Roo Guide

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1 Introduction

Roo was originally provided to the Robotics Systems Laboratory as an empty chassis. Since then, it has undergone significant development and has progressed into a functional robotic platform. Roo serves as the smaller counterpart to Kanga, another robot maintained by the lab. At present, there are three Roo units in different stages of readiness: one is fully operational, one is mostly functional but exhibits issues with responding to controller commands, and the third is partially wired and requires additional components to be completed.

The primary objective of the Roo project is to improve the robustness and reliability of the platform. The long-term vision for Roo is to serve both educational and applied purposes. In an educational setting, it provides students with hands-on experience in robotics design, programming, and testing. In potential field applications, Roo could be adapted for public safety tasks such as scouting hazardous environments or collecting samples. Currently, Roo demonstrates reliable manual control, but further work is needed to enhance its autonomous navigation capabilities.

2 Manual Control Guide

2.1 Enabling Control

1. Ensure that Roo is placed on a smooth surface like tiling or concrete. Roo does not move well on uneven surfaces like loose dirt or grass.

2. Turn on Roo by flipping the on/off switch located at the back side. Wait until it beeps and the LEDs on the GPS blink. If it does not blink, that means power is not getting to all necessary parts of Roo, requiring troubleshooting.

3. Grab the controller.

4. Ensure that (2) is in proper position by positioning at the bottom in line with the middle line.

5. Flip (1) from the left to the right to turn on the controller.

6. Wait until the screen is stabilized, then bring (1) to the middle.

7. Flip (3) down. This switch arms the robot. If you hear a long beep and can then drive Roo, you have successfully gained manual control. If you hear multiple "alarm" beeps, that means Roo is unable to be armed, which is likely an issue with the mode Roo is currently set to. This can be changed by using the QGroundControl menu.

2.2 Driving Roo

The controller operates as follows:

1. Stick (1) controls forward and backward motion.

2. Stick (2) controls left and right motion.

The front of Roo is opposite the side with the on/off switch.

If pushing Stick (1) forward causes Roo to move backward, the motor direction is reversed. To correct this, connect the motor controller to RoboRun+, load the robot configuration, and set the motor direction from Direct to Inverse.

If Stick (1) controls left and right movement while Stick (2) controls forward and backward movement, the channel mapping is incorrect. This can be resolved by recalibrating the controller in QGroundControl.

3 Autonomous Control

3.1 General Guide

Roo uses QGroundControl to execute autonomous navigation. Within QGroundControl, users can define a series of waypoints that the robot will follow sequentially. To create a waypoint mission, first connect Roo to QGroundControl and ensure that the telemetry link is active. Then, switch to the "Plan" view. In this view, waypoints can be added to the map by clicking on the desired locations.

Once all waypoints have been placed, save the mission and upload it to Roo. After uploading, switch to the "Fly" view and arm the robot. The mission can then be started, and Roo will navigate to each waypoint in order. During operation, the mission can be paused or aborted at any time if manual intervention is required.

At present, Roo is capable of executing waypoint missions; however, additional work is needed to improve its reliability and consistency in autonomous mode.

3.2 Issues with Autonomous Control

Several issues currently limit Roo's autonomous performance. First, the gain parameters require adjustment. At present, the control system tends to rely on one motor at a time, which leads to overcompensation. Many of the parameters were adapted directly from Kanga and therefore need to be tuned specifically for Roo to achieve smoother navigation.

In addition, the GPS introduces an error of approximately 4–5 meters. As a result, waypoint navigation is not always precise. To mitigate this issue, it is recommended to test Roo in open outdoor environments where GPS reception is stronger, and to monitor the robot closely during autonomous operation to prevent unintended behavior.

4 Power System

Roo is powered by 12 V lead-acid batteries. These batteries provide the necessary current to drive the motors and power the onboard electronics. Each battery should be fully charged prior to operation to ensure stable performance and to reduce the risk of unexpected shutdowns during testing.

When installing the batteries, ensure that the polarity is correct and that all connections are secure. Loose connections can lead to power loss or inconsistent behavior. It is also important to monitor the battery voltage during operation; discharging lead-acid batteries below their recommended cutoff voltage can significantly shorten their lifespan.

After use, batteries should be recharged using an appropriate lead-acid battery charger. They should never be left in a fully discharged state for extended periods of time. For safety, inspect the batteries regularly for signs of wear or damage.