



A Multi-task Model for Emotion and Offensive Aided Stance Detection of Climate Change Tweets

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code: https://github.com/apoorva-upadhyaya/Emotion_Offensive_Aided_Stance

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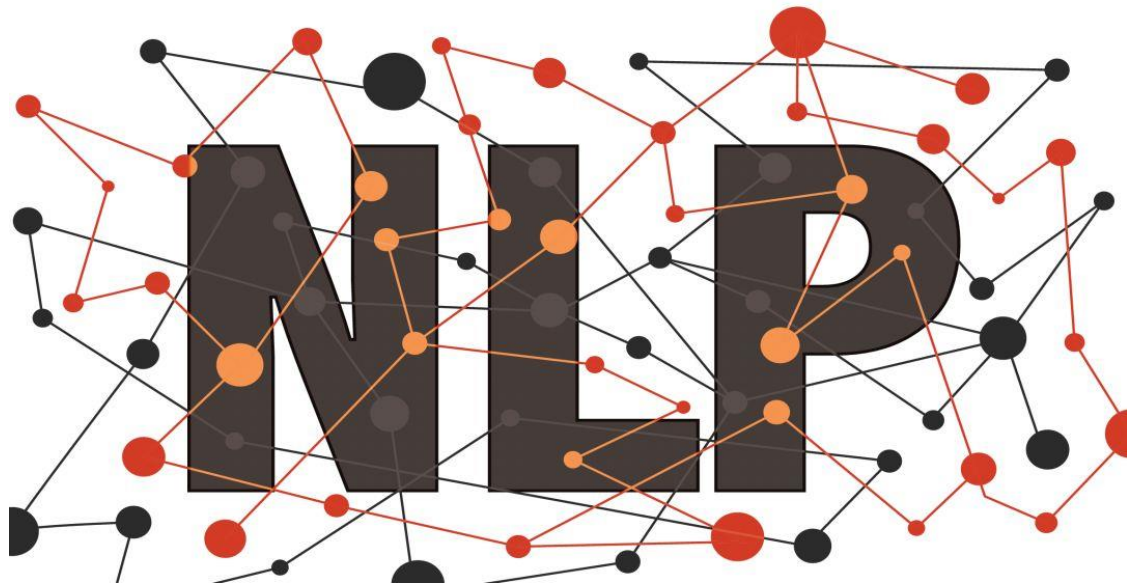
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NATURAL LANGUAGE PROCESSING



- 1. Introduction**
- 2. Method**
- 3. Experiments**





Introduction

Problem Statement: Design a stance detection method that uses textual and emoji features and combines the emotional and offensive aspects to **classify the attitude of a tweet on climate change** into one of the polarized classes (believe/deny/ambiguous).

Most existing approaches for detecting stances and classifying climate change tweets either **overlook deniers' tweets** or **do not have a suitable architecture**.

