	1.17	7.35	6.77	100.00	3.54	4.48	2.20	6.77	4.04	0.90	0.85	6. con prot
Here is a state in the state is a state state is a state i	4.41 4.17 3.58	4.41	15.02	7.39	18.95	0.72	1.19	4.77	1.19	7.27	16.33	6.44	1.19	21.33	5.84	19.55	100.00	18.00	15.73	7.15	8.34	14.54	19.67	9.06	0.95	1. Dischecht
6       1	12.09 2.13 8.00	12.09	9.51	4.62	8.18	3.02	3.29	6.84	3.20	7.91	12.09	5.69	1.51	32.89	3.91	100.00	14.58	14.58	16.98	4.09	4.89	28.89	11.20	4.09	1.51	Disculletrion
OUD	7.29 2.83 1.21	7.29	14.98	6.88	14.98	4.05	1.62	8.91	7.29	9.72	9.72	7.69	3.24	11.74	100.00	17.81	19.84	10.53	15.38	6.88	7.29	14.98	12.15	6.48	4.45	9. Discontusint
Der ball gent       2107       0.10       0.10       0.25       0.11       0.26       0.10       0.26 </td <td>1.17 1.72 0.84</td> <th>1.17</th> <td>0.22</td> <td>0.45</td> <td>0.55</td> <td>8.02</td> <td>6.13</td> <td>0.21</td> <td>18.66</td> <td>0.31</td> <td>1.09</td> <td>20.37</td> <td>3.61</td> <td>100.00</td> <td>0.15</td> <td>1.95</td> <td>0.94</td> <td>2.00</td> <td>0.77</td> <td>19.93</td> <td>0.22</td> <td>26.96</td> <td>0.68</td> <td>0.29</td> <td>3.36</td> <td>oubt rassment</td>	1.17 1.72 0.84	1.17	0.22	0.45	0.55	8.02	6.13	0.21	18.66	0.31	1.09	20.37	3.61	100.00	0.15	1.95	0.94	2.00	0.77	19.93	0.22	26.96	0.68	0.29	3.36	oubt rassment
1.1       1.1       0	1.65 <b>20.88</b> 2.04	1.65	0.25	1.21	0.70	22.28	9.61	0.19	45.77	0.57	0.38	29.66	100.00	43.67	0.51	1.08	0.64	2.48	0.13	39.15	0.25	28.26	0.13	0.13	21.07	10. Embanagemen
1       0.80       1.60       9.70       1.03       2.74       6.51       10.9       2.85       10.00       3.07       1.07       8.90       2.85       8.20       2.74       14.04       6.96         1       1.12       1.10       1.10       1.10       2.03       7.29       8.21       9.25       5.47       14.04       5.75       1.26       1.28       1.28       3.65       1.28       1.26       7.29       1.28       1.26       7.29       1.28       1.26       1.28 <td< td=""><td>2.66 2.94 0.79</td><th>2.66</th><td>0.06</td><td>0.36</td><td>0.03</td><td>18.43</td><td>4.66</td><td>0.06</td><td>45.33</td><td>0.65</td><td>0.39</td><td>100.00</td><td>6.43</td><td>53.37</td><td>0.26</td><td>0.88</td><td>0.74</td><td>0.66</td><td>0.19</td><td>39.11</td><td>0.15</td><td>28.51</td><td>0.30</td><td>0.15</td><td>7.10</td><td>11. E. Eng Esternt</td></td<>	2.66 2.94 0.79	2.66	0.06	0.36	0.03	18.43	4.66	0.06	45.33	0.65	0.39	100.00	6.43	53.37	0.26	0.88	0.74	0.66	0.19	39.11	0.15	28.51	0.30	0.15	7.10	11. E. Eng Esternt
