ECE4078: Intelligent Robotics Lab Project (2020)

Timeline and Format

Week	Objectives	Milestones
2	Introduction and setup	M1: teleoperating the robot
3	Motion model	
4	ARUCO markers	
5	SLAM	M2: manual SLAM
6	Training an object recognition model	
7	Improving the recognition model	M3: vision-based recognition
8	Auto navigation	
9	Learning and planning	M4: path planning
10	Integration and improvement	
11	Integration and improvement	M5: integrated system
12	Final demo / competition	Bonus point for top 5 teams

The lab sessions will start from week 2. Every week there are three sessions as listed below. Please check Moodle to see which one you are allocated to.

- Lab 02 is on **Mon 2pm-5pm**. Your demonstrators are Tina and Kal. (Zoom)
- Lab 01 is on **Wed 3pm-6pm**. Your demonstrators are Yanjun and Tin. (Zoom)
- Lab 03 is on **Wed 6pm-9pm**. Your demonstrator is Aaron. (Zoom, Pwd: 336019)

Before each week's sessions, the instructions and getting-started codes will be made available to you in the GitHub repo. During each 3-hour lab session, you will get an overview of that week's objectives at the beginning of the lab session. At least one demonstrator will be reachable via Zoom to support you during the whole session. At the end of the lab session, the demonstrator(s) will either show a sample solution or one of your solutions in the simulator or on the physical robot if possible, and you can view it through shared screen or videolink.

You will work together with two of your classmates as a group of three throughout the semester. Your mark will depend on your contribution to the group. For M1 to M5, each milestone will amount to 4% of your course score. You should submit your codes on Moodle within a week of the milestone. Each group just need to make one submission. If multiple people from the same group have made multiple submissions, the latest submission before the deadline will be graded. The demonstrators will run your codes for evaluation. In the final demonstration / competition, the top 5 teams will be awarded a bonus 1% score.

Project Description

Task

During this lab project, you will learn the basics of robot controls, mapping, localisation, navigation, vision-based object recognition, learning and planning. You will also combine these functions to develop an integrated system.

The task is for the robot to navigate through a terrain and locate targets accurately. For each trial, the map will vary so the robot will have to rely on its visual inputs for the task.

Robot

PenguinPi (https://cirrusrobotics.com.au/products/penguinpi/) is a differential drive two wheeled robot equipped with a camera (see Figure 1). It has:

- A Raspberry Pi (https://www.raspberrypi.org/) 3B computer with a color camera.
- An i/o board with embedded processor that interfaces with motors and provides a simple UI (20×4 OLED display, pushbuttons and other LEDs).
- Ability to run codes onboard written in Python or C++.

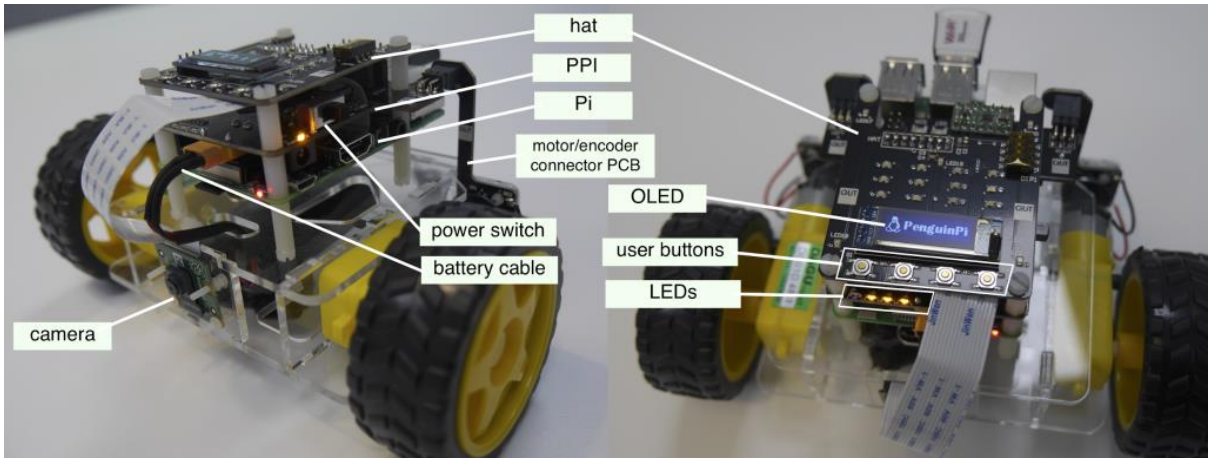

Figure 1. The PenguinPi Robot.

