

Creating Trust Between Groups of Humans and Robots Using a Novel Music Driven Robotic Emotion Generator

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Motivation

- Creating affective trust and likeable robots for human-robot interaction requires socially believable emotional agents
- Music is one of the richest means to show emotion, avoiding high degrees of freedom and uncanny valley
- Musical prosody can allow robots to communicate and demonstrate emotions and state of mind
- We present a new generative process for emotional musical prosody, and evaluate its potential across different robotic platforms

Dataset and Generative System

- We first collected a new dataset, from 3 singers. Each singer improvised 4 hours of emotion tagged musical phrases. 20 emotion labels were used, taken from the Geneva Emotion Wheel.
- Our generative system combines the advantage of SOTA symbolic generation, using a conditional, convolutional variational auto-encoder and performs the symbolic representation using an audio sampler

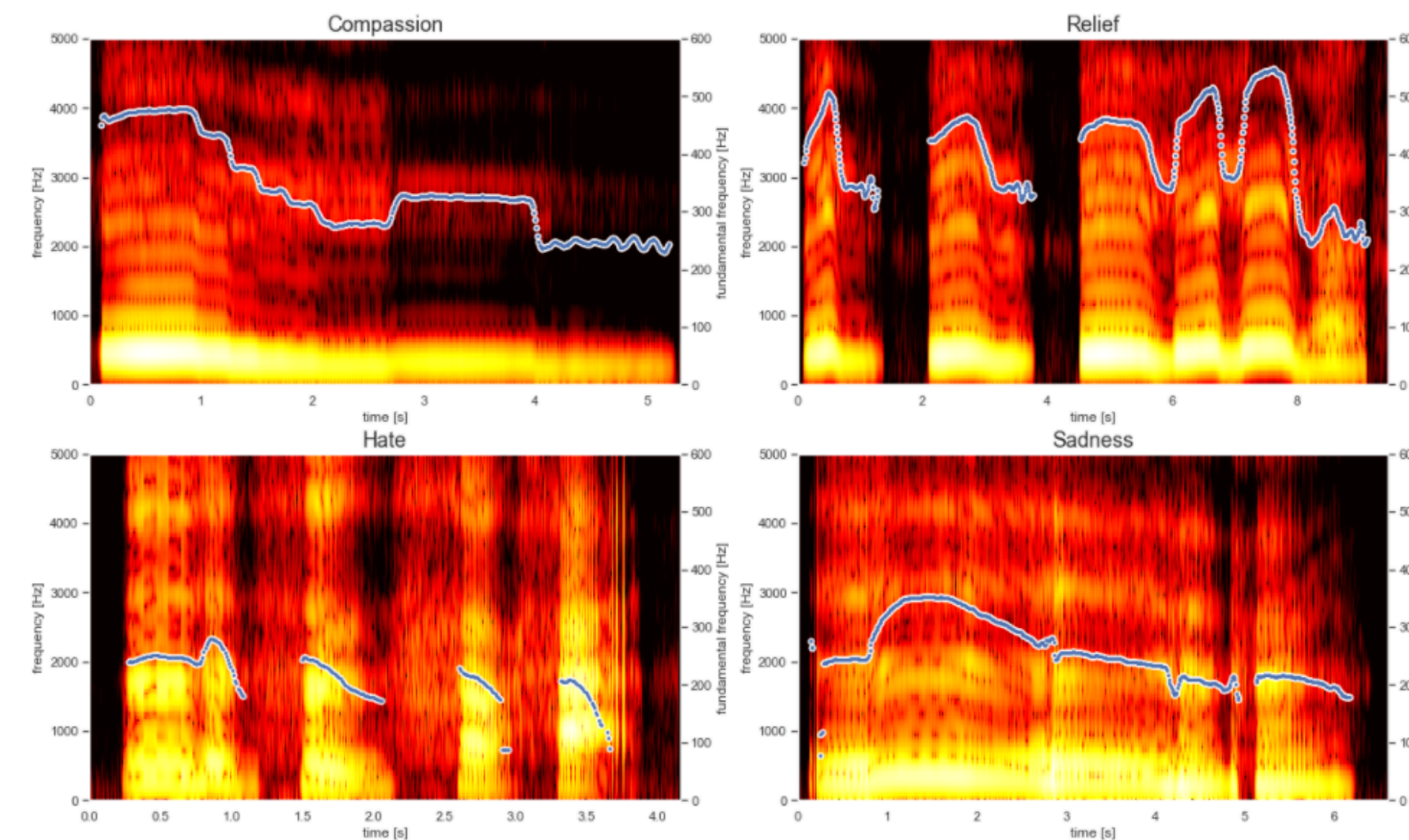


Figure 3: Spectrogram of phrase "Dog's are sitting by the door" with various emotions