1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.	6.96 1.48 7.88	6.96	14.04	2.74	8.33	2.85	8.90	11.07	3.77	3.08	100.00	3.20	0.68	23.63	2.74	15.53	15.64	23.63	10.96	6.51	2.74	10.39	9.70	1.60	0.80	The TS citemue
15       13.59       0.02       0.07       17.39       0.02       20.88       0.11       1.16       0.11       0.99       0.20       88.87       7.88       36.03       0.04       10.00       0.88       10.75       24.86       0.01       0.67       0.10       2.19         10.10       11.26       7.55       12.58       7.86       10.25       2.20       10.00       1.57       2.20       10.69       10.57       2.20       10.40       1.57       2.20       10.45       10.69       53.14       16.67         19       10.21       0.00       0.15       11.62       0.50       12.58       2.12       0.30       0.55       25.52       0.22       1.18       0.16       0.30       0.27       41.76       9.59       36.61       0.69       0.19       52.13       0.19       14.88       10.00       0.00       1.48       34.89       1.25       2.90       0.61       0.59       0.11       1.67       0.10       1.67       1.67       0.10       1.67       0.10       0.10       1.67       0.10       0.10       1.67       0.10       1.67       0.10       0.10       1.67       0.10       0.10       1.67       0.10	12.77 2.74 4.86	12.77	20.36	9.73	21.88	2.13	3.65	11.85	1.22	100.00	8.21	14.29	2.74	17.63	7.29	27.05	18.54	5.47	9.42	8.21	7.29	20.36	11.55	6.99	1.82	14. EA Fallisar
Applied beta beta beta beta beta beta beta beta	2.19 6.47 0.84	2.19	0.10	0.67	0.01	24.86	10.75	0.08	100.00	0.04	0.36	36.03	7.88	38.87	0.20	0.39	0.11	1.16	0.11	20.88	0.02	17.38	0.07	0.02	13.59	1316.Fess
$ \begin{array}{c} 1.11 \\$	16.67 6.29 15.09	16.67	53.14	10.69	31.45	2.20	1.57	100.00	2.20	12.26	30.50	1.26	0.94	12.58	6.92	24.21	12.58	5.66	23.27	3.77	4.40	7.86	12.58	7.55	1.26	Lappine
$\begin{array}{c} P_{1}P_{2}P_{2}P_{3}P_{4}P_{4}P_{4}P_{4}P_{4}P_{4}P_{4}P_{4$	1.49 4.94 4.23	1.49	0.33	5.05	0.82	20.16	100.00	0.19	36.39	0.45	2.90	12.55	5.61	43.26	0.15	1.37	0.37	6.98	0.30	20.50	0.15	11.62	0.15	0.00	10.21	17. 18. race
$\frac{1}{26} + \frac{1}{26} $	3.51 6.69 1.64	3.51	0.14	1.07	0.00	100.00	14.88	0.19	62.13	0.19	0.69	36.61	9.59	41.76	0.27	0.93	0.16	1.18	0.22	25.92	0.55	15.35	0.05	0.03	22.12	19. Peure
20.52011.5 = 9.47 = 2.49 = 6.31 = 10.80 = 3.32 = 3.82 = 5.81 = 4.82 = 10.30 = 8.64 = 2.82 = 14.12 = 3.16 = 4.32 = 3.99 = 5.32 = 10.13 = 5.65 = 22.59 = 6.48 = 17.94 = 100.00 = 13.46 = 2.16 = 21.55 = 10.11 = 10.20 = 10.10	1.92 12.36 4.53	1.92	34.89	14.84	100.00	0.00	3.02	13.74	0.14	9.89	10.03	0.27	1.51	14.42	5.08	12.64	21.84	9.07	12.09	0.55	6.04	3.30	9.48	4.67	2.47	Pleasess
