Robots in Social Networks?
No, it's Neural Networks in Social Robotics!

MODELLING SOCIAL AND EMOTIONAL COMPONENTS IN SOCIAL ROBOTICS USING ROBOT ARTIFICIAL INTELLIGENCE

There are many ways to do that:

1. Detecting emotion based on sentyment analysis [1]

Figure 1. *Short messages - words assigned to an emotional category.*

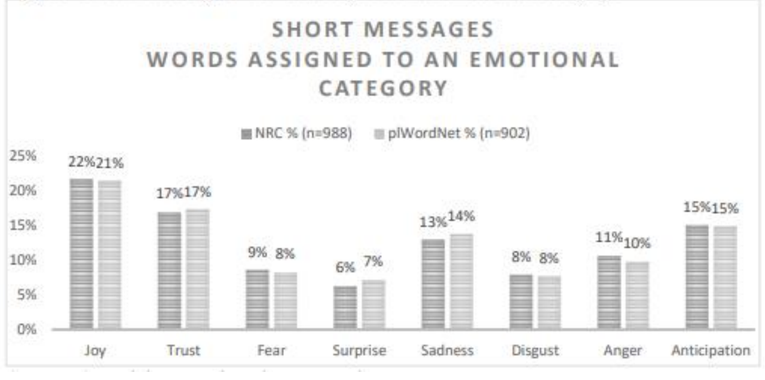


Figure 2. *Long messages - words assigned to an emotional category.*

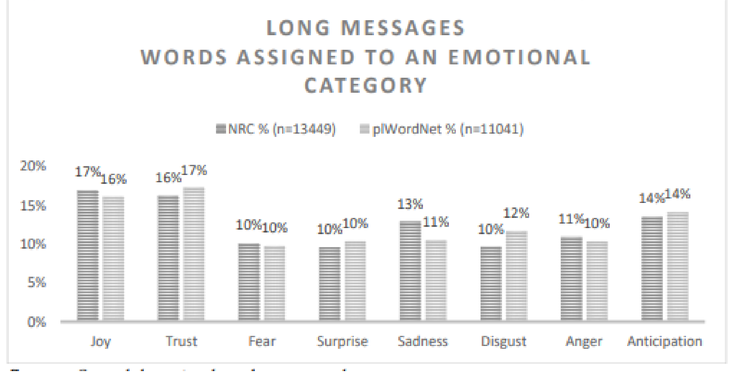
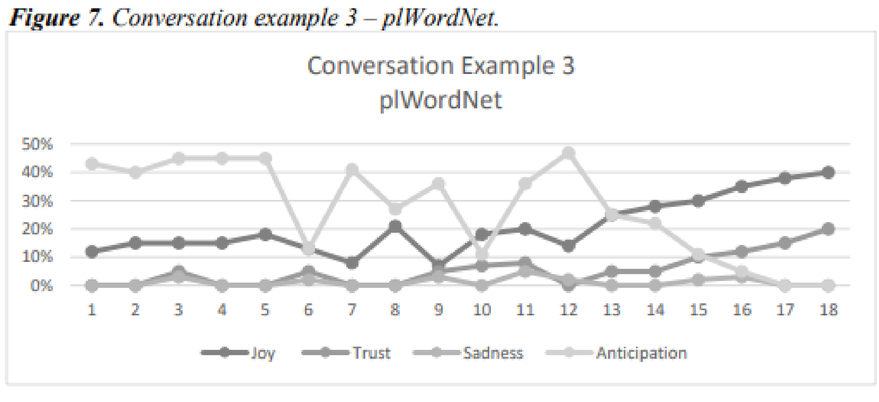


Figure 7. *Conversation example 3 – plWordNet.*



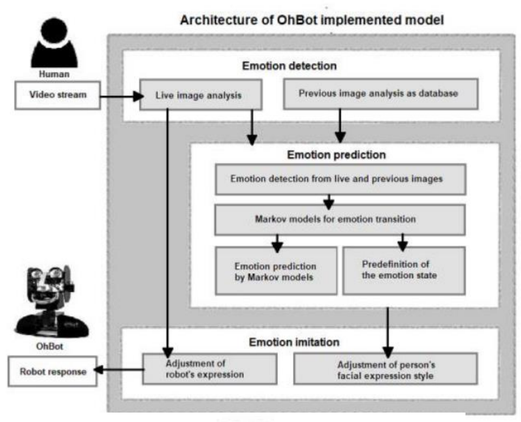
2. Modelling emotions using markov chains and YOLOv5 in ohbot social robots [2]

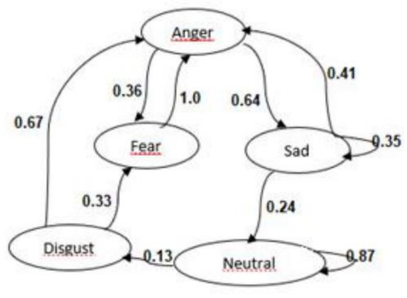
Algorithm for selecting emotional characteristic

n_p=number of detected positive emotions
n_n=number of detected negative emotions
n_{all}=number of all detected emotions
t = time

