Empathy in Human Robot Interaction

Intelligent Robotics Seminar
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Structure of the Presentation

- Motivation
- Definitions
- Neural Basis
- Human Robot Feedback Loop
- Efforts in Robotics
- Commercial examples
- Conclusion & Remarks

Motivation

"What I cannot create, I do not understand" - Richard Feynman

- Empathy as a biological advantage in evolution.

- A comprehensive overview of Empathy in Human Robot Interactions.

- Empathy as an emergent behavior

Meat Machines

A term coined by Marvin Minksy.

- Thoughts,Feelings, Hopes, Emotions as operations of the brain.
- Rejects the idea that mind stems from the immaterial.
- Helps in developing computational models.
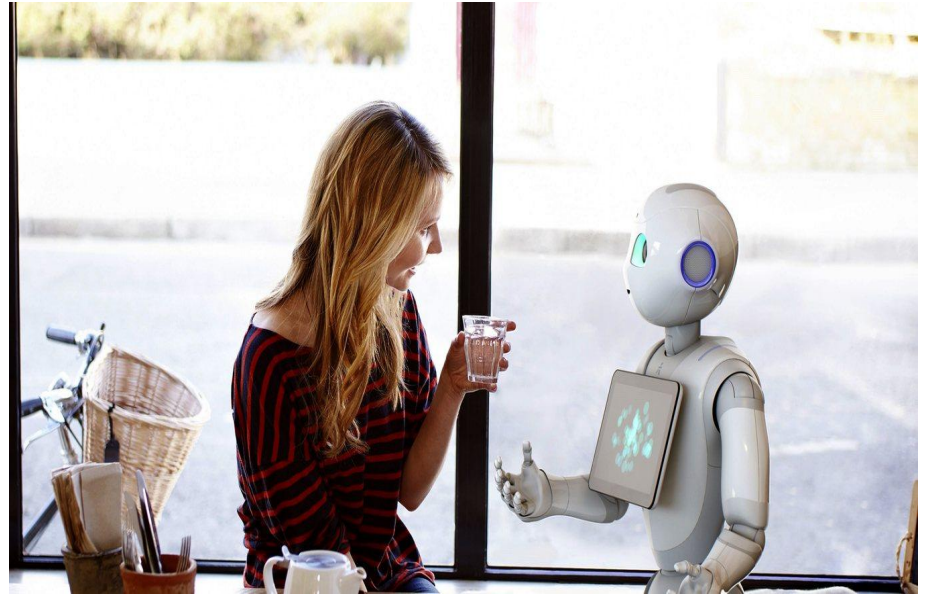
Defining Empathy

Cognitive Empathy

- Capacity to understand

  mental states

Affective Empathy

- Capacity to respond to

  mental states

[1]

Elements of Empathy

Cognitive Empathy

- Recognize an emotional state.
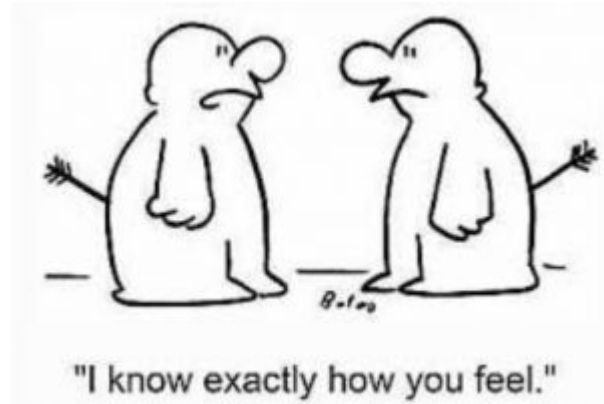- Theory of mind.
- Mind is not observable.

[2]

Elements of Empathy

Affective Empathy

- Emotional contagion.
- Mimicry
- Emotional Convergence.

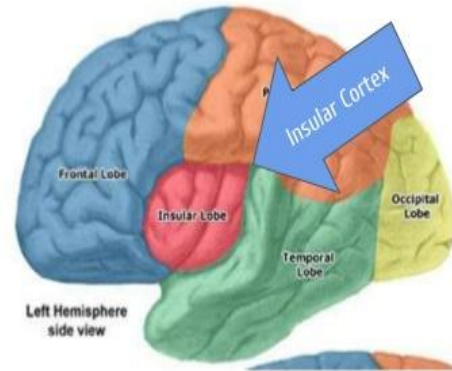"I know exactly how you feel."