$\frac{21}{23} + \frac{1}{20} + \frac{1}{20}$	2.16 8.64 14.29	2.16	13.46	100.00	17.94	6.48	22.59	5.65	10.13	5.32	3.99	4.32	3.16	14.12	2.82	8.64	10.30	4.82	5.81	3.82	3.32	10.80	6.31	2.49	9.47	20. Sadin
$ \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c}$	10.22 7.82 10.62	10.22	100.00	6.23	50.90	1.00	1.80	33.07	1.00	10.40	24.00	0.00	0.00	0.42	7.41	21.44	20.20	7.41	22.77	1.00	0.02	4.21	10.10	0.22		21. peristing
$\begin{array}{c} 2^{23} \\ 5^{3} \\ 5^{3} \\ 5^{4} \\ 5^{4} \\ 5^{4} \\ 7^{6} $	100.00 3.29 7.87	100.00	7.30	1.86	2.00	18.31	5.72	7.58	28.61	6.01	8.73	27.61	3.72	31.76	2.58	19.46	5.29	3.15	12.16	12.02	2.58	17.60	4.15	2.00	7.30	LE. Sufferise
$\frac{2^{5} \text{Vert}^{10}}{2^{6} \text{Vert}^{10}} = \frac{326}{2} \frac{122}{3.05} \frac{15.06}{1.22} \frac{12.2}{5.70} \frac{12.2}{6.21} \frac{5.70}{3.26} \frac{6.21}{3.26} \frac{3.05}{3.05} \frac{9.16}{9.16} \frac{0.31}{16.17} \frac{16.17}{3.26} \frac{3.26}{5.80} \frac{5.00}{7.02} \frac{7.02}{1.63} \frac{1.63}{7.83} \frac{7.83}{4.88} \frac{4.88}{11.60} \frac{11.60}{6.10} \frac{6.10}{3.7} \frac{3.75}{8.75} \frac{5.39}{5.60} \frac{5.60}{5.60} \frac{25}{5.80} \frac{7.02}{7.02} \frac{1.63}{7.83} \frac{7.83}{4.88} \frac{4.88}{11.60} \frac{11.60}{6.10} \frac{6.10}{3.7} \frac{3.75}{8.75} \frac{5.39}{5.60} \frac{5.60}{5.60} \frac{25}{5.80} \frac{7.02}{7.02} \frac{1.63}{7.83} \frac{7.83}{4.88} \frac{4.88}{11.60} \frac{11.60}{6.10} \frac{6.10}{3.7} \frac{3.75}{8.75} \frac{5.39}{5.60} \frac{5.60}{5.60} \frac{25}{5.80} \frac{7.02}{7.61} \frac{1.63}{7.83} \frac{7.83}{4.88} \frac{4.88}{11.60} \frac{11.60}{6.10} \frac{6.10}{3.7} \frac{3.75}{8.75} \frac{5.39}{5.60} \frac{5.60}{5.60} \frac{25}{5.80} \frac{1.60}{7.61} \frac{1.61}{5.60} \frac{1.62}{5.80} 1.$	1.74 <mark>100.00</mark> 1.74	1.74	2.95	3.93	6.80	18.43	10.05	1.51	44.56	0.68	0.98	16.09	24.77	24.62	0.53	1.81	2.64	1.28	1.06	15.86	1.06	17.90	0.45	0.23	32.85	2.5. Surpthy
26. Yeal Atection Anger ance ation are interce on a contract of the second and the second at the sec	5.60 2.34 100.00	5.60	5.39	8.75	3.	6.10	11.60	4.88	7.83	1.63	7.02	5.80	3.26	16.17	0.31	9.16	3.05	3.26	6.21	5.70	1.22	15.06	3.05	1.22	3.26	Sympaing
1. 3. M. * W. 2. C. J. D. D. C. D. M. Way Study V. * E. V. J. K. S. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5.	ise and the aning	Prise S.S.M	2 <sup>A.Sur</sup>	inity 23.Suff	ness 2.sensi	85118 536 21. 2	20.Fler	Pain 9.	Iness .	Feat Hap	ingue ,6	TS.F2	E E E E E E E E E E E E E E E E E E E	1.3.H	ment	Datrass	ment bloom	ction diet	sconne	pisapi	Contra	S.AVE	Anticip	Anno	stion 2.h	25. Yean. 26. Yean.