MIN($t > 120s$)

1. If $n_p > \frac{3}{4} n_{all} \cup n_{all} > 4$
2. then return *positive vivid*
3. otherwise return *positive steady*
4. If else $n_n > \frac{3}{4} n_{all} \cup n_{all} > 4$
4. then return *negative vivid*
5. otherwise return *negative steady*
6. If else $\sim \left(n_n > \frac{3}{4} n_{all} \cup n_p > \frac{3}{4} n_{all} \right) \cup n_{all} > 4$
7. then return *neutral vivid*
8. otherwise return *neutral steady*
9. End if
10. Repeat every t=120s until $n_{all} = 0$





Long human-robot interaction - emotion transition

3. Recognizing selected emotional stated based on PDDL [3,4,5]

Table 1: Robot Conditions and Decisions in PDDL Language

(define (domain emotion_domain_2) (: requirements: conditional-effects: sensing) (: constants sadness fear anger upset contempt) cheeks - lifting cheeks eyelids - lifting of the lower eyelids and upper tension ; kacik_ust - lifting the mouth corner ; pulled_brows - pulling your brows towards you
(: action_expression_face analysis : parameters () : precondition () : effect (and (when (or (sad)) (cheeks)) (when (or (anger) (fear)) (eyelids)) (when (contempt) (kacik_ust))))
(: action face_expression detection : parameters () : precondition () : effect (and (observes (cheeks)) (observes (eyelids)) (observes (kacik_ust))))
(: action eyebrow_expression analysis : effect (and (when (or (sadness) (fear)) (sciagniete_brwi))))
(: action eyebrow_expression detection : effect (observes (sciagniete_brwi)))
(: action work_reduction_working : parameters (? emotion) : precondition (object? emotion) : effect (and (when (? emotion) (not (? emotion))) (when (not (? emotion)) (escalation_emotion)))))

Table 4: Initial and target states in PDDL in scenario 2

(: init (not (cheeks)) (not (eyelids)) not (kacik_ust)) (not (eyebrow pulled)) oneof (contempt) (anger) (shame)) (not (sadness)) (not (fear)) (not (escalation_emotion)))
(: goal (and (not (sadness)) (not (fear)) (not (anger)) (not (upset)) (not (contempt)) (not (escalation_emotion)))))

Table 5: Possible initial states and robot decisions in PDDL in scenario 2

Possible world 1	Possible world 2	Possible world 3	Robot decisions
(object contempt) (object stop) (object anger) (object fear) (object sadness) (not (emotion_ Escalation)) (not (fear)) (not (sadness)) (hate) (not (contempt)) (not (anger)) (not (eyebrow pulled)) (not (corner of mouth)) (not (eyelids)) (not (cheeks))	(object contempt) (object stop) (object anger) (object fear) (object sadness) (not (emotion_ Escalation)) (not (fear)) (not (sadness)) (not (shame)) (anger) (not (contempt)) (not (eyebrow pulled)) (not (corner of mouth)) (not (eyelids)) (not (cheeks))	(object contempt) (object stop) (object anger) (object fear) (object sadness) (not (emotion_ Escalation)) (not (fear)) (not (sadness)) (not (shame)) (not (anger)) (contempt) (not (eyebrow pulled)) (not (kacik_ust)) (not (eyelids)) (not (cheeks))	((((face_expression analysis))) (((face_expression))) (((reaction_ of work_reducing contempt) 1 2) ((reaction_working_reducing shame) 2 3) ((reaction_working_reducing anger) 1 3)))

4. Detecting and recognizing face by social robot [6]

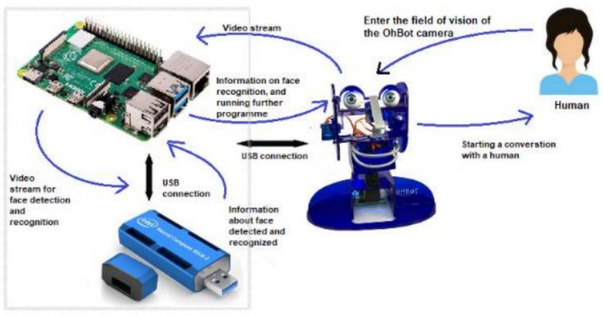


Fig. 1. System architecture diagram

TABLE II. FPS MEAN FRAME RATES FOR TESTED MODELS

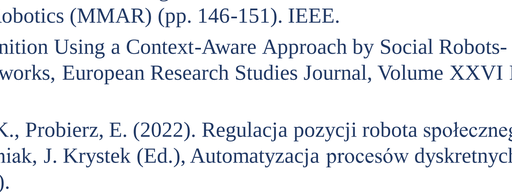
Network + Dataset	Raspberry Pi	Raspberry Pi + Intel Neural Stick 2
YOLOv4-tiny, MS COCO	4.3 FPS	13.1 FPS
YOLOv4-tiny. Face Mask	7.1 FPS	24 FPS
YOLOv5s, MS COCO	5.7 FPS	17.1 FPS
YOLOv5s, Face Mask	8.3 FPS	31.2 FPS

