Empathetic engagement drives nonverbal interactions between humans and a small-scale robot

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Motivation

- Our ongoing user-centered design project maps user responses to small-scale, non-humanoid robots.
- Research aims to identify:
  1. Minimal affectively expressive design features.
  2. How users understand and categorize these affective cues in small-scale and non-humanoid forms.

Robot Design

- The unintimidating size invites tactile interaction between humans and the robot.
- The small size requires focus on hardware that elicits empathetic engagement.

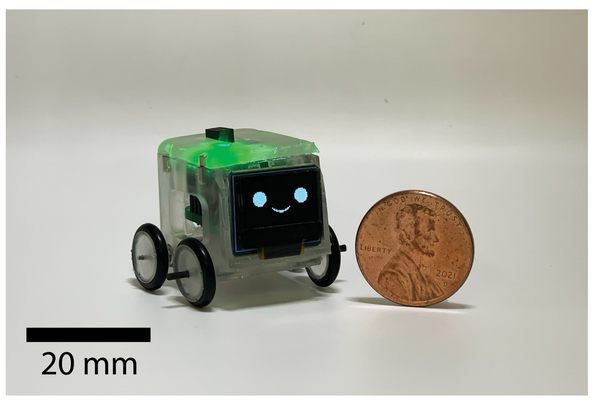

Fig 1. The robot is approximately 1 in^3 with a mass of 10.8 g. The robot has on-board sensing and computation.

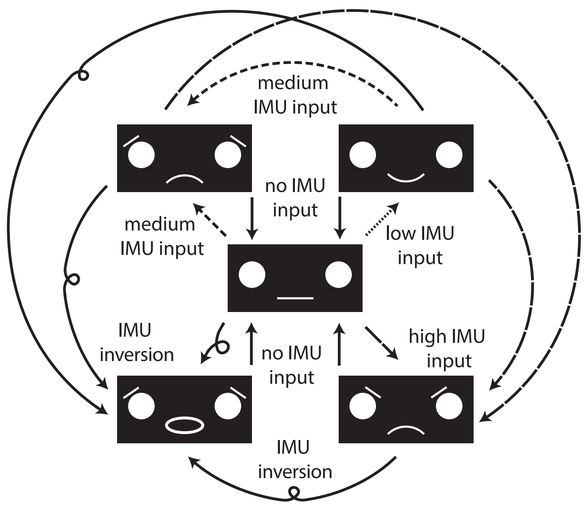

Fig 2. A software finite state machine utilizes an IMU to display affect.

Methods

- 11 participants recruited using snowball sampling.
- Participants were asked to interact with the robot for up to five minutes and to narrate their thought process as they did so.
- A minimum of 2 out of 3 researchers were present for observations, notes were cross-referenced.

Fig 3. A participant interacts with the robot.

Qualitative Data Analysis

First Cycle: open, inductive coding
- Descriptive—How do participants talk about, characterize, and understand what is going on?
- Process—What are participants doing? What specific means and/or strategies are they using?

Second Cycle: thematic coding
- Identifying patterns and groupings across descriptive and process codes.

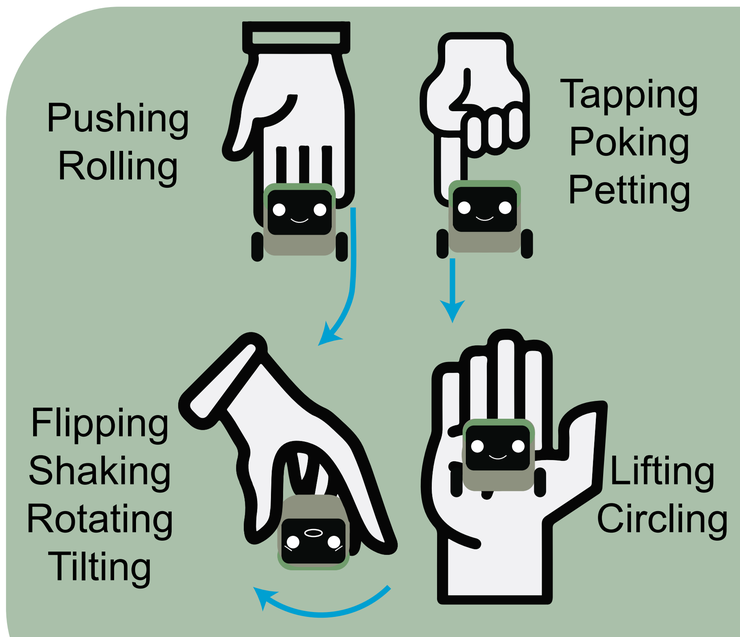

Fig 4. Nonverbal, tactile interactions by participants.

Results

Nonverbal interactions
- Pushing/rolling - 31 instances
- Tapping/poking - 17 instances
- Flipping/shaking - 21 instances
- Lifting/circling - 8 instances

Affective descriptors
- 21 key descriptors of:
  - Emotional states (81%)
  - Facial expressions (19%)

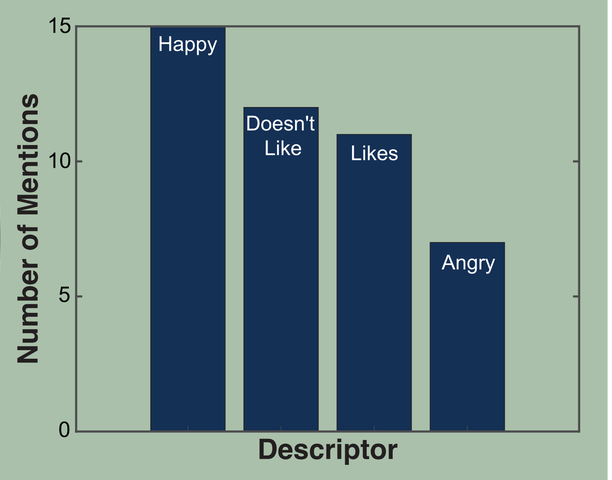

Fig 5. Top affective descriptors.

Conclusions

Minimal expression through ***simple affective displays*** can ***elicit empathy***, attentiveness, and social responsiveness in human-robot interactions, even at small scales and in non-humanoid designs.

- **Empathetic Connection**
  A minimal set of cues prompted perception of emotional states.
- **Nonverbal, Tactile Interaction**
  Participants engaged through touch, handling, and movement.

What's next?

- Reproduce the pilot study on a larger scale with video recordings to validate our initial findings.
- Test minimal design factors by examining how different modalities such as sound and light influence empathetic identification and interaction.
- Draw on the unique affordances of the robot size scale to examine grasping and handling in human-robot interaction.