### **EMOTIC – Analysis**<sup>[J]</sup> – Co-occurence



### **EMOTIC – Analysis<sup>[J]</sup> –** Cross Relationship



### **EMOTIC – Analysis<sup>[J]</sup> –** Cross Relationship


### **EMOTIC – Analysis<sup>[J]</sup> –** Cross Relationship



### **Next Section**

### (1) What is Emotion Recognition?

### (2) EMOTIons in Context (EMOTIC) Dataset

(3) Modeling and Analysis

(4) Conclusions

#### Person Features<sup>[C]</sup>



[1] Krizhevsky, Alex, Ilya Sutskever, and Geoffrey E. Hinton. "Imagenet classification with deep convolutional neural networks." In Advances in neural information processing systems, pp. 1097-1105. 2012.

#### Visual Scene Features<sup>[C]</sup>



[1] Zhou, B., Lapedriza, A., Khosla, A., Oliva, A., and Torralba, A. (2017a). Places: A 10 million image database for scene recognition. IEEE transactions on pattern analysis and machine intelligence















### <u>Combined Criterions</u><sup>[C, J]</sup>



### <u>Combined Criterions</u><sup>[C, J]</sup>

$$L_{comb1} = \lambda_{disc} L_{disc} + \lambda_{cont} L_{2cont}$$

$$L_{comb2} = \lambda_{disc} L_{disc} + \lambda_{cont} SL_{1cont}$$
  
Emotion Category Continuous Dimensions  
(Generic)

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### <u>Combined Criterions</u><sup>[C, J]</sup>

$$L_{comb1} = \lambda_{disc} L_{disc} + \lambda_{cont} L_{2cont}$$

$$L_{comb2} = \lambda_{disc} L_{disc} + \lambda_{cont} S L_{1cont}$$

$$\lambda_{disc} = \lambda_{cont} = 0.5$$

#### **B** Model



#### **B** Model



Trained with L<sub>comb1</sub> & L<sub>comb2</sub>

#### B+I Model (Fusion CNN Model)



#### B+I Model (Fusion CNN Model)



Trained with L<sub>comb1</sub> & L<sub>comb2</sub>

	B Model	<b>Fusion Model</b>
L <sub>comb1</sub>	23.86	24.88
L <sub>comb2</sub>	22.36	27.38

	B Model	Fusion Model	
L <sub>comb1</sub>	23.86	24.88	<b>◄</b> ──── 4.3% highe
L <sub>comb2</sub>	22.36	27.38	

	B Model	<b>Fusion Model</b>	
L <sub>comb1</sub>	23.86	24.88	<b>◄</b> ──── 4.3% higher
L <sub>comb2</sub>	22.36	27.38	<b>←</b> 22.5% higher

	B Model	<b>Fusion Model</b>	
L <sub>comb1</sub>	23.86	24.88	<b>◄</b> ──── 4.3% higher
L <sub>comb2</sub>	22.36	27.38	<b>←</b> 22.5% higher

	B Model	<b>Fusion Model</b>
L <sub>comb1</sub>	0.0569	0.0589
L <sub>comb2</sub>	0.0581	0.0573

	B Model	Fusion Model	
L <sub>comb1</sub>	0.0569	0.0589	◄─── 3.5% lower
L <sub>comb2</sub>	0.0581	0.0573	

	B Model	Fusion Model	
L <sub>comb1</sub>	0.0569	0.0589	
L <sub>comb2</sub>	0.0581	0.0573	◀─── 1.4% higher

	B Model	Fusion Model	
L <sub>comb1</sub>	0.0569	0.0589	
L <sub>comb2</sub>	0.0581	0.0573	<b>◄</b> ──── 1.4% higher