Method

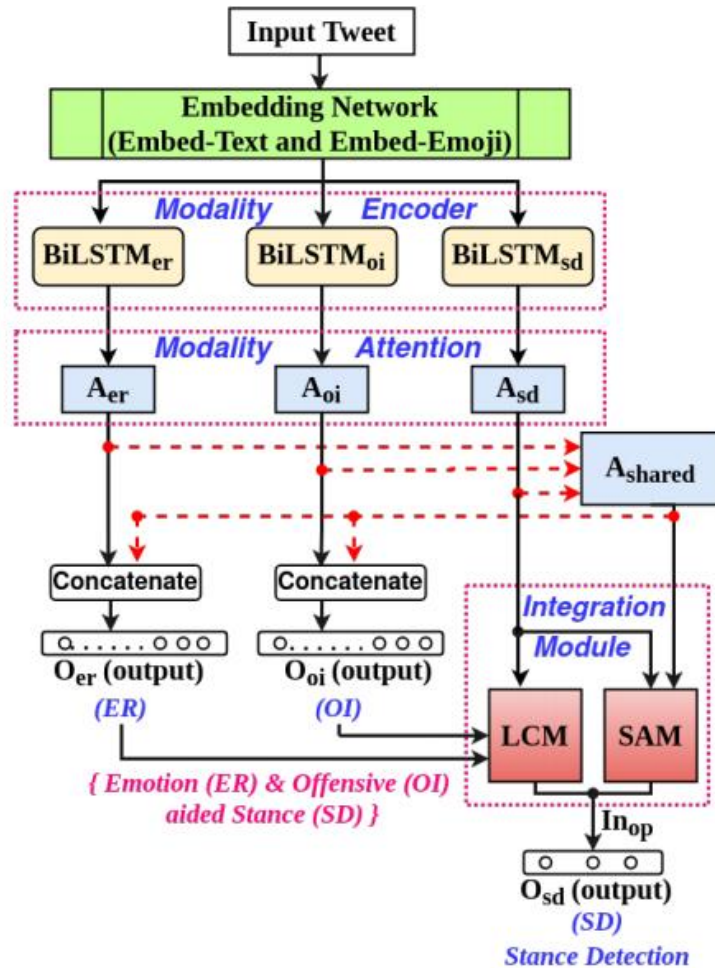


Figure 1: Architectural overview of our proposed MEMOCLiC framework

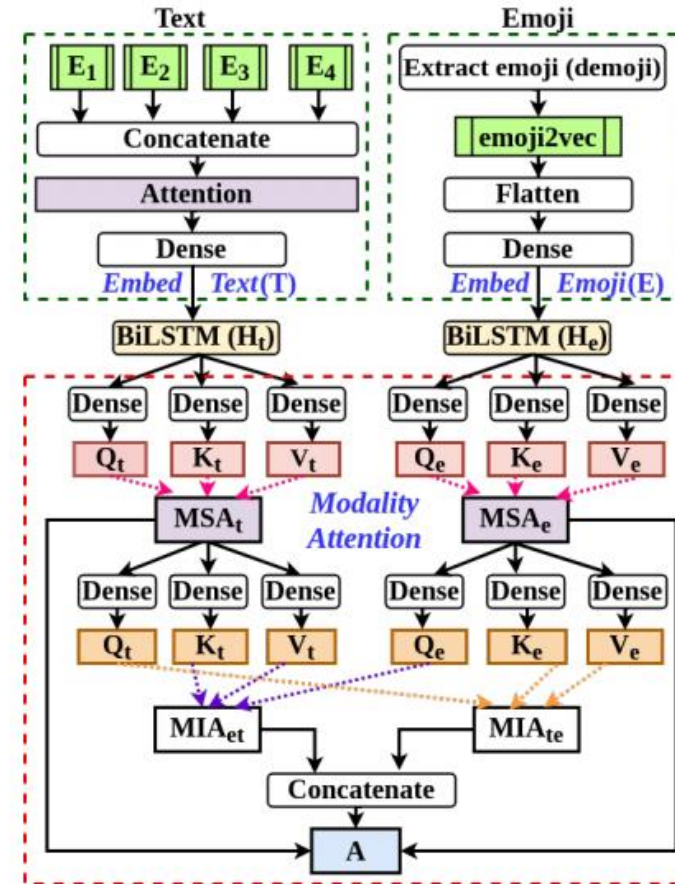


Figure 2: Overview of MEMOCLiC Components with text and emoji: (Top) Embedding Component (Embed-Text, Embed-Emoji) [common for all tasks]; (Bottom) Modality Attention [specific to each task]

