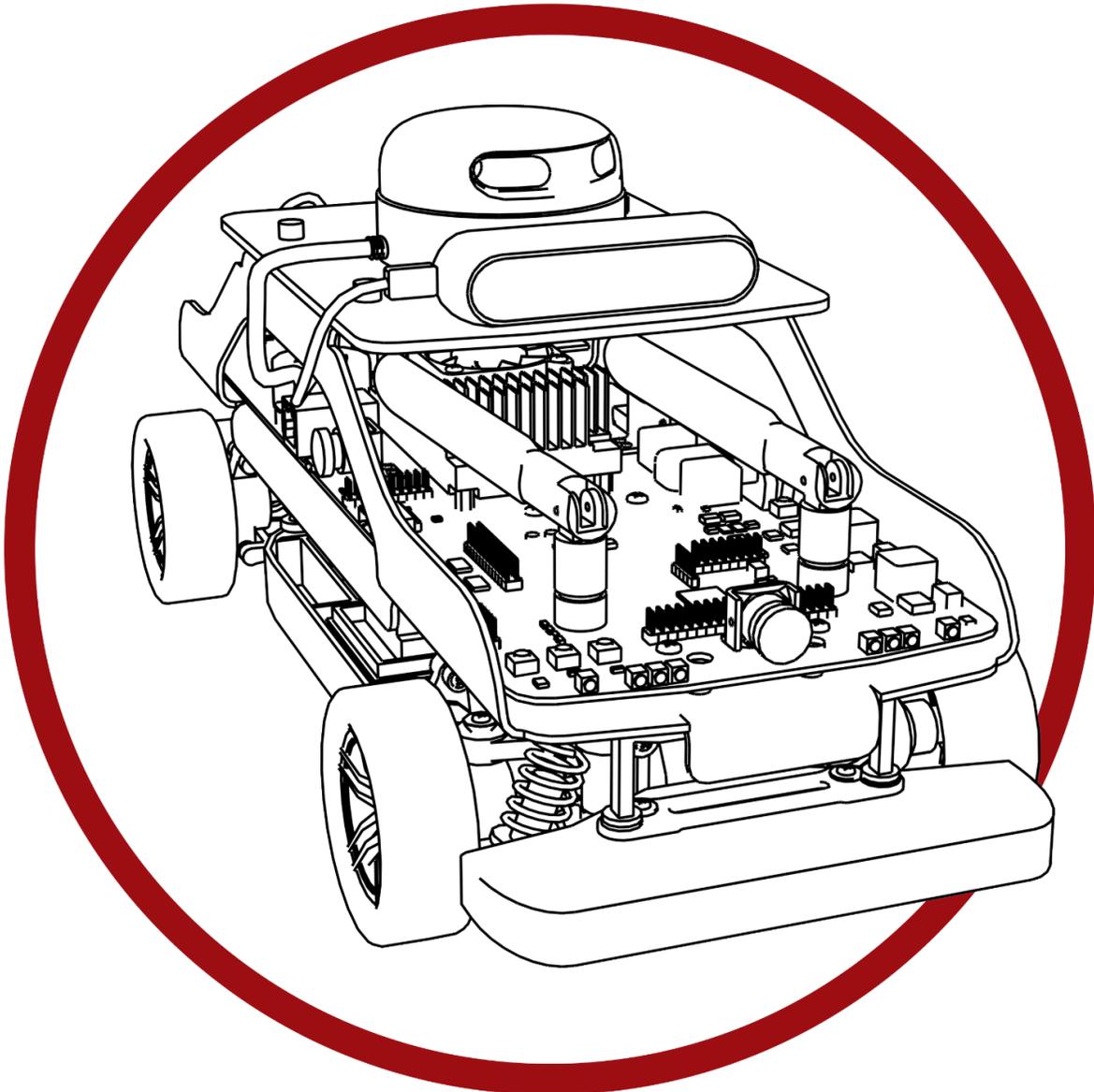


# Self-Driving Car Research Studio



## Hardware Tests - ROS

The following steps are meant to allow you to test the hardware available on the QCar via the ROS development environment. Please refer to the **User Guide** to ensure all necessary setup steps are completed before proceeding.

## Setup

The setup process can be summarized as a file transfer, permission setup, and package build. Start by copying files over to the QCar.

1. Ensure that you have the latest content by visiting the following link and clicking on **Resources**.

<https://www.quanser.com/products/qcar/>

If you downloaded the files on a remote machine, you can use WinSCP to transfer files over, or a USB flash drive (see the Connectivity User Guide for more information). If you downloaded the files directly onto the QCar, ensure that they are placed in the correct folder location as specified below. Copy the contents of the **Core Modules/ROS-Python** folder in your downloaded resources to the `~/ros1/src/` directory of the QCar (3 packages – **qcar**, **rplidar\_ros**, and **vision\_opencv**).

