



Emotion Recognition in Online Text Chats

- Recognizing emotions is an ambiguous process with high dependence on the contextual information both on the utterance and dialog level.
- State-of-the-art approaches exploit whole dialog knowl-• A trainable *Word2Vec embeddings* mechanism is presented with the input sequence. edge and have difficulties capturing temporal dependen-• A *bidirectional Long Short-Term Memory* (BiLSTM) is used to capture the salient lingual cies over long horizons. information contained within each utterance.
- Accurate real time emotion recognition is paramount im-• A *Gated Recurrent Unit* (GRU) that performs dialog context-level representation to allow for portance for early identification of cyberbullying and suicapturing the salient dynamics over the whole dialog span. cidal ideation in Online Social Networks (OSNs). • A *self-attention layer* on top of the dialog-level GRU network.

Dataset

- We utilize a well-known benchmark for emotion recognition, namely the IEMOCAP dataset.
- The dataset has been collected by emulating conversations in a controlled environment in order to study expressive human behaviors.
- The conversations have been performed by ten unique speakers over five dyadic sessions in both a scripted but also an improvisation manner with various audio-visual modalities being recorded.
- Utterance at *t* t-10 t-9 t-8 t-7 t-6 t-5 t-4 t-3 0.02 0.45 0.02 0.02 0.03 0.32 0.02 0.08 Then she's gone. 0.29 0.00 0.00 0.01 0.39 0.00 0.02 0.00 It's going to be ... annotators using categorical labels; these include angry, 0.04 0.03 0.04 0.32 0.03 0.10 0.01 0.01 Well, you know ... sad, happy, frustrated, excited, neutral as well as other 0.05 0.08 0.21 0.08 0.11 0.07 0.01 0.07 Sure categories which we omit in this study. 0.01 0.51 0.00 0.03 0.00 0.00 0.00 0.30 to talk to somebody ... you shouldn't be ... 0.32 0.00 0.01 0.00 0.00 0.00 0.10 0.00 notators who assess the emotional states of the speakers 0.00 0.01 0.00 0.00 0.00 0.06 0.00 0.00 It's just going to ... taking into consideration dialog context. 0.02 0.02 0.00 0.01 0.05 0.02 0.01 0.04 Yes. 0.00 0.00 0.00 0.13 0.00 0.00 0.04 0.41 Ah. 0.00 0.01 0.06 0.03 0.02 0.04 0.16 0.29 0.18 0.09 0.10 Sad Thank you.
- Each utterance in the dataset is labeled by three human • The available annotation has been performed by three an-• We only utilize the textual modality (prevalent form in
- OSNs) and the label information derived by performing majority voting.
- The dataset contains 151 conversations with a total number of 10,039 utterances. However, only 7,380 utterances contain the six types of emotions we retain in this study.

A Self-Attentive Emotion Recognition Network

Harris Partaourides, Kostantinos Papadamou, Nicolas Kourtellis, Ilias Leontiadis, Sotirios Chatzis

{c.partaourides, sotirios.chatzis}@cut.ac.cy, ck.papadamou@edu.cut.ac.cy
{nicolas.kourtellis, ilias.leontiadis}@telefonica.com

Self-Attentive Emotion Recognition Network

For the first time in the literature, we introduce a *self-attentive hierarchical encoder* network that is capable of extracting salient information on both the individual utterance level as well as the level of the dialog context, as it has evolved until any given time point.



- The devised model is trained in an end-to-end fashion.
- The employed training objective function is the categorical cross-entropy of the model.

Acknowledgments

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<i>t</i> -2	<i>t</i> -1	t	Emotion
0.00	0.00	0.04	Sad
0.00	0.00	0.28	Sad
0.03	0.33	0.07	Sad
0.11	0.09	0.12	Sad
0.00	0.00	0.14	Sad
0.00	0.02	0.55	Sad
0.01	0.37	0.54	Sad
0.22	0.43	0.17	Sad
0.33	0.00	0.08	Sad
0.18	0.09	0.10	Sad

Utterance at *t* Oh, you infuriate me ... Yeah, well I ignore ... And she-she's Larry's ... Well, from your father's . Cause listen, I'm telling ... What do you want from . Every time I reach out ... You're a considerate ...

