

1) "Robot, Explain Yourself"

Enhancing Human-Robot Communication with Large Language Models

Objective:

The project aims to bridge the communication gap between humans and robots by integrating a Large Language Model (LLM) on the robot. The focus is on developing a system where the robot can explain its actions, decisions, and processes in natural language, and in particular its use and interpretation of low-level perception information and known context. This project emphasizes the importance of interpretability and trust in human-robot interactions, particularly in complex environments where comprehension of robotic actions is crucial and perception information robustness is challenged.

Duration: Max. 150 hours of work per student, over a semester.

Tasks:

1. Literature Review: Conduct an review of current technologies and methodologies in human-robot communication, with a particular focus on the use of LLMs for enhancing interpretability of low-level perception information in robotics. Identify challenges and opportunities in making robotic actions and decisions understandable to human users.
2. Integration Framework Design: Design a framework for integrating a Large Language Model with the robot. This framework should enable the robot to explain to humans its actions based on its interpretation of low-level perception information and context. Consideration should be given to real-time processing and response generation.
3. LLM Customization: Customize or fine-tune a pre-existing LLM to understand and generate explanations about the robot's actions, sensor data, and decision-making processes. This task involves training the model on domain-specific data to ensure relevance and accuracy in the explanations provided.
4. Human-Robot Interaction (HRI) Prototyping: Develop a prototype system that demonstrates effective human-robot communication. The prototype should include a user interface for inputting queries and displaying the robot's explanations. Test the prototype in various scenarios to assess the system's ability to enhance human understanding of the robot's actions.
5. Evaluation: Design and conduct an evaluation to assess the effectiveness and efficiency of the developed explanation system. Evaluate the system accuracy in explaining the cause of a decision.
6. Project Documentation and Presentation: Document all phases of the project, including the literature review, framework design, LLM customization process, prototype development, and evaluation results. Prepare a comprehensive project report and a presentation summarizing the key findings, challenges, and future directions for enhancing human-robot communication through LLMs.

Deliverables:

- Literature review report on human-robot communication and LLMs
- Design documentation of the integration framework
- Customized LLM and training dataset
- HRI prototype system
- Evaluation report and user study results
- Final project report and presentation