

COMP3631 Project:

You are asked to implement a program that controls a simulated Turtlebot to find and identify a Cluedo character in an environment. In the environment, there will be two rooms. Your robot needs to enter the “green room”, which has a green circle near its entrance, and identify the character in the room. The second room will be a “red room”, with a red circle near its entrance. Your robot should **not** go into this room.

You will work on this project as a group.

During week 11, your program will be tested in a demo using the Turtlebot Gazebo simulation. At the beginning of your demo, you will be given a map of the environment (You will learn about what a map is, how to build it and how to use it, in Lab Session 4). Your robot will be placed at a start point, which will be the same for all groups. You will be given (x,y) coordinates of the entrance points of the two rooms in the map. One room will have a red circle on the wall near its entrance, and the other a green circle. The green/red circles on the walls will be visible from these entrance points, but not necessarily from a direct angle. (You might or might not need to move your robot around the entrance points to have a better view of the circles. You are recommended to experiment with different positions of the circles and robot, build a robust program, and report your findings in your report.) Your robot will need to enter the room with the green circle on the door. You will be given the (x,y) coordinates of the centre points of both rooms. There will be a Cluedo character in the green room. Your robot will have to find this Cluedo character and report the identity of the character. In your group’s gitlab repo, we will provide you with a set of images of different Cluedo characters and their names. Your robot will need to identify which one is in the green room. We will also provide you with an example Gazebo environment, an associated map, and an example input file. This will be just an example; the actual shape of the environment, shape of the rooms, exact position of the green/red circles, and the position of the Cluedo character may change. Your program should be robust to such changes.

In addition to the test in simulation, we encourage you to test your program on a real Turtlebot. You will get marks for testing your program on a real robot and describing it in your report.

This project has three components:

- The Simulation Demo - to be implemented as a group
- The Written Group Report – to be written and submitted as a group
- The Written Individual Report – to be written and submitted individually

Grading

In total, this project corresponds to 40% of your module grade. 10% of this will come from the demo on week 11, 25% will be based on your group written report and the final 5% will be from an individual report. Details of the test and the written report are below.

Simulation Demo

Deadline: Monday, 9 December, 10:00 am. (Your group's actual demo time during week 11 will be announced later, but your code should be ready by the deadline above. You will need to push your code to your group's gitlab repo by that time, and we will use your code from gitlab during your demo.)

Submission: You will write a Python program to perform the task, which should be pushed to the gitlab repo of your group by the above deadline.

You can collect 10 points, according to the following rules.

Detecting the green room (3 points): We would like your robot to find the green circle and save a snapshot of the camera image of the green circle (3 points). The green circle must be completely contained within the saved image. The image file name must be "green_circle.png". If an image with this name is saved and it does not show the green circle, you will get an -2 penalty point.

Going into the green room (3 points): Accessing the centre point of the green room will earn you 3 points. Going into the red room will cost you -2 penalty points.

Character identification (4 points): When your robot thinks it saw the image of the Cluedo character, it should save a snapshot of the camera image with the filename "cluedo_character.png" (2 points). The character must be completely contained within the saved image. If an image with this name is saved and it does not show the character, you will get -1 penalty point. Your program must then identify the character, by printing out the character name into a text file with the filename "cluedo_character.txt" (2 points). If a file with this name is created, but includes a wrong character name, you will get -1 penalty points.

The minimum you can get from the demo is 0 (zero) points; in other words you cannot go negative due to penalties.

Your program will have at most 5 minutes to complete the tasks. If, after 5 minutes of running, your program has not stopped by itself, it will be stopped and the points you have collected up to that point will be your mark.

Written Group Report

Deadline: Monday, 9 December, 10:00am

Submission: The report is to be submitted electronically in the VLE as a PDF file. Only one member of a group should submit this group report. (Please see below for the additional individual report, which should be submitted by every member of the group separately.) All code should be submitted into the group gitlab repo.

Content: Write up your solution as a group, as if it was a report to a client. This should be **no more than 10 sides**. In particular;

- Include details of the design options you considered and justification of why you chose the particular options you did.

- Describe how you have tested your solution. Give examples of different environments/maps you have created to test your program.
- Include in your report **images**, **a link to a video** and **data** to demonstrate that your solution works. Outline and discuss the limitations of your proposed approach. Suggest scenarios where it might not work.
- State any OpenCV/ROS codes you have used that are not part of the standard distribution.
- If you have tested your program on a real Turtlebot, report about any specific issues you had with your real robot implementation, and provide **a link to a video** showing your robot attempting the task. Feel free to use your smartphone to record this video and upload to youtube.

Markscheme:

Design (14 points): Marks will be awarded for:

- Well designed solutions
- Justification of decisions and general knowledge of possible methods
- Novelty
- Likelihood of working in a wide range of environments and images (other than those provided)

Implementation and Results (5 points): Marks will be awarded for:

- Efficiency/accuracy of reaching to the rooms, use of planning and search methods.
- Accuracy of identification of the room colors and cluedo character.

[so test results, numbers, figures and diagrams should be presented!]

Real robot test (3 points): Marks will be awarded if you test your program on a real Turtlebot:

- *Describing what needed to be done to make the program work on the real robot*
- *Describing how the robot performed in the real world*
- *A link to a video showing real robot attempt*

Writeup (3 points): Marks will be awarded for:

- Clarity of presentation of solution and results [N.B. Large chunks of code with no explanation are unlikely to gain high marks!]
- Discussion of the strengths and weaknesses of the system presented
- Presentation
- Use references to credit the resources you used, if any.

Written Individual Report

Deadline: Monday, 9 December, 10:00am

Submission: The report is to be submitted electronically in the VLE as a PDF file. Each student should submit one individual report.

Content: Write up individually. Should be **no more than 1 side of a page**.

Markscheme: (5 points) Marks will be awarded on the basis of your individual contributions to the group work, which will be checked against what the rest of the members of your group say about your contributions in their individual reports.

- Give details of your individual contributions to the group work.
- Assign a mark (between 0-5, 5 being the highest mark) to every other member of the group using the following criteria:
 - 1) Attendance at meetings and lab sessions organized by the group.
 - 2) Contribution to the design of the solution.
 - 3) Contribution to the implementation of the solution.
 - 4) Contribution to the testing of solution.
 - 5) Contribution to writing up the report.

Provide a brief justification of your mark for the other members.