Experimental Evaluation

			A	cura	cy	y Precision			Recall			F1 Score			
S	VM		0.31	$3(\pm 0)$).00) (0.484	$(\pm 0.0$)0) 0 .	235 (:	± 0.00) 0.32	16 (:	$\pm 0.00)$		
ŀ	BiLS	ΓM	0.47	$7(\pm 0)$).01) (0.471	$(\pm 0.0$	$(02) \ 0.$	459 (:	± 0.01) 0.46	55 (=	$\pm 0.01)$		
I	BiLS	ΓM_{att}	0.51	$6(\pm 0)$).02) (0.516	$(\pm 0.0$	$(02) \ 0.$	501 (:	± 0.02) 0.50)9 (=	$\pm 0.02)$		
S	ERN		0.52	$2(\pm 0)$).02) (0.544	(± 0.0))2) 0 .	.517 (:	± 0.02) 0.53	30 (=	$\pm 0.02)$		
			Ang	y Ex	cited	Frus	strate	d Ha	ppy]	Neutr	al S	Sad	Recall		
A	Angry		11	0	2		2	9	0		22	7	0.647		
F	Excite	d		9	156			8	74		27	25	0.522		
F	rustr	ated		71	6		19	3	1		87	23	0.507		
F	Happy	7]	4	19			0	80		29	1	0.559		
Γ	Neutra	al		35	34		8	3	11	1	97	24	0.513		
S	Sad			9	12		4	2	7		11	164	0.669		
F	Precis	ion	0.44	4	0.681		0.54	4 0	.462	0.52	28 0.0	672			
	Classe	es A	Accui	racy	F	Precis	sion		Reca	11	\mathbf{F}	l Sc	ore		
	4	0.6	589 (=	±0.03	8) 0.6	85 (±	=0.02)	0.6	99 (±	0.02)	0.69	2 (Ⅎ	=0.02)		
	5	0.5	583 (=	± 0.02	2) 0.5	89 (±	=0.02)	0.50	69 (±	0.02)	0.57	9 (Ⅎ	=0.02)		
	6	0.5	522 (=	±0.02	2) 0.5	44 (±	=0.02)	0.5	$17 (\pm$	0.02)	0.53	0 (Ⅎ	=0.02)		
				A	ccura	icy P	recisi	on R	lecall	F1 S	core				
		S	ERN	V_5	0.5	57	0.5	63 (0.552	0.	.558				
		S	ERN	V_{10}	0.5	570	0.5	70 (0.591	0	.581				
		S	ERN	V_{20}	0.5	84	0.5	83 (0.580	0.	.582				
		S	ERN	V_{40}	0.5	81	0.5	95 (0.565	0	.579				
		S	ERN	\checkmark	0.5	55	0.5	55 (0.570	0.	.562				
	<i>t</i> -10	<i>t</i> -9	<i>t</i> -8	<i>t</i> -7	<i>t</i> -6	<i>t</i> -5	<i>t</i> -4	<i>t</i> -3	<i>t</i> -2	<i>t</i> -1	t	Em	otion		
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	Δ	norv		
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.70	Fru	strated		
	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.69	Fru	strated		
	0.00	0.00	0.00	0.00	0.00	0.16	0.05	0.02	0.00	0.00	0.68	Fru	strated		
••	0.00	0.07	0.00	0.00	0.00	0.02	0.00	0.02	0.00	0.28	0.00	Fru	strated		
•	0.07	0.01	0.00	0.05	0.09	0.02	0.03	0.02	0.22	0.08	0.30	Fru	strated		
•	0.00	0.02	0.12	0.00	0.00	0.00	0.11	0.13	0.07	0.02	0.54	Fru	strated		
	0.02	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.92	Ne	eutral		
	0.01	0.10	0.69	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.15	A	ngrv		

