**ROCO318 Coursework Assignment 2019/2020**

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| **Assignment Brief** | |
| Assignment Title: | Mobile and Humanoid Robots Coursework |
| Submission Deadlines: | **4pm, 16th January 2020** |
| Submission: | Online (DLE) |
| Contribution to Module Grade: | 30% |
| Individual/Group Assignment: | Individual |
| Module: | ROCO318 |
| Module Leader: | Dr Mario Gianni |

**Requirements**

For this coursework, you are required to

* Design and develop a robotic application in the context of mobile and humanoid robots [**80% of your mark**].
* Produce a documentation of the robotic application [**20% of your mark**].

The robotic application can be something related to (1) what was covered during our practical sessions, (2) a particular topic in robotics that you find interesting or (3) a project in the list available on the DLE. Some project ideas that you can find in this list are

* Design and develop ORBO in V-REP and connect to ROS
* Design and develop ORBO in Gazebo and connect to ROS
* Assembly the top part of ORBO to complete the Humanoid Robot. Integrate the extended platform into ROS. tf and RVIZ visualization of the correct joint positions is considered part of the project only.
* Design the full humanoid robot (ORBO with arms and head) in VISION 360 or AUTOCAD. Provide using one of these tools the physical measurements of the mechanical components (e.g., dimensions, CAD of each piece, masses, motor parameters, relative transformations, joint axes, centre of masses).
* Design and develop the VISON system of ORBO. This includes assembling a PAN-TITLT unit using the motors used during the practical sessions, and 3D printed parts designed by you. Moreover, it would require an RGB camera on top for the acquisition of the images. The PAN-TILT unit + RGB camera must be integrated in ROS.
* Head Tracking in 3D with the VISON system of ORBO (simulation or/and hardware).
* Mobile autonomous navigation based on the move\_base navigation stack in ROS with the Turtlebot2 (simulation or/and on real platform).
* Use techniques from Deep Reinforcement Learning to teach a robotic arm to play a game.
* Use techniques from Deep Reinforcement Learning to understand how to better move a camera mounted on the wrist of a robotic arm to optimise the 3D reconstruction of a set of specific objects.
* Use techniques from Multi-Robot Q-Learning to coordinate two robots with different locomotion systems for navigation tasks on uneven terrain under space constraints.
* Implement an algorithm (e.g., using Convolutional Neural Networks) for the recognition of a number of classes of materials composing the soil (e.g., grass, concrete, water, sand, asphalt, rock, debris).
* Implement an algorithm allowing a robotic arm to draw the portrait of a person from images collected from an external camera pointing at the face of the person.
* Design using FUSION 360 or AUTOCAD and develop the components of a human-inspired end effector for manipulation tasks to be mounted on a robotic arm.
* Design using FUSION 360 or AUTOCAD and develop a lightweight gripper to be mounted on a drone for package delivery tasks.
* Design using FUSION 360 or AUTOCAD and develop a low-cost robot capable of inspecting the interior of variable size, multi-path and nonplanar stainless-steel pipes.

Once you have identified the project that you want to develop in your coursework, then

***please notify the Module Leader (either verbally or via email at*** [***mario.gianni@plymouth.ac.uk***](mailto:mario.gianni@plymouth.ac.uk)***).***

After the notification, the Module Leader will arrange with you a **face-to-face session** where you will be provided with instructions about **what** you are expected to do in the coursework and **how** it will be evaluated.

Finally, you will receive indications about the content of the documentation of the robotic application that you are required to implement and the details on submission.

Examples of coursework specifications, marking schema, structure of documentation and submission details are available in the [Project proposal](https://dle.plymouth.ac.uk/mod/folder/view.php?id=816709) folder on the DLE.

The Module Leader will schedule dedicates sessions during the hours of the available practical sessions where the face-to-face discussions will take place. Please do not miss your opportunity.

Moreover, the Module Leader will use some of the hours of the available practical sessions to assist you during the development of your project coursework in a form of formative feedback. Please attend these sessions. They might be very helpful to you.

*Below you can find an example of a type of coursework you may want to do including the marking schema and the specification of the documentation*

**Project aims and objectives**: design and build a robotic device to execute dedicated tasks.

**Activities**

* Design the mechanical component of the device in Fusion 360 and produce a CAD module.
* Assemble the device
* Implement libraries for control.
* Testing

**Resources** *(provided by the Module Leader depending on the available resources)*

* Electronic components (e.g., space Dynamixel motors)
* 3D printing
* Connection wires
* Microcontroller (optional for higher grades)

**Marking schema**

30% - Design CAD model

40% - Partial functionality of built device

50% - Fully functional built model with good engineering (etc. neat cable placing)

60% - Incomplete software

70% - Full Software Complete but with bad technique

80% - Fully working software with good technique

90% - Using a microcontroller and implementing ROS

100% - Full control of the device.

**Documentation of the Robotic application**: It consists of a Wiki Page, to include

* 1. Explain how to build the device
  2. How to run the application
  3. How to run given examples and what to expect from them
  4. Visual demo
  5. Pictures to show steps
  6. Equipment used

**Submission Details**

* CAD model file
* Code files
* YouTube Video demo
* Wiki page.

**Submission Details**

**For robotic applications**

* You must create a new project on github with private visibility level.
* Name your project studentID\_project\_name and include me in the project with the role of developer.
* The project repository must contain a README.md file with information about system requirements, how to install and how to run your application in simulation and, finally, main references.
* It must also contain a folder named project\_name\_wss. In this folder you must implement your hierarchy of ROS workspaces and packages for your project.
* The project repository must finally contain a folder named videos where you must upload videos showing evidence of your project working.

**For non-robotic applications**

In case your work does not involve any software or hardware then it must be submitted online via the DLE.

As a reminder

* please notify the Module Leader (either verbally or via email at [mario.gianni@plymouth.ac.uk](mailto:mario.gianni@plymouth.ac.uk)) with your choice for the project.
* Ensure to have a **face-to-face session** with the Module Leader to know better and in time **what** you are expected to do in the coursework and **how** it will be evaluated.
* Clarify the indications about the content of the documentation of the robotic application that you are required to implement and the details on submission.
* Attend the formative assessment sessions scheduled for you to revise your work.
* Start you project soon.

**Deadline and Marking**

The deadline for submission is **4pm, 16th January 2020** via the submission instructions above. **If the marker has difficulty compiling or running your code, or some aspect of what you have done is unclear, you may be required to attend a short viva with me to explain your work.** Feedback and marks will be returned within 20 working days.

**Plagiarism**

This is an **individual** assignment and must reflect the work of that individual.

Thus, while you may discuss this assignment in general with your colleagues and give each other technical help (e.g. diagnosing compiler errors), your code and report must be entirely your own work.

**The University treats plagiarism very seriously. If you cannot satisfy me that your work is your own, formal plagiarism procedures will be started.**

The penalty for submitting work which is wholly or partially the work of someone else is usually, at least, a mark of zero for the assignment. Do not be tempted to help a colleague by giving them your code or design, as both parties will be guilty of an assessment offence and both face the risk of a zero mark. Please refer to your student handbook for guidance as to what constitutes original / individual work.

**Module Learning Outcomes Assessed**

* **ALO-3**: Reasoning and grasping theoretical concepts of humanoid robot locomotion, planning, vision, manipulation and guidance.
* **ALO-4**: Use computer vision, machine learning, AI and machine learning techniques in moderately complex robotic problems.