Method

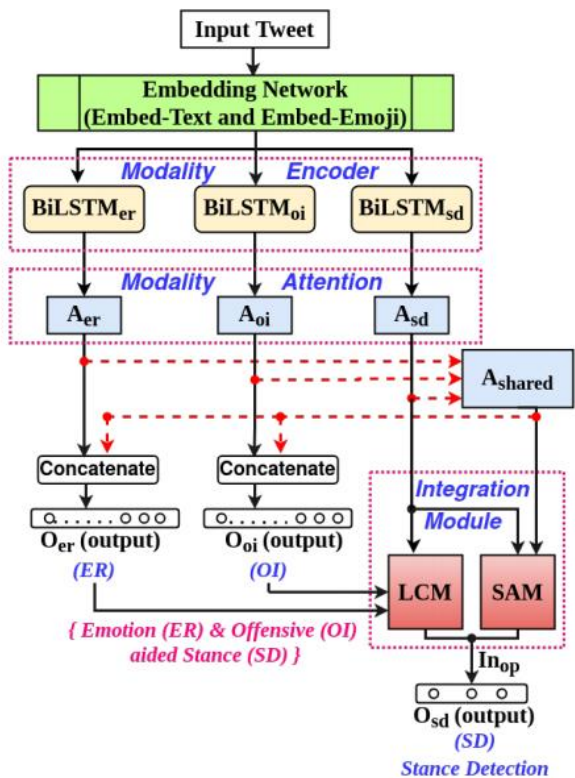


Figure 1: Architectural overview of our proposed MEMOCLiC framework

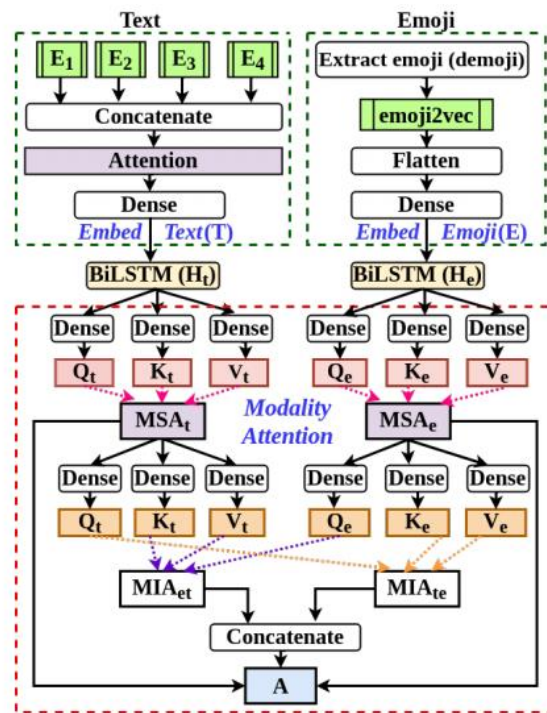


Figure 2: Overview of MEMOCLiC Components with text and emoji: (Top) Embedding Component (Embed-Text, Embed-Emoji) [common for all tasks]; (Bottom) Modality Attention [specific to each task]

E_1 : GLOVE, E_2 : BERTweet, E_3 : SBERT, and E_4 : USE.

$$T = \text{Attention}(\text{Concatenate}(E_1, E_2, E_3, E_4))$$

$$MSA_i = \text{softmax}(Q_i K_i^T) V_i \quad (1)$$

$$MIA_{et} = \text{softmax}(Q_e K_t^T) V_t, \quad (2)$$

$$MIA_{te} = \text{softmax}(Q_t K_e^T) V_e, \quad (3)$$

$$(O_{er} * A_{sd})_n = \sum_{m=-\infty}^{\infty} O_{er}[m] A_{sd}[n-m], (LCM_1) \quad (4)$$

$$(O_{oi} * A_{sd})_n = \sum_{m=-\infty}^{\infty} O_{oi}[m] A_{sd}[n-m], (LCM_2) \quad (5)$$