# Quantitative Analysis – Emotion Categories

### Jaccard Coefficient (JC)<sup>[C,J]</sup>

**P** = Predicted Categories**G** = Ground Truth Categories

# Quantitative Analysis – Emotion Categories

### Jaccard Coefficient (JC)<sup>[C,J]</sup>

**P** = Predicted Categories**G** = Ground Truth Categories

 $JC = \frac{\text{Intersection (P, G)}}{\text{Union (P, G)}}$ 

# Quantitative Analysis – Emotion Categories

### Jaccard Coefficient (JC)<sup>[C,J]</sup>

**P** = Predicted Categories**G** = Ground Truth Categories



#### High JC values



Anticipation	V: 0,57
Confidence	A: 0,83
Engagement	D: 0,67
Excitement	

#### Ground Truth

### **High JC values**



Anticipation	V: 0,57
Confidence	A: 0,83
Engagement	D: 0,67
Excitement	

#### **B** Model

Anticipation	<b>V: 0,6</b> 1
Confidence	A: 0,6
Engagement	D: 0,67
Excitement	
Happiness	
Surprise	
Sympathy	
<b>IC</b> · 0 57	

Ground Truth

### **High JC values**



Anticipation	V: 0,57
Confidence	A: 0,83
Engagement	D: 0,67
Excitement	

#### **B** Model

Anticipation	V: 0,61
Confidence	A: 0,61
Engagement	D: 0,67
Excitement	
Happiness	
Surprise	
Sympathy	
<b>C</b> : 0,57	

#### **Fusion Model**

Anticipation	V: 0,62
Confidence	A: 0,70
Engagement	D: 0,66
Excitement	

**JC**: 1.00

Ground Truth

### High JC values



AnticipationV: 0,57ConfidenceA: 0,83EngagementD: 0,67Excitement

#### Ground Truth

#### **B** Model

Anticipation	V: 0,61	
Confidence	A: 0,61	
Engagement	D: 0,67	
Excitement		
Happiness		
Surprise		
Sympathy		
<b>C</b> : 0,57		

AE = 0.087

#### **Fusion Model**

Anticipation	V: 0,62
Confidence	A: 0,70
Engagement	D: 0,66
Excitement	

**JC**: 1.00

**AE = 0.045** 

### High JC values



AnticipationV: 0,57ConfidenceA: 0,83EngagementD: 0,67Excitement

#### Ground Truth

#### **B** Model

Anticipation	V: 0,61
Confidence	A: 0,61
Engagement	D: 0,67
Excitement	
Happiness	
Surprise	
Sympathy	
<b>IC</b> : 0,57	

AE = 0.087

#### **Fusion Model**

Anticipation	
Confidence	
Engagement	
Excitement	

V: 0,62 A: 0,70 D: 0,66

**JC**: 1.00

AE = 0.045

#### Low JC values



Anger	V: 0,50	
Annoyance	A: 0,33	
Aversion	D: 0,67	
Doubt/Confusion		
Sadness		
Surprise		
Ground Truth		

#### Low JC values



Anger	V: 0,50	
Annoyance	A: 0,33	
Aversion	D: 0,67	
Doubt/Confusion		
Sadness		
Surprise		
Ground Truth		

#### **B** Model

Anticipation	V: 0,60
Confidence	A: 0,50
Disconnection	D: 0,63
Engagement	
Happiness	
Pain	

**JC**: 0,00
# Qualitative Analysis (L<sub>comb2</sub>)

### Low JC values



Anger	V: 0,50		
Annoyance	A: 0,33		
Aversion	D: 0,67		
Doubt/Confusion			
Sadness			
Surprise			
Ground Truth			

#### B Model

Anticipation	V: 0,60
Confidence	A: 0,50
Disconnection	D: 0,63
Engagement	
Happiness	
Pain	

**JC**: 0,00

### **Fusion Model**

Affection	V: 0,64
Anticipation	A: 0,54
Disquietment	D: 0,62
Doubt/Confusion	
Engagement	
Happiness	
Pleasure	

**JC**: 0,08

# Qualitative Analysis (L<sub>comb2</sub>)

### Low JC values



Anger	V: 0,50		
Annoyance	A: 0,33		
Aversion	D: 0,67		
Doubt/Confusion			
Sadness			
Surprise			
Ground Truth			

#### **B** Model

Anticipation	V: 0,60	A
Confidence	A: 0,50	A
Disconnection	D: 0,63	C
ingagement		Ľ
lappiness		E
Pain		H
		F
<b>C</b> : 0,00		J