			Accuracy		су	Precision			Recall			F1 Score		
S	SVM		0.31	3 (± 0).00) (0.484	$(\pm 0.0$)0) ().235 (:	± 0.00) 0.3	16 (:	$\pm 0.00)$	
ŀ	BiLSI	ΓM	0.47	$7 (\pm 0)$) .01) (0.471	$(\pm 0.0$)2) C).459 (:	± 0.01) 0.40	65 (:	$\pm 0.01)$	
ŀ	BiLSZ	ΓM_{att}	t 0.5 1	6 (±0) .02) (0.516	$(\pm 0.0$)2) C).501 (:	± 0.02) 0.50)9 (=	$\pm 0.02)$	
S	ERN		0.52	$2(\pm 0)$) .02) (0.544	$(\pm 0.0$)2) ().517 (:	± 0.02) 0.53	30 (:	$\pm 0.02)$	
			Ang	ry Ex	cited	Frus	strate	d H	appy I	Neutr	al S	Sad	Recall	
A	Angry	r	11	10	2		2	9	0	/	22	7	0.647	
F	Excite	d		9	156			8	74	/	27	25	0.522	
F	rustr	ated	-	71	6		19	3	1		87	23	0.507	
F	Iappy	Y	1	14	19			0	80		29	1	0.559	
ľ	Neutra	al		35	34		8	3	11	1	97	24	0.513	
S	Sad			9	12		4	2	7		11	164	0.669	
F	Precis	ion	0.44	14	0.681		0.54	4 (0.462	0.52	28 0.	672		
	Classe	es A	Accu	racy	F	Precis	sion		Reca		F	1 Sc	ore	
	4	0.6	589 (=	± 0.03	6) 0.6	85 (±	=0.02)) 0.6	$599(\pm$	0.02)	0.69	2 (=	=0.02)	
	5	0.5	583 (=	± 0.02	2) 0.5	89 (±	=0.02)) 0.5	569 (\pm	0.02)	0.57	9 (=	±0.02)	
	6	0.5	522 (=	± 0.02	2) 0.5	44 (±	=0.02)) 0.5	517 (±	0.02)	0.53	0 (=	±0.02)	
				A	ccura	icy P	recisi	on I	Recall	F1 S	core			
		S	EERN	V_5	0.5	57	0.5	63	0.552	0	.558			
		S	ERN	V_{10}	0.5	570	0.5	70	0.591	0	.581			
		S	SERN	V_{20}	0.5	84	0.5	83	0.580	0	.582			
		S	SERN	V_{40}	0.5	681	0.5	95	0.565	0	.579			
		S	SERN	V	0.5	55	0.5	55	0.570	0	.562			
	<i>t</i> -10	<i>t-</i> 9	<i>t</i> -8	<i>t-</i> 7	<i>t</i> -6	<i>t-</i> 5	<i>t</i> -4	<i>t</i> -3	<i>t</i> -2	<i>t</i> -1	t	Em	otion	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	Α	ngry	
	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.0	0.06	0.20	0.70	Fru	strated	
	0.00	0.00	0.00	0.02	0.00	0.04	0.24	0.0	1 0.00	0.00	0.69	Fru	strated	
	0.00	0.00	0.01	0.00	0.00	0.16	0.05	0.02	2 0.00	0.07	0.68	Fru	strated	
	0.01	0.07	0.00	0.03	0.15	0.02	0.00	0.0	0.20	0.28	0.21	Fru	strated	
	0.07	0.01	0.00	0.05	0.09	0.13	0.03	0.02	2 0.22	0.08	0.30	Fru	strated	
	0.00	0.02	0.12	0.00	0.00	0.00	0.11	0.13	3 0.07	0.02	0.54	Fru	strated	
	0.02	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.92	N	eutral	