$$LCM_{op} = \text{Average}(LCM_1, LCM_2) \quad (6)$$

Method

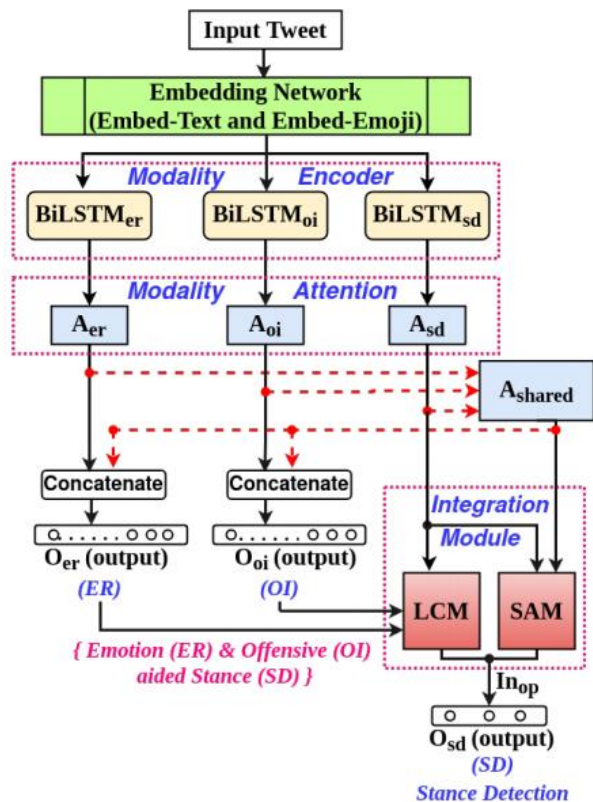


Figure 1: Architectural overview of our proposed MEMOCLiC framework

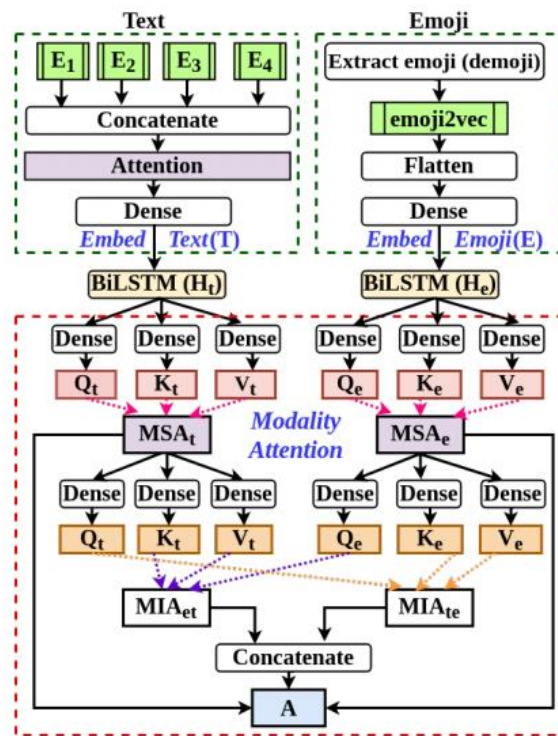


Figure 2: Overview of MEMOCLiC Components with text and emoji: (Top) Embedding Component (Embed-Text, Embed-Emoji) [common for all tasks]; (Bottom) Modality Attention [specific to each task]

$$SAM_{op} = \text{softmax}(Q_{sd}K_{shared}^T)V_{shared} \quad (7)$$

$$In_{op} = [LCM_{op}; SAM_{op}; LCM_{op} - SAM_{op}; LCM_{op} \odot SAM_{op}] \quad (8)$$

$$L = \alpha L_{sd} + \beta L_{er} + \gamma L_{oi} \quad (9)$$

Experiment

Category	Anger	Anticipation	Disgust	Fear	Joy
Believe	9.99	28.54	4.80	16.28	20.40
Deny	27.20	9.86	24.62	20.88	1.53
Ambiguous	9.93	22.88	5.84	24.08	16.64

Category	Sadness	Surprise	Trust	Positive	Negative
Believe	8.21	10.32	28.76	59.08	15.79
Deny	27.78	24.90	14.27	5.27	61.21
Ambiguous	14.25	8.96	27.53	51.56	23.02