**AE = 0.10** 

### **Fusion Model**

Affection	V: 0,64
Anticipation	A: 0,54
Disquietment	D: 0,62
Doubt/Confusion	
Engagement	
Happiness	
Pleasure	
<b>JC</b> : 0,08	
AE = 0.13	

# Qualitative Analysis (L<sub>comb2</sub>)

### Low JC values



AngerV: 0,50AnnoyanceA: 0,33AversionD: 0,67Doubt/ConfusionSadnessSurpriseGround Truth

#### **B** Model

Anticipation	V: 0,60
Confidence	A: 0,50
Disconnection	D: 0,63
Engagement	
Happiness	
Pain	
<b>JC</b> : 0,00	

**AE = 0.10** 

### **Fusion Model**

Affection	V: 0,64
Anticipation	A: 0,54
Disquietment	D: 0,62
Doubt/Confusion	
Engagement	
Happiness	
Pleasure	
<b>JC</b> : 0,08	

AE = 0.13

#### 75

Image Sentiment?

#### Image Sentiment?



#### Image Sentiment?



#### "Sunset at the beach"

#### Image Sentiment?



#### "Beautiful Sunset at the beach"

#### Image Sentiment?

Adjective – Noun Pair (ANP) (Sentibanks)



"Beautiful Sunset at the beach"





"A Dog"



"A Muddy Dog"



Adjective – Noun Pair (ANP) (Sentibanks)

"A Muddy Dog"

## Sentibanks as Visual Context Features (Experiments)

B<sub>F</sub>



## Sentibanks as Visual Context Features (Experiments)



## Sentibanks as Visual Context Features (Experiments)



### **Logistic Regression**

Features	B <sub>f</sub>	$B_{f} + I_{f}$	B <sub>f</sub> +I <sub>s</sub>
AP	23.00	27.70	29.45
AE	0.0704	0.0643	0.0713

### **Logistic Regression**

	Features	B <sub>f</sub>	$B_{f} + I_{f}$	B <sub>f</sub> +I <sub>s</sub>
Emotion Categories ——	AP	23.00	27.70	29.45
	AE	0.0704	0.0643	0.0713

### Logistic Regression

Sentibanks

	Features	B <sub>f</sub>	$B_{f} + I_{f}$	B <sub>f</sub> +I <sub>s</sub>
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### Logistic Regression

	Features	$B_{f}$	$B_{f} + I_{f}$	B <sub>f</sub> +I <sub>s</sub>
Emotion Categories ——	AP	23.00	27.70	29.45
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$$I_s$$
 (sentibanks) – a good source for Visual Scene Context

### **Next Section**

### (1) What is Emotion Recognition?

### (2) EMOTIons in Context (EMOTIC) Dataset

(3) Modeling and Analysis

(4) Takeaways

## Main Takeaways

(1) EMOTIC – A Novel Emotion Recognition Dataset

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(2) Fusion CNN model – models visual scene

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(1) EMOTIC – A Novel Emotion Recognition Dataset

(2) Fusion CNN model – models visual scene

(3) Sentibank features and Scene context features – both good

sources of visual context information

### **Future Work**

(1) Data Augmentation

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- (1) Data Augmentation
- (2) Strategy of Emotion labels

### **Future Work**

- (1) Data Augmentation
- (2) Strategy of Emotion labels
- (3) Emotion Captioning

## **Contributions - Publications**

[C] Kosti, Ronak, Jose M. Alvarez, Adria Recasens, and Agata Lapedriza. "Emotion recognition in context." In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, pp. 1667-1675. 2017.

- [W] Kosti, Ronak, Jose M. Alvarez, Adria Recasens, and Agata Lapedriza. "*Emotic: Emotions in context dataset*." In 2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), pp.2309-2317. IEEE, 2017.
- [J] Kosti, Ronak, Jose M. Alvarez, Adria Recasens, and Agata Lapedriza. "*Context Based Emotion Recognition using EMOTIC Dataset.*" IEEE transactions on pattern analysis and machine intelligence (2019).