[2]

Empathy in the Brain

- Neural Basis of Empathy
- Insular Cortex - Anterior Insula and Anterior Cingulate Cortex
- Mirror Neurons

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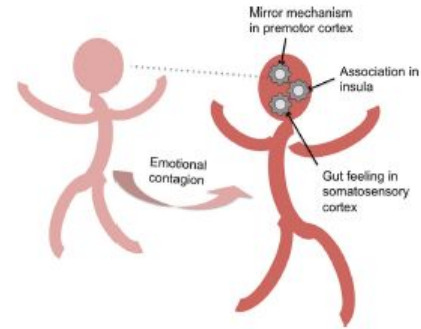- Ventromedial prefrontal cortex

The Insular Cortex

[3]

A Recipe for creating empathy

Model the Mirror Neuron system

Model the Insula
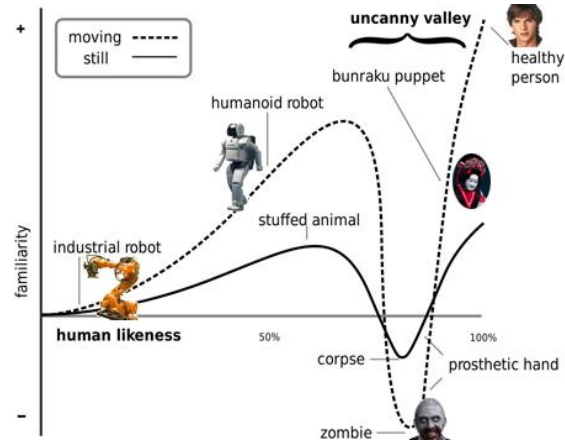
Model the internal feeling.

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An Empathetic Human Robot Feedback Loop

- Begins with the Human.
- Anthropomorphic Design.
- Embodiment & Communication
- Expression & Gestures

Overcoming the Uncanny Valley

- Reducing the near perfect human likeness of the robot.
- Fluent Display of emotions in robots.
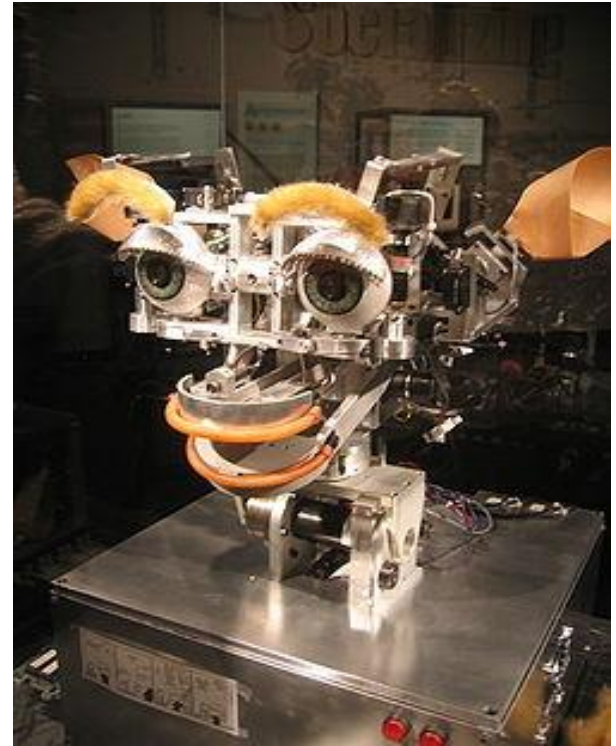- Computationally expensive.