5. Recognizing emotions with context-aware approach [7]

Table 2. *Performance scores (AP) for emotic dataset on modified neural networks*

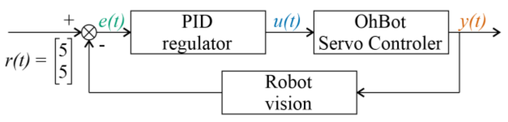
Labels	CNN (Kosti *et al.*, 2019)	GCN (Zhang *et al.*, 2019)	EmotiCon (Mittal *et al.*, 2020)	YOLO v3	Faster R-CNN
Affection	**45.23**	31.12	29.47	30.14	41.41
Anger	**15.46**	14.74	11.29	12.12	13.88
Annoyance	21.92	18.41	21.16	16.48	**27.48**
Anticipation	72.12	67.25	71.18	69.44	**82.04**
Aversion	17.81	**18.81**	14.39	18.44	14.02
Confidence	68.65	77.53	86.84	71.79	**88.44**
Disapproval	19.82	20.54	18.46	**21.88**	19.43
Disconnection	**43.12**	33.02	27.56	31.94	38.25
Disquietment	18.73	17.42	23.21	15.47	**27.81**
Doubt / Confusion	35.12	31.89	35.47	36.44	**39.44**
Embarrasement	14.37	**17.22**	6.04	17.02	14.70
Engagement	**91.12**	89.11	87.26	90.78	89.38
Esteem	23.62	25.55	22.73	**26.77**	25.31
Excitement	93.26	**95.62**	92.19	91.45	94.15
Fatigue	16.23	18.41	19.47	19.44	**22.66**
Fear	**23.65**	19.92	17.52	18.40	19.12
Happiness	74.71	76.70	77.41	72.88	**79.49**
Pain	13.21	11.29	14.12	10.61	**16.77**
Peace	34.27	30.12	36.87	29.11	**45.63**
Pleasure	**65.53**	29.99	24.36	31.25	40.47
Sadness	23.41	24.20	26.07	22.22	**28.08**
Sensitivity	8.32	8.46	6.71	6.55	**9.09**
Suffering	26.39	27.44	25.81	26.05	**29.12**
Surprise	17.37	16.74	24.12	22.18	**31.71**
Sympathy	34.28.	31.85	36.44	27.44	**38.43**
Yearning	**14.29**	12.81	9.47	11.03	14.22
mean	35.48	33.31	33.29	32.59	**38.09**

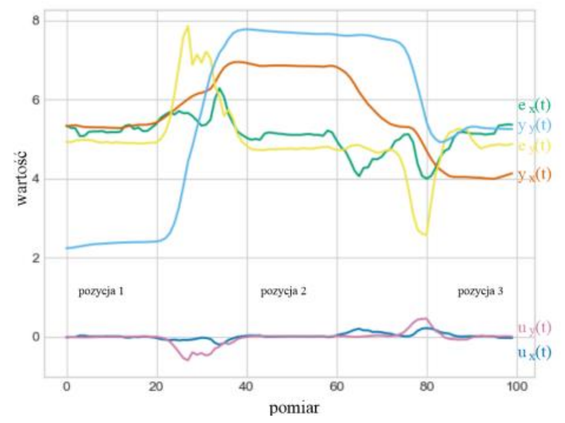
Figure 1. *Example of a image from EMOTIC database*



Source: *Kosti et al., 2019.*

6. Tracking human movements and gaze by social robots [8]





SO, ARE THERE ANY MORE WORK NEED TO BE DONE?

A LOT!!!

- ❑ EMOTIONAL GAP IN THERAPY
- ❑ ROBO-TUTORS AND EDUBOTS
- ❑ MORAL GUARDIANS IN A DIGITAL WORLD
- ❑ ELDERLY CARE: COMPASSIONATE ROBOTS

- ❑ INTERDISCIPLINARY ODYSSEY
- ❑ UNPREDICTABLE ENVIRONMENTS
- ❑ PUBLIC SPACES AND PRIVATE LIVES
- ❑ ETHICAL DATA HANDLING
- ❑ LONG-TERM INTERACTIONS

The realm of social robotics is at a transformative juncture, balancing between unparalleled technological advancements and complex ethical quandaries. From robots with emotional acumen to those integrated into healthcare and education, the field offers a fascinating confluence of artificial intelligence, psychology, and social science.

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