		A	cura	cy	Pre	cisior	1	Recall				F1 Score	
SVM		0.31	3 (± 0).00) (0.484	$(\pm 0.0$) (0)	.235 (:	± 0.00) 0.32	16 (:	$\pm 0.00)$	
BiLSI	TM	0.47	$7(\pm 0)$).01) (0.471	$(\pm 0.0$	(02) 0	.459 (:	± 0.01) 0.46	65 (:	$\pm 0.01)$	
BiLSI	TM_{att}	t 0.5 1	$6(\pm 0)$).02) (0.516	$(\pm 0.0$	(02) 0	.501 (:	± 0.02) 0.50)9 (:	$\pm 0.02)$	
SERN		0.52	$2(\pm 0)$).02) (0.544	$(\pm 0.0$	(02) 0	.517 (:	± 0.02) 0.53	30 (:	$\pm 0.02)$	
		Ang	ry Ex	cited	Frus	strate	d Ha	ppy]	Neutr	al S	Sad	Recall	
Angry	7	11	0	2		2	.9	0	,	22	7	0.647	
Excite	d	_	9	156			8	74	,	27	25	0.522	
Frustr	rated	Ĩ	71	6		19	3	1		87	23	0.507	
Нарру	y]	4	19			0	80		29	1	0.559	
Neutra	al		35	34		8	3	11	1	97	24	0.513	
Sad			9	12		4	-2	7			164	0.669	
Precis	ion	0.44	14 (0.681		0.54	-4 0	.462	0.52	28 0.0	672		
		• • • • • •		T		•		D	11				
	es A				recis	Sion			$\frac{\mathbf{II}}{0,0,0}$	F			
4	0.6)89 (=	±0.03	6) 0.6	85 (±	=0.02) 0.6	99 (±	(0.02)	0.69	2(=	$\pm 0.02)$	
5	0.5	583 (=	± 0.02	() 0.5	89 (±	=0.02) 0.5	69 (±	(0.02)	0.57	9 (=	E0.02)	
6	0.5	522 (=	± 0.02	() 0.5	44 (±	=0.02) 0.5	$17 (\pm$	0.02)	0.53	0 (=	E0.02)	
					D		D	11					
			\mathbf{A}		$\mathbf{r} \mathbf{r} \mathbf{r}$	recisi	$\frac{1}{2}$		F15	core			
	\mathcal{S}	ERP	V 5 T	0.5		0.5	03 (J.552	0	.338			
	\mathcal{S}	ERP	V ₁₀	0.5/0 0.5			$\frac{10}{2}$	J = 0.591 = 0.5			582		
	S	ERN	V ₂₀	0.5	0.584 0.582			0.580 0.58					
	S	ERN	V_{40}	0.5	081 	0.5	95 (J.565	0	.579			
			V	0.5	55	0.5	55 (J.570	0	.562			
<i>t</i> -10	<i>t-</i> 9	<i>t</i> -8	<i>t</i> -7	<i>t</i> -6	<i>t</i> -5	<i>t</i> -4	<i>t</i> -3	<i>t</i> -2	<i>t</i> -1	t	Em	otion	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	Α	ngry	
0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.06	0.20	0.70	Fru	strated	
0.00	0.00	0.00	0.02	0.00	0.04	0.24	0.01	0.00	0.00	0.69	Fru	strated	
0.00	0.00	0.01	0.00	0.00	0.16	0.05	0.02	0.00	0.07	0.68	Fru	strated	
0.01	0.07	0.00	0.03	0.15	0.02	0.00	0.01	0.20	0.28	0.21	Fru	strated	
0.07	0.01	0.00	0.05	0.09	0.13	0.03	0.02	0.22	0.08	0.30	Fru	strated	
0.00	0.02	0.12	0.00	0.00	0.00	0.11	0.13	0.07	0.02	0.54	Fru	strated	
0.02	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.92	N	eutral	

