Gathering and processing sensory data

Practice

1: Leo Rover

1. Install the Leo rover ROS packages:

```
sudo apt update
sudo apt install ros-noetic-leo*
```

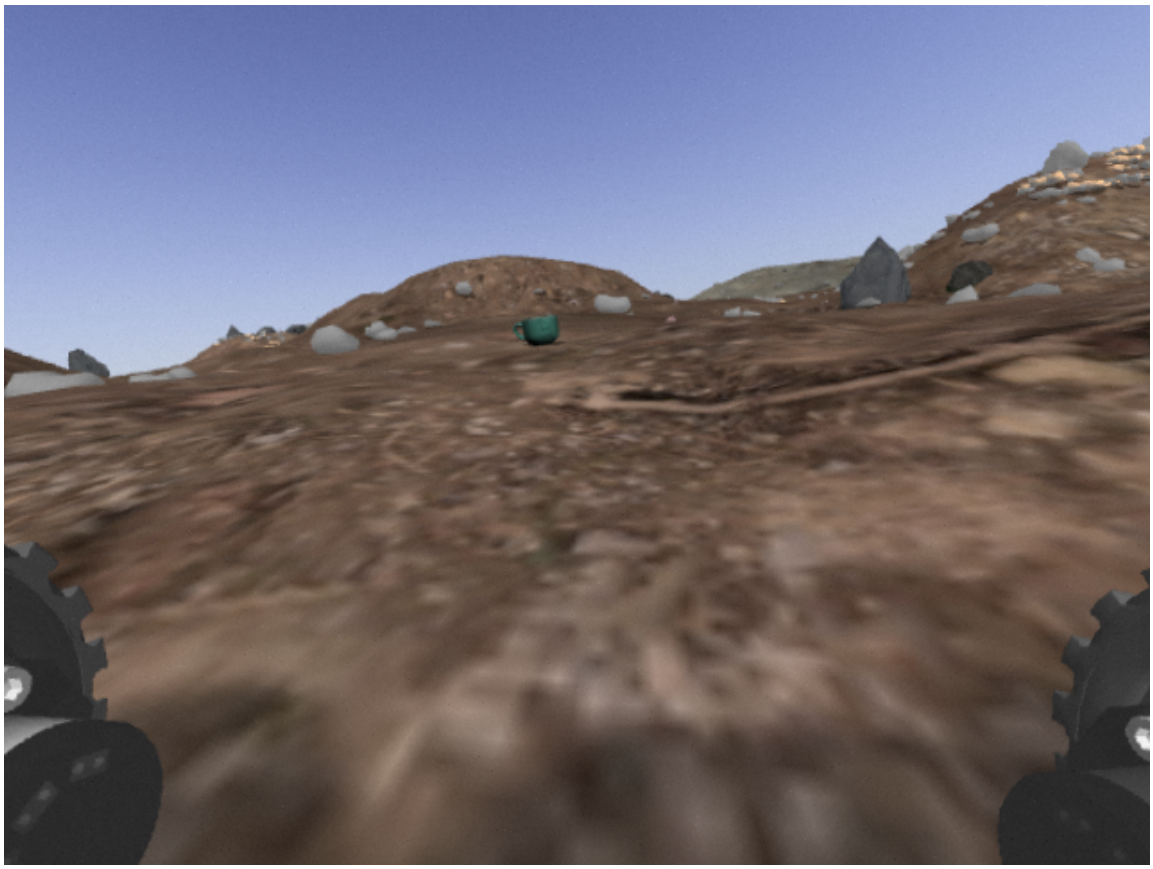
2. Start the Gazebo simulator with the Mars landscape using the instructions from http://wiki.ros.org/leo_gazebo.

3. Start the teleop node and move the robot.

2: Coffee on Mars - Capturing Images

Warning

The Mars rover sent an image of an unusual object that looks like a coffee mug! The task is to turn the rover towards the mug and approach it for detailed examination.



1. Start Gazebo:

```
gazebo
```

2. In the `insert` panel, search for the `googleresearch/models/cole_hardware_mug_classic_blue` model and place it in the simulation. This is necessary to have the mug model in our file system later.

3. Close Gazebo.

4. Download the `leo_masryard_coffee.launch` and `marsyard_coffe.world` files, then copy them to the `catkin_ws/src/ros_course/launch` and `catkin_ws/src/ros_course/worlds` directories respectively.

5. Modify the file paths `/home/tamas/.ignition/fuel/fuel...` in the `.world` files to match your own.

6. Launch the simulator:

```
roslaunch ros_course leo_marsyard_coffee.launch
```

7. Start the teleop and `rqt_image_view`:

```
rosrun leo_teleop key_teleop
```

```
rosrun rqt_image_view rqt_image_view
```

8. Capture images showing the coffee mug being visible and not visible.

3: Coffee on Mars - Offline Image Processing

1. Write a Python script to read and display the captured images.

2. Perform color-based segmentation (or any other method) to segment the coffee mug.

3. Determine the center of the mug in image coordinates.

4. Filter out the noise caused by segmentation.

4: Coffee on Mars - Online Perception Node

1. Subscribe to the `/camera/image_raw` topic and display the received images using the `cv.imshow()` function.

2. Integrate our working computer vision algorithm into a ROS node.

3. Publish the detected mug's center coordinates in a new topic. You can use types like `Int32MultiArray`, `Point2D`, or define your own (the mug size will be needed later).

4. *Bonus: Publish the mask and masked image in separate Image topics.*

5: Coffee on Mars - Operation Logic Node

1. Write a new ROS node that receives messages from the perception node and is capable of controlling the rover's movement.

2. Rotate the rover in place until the mug is in the center of the image.

3. Approach the mug until its apparent size does not exceed 50% of the image size.

4. Capture an image of the suspicious object.

5+1: Bonus

1. Explore the insertable models in Gazebo's `insert` panel and choose one that can be detected on the camera image using a different method (e.g., template matching).

2. Modify the nodes to approach this object with the rover.

Useful links

- http://wiki.ros.org/leo_gazebo

- http://wiki.ros.org/cv_bridge/Tutorials/ConvertingBetweenROSImagesAndOpenCVImagesPython
- https://realpython.com/python-opencv-color-spaces/
- https://stackoverflow.com/questions/59164192/how-to-find-the-contour-of-a-blob-using-opencv-python
- Turtlebot