Simulator

Due to COVID-19 restrictions, for robot development and testing, you will be using the Gazebo simulator environment: http://gazebosim.org/. Model of the PenguinPi robot has been provided by Cirrus Robotics: https://bitbucket.org/cirrusrobotics/penguinpi_gazebo (see Figure 2).

You will write Python3 codes during the lab sessions, which are executed on the robot inside the simulator through a web service. The web service also offers a basic view of the robot (see Figure 3). These codes can also run onboard of the physical robot. During lab sessions, the demonstrator(s) will show execution of codes in simulator or on the physical robot if possible.

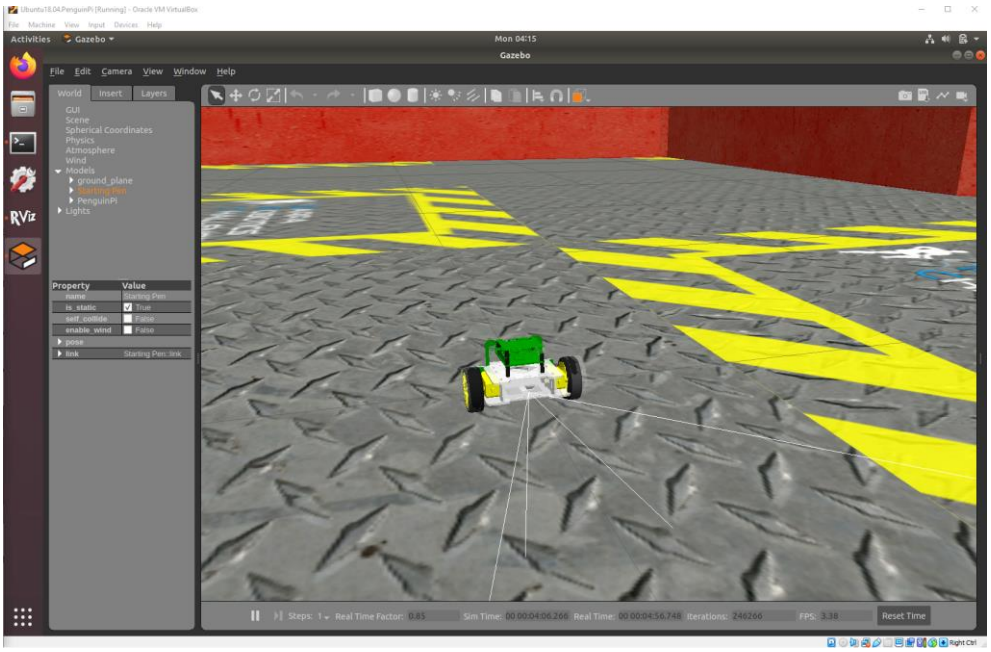

Figure 2. The Gazebo simulator environment.

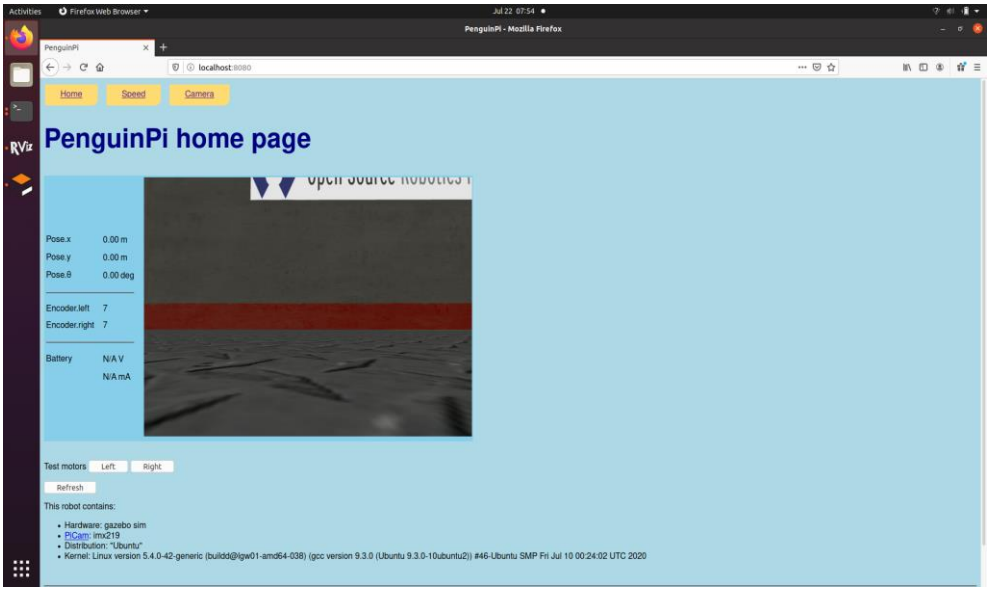

Figure 3. The PenguinPi web interface.