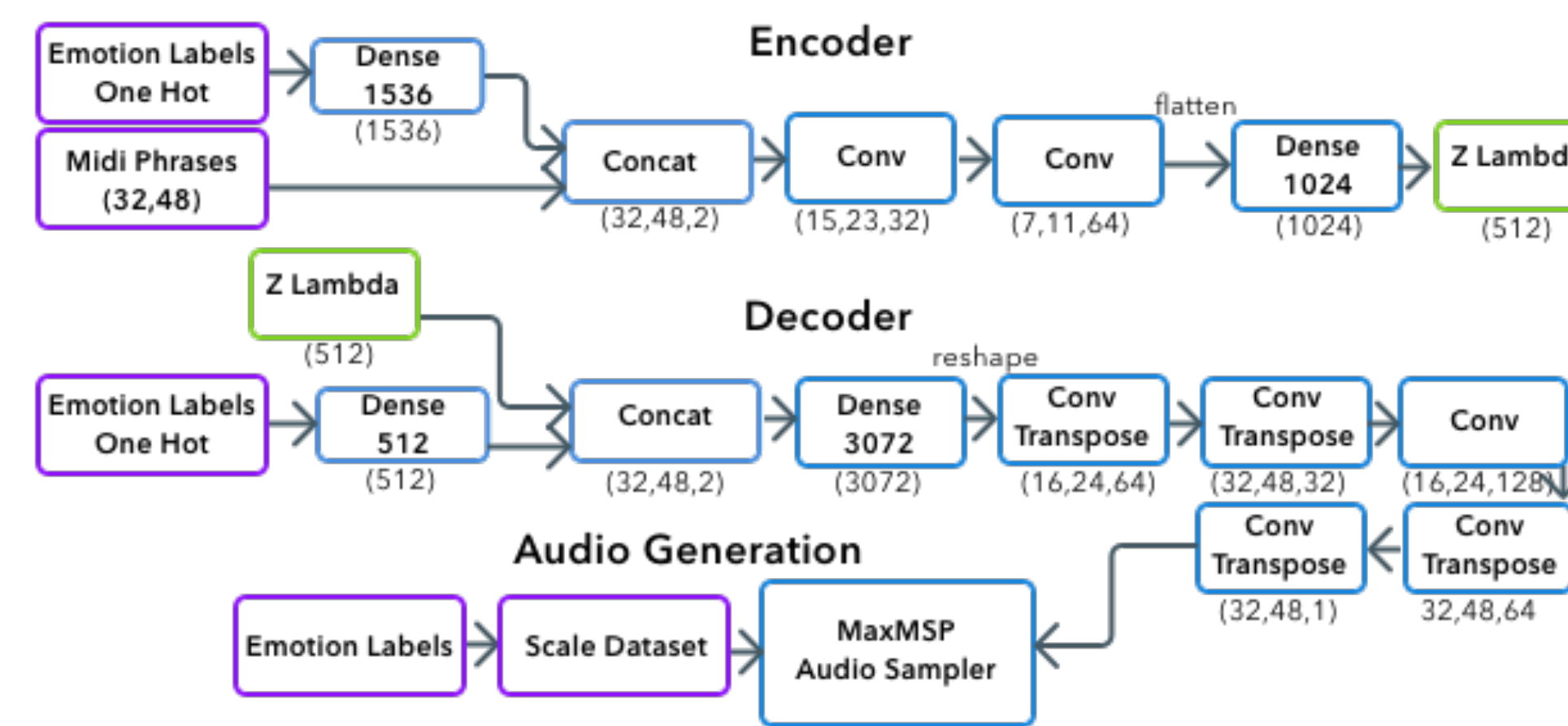


Figure 4: Overview of Generative System

Emotion	Emotion description (referenced from paper)	xArm (cobot arm)			Stretch (mobile manipulator)			SeekerBot (social robot)		
		Robot DOF	Speed Effect	Position adaptation	DOF	Speed	Position	DOF	Speed	Position
Sadness	Head bent down	Joint 6	Slow	Joint tilts end of robot upwards	camera	Slow	Camera looks at floor	Eyes		Eyes look down at floor
	"Collapsed Upper Body"	Joint 4	Slow	Joint collapses top half of robot towards itself				Legs	Slow	Legs bend to collapse robot
	"Low Movement Dynamics"				Telescopic arm	Slow	Gripper telescopes inward			
	Smooth falling hands		Slow		Lifting arm	Slow	Arm slides down to floor			
	inner corners of eyebrows are drawn up							Eyebro ws		Inner corners of eyebrows move upwards
	corners of the lips are drawn downwards							Mouth	Slow	Mouth Frowns

Table 1: Gesture Generation

Experiment

- We then conducted a study analyzing the Godspeed metrics and trust for a robotic arm (Figure 5). This showed significant results for prosody for Trust and Likeability.
- This was followed by comparing prosody for a humanoid and the robotic arm (Figure 6) We found no significant results for the humanoid, and significant results for the arm.