	Accuracy			Precision			Recall				F1 Score		
	0.31	3 (± 0).00) (0.484	$(\pm 0.0$)0) 0 .	235 (:	± 0.00) 0.31	16 (:	$\pm 0.00)$		
M	0.47	$7(\pm 0)$).01) (0.471	$(\pm 0.0$) 2) 0 .	459 (:	± 0.01) 0.46	55 (:	$\pm 0.01)$		
M_{att}	0.51	$6(\pm 0)$) .02) (0.516	$(\pm 0.0$) 2) 0 .	501 (:	± 0.02) 0.50)9 (:	$\pm 0.02)$		
	0.52	$2(\pm 0)$).02) (0.544	(± 0.0)) 2) 0 .	517 (:	± 0.02) 0.53	30 (:	$\pm 0.02)$		
	•		• • •					· •		. .			
	Ang	ry Ex	cited	Frus	strate	d Ha		Neutr	al S	Sad	Recall		
		0	2		2	9	0	,	22		0.647		
]	-	9 71	156		10	8	/4		27	25	0.522		
ea	1	/ 1	0		19	0	1		8/ 20	23	0.507		
		25	19		Q	0	8U 11	1	29	1 24	0.539		
		0	54 12		о Л	っ つ	11 7	12	9/ 11 1	24 164	0.515		
n	0 4/	9 1 <u>/</u> ($\frac{12}{0.681}$			$\frac{\Delta}{\Delta}$	/	0.5	$\frac{11}{2806}$	572	0.009		
	0.7-		5.001			- 0	.+02	0.5	20 0.0	<i>J T Z</i>			
A	Accui	racy	P	recis	ion		Reca	11	F 1	l Sc	ore		
0.6	589 (=	$\frac{1}{\pm 0.03}$) 0.6	85 (±	:0.02	0.69	99 (±	0.02)	0.69	2 (=	E0.02)		
0.5	583 (=	±0.02) 0.5	89 (±	:0.02	0.50	59 (±	0.02^{\prime}	0.57	9 (=	±0.02)		
0.5	522 (=	±0.02	() 0.5	44 (±	:0.02	0.5	17 (±	$0.02^{'}$	0.53) (±0.02)		
			/		/			/			/		
		A	ccura	cy P	recisi	on R	ecall	F1 S	core				
\overline{S}	ERN	V_5	0.5	57	0.5	63 ().552	0	.558				
S	ERN	V_{10}	0.5	70	0.5	70 ().591	0	.581				
S	ERN	V_{20}	0.5	584 0.58		83 ().580	0	0.582				
S	ERN	V_{40}	0.5	0.581		95 (0.565 0).579				
\underline{S}	ERN	V	0.5	55	0.5	55 ().570	0	.562				
9	<i>t</i> -8	<i>t</i> -7	<i>t</i> -6	<i>t</i> -5	<i>t</i> -4	<i>t</i> -3	<i>t</i> -2	<i>t</i> -1	t	Em	otion		
.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	Α	ngry		
.00	0.00	0.00	0.01	0.01	0.00	0.01	0.06	0.20	0.70	Fru	strated		
.00	0.00	0.02	0.00	0.04	0.24	0.01	0.00	0.00	0.69	Fru	strated		
.00	0.01	0.00	0.00	0.16	0.05	0.02	0.00	0.07	0.68	Fru	strated		
07	0.00	0.03	0.15	0.02	0.00	0.01	0.20	0.28	0.21	Fru	strated		
01	0.00	0.05	0.00	0.02	0.00	0.01	0.20	0.20	0.21	Em	strated		
.01	0.00	0.05	0.09	0.13	0.03	0.02	0.22	0.08	0.50	гти г	sualed		
.02	0.12	0.00	0.00	0.00	0.11	0.13	0.07	0.02	0.54	Fru	strated		
.01	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.92	No	eutral		

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To hell with that.



Skłodowska-Curie ENCASE project