Table 1: % of emotions present in tweets

Category	Severe_Toxicity	Identity_Attack	Insult	Profanity
Believe	0.60	0.53	1.43	0.92
Deny	6.70	1.82	17.62	10.06
Ambiguous	1.33	0.59	2.62	1.70

Category	Threat	Sexually_Explicit	Toxicity	Non_toxic
Believe	2.19	0.32	0.42	96.06
Deny	4.69	2.01	7.37	78.35
Ambiguous	2.85	0.59	2.29	94.66

Table 2: % of offensive labels present in tweets

Experiment

Model	Single Task Stance Detection			
	Text		Text+Emoji	
	Macro F1	Accuracy	Macro F1	Accuracy
	Avg/St.dev	Avg/St.dev	Avg/St.dev	Avg/St.dev
GLOVE	74.09/0.46	75.64/0.86	76.08/1.11	77.47/0.37
GLOVE+MSA	76.27/1.12	78.31/1.16	79.88/0.67	80.66/0.21
BERTweet+MSA	78.23/0.58	80.01/0.83	81.17/1.32	83.38/1.09
SBERT+MSA	76.54/0.77	76.98/0.24	78.07/2.19	80.54/2.07
USE+MSA	77.31/1.08	78.29/0.81	80.93/1.47	82.82/1.34
METC+MSA	78.19/0.64	80.52/0.39	82.79/1.03	84.65/0.95
META +MSA	79.71/0.81	81.26/0.32	83.50/1.12	85.03/1.01
META +MA (MSA+MIA)	-	-	84.88/0.71	85.96/0.35
META +MA+ emo. and offens. as i/p features	81.79/0.38	84.03/1.31	85.78/0.87	87.66/1.22

Table 3: Results of the single task stance detection models in varying combinations

Experiment

Model	Stance + Emotion (SD+ER)				Stance + Offensive (SD+OI)				Stance+Emotion+Offensive (SD+ER+OI)			
	Text		Text+Emoji		Text		Text+Emoji		Text		Text+Emoji	
	F1 score	Acc	F1 score	Acc	F1 score	Acc	F1 score	Acc	F1 score	Acc	F1 score	Acc
	Avg/St.dev	Avg/St.dev	Avg/St.dev	Avg/St.dev	Avg/St.dev	Avg/St.dev	Avg/St.dev	Avg/St.dev	Avg/St.dev	Avg/St.dev	Avg/St.dev	Avg/St.dev
METC+MA	82.66/1.30	83.98/1.42	84.54/1.08	86.33/1.27	81.66/1.09	82.99/2.12	84.06/1.05	85.55/0.64	84.54/1.23	85.19/1.01	86.51/1.05	89.45/1.07
META +MA	83.90/1.33	85.55/0.32	87.35/1.01	89.18/0.96	83.36/0.21	86.53/0.50	85.66/1.58	87.51/1.09	86.38/2.11	89.17/2.13	89.20/0.74	91.17/0.39
META+MA+LCM	87.01/0.58	88.10/1.04	90.31/1.41	92.51/2.09	87.12/0.63	89.72/0.69	88.89/0.22	90.63/1.09	88.34/1.41	92.10/1.72	92.04/0.72	94.73/0.38
META+MA+SAM	85.19/0.65	87.18/0.55	89.41/0.34	90.77/0.90	85.41/0.62	86.59/1.04	87.52/1.66	89.11/2.12	89.04/1.05	90.61/0.41	90.23/2.25	92.89/1.93
META+MA Integ.(LCM,SAM)	89.62/0.16	90.50/0.23	92.05/0.69	93.88/0.62	87.31/0.31	88.02/0.75	90.51/1.61	91.69/1.28	90.67/1.01	91.99/1.10	93.76/0.62 (MEMOCLiC)	95.15/0.88 (MEMOCLiC)

Table 4: Results of Stance Detection in Multi-task architectures on Climate Change Dataset (Macro F1 score & Accuracy). MEMOCLiC outperforms other variants while meeting statistical significance under t-tests ($p < 0.05$).

