Real-Time VR Teleoperation of a Franka Arm for Construction Automation and Human-Robot Interaction

Arpit Jain*[1], Yuezhen Gao[1], Qipei Mei[1]

[1] Civil and Environmental Engineering Department, University of Alberta, Canada

Introduction

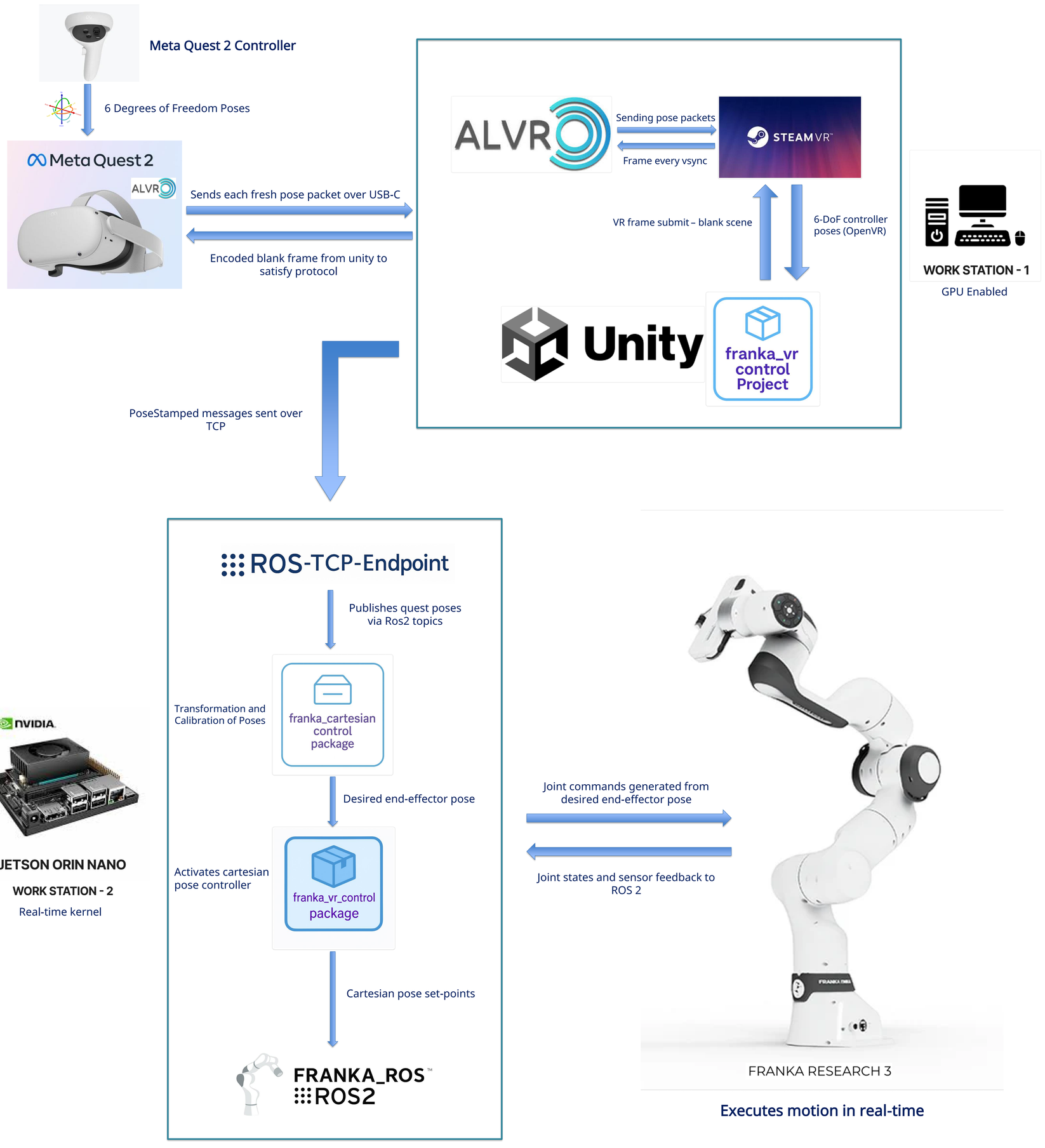
- Tele-operated robotic systems still rely on expensive, Windows-only VR software, which introduces latency and excludes many research labs that use Linux.
- We demonstrate that consumer-grade Meta Quest hardware can control a Franka robot on Linux with less than 20 ms end-to-end delay, enabling low-cost, intuitive human-robot interaction for research and remote manipulation.
- Our pipeline is fully open-source and self-contained - Unity, ROS 2 nodes, and real-time control run on a Jetson Nano RT, so any lab can reproduce the setup in a single day.

Key Technologies

- Franka Research 3
- Meta Quest 2
- ALVR & SteamVR
- Unity 2022
- ROS-TCP Connector
- ROS 2 Humble
- Jetson Nano (RT)
- Franka Ros2

Video Link

Workflow



Results and Impacts

- Achieved smooth, real-time XR teleoperation on Linux using consumer-grade Meta Quest hardware, allowing operators to control the Franka arm as naturally as a handheld tool.
- Demonstrated millimeter-level placement of mock bricks and sensors, indicating readiness for masonry alignment, bolt seating and structural monitoring tasks.
- Offering an open-source platform that can be used for operational training and site automation in the future.

Future Work

- Add an eye-in-hand vision module (Intel RealSense) and train a vision-language model so the robot can recognize construction materials and follow spoken commands (“stack two bricks”, “hand me the wrench”).
- Develop semi-autonomous task macros-the operator points once in XR and the robot finishes precise placement or tool delivery without continuous joystick-style guidance.
- Integrate onsite progress logging: the robot captures depth images, tags objects, and streams data to BIM databases for real-time construction monitoring.

Acknowledgements

FRANKA ROBOTICS
Meta
NVIDIA
UNIVERSITY OF ALBERTA

Contact : arpit.jain1@iitb.ac.in

*Intern and presenting author. Work conducted under the supervision of Yuezhen Gao and Dr. Qipei Mei.