Project Proposal: LLM-Based Human–Robot Interaction using ROS2 and Quanser QArm

The integration of Large Language Models (LLMs) with robotic systems opens a new frontier in human–robot interaction. This project aims to develop a conversational interface that allows users to communicate naturally with a Quanser QArm robotic manipulator. Using the ROS2 framework, the system will interpret verbal or textual commands, analyze available topics, services, and actions, and autonomously plan and execute appropriate robotic behaviors.

The core idea is to create a GPT-based node in ROS2 that acts as the robot's 'brain.' This node will receive user inputs through speech or text, query the ROS graph to understand what functionalities are available, and generate structured action plans to control the QArm. By integrating natural language processing and robotic control, the system aims to demonstrate seamless communication between humans and robots without manual coding or predefined scripts.

Objectives:
• Develop an LLM-powered ROS2 node that can interpret human instructions.
• Enable the Quanser QArm to perform autonomous actions based on contextual understanding.
• Demonstrate natural, voice-based human–robot interaction.
• Evaluate safety, responsiveness, and adaptability of the system.

Method Overview:
The system architecture combines ROS2 for hardware control, an LLM interface for decision-making, and optional speech modules for voice input and output. The ROS2 node will periodically scan the system for available topics and services, provide this information to the LLM, and execute the generated commands in a safe and validated manner. The QArm will be used for motion tasks such as object manipulation and gesture demonstration.

Expected Outcomes:
• A functional prototype of a conversational robotic arm.
• Demonstration of context-aware task execution using natural language.
• A modular ROS2 framework that can be extended to other robotic systems.
• Contribution toward intuitive human–robot interaction research.

Estimated Duration: 6 months