Then, navigate to the **Hardware Tests/ROS-Python/qcar/launch** folder and copy the **qcar.launch** file to the `~/ros1/src/qcar/launch` directory on the QCar.

2. Once you transfer the files, you will also have to set correct file read/write permission. Within the same directory `~/ros1/src/qcar/src` run the following command in a terminal:

```
>> sudo chmod +x <NAME OF FILE #1> <NAME OF FILE #2> <NAME OF FILE #3>
```

You will need to put the file names for all the qcar nodes:

- commandnode.py
- csinode.py
- lidarnode.py
- qcarnode.py
- rgbnode.py

You can close this terminal.

3. The first step in running any ROS application is sourcing the correct ROS version. Since both ROS1 and ROS2 are installed on the QCar, open a new terminal, and browse to the `~/ros1` directory. Type the following command to source correctly,  
>> `source /opt/ros/<ROS_VERSION>/setup.bash`

In our case, the `<ROS_VERSION>` is **melodic**. Now retrieve a list of all the ROS packages installed by running the following command

```
>> rospack list-names
```

Note that the **qcar**, **rplidar\_ros** and **vision\_opencv** packages are not present.

4. The next step will build the packages that we are interested in deploying. Type the following command to build the packages in the src folder.

```
>> catkin_make -DPYTHON_EXECUTABLE=/usr/bin/python3
```

This will build 3 packages – **qcar**, **rplidar\_ros**, and **vision\_opencv**. When the build is complete, you are now ready to run your applications. Enter the following command to enable superuser authority

```
>> sudo -s.
```

You will have to re-source your ROS installation. Run the following command to source the melodic ROS version again.

```
>> source /opt/ros/melodic/setup.bash
```

If you check the list of ROS packages installed, it still won't list our packages. To do so, source the setup.bash of the corresponding packages that were just built. Run the following command,

```
>> source devel/setup.bash
```

Finally, type the following command to see the installed ROS packages. You will find the qcar, rplidar\_ros and vision\_opencv packages.

```
>> rospack list-names
```

You are now ready to run the tests.

## Example 1 – running the full package

In the first method, you will run the full qcar package.

1. Use the following command in the same terminal you used in the Setup section.  

```
>> roslaunch qcar qcar.launch
```

This will launch RViz. To properly view the LiDAR and RGBD video streams you must set the Displays > Global Options > **Fixed Frame** drop-down menu at the left section in Rviz to use the **base** frame.

2. To set up the **RGB image** feed from the RealSense RGBD camera on the QCar use the following steps:
  - Under **Displays** click on **Add** and select **Image** under **By display type**.
  - For the **Image Topic** option select **/qcar/rgbd\_color**

This will show you a small window on the bottom left corner of the RViz session with the image feed from the RealSense RGBD camera.

3. To set up the **RPLiDAR** use the following steps:
  - Under **Displays** click on **Add**, choose **By topic** and select **LaserScan**. By default, the LiDAR is broadcasting a topic called **/scan**.
4. To view the QCar model within RViz do the following step:
  - Under **Displays** click on **Add**, choose **By display type** and select **RobotModel**. Then a QCar model will be shown in RViz