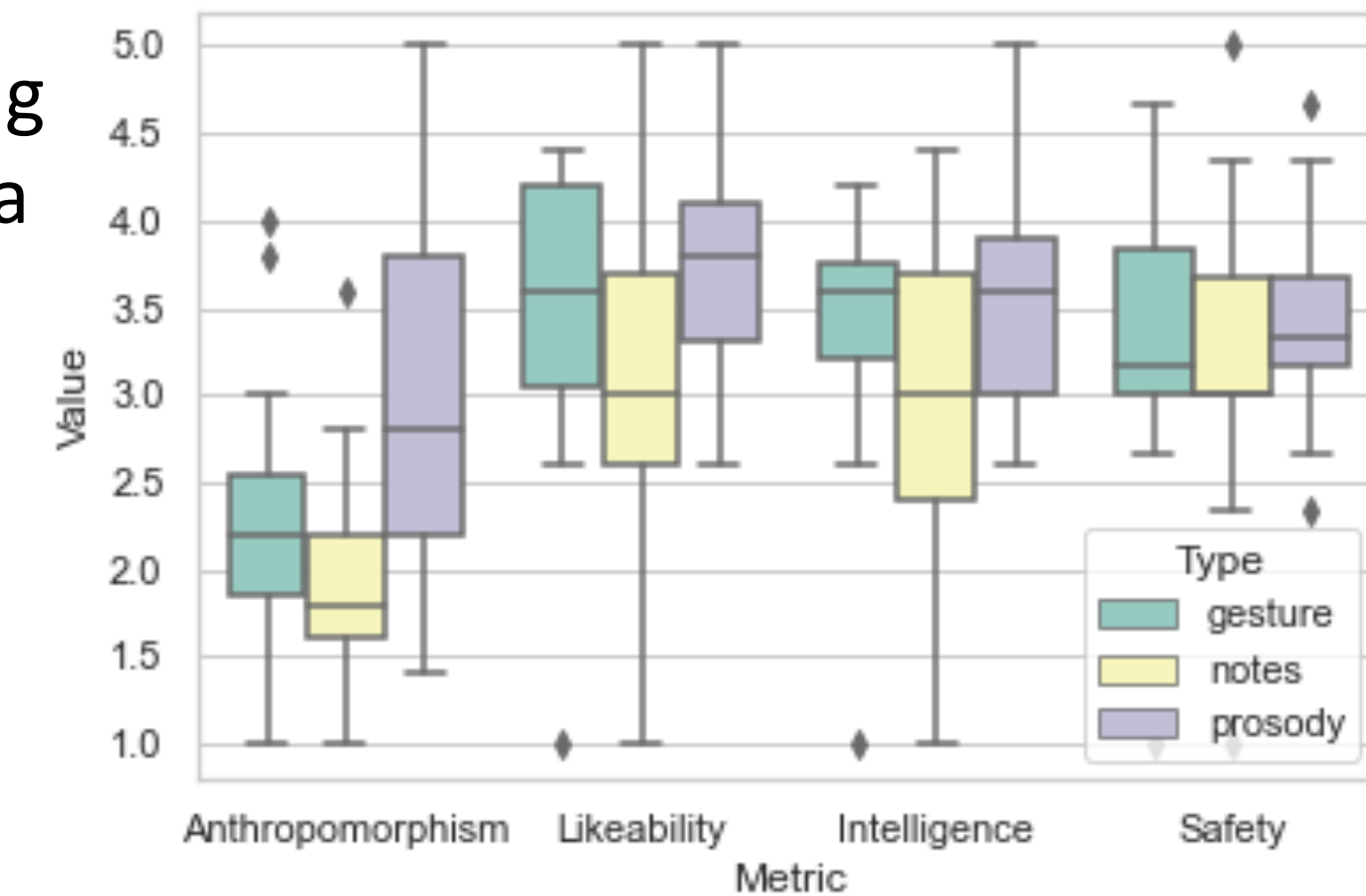


Figure 5: Godspeed Metrics and Trust for an Industrial Robotic Arm

