Cover Letter and Project Ideas Proposal

Dear Sai Kishor Kothakota and the Mentorship Team,

I am excited to apply for the “ROS 2 Action Mux” project for GSoC. The challenge of building a middleware tool that can manage multiple action servers with predefined priority levels truly excites me. My background in ROS 2, C++ programming, and middleware design positions me well to create an efficient multiplexer that prioritizes critical actions—such as emergency stops—over routine operations.

What Excites Me About This Project

In robotics and automation, shared resources often become bottlenecks when multiple programs compete for them. Not all goals are created equal—emergency actions must preempt lower-priority tasks to ensure safe and optimal operation. I am particularly drawn to this project because it combines several interesting technical challenges:

- **Dynamic Goal Management:** Developing a system that routes action requests to a single server, while dynamically managing multiple action servers with different priorities, is a fascinating problem.
- **Preemption Mechanism:** Implementing a robust preemption mechanism so that higher-priority goals interrupt ongoing lower-priority ones is essential for ensuring safety in real-world scenarios.
- **User-friendly API:** Creating a clear and simple client interface that integrates seamlessly with existing ROS 2 systems is critical for adoption by the robotics community.
- **Extensibility:** The idea that this multiplexer can work with any type of action message adds great versatility, making the tool useful across a wide array of robotic applications.

For instance, consider a scenario where a robot is performing a routine navigation task, and suddenly an obstacle is detected requiring an emergency stop. With the Action Mux, the emergency goal would automatically preempt the ongoing routine, ensuring rapid and safe responses. This is exactly the type of real-world impact that motivates me to contribute to this project.

Project Strategy and Approach

To ensure the project is modular and manageable, my approach would be divided into several key phases:

- **Action Multiplexer Core Development (50 hours):**

    - Develop the core middleware to route requests to a single action server.
    - Design and implement a mechanism to assign and manage priorities for incoming goals.
    - Ensure that high-priority goals preempt lower-priority ones smoothly.
- **Client API Development (40 hours):**
    - Create a user-friendly client API that abstracts the complexity of action multiplexing.
    - Integrate callback handling, feedback propagation, and result management.
- **Testing and Validation (40 hours):**
    - Develop comprehensive tests (unit and integration) for verifying the preemption mechanism and overall behavior.
    - Validate with simulated scenarios where multiple goals are issued with varying priorities.
- **ROS 2 Integration and Documentation (30 hours):**
    - Wrap the middleware into ROS 2 nodes and create launch files.
    - Prepare thorough documentation, including example use cases and guidelines for integration.
- **Buffer and Review (15 hours):**
    - Reserve time to handle unforeseen challenges and incorporate feedback from mentors and the community.

Time Commitment and Scheduling

I currently work on robotics projects where I have gained significant experience with ROS 2 and C++ programming. This project aligns perfectly with my interests, and I can commit the full 175 hours required. I have arranged my schedule to dedicate approximately 15–20 hours per week exclusively to GSoC development, ensuring steady progress throughout the project period.

I am enthusiastic about the opportunity to develop a robust and versatile action multiplexer that will contribute meaningfully to robotic systems requiring dynamic resource management. Thank you very much for considering my application. I look forward to the opportunity to discuss my ideas further and to contribute to this innovative project.

Sincerely,

Beniamino Squitieri

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