Begränsad delning

Umeå universitet, 901 87 Umeå
TAIGA – Centrum för transdisciplinär AI
Microproject Report

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Sid 1 (2)

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Report: Micro-project

Project Details

Title: **Understandable non-humanoid robots**

TAIGA Focus Area: Embodied Interactive AI

Start date: 241001   End date: 241231

Responsible person(s): Suna Bensch, Department of Computing Science

Summary
The project aims to conduct a study of generic patterns of movements and actions that relate to understandability of a robot arm with a manipulator.

Method

The project was implemented with a mix-method approach comprising theory development, algorithm development, and its implementation and testing.

The specific activities and work that were carried out to achieve the project objectives of

a) A taxonomy of atomic understandability categories (AUCs) for non-humanoid robots.

b) Proposed design of CAs for different AUCs

were

- developing the theory of Levels of Explanations (LoE) as part representation of AUCs for non-humanoid robots, in particular, robot arms,
- utilizing two Markov Models (HMM and POMDP) to design and automate CAs for different LoEs.

This project was a transdisciplinary and international project carried out together with researchers **Shikhar Kumar and Yael Edan** at Ben-Gurion University of the Negev, Israel.

Results

The results of this transdisciplinary project incorporate **human factors and algorithm development for Human-Robot interaction.** To approach how humans perceive and work with non-humanoid robot arms, human reactions to robotic arm movements were studied and categorized and then

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integrated into algorithm development that automates robotic arm movement (CAs) according to the exhibited behaviour of the human.

The results are a taxonomy of Levels of Explanations (LoE) based on levels of understandability, which informed the algorithm development. In particular, we used Markov algorithms (HMM and POMPD) to design understandable robot behaviour in accordance with human behaviour, implemented and evaluated the performance of the algorithms. The results demonstrated that both models can interpret human behaviour and generate corresponding understandable robot behaviour.

The project results in a submitted journal publication, currently available at

https://www.techrxiv.org/users/882271/articles/1260883-advancing-understandable-robots-a-model-for-levels-of-explanation-and-methods-to-use-them

Resource allocation

1. Personnel costs (inc overhead): 50.000 SEK
2. Material costs: 0 SEK
3. Travel costs: 0 SEK
4. Other costs (specify):

Evaluation

The project resulted in research that is rare in the field of Human-Robot Interaction, where the focus is often limited to human factors, and in robotics research, where the emphasis is typically on algorithm development, implementation, and testing. By combining both human factors and algorithm development, this research **pushes the frontier into a more holistic, transdisciplinary approach**. It bridges the gap between technical design and human-centered needs, emphasizing the importance of understanding the interplay between human behaviors and robotic systems. This approach not only advances the technical aspects of robotics but also ensures that the technology is developed in a way that is more intuitive, effective, and beneficial for real-world applications. The integration of these two disciplines opens up new possibilities for creating more adaptive, user-friendly robotic systems that can better serve human needs.

Responsible person(s)   Date: ____24/02/2025___

____Suna Bensch