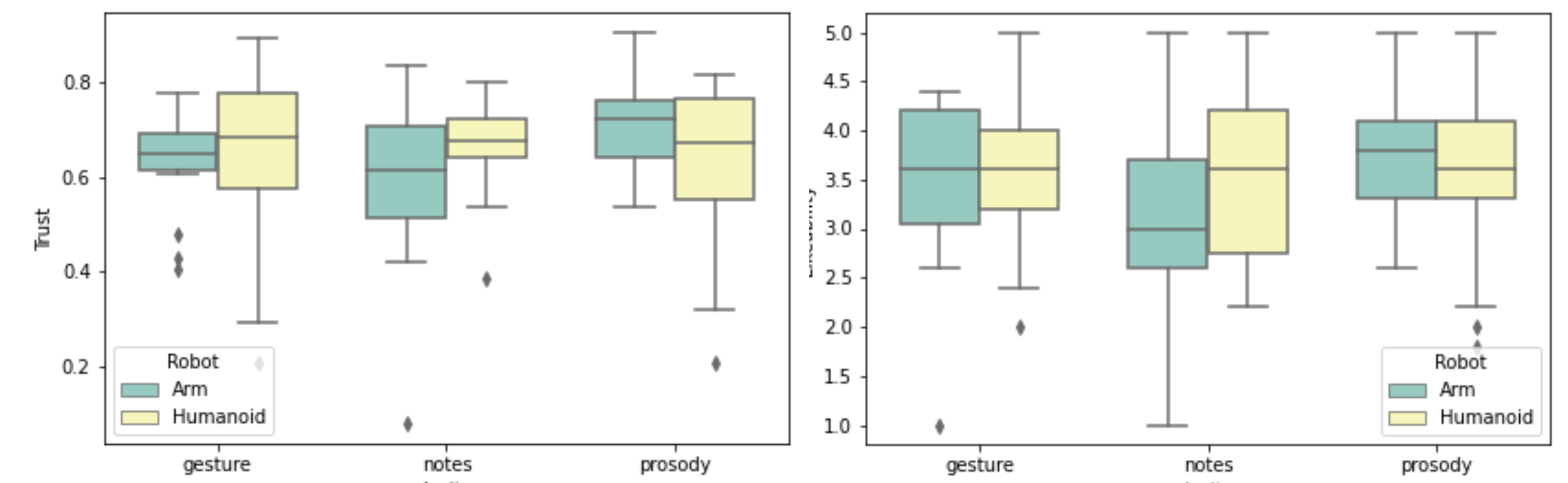


Figure 6: Comparing a Humanoid and Industrial Robot for Trust (Left) and Likeability (Right)

