Literature Review – Industrial Robotics Arm Control using ROS2 and MuJoCo 1. Introduction Industrial robotic arms are a cornerstone of modern manufacturing automation, providing precision, repeatability, and efficiency in tasks such as assembly, packaging, and material handling. This project focuses on modeling, simulating, and controlling a 6 Degrees of Freedom (DoF) robotic manipulator using ROS2 and MuJoCo, integrated through Python for real-time visualization and control. The goal is to develop a system capable of simulating an industrial robot performing a pick-and-place operation, visua... 2. Related Work Several open-source projects have demonstrated the integration of ROS with physics-based simulators for robotic applications: - UR5 with ROS2: The Universal Robots UR5 arm is one of the most commonly used models for research. The ROS2 packages (e.g., universal_robot2, moveit2_ur5_demo) provide complete control interfaces, allowing for trajectory execution and end-effector manipulation. - MuJoCo for Robotic Simulation: MuJoCo (Multi-Joint dynamics with Contact) is a lightweight physics engine used in robotics research for accurate joint control and visualization. Its XML-based model format allows integration with ROS2 nodes through ros2_control and mujoco_ros_pkgs. - Pick-and-Place Automation: Research studies demonstrate how trajectory planning and inverse kinematics can be combined in ROS2 to control robot manipulators for pick-and-place tasks with precise motion control and real-time feedback. 3. Selected Robot and Simulation Tools - Robot Model: UR5 (6 DoF, revolute joints, end-effector gripper) - Simulation Tool: MuJoCo (real-time physics-based simulation) - Control Framework: ROS2 (Humble) and Python nodes for movement and trajectory control The UR5 arm provides a balance between complexity and accessibility, with extensive documentation and community support in both ROS2 and MuJoCo environments. 4. Proposed Application The chosen industrial task is an Automated Pick and Place System in a packaging line. The UR5 robotic arm will: 1. Detect or assume an object position on a conveyor. 2. Plan a trajectory to reach the object. 3. Pick the object using its end-effector. 4. Move to a designated drop zone and place the object. This simulation represents a typical automation process found in logistics and manufacturing industries. 5. Future Work Plan 1. Milestone 1: Literature review, environment setup (ROS2 + MuJoCo), and robot model collection. 2. Milestone 2: Implement forward/inverse kinematics and basic trajectory control. 3. Milestone 3: Full control node integration with GUI visualization of the industrial scenario. 6. References - Universal Robots Support Packages for ROS2. GitHub: UniversalRobots/Universal_Robots_ROS2_Description - Todorov, E. (2015). MuJoCo: A physics engine for model-based control. IEEE International Conference on Intelligent Robots and Systems (IROS). - MoveIt2 Tutorials – ROS2 Motion Planning Framework. - Zhao et al. (2021). ROS-based Control of Industrial Manipulators for Automation Tasks. Robotics and Computer-Integrated Manufacturing.