Experiment

Model	Precision	Recall	F1 score	Acc.
-	Avg/St.dev	Avg/St.dev	Avg/St.dev	Avg/St.dev
MEMOCLiC[Proposed]	92.06/0.81	95.44/0.29	93.76/0.62	95.15/0.88
RoBERTa-Base[44]	83.38/1.55	85.24/1.28	84.69/1.89	86.42/2.01
SP-MT[42]	87.95/1.11	90.01/1.80	89.29/1.31	91.47/0.91
MT-LRM-BERT [12]	87.12/1.61	88.70/0.99	88.59/1.29	90.01/1.67
S-MDMT [47]	86.12/1.02	88.67/0.39	86.91/0.44	88.33/0.48
ESD [46]	81.55/1.72	84.39/2.05	83.28/2.31	86.92/2.01
HAN[48]	84.61/1.22	84.23/1.78	84.54/1.65	86.59/1.82
MNB[17]	78.11/0.66	79.51/0.73	78.43/1.33	80.16/1.32
DNN[6]	77.64/1.58	76.38/1.08	77.15/1.18	79.92/1.34

Table 5: Results for Stance Detection on Climate Change Dataset with Baselines. MEMOCLiC outperforms all baselines while meeting statistical significance under t-tests ($p < 0.05$).

Experiment

Model	Precision	Recall	F1 score	Acc.
MEMOCLiC[Proposed]	0.554	0.5206	0.537	81.49%
RoBERTa-Base[44]	0.528	0.502	0.510	81.22%
BERT-Base	0.507	0.446	0.464	77.51%
BERT-Large	0.530	0.470	0.489	77.78%
RoBERTa-Large	0.473	0.507	0.489	82.54%
DistilBERT	0.497	0.430	0.448	79.37%

Table 6: Results for Stance Detection on benchmark ClimateStance-2022 dataset

Model	Atheism F_{avg}	Climate F_{avg}	Feminism F_{avg}	Hillary F_{avg}	Abortion F_{avg}	Mac F_{avg}
MEMOCLiC[Proposed]	74.39	64.51	63.62	75.84	71.36	69.94
MT-LRM-BERT[12]	76.14	53.05	63.12	74.67	70.32	67.46
SP-MT[42]	69.5	63.5	63.2	67.5	70.5	66.84
S-MDMT[47]	69.50	52.49	63.78	67.20	67.19	64.03
ESD[46])	66.64	43.82	62.85	67.79	64.94	61.20
HAN[48]	70.53	49.56	57.50	61.23	66.16	61.00
AT-JSS-LEX[18]	69.22	59.18	61.49	68.33	68.41	65.33
SVM-ngram[39]	65.19	42.35	57.46	58.63	66.42	58.01

Table 7: Results for Stance Detection on SemEval-2016 Dataset with Baselines

Experiment

Category	Anger	Anticipation	Disgust	Fear	Joy
Favor	8.90	15.78	3.79	30.89	8.69
Against	15.89	15.14	12.01	48.06	8.52
Ambiguous	11.03	14.38	6.66	31.14	9.36

Category	Sadness	Surprise	Trust	Positive	Negative
Favor	6.96	5.85	21.47	53.05	29.47
Against	14.34	12.79	18.21	31.47	47.28
Ambiguous	7.69	6.68	18.39	42.14	31.43

Table 8: % of Emotions present in different stances of ClimateStance-2022 Dataset

Experiment

Category	Severe_Toxicity	Identity_Attack	Insult	Profanity
Favor	1.87	1.27	5.05	2.86
Against	3.76	2.51	17.55	6.89
Ambiguous	3.13	2.08	8.09	5.22

Category	Threat	Sexually_Explicit	Toxicity	Non_toxic
Favor	2.65	0.9	2.22	92.18
Against	4.70	2.19	8.46	79.62
Ambiguous	4.69	1.82	4.96	86.68

Table 9: % of Offensive Expressions present in different stances of ClimateStance-2022 Dataset