[4]

Early efforts in Robotics

Kizmet by Cynthia Brezeal, MIT

- Classes of affective intent: approval, prohibition, attention, comfort, and neutral.
- Auditory system
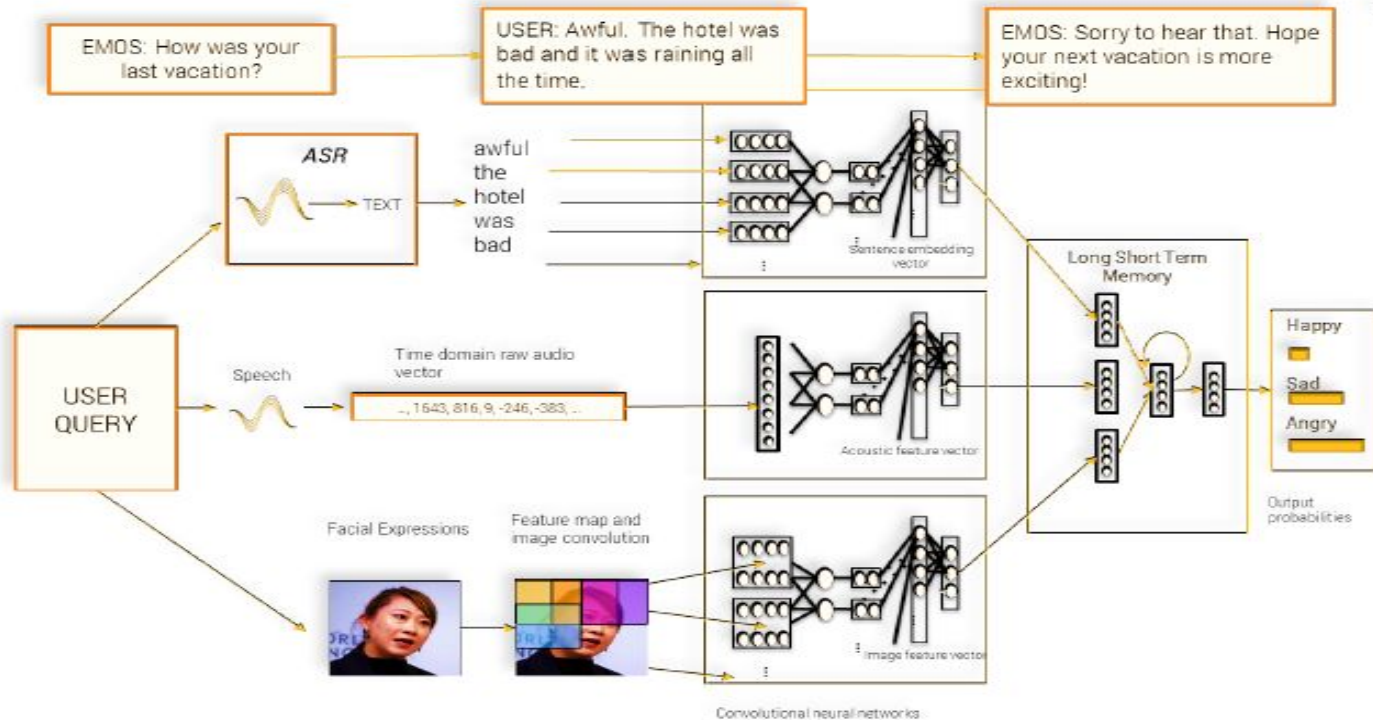- Visual System
- Vocalization System


[2]

Towards an Empathy Engine

- Zara, an empathetic android
- Developed in Hong Kong.
- Integrates Facial features, Speech tones and language inputs.
- Uses a recurrent neural network to preserve the memory
- Emotion and intent expression capability.

Deep Learning for empathy engine.