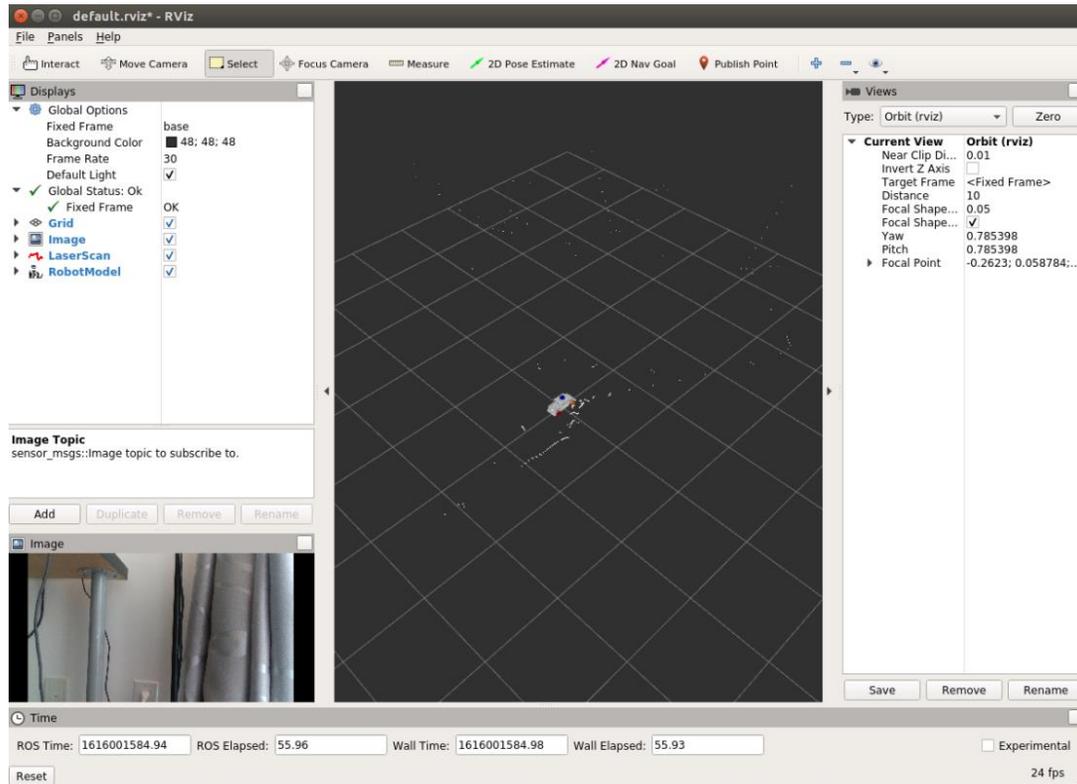


Figure 1: Sample image of configured RViz window.

**NOTE:** The illustrated 3D data in RViz represents the raw LiDAR data from the RPLiDAR. The head reference of the raw data is pointed at 90° to the left of the QCar. These raw data will need to be rotated properly to align with the heading of the QCar.

You can use Figure 1 as a reference for the topics which should be displayed. Please note that topics that have **not been set correctly** will have a **yellow exclamation mark** beside the name of the feature being displayed. If the topic is **not receiving** any data, you will see a **red warning** beside the name of the display feature.

Running the QCar launch file will also start streaming the image feed from all 4 CSI cameras.



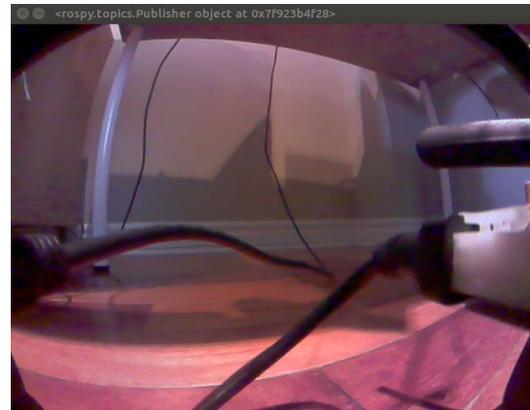
a. CSI front camera



b. CSI back camera



c. CSI left camera



d. CSI right camera

Figure 2: Video stream from all 4 CSI cameras on the QCar.

5. To **test** the **drive motor** and **steering servo** you will need to send commands with the **Logitech Gamepad**.

Controlling the QCar:

- Use the **LB** button on the Logitech gamepad to **enable** motor commands,
- Use the **RT** to **accelerate** forwards and use the **left joystick** to **steer**.
- To move in **reverse**, hold the **LB** and **A** buttons while using the **RT** to control acceleration.

Once you have verified that the QCar's sensors and actuators are working correctly you need to terminate RViz by using **Ctrl+C** on the terminal used to launch the qcar.launch file.

## Example 2 – running nodes one by one

1. Open a new terminal and source your ROS installation with the following command  
`>> source /opt/ros/melodic/setup.bash`
2. In this terminal, run the ros-master with the following command,  
`>> roscore`
3. Open a new terminal, browse to the `~/ros1` directory, and source your ROS installation with the following command  
`>> source /opt/ros/melodic/setup.bash`

Next source your package files by running the following command,  
`>> source devel/setup.bash`

Repeat step 3 for every node you want to run.

4. Now you can run any of the following 5 nodes as you see fit.
  - i. `commandnode.py`
  - ii. `csinode.py`
  - iii. `lidarnode.py`
  - iv. `qcarnode.py`
  - v. `rgbdnode.py`

To run these nodes, use the following command,  
`>> rosrun qcar <nodename>`

For example, to drive the QCar, run the `qcarnode.py` node, as well as the `commandnode.py` node (in separate terminals).