Introduction to Mobile Robotics

Practical Work 1: ROS 2 Installation

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1 Objective

The goal of this session is to install ROS 2 Humble Hawksbill on your personal machine and verify that it is working correctly. ROS 2 Humble is a Long-Term Support (LTS) release and targets Ubuntu 22.04 (Jammy Jellyfish).

2 Prerequisites

- A computer running a native installation of **Ubuntu 22.04 LTS**.
- **Important:** Using a virtual machine (like VirtualBox or VMWare) is possible but may lead to performance issues, especially with graphical tools like Gazebo and Rviz. Dual-booting is a better alternative if you are on Windows or macOS.
- A stable internet connection.
- Familiarity with the Linux terminal.

To check your Ubuntu version, open a terminal (`Ctrl+Alt+T`) and run:

```
lsb_release -a
```

The output should confirm you are running Ubuntu 22.04.

3 Installation Procedure

Follow these steps carefully in your terminal.

3.1 Set Locale

Make sure your system supports UTF-8.

```
sudo apt update && sudo apt install locales
sudo locale-gen en_US en_US.UTF-8
sudo update-locale LC_ALL=en_US.UTF-8 LANG=en_US.UTF-8
export LANG=en_US.UTF-8
```

3.2 Add the ROS 2 APT Repository

First, authorize the ROS GPG key.

```
sudo apt update && sudo apt install curl -y
sudo curl -sSL https://raw.githubusercontent.com/ros/rosdistro/master/ros.
   key -o /usr/share/keyrings/ros-archive-keyring.gpg
```

Then, add the repository to your sources list.

```
echo "deb [arch=$(dpkg --print-architecture) signed-by=/usr/share/keyrings/
   ros-archive-keyring.gpg] http://packages.ros.org/ros2/ubuntu $(. /etc/os
   -release && echo $UBUNTU_CODENAME) main" | sudo tee /etc/apt/sources.
   list.d/ros2.list > /dev/null
```

3.3 Install ROS 2 Packages

Now, update your package index and install the full desktop version.

```
sudo apt update
sudo apt install ros-humble-desktop
```

Note: This installation includes ROS, RViz, Gazebo, demos, and tutorials. It can take some time.

3.4 Setup Environment

For the system to find the ROS 2 executables, you need to "source" the setup file.

```
source /opt/ros/humble/setup.bash
```

To avoid having to run this command in every new terminal, add it to your shell startup script.

```
echo "source /opt/ros/humble/setup.bash" >> ~/.bashrc
```

You will need to restart your terminal or run `source ~/.bashrc` for this change to take effect.

4 Verification

Let's run a few simple examples to confirm the installation was successful.

4.1 Talker and Listener

The ROS 2 ecosystem works on a "publish/subscribe" model. We will run a "talker" node that publishes messages and a "listener" node that subscribes to them.

Open a new terminal (Terminal 1) and run the C++ talker node:

```
ros2 run demo_nodes_cpp talker
```

You should see output like: `[INFO] [...] Publishing: 'Hello World: 1'`.

Open a second terminal (Terminal 2) and run the Python listener node:

```
ros2 run demo_nodes_py listener
```

You should see output like: `[INFO] [...] I heard: [Hello World: 1]`. This confirms that the two nodes can communicate. You can close both terminals with `Ctrl+C`.

4.2 Turtlesim Simulator

Turtlesim is a lightweight simulator, perfect for checking the basic tools.

In Terminal 1, run the simulator node:

```
ros2 run turtlesim turtlesim_node
```

A blue window with a turtle in the middle should appear.

In Terminal 2, run the teleoperation node which reads keyboard inputs:

```
ros2 run turtlesim turtle_teleop_key
```

Click on this terminal to make it active, and use the arrow keys on your keyboard to move the turtle in the simulator window.

5 Troubleshooting

- **Command not found:** If you get an error like `ros2: command not found`, it's almost always because the environment is not sourced correctly. Close and reopen your terminal or run `source /opt/ros/humble/setup.bash`.
- **Installation errors:** If `apt` fails, check your internet connection and make sure you have added the repository correctly in section 3.2.

If you encounter other issues, the official ROS 2 documentation and ROS Answers are excellent resources.

Congratulations! You now have a working ROS 2 environment.