Long Short Term Memory - RNN

- Extension of Recurrent Neural Networks.
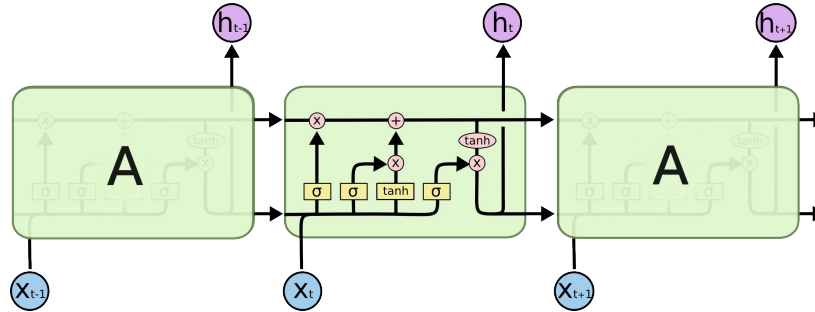- The Problem of Long-Term Dependencies
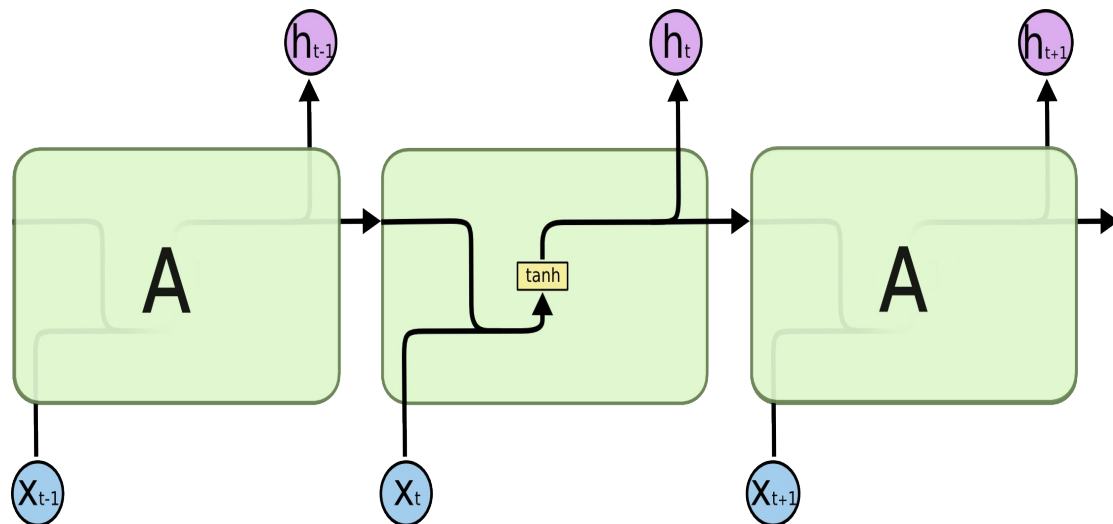
[9]

# Long Short Term Memory - RNN

- Extension of Recurrent Neural Networks.
- The Problem of Long-Term Dependencies
- Process data that has periodic patterns.

[9]

# SIRE Model

- Inspired by development in children
- Modality Independent Representation
- Tries to find "universals" across emotional states
- Maps High Level perceptual features to Low Level features
- Speed, Intensity, Regularity and Extent
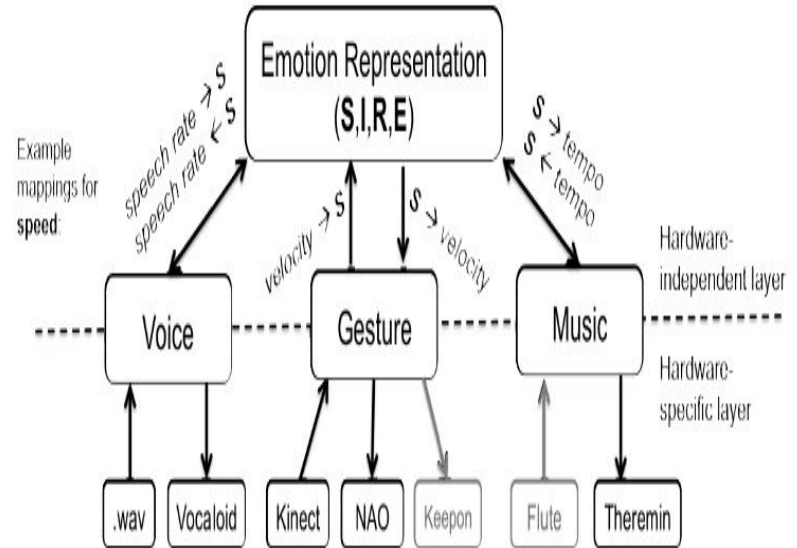
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MEI - Multimodal Emotional Intelligence