Experiment

Category	Anger	Anticipation	Disgust	Fear	Joy
Favor	13.26	17.56	6.45	27.24	11.82
Against	8.33	25	12.5	33.33	12.5
Neutral	12.65	20.48	7.23	20.48	20.49

Category	Sadness	Surprise	Trust	Positive	Negative
Favor	13.26	6.09	29.03	54.48	36.55
Against	33.33	8.33	25	16.66	79.16
None	11.44	7.22	29.51	59.63	32.53

Table 10: % of Emotions present in different stances of "Climate Change is a Real Concern" target of SemEval-2016 Dataset

Experiment

Category	Anger	Anticipation	Disgust	Fear	Joy
Favor	13.26	17.56	6.45	27.24	11.82
Against	8.33	25	12.5	33.33	12.5
Neutral	12.65	20.48	7.23	20.48	20.49

Category	Sadness	Surprise	Trust	Positive	Negative
Favor	13.26	6.09	29.03	54.48	36.55
Against	33.33	8.33	25	16.66	79.16
None	11.44	7.22	29.51	59.63	32.53

Table 10: % of Emotions present in different stances of "Climate Change is a Real Concern" target of SemEval-2016 Dataset

Experiment

Category	Severe_Toxicity	Identity_Attack	Insult	Profanity
Favor	6.28	7.48	8.08	7.78
Against	11.54	19.23	15.38	3.84
None	9.85	13.79	11.33	8.37

Category	Threat	Sexually_Explicit	Toxicity	Non_toxic
Favor	9.58	7.78	6.69	81.73
Against	15.38	7.69	11.68	73.07
None	14.77	14.28	9.90	74.38

Table 11: % of Offensive Expressions present in different stances of "Climate Change is a Real Concern" target of SemEval-2016 Dataset

Experiment












S.No.	Stance	Tweet	Emoji	Emotions	Offensive labels
1.	Deny	charge you vehicle at night....from your solar panels...did he really say this..and they think We are dumb.	  	surprise, negative	insult
2.	Deny	Fools and morons backing the #ClimateHoax religion of the socialist party.	  	disgust, negative	severe_toxicity, identity_attack, insult, toxicity
3.	Deny	you own three houses asshole... clean up your own stupid ""carbon footprint "" first #ClimateChangeHoax"		anger,disgust, negative	severe_toxicity, insult, profanity ,toxicity
4.	Believe	wonderful they provide #veganfood @fflglobal #plantbasedfood this is called #ClimateAction	 	trust, joy positive	non-toxic
5.	Believe	Why not own and nurture a tree today...Imagine having a life share life even after you are gone #PetaTree#ClimateEmergency	 	anticipation, positive	non-toxic

Figure 3: Significance of incorporating emoji, emotion and offensive expressions for stance detection

Experiment

Model	Single Task Stance Detection			
	Text		Text+Emoji	
	Precision	Recall	Precision	Recall
	Avg/St.dev	Avg/St.dev	Avg/St.dev	Avg/St.dev
GLOVE	75.52/0.11	74.26/0.18	76.50/0.14	75.92/0.91
GLOVE+MSA	76.59/1.41	75.92/2.05	80.16/0.55	79.45/0.71
BERTweet+MSA	77.41/0.39	80.16/0.65	81.24/1.53	83.49/1.50
SBERT+MSA	77.09/1.33	76.8/0.12	79.07/2.06	81.47/1.45
USE+MSA	75.61/1.39	76.90/0.48	80.36/0.12	82.02/2.15
METC+MSA	78.25/0.41	79.52/0.39	81.02/1.04	84.24/0.76
META+MSA	79.08/1.05	81.66/1.01	83.76/0.61	85.55/1.02
META+MSA+MIA	-	-	85.21/1.06	83.69/0.66
META+MSA+MIA+ emo. & offens. as i/p features	80.28/0.23	82.40/0.11	85.95/1.03	87.17/0.49

Table 12: Results of the single task stance detection models in varying combinations



Thank you!



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