

# Developing a Framework for Cognitive Empathy in Human-Robot Interactions

Elahe Bagheri<sup>1</sup>, Oliver Roesler<sup>2</sup>, Bram Vanderborght<sup>1</sup>

1. Robotics and Multibody Mechanics Research Group, Vrije Universiteit Brussel and Flanders Make, Brussels, Belgium
2. Artificial Intelligence Lab, Vrije Universiteit Brussel, Brussels, Belgium.

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# When and How to make empathy?

- **When to exhibit an empathic behavior?**

- Facial Emotion Recognition

- **How to make empathy?**

- Reinforcement Learning

# Designed scenario and experimental setup

- . **Applied Platform: Pepper**
- . **Collaborative Game**
- . **Personality Questionnaire (Big 5)**
- . **N=28 (14 Ambivert, 9 Extrovert, 6 Introvert)**
- . **4 Emotions: Happiness, Anger, Sadness, Surprise**

*Pepper*



*Participant*

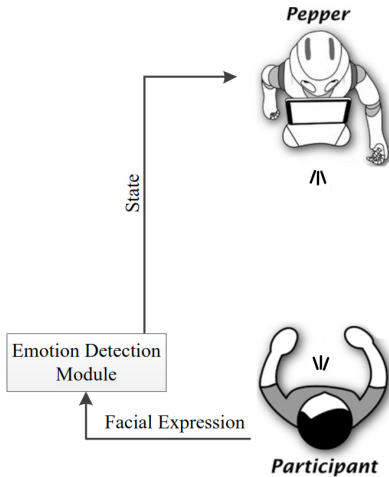
# Proposed framework

*Pepper*



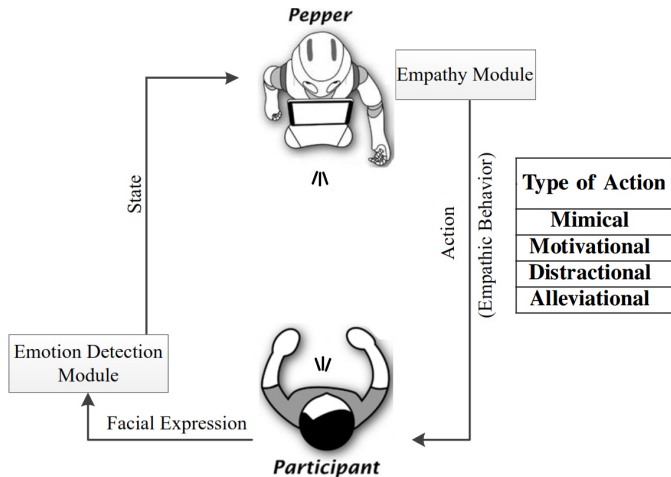
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# Proposed framework



- 12 states (4 emotions  $\times$  3 personality type)

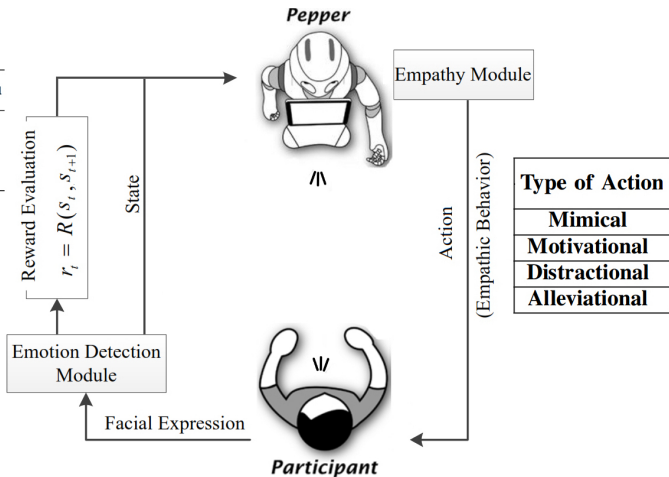
# Proposed framework



- 12 states (4 emotions × 3 personality type)
- 4 actions

# Proposed framework

$S_t \backslash S_{t+1}$	A/Sa	N/H/Su
A	-1	1
Sa	-1	1
H	-1	1
Su	-1	1



- 12 states (4 emotions  $\times$  3 personality type)
- 4 actions

# Defined and converged actions in each emotional state

Category	Emotion	Utterances	
<b>Mimical</b>	Anger	Is it annoying?	It is annoying me too!
	Sadness	Ooh, it's a pity!	You seem disappointed!
	Happiness	I'm happy you are happy!	I'm happy to play with you!
	Surprise	Seems wonderful!	Amazing, it's fantastic!
<b>Motivational</b>	Anger	Let it go, look for next round.	Hey buddy look forward, next round you will win.
	Sadness	So far you did your best, keep going!	Hey, don't worry, next time you will win.
	Happiness	You seem more beautiful when you smile.	I'm proud of you, you play very good.
	Surprise	Amazing you are very good in this game!	Hey, it's amazing no? Let's go forward.
<b>Distractional</b>	Anger	I preferred if I could play soccer!	I think I'm a lucky robot that can speak with you!
	Sadness	You know I cannot walk when I'm plugged in!	Hey buddy I forget your name! can you repeat your name?
<b>Alleviational</b>	Anger	I'm sorry, if you are annoyed!	Hey buddy, it's just a short game, take it easy!
	Sadness	Indeed without you I couldn't pack my bag as this full!	You did your best, don't regret.

THE TYPE OF UTTERANCES WHICH THE MODEL CONVERGED TO IN DIFFERENT STATES ARE INDICATED BY SIGN \*.

Type of Action	Ambivert			Extrovert		Introvert		
	Anger	Happiness	Surprise	Happiness	Surprise	Anger	Happiness	Surprise
<b>Mimical</b>		*	*	*			*	*
<b>Motivational</b>					*	*		
<b>Distractional</b>								
<b>Alleviational</b>	*							



# Future Work

- Improving emotion recognition
- Evoking negative emotions like sadness and anger
- Interacting with introvert users

Thank you for your attention!



Contact:  
Elahe Bagheri, [elahe.bagheri@vub.be](mailto:elahe.bagheri@vub.be)