- Mei Mei Robot
- Three significant characteristics: a recognition ability, an interpretable model, and an expression ability.
- overall crossmodal recognition rate is 63%
- explicit theory for robot development of emotional intelligence through expressive facial and vocal interaction with a caregiver.
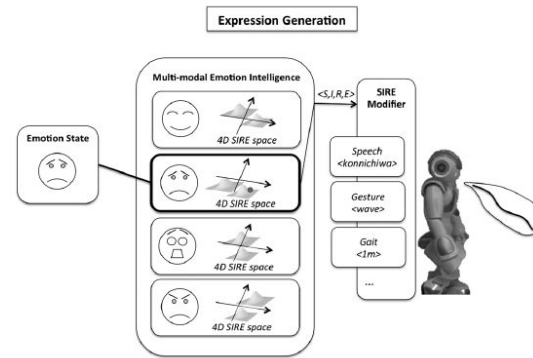

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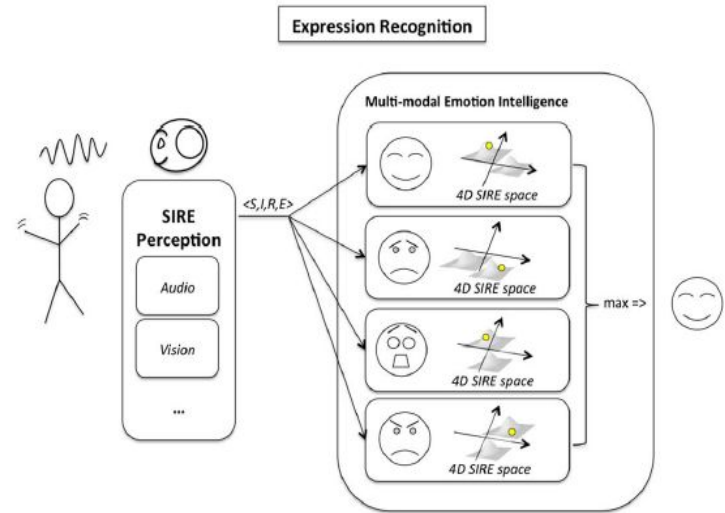
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Pepper by Softbank Robotics

- Commercially available robot.
- SDK available for Android.
- Uses proprietary algorithm.
- Choreographe, a software for a programming Pepper.
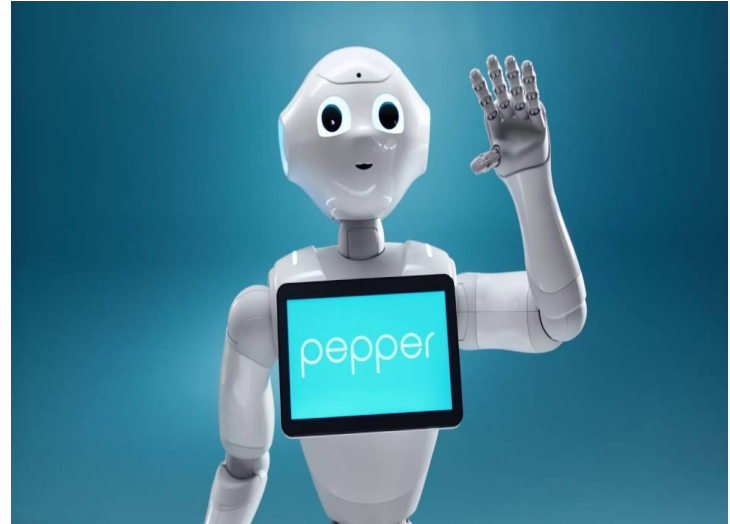
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Conclusion

- Standardized Empathy learning Engine for social robots.
- Modality independence.
- Far from a commercially viable empathetic robot.
- Does not consider Limbic system.

Remarks

- What is authentic empathy?
- Empathy model's believability.
- Ethical concerns of embedding robots with with abstract layers of intelligence.
- Effect on Human Empathy development.
- Cognitive Offloading: If we don't exercise a mental faculty, it will become extinct.
- Empathy is not the enemy of reason, rather it helps us assign value.
- Ethnocultural empathy

References

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[2] http://blog.teleosleaders.com/2013/07/19/emotional-empathy-and-cognitive-empathy

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[9]http://colah.github.io/posts/2015-08-Understanding-LSTMs

[10]http://www.softbank.jp/en/robot/

[11]https://www.youtube.com/watch?v=SupXHWZ5kcs

Questions?