Future Work:

- Emotional musical prosody showed significant results for key metrics for social and industrial robotics
- Supports that different applications need to consider audio in different ways, default text-to-speech does not support collaboration
- Early results indicate that personality types can be utilized to predict human preferences for emotional responses, although further studies are required
- Future work will aim to consider how musical prosody and personality can be used in groups of robots and groups of humans.

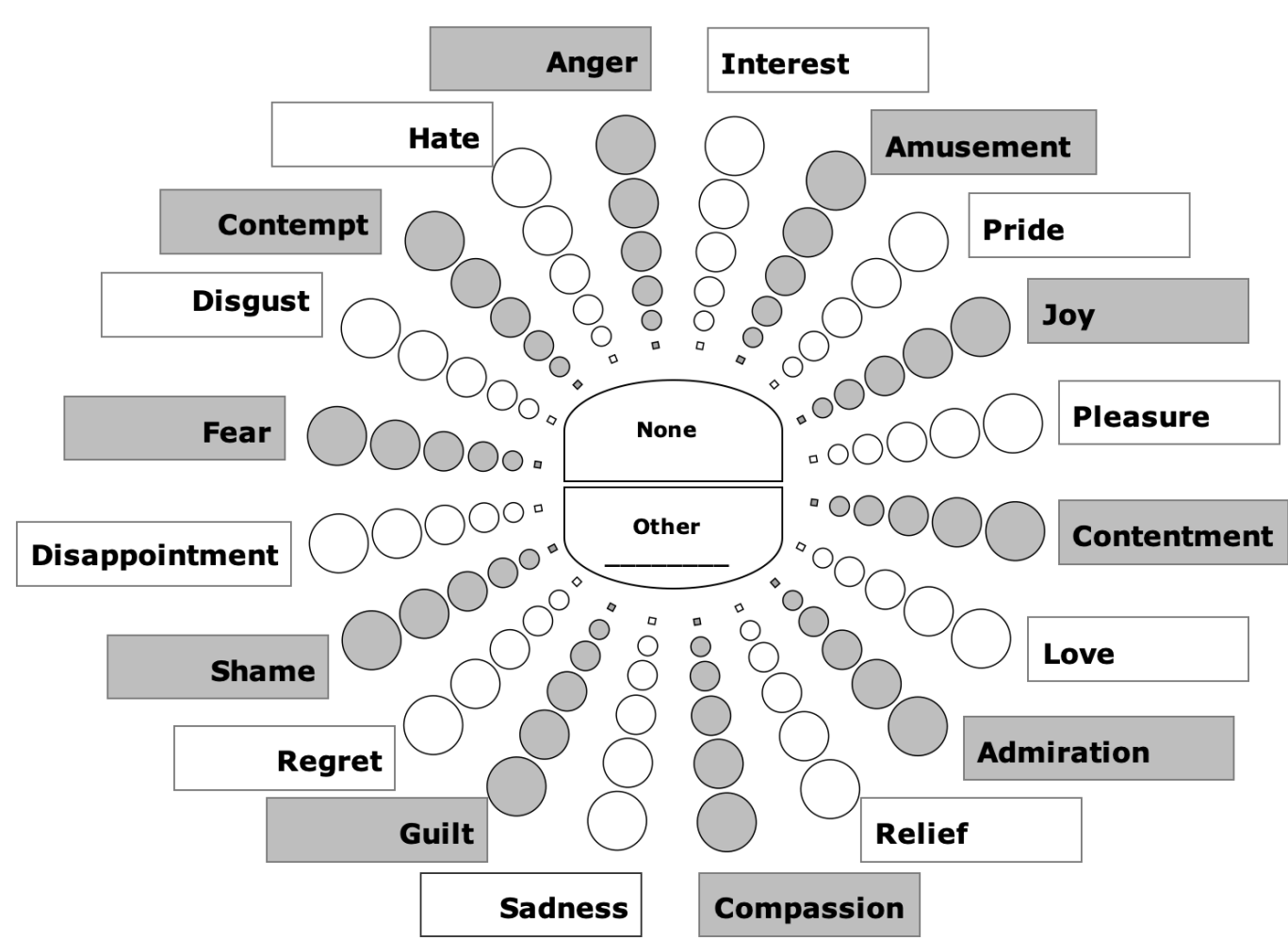


Figure 1: Geneva Emotion Wheel

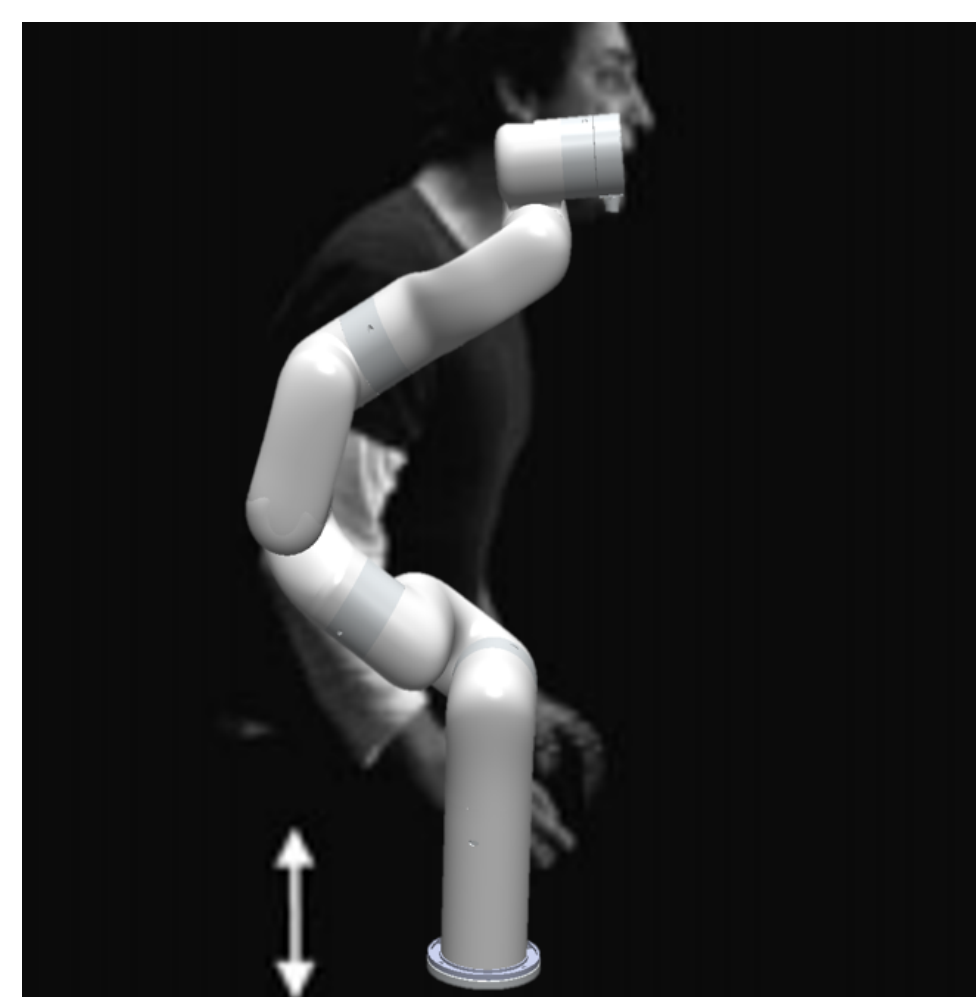


Figure 2: Gestures Modeled on Human Actor

Gestures

- We then developed a new system based on human movement for emotions to create gestures for robotic arms