Exercise 1: Exploration and Mapping, Report

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1 TASK

We were tasked with producing a map of the Lower-Ground floor of the School of Computer Science. We were to complete this by using the laser rangefinders attached to our robot. By moving the robot around the area, the system was able to use the lasers to build up a detailed image of it's surroundings.

2 METHOD

In order to move the robot around the Lower-Ground floor of the School of Computer Science, we had to teleoperate the Pioneer robot using a gamepad as input for movement. At first, we traversed the LG floor of Computer Science in the lab session, however this produced a fair few challenges (explored in the next section) as well as having a lot of potential for interference as there were a lot of groups mapping out the floor. Instead, we came back on the Sunday and traversed the empty lab to reduce interference. We moved around the floor, teleoperating the robot with the gamepad, making sure to aim the laser rangefinder at all the edges we wanted to capture by rotating it when exploring.

2.1 Commands

The commands we ran were as follows:

1. ***roscore*** to begin the ROS master session
2. ***roslaunch*** *socspioneer p2os_laser.launch* to start making readings from the on-board laser rangefinders
3. ***roslaunch*** *socspioneer p2os_teleop_joy.launch* to connect the robot to the gamepad
4. ***rosbag*** *record <file_path> /base_scan /tf /odom* to begin recording laser range finder readings to a *rosbag*

From here, we moved around the area, as described above to map the room. Once happy with our coverage we proceeded to kill the above processes (except ***roscore***) and run:

1. ***rosparam*** *set use_sim_time true*
2. ***rosrun*** *gmapping slam_gmapping scan:=base_scan*
3. ***rosbag*** *play <file_path>*

We then had to wait for the rosbag to *play* and convert the readings to a usable map via the gmapping software. When this was complete we ran ***rosrun*** *map_server map_saver* to produce *map.pgm*, our finalised map.

3 CHALLENGES

The main challenge that was faced was noise from individuals moving around, which would result in abnormalities in the outputted map. To combat this we came back at a time when the basement was less populated and ran the procedure then. This resulted in a much clearer map.

Another problem encountered was due to hardware issues. Halfway through mapping the controller disconnected, requiring the motor drivers to be restarted. As a result of this the orientation of the robot in the mapping software was reset resulting in misshapen map (Fig. 4).

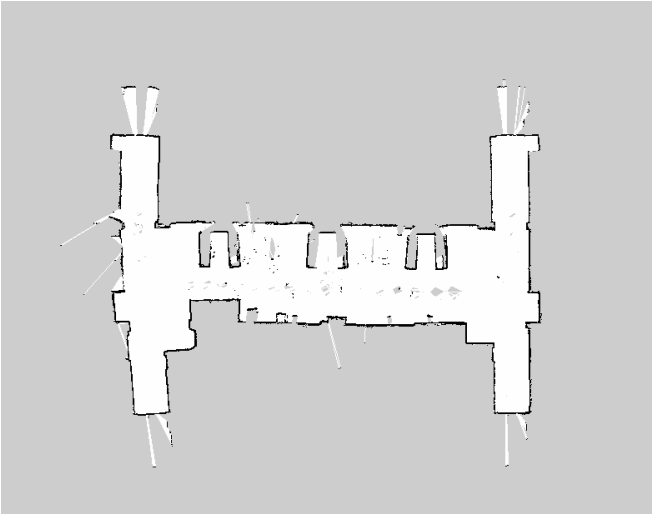

Fig. 1. Our initially produced map of the Lower Ground floor of the School of Computer Science

4 PRODUCED MAP

4.1 Processing

Having followed the steps detailed above, we produced the map seen in *Fig. 1.* As you can clearly see the map has some imperfections that could cause issues for our robot when using it to navigate. To circumvent these issues, I opened the map in *GNU Image Manipulation Tool* and removed the rogue *"shafts"* seen in the original map. I also removed a lot of noise from the walls. The *"shafts"* I believe were caused by the glass panes in many of the doors. The laser range finder was able to map sections of rooms beyond our scope as a result.

4.2 Final Map

After editing the image, the resulting map was *Fig. 2.*. I feel that this map should allow our robot to navigate well as there is minimal interference. However the bottom left of the map is slightly crooked. This too could be corrected in GIMP. This inaccuracy may be due to the wheel-encoders operating over carpet. The friction of the carpet may have

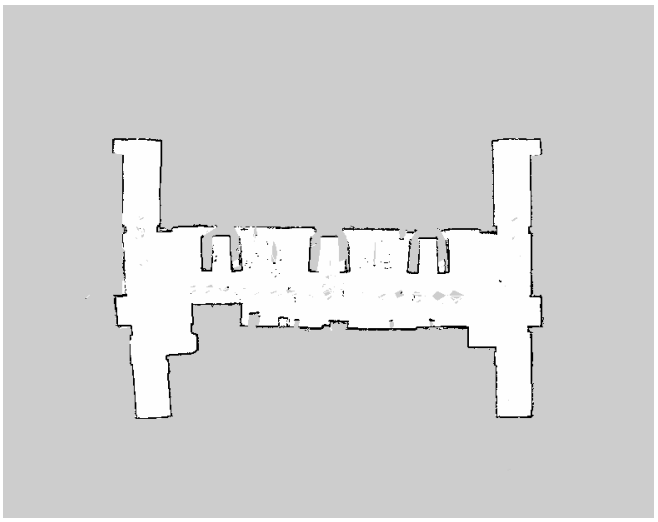

Fig. 2. Our Produced Map of the Lower Ground floor of the School of Computer Science, after removing rogue lines

caused the wheels to spin at different speeds and lead to a perceived change in direction where there was none.

4.3 Intermediary Maps

Also included in this document are *Fig. 3.* and *Fig. 4.*.

Figure 3 shows our initial attempt at producing a map. This is a map of the Undergraduate Robotics Laboratory. You can clearly see it features a lot of noise and interference. At the time of mapping, this room was very busy and as such many people were recorded by the laser senors during mapping, leading to spurious static obstacles in the final product. A more accurate map may have been produced by being more meticulous in exploring and making sure the robot had an opportunity to record values for each of the 4 walls. This is a fact we realised at the time and learned from when producing the our following maps of the Lower Ground hallways and study spaces.

Figure 4 shows our first attempt at mapping the Lower Ground floor. As you can clearly see, there were some complications. The entire map seems to be duplicated and rotated through approximately $100°$. This occurred due to a connection becoming loose at around the "*pivot*" point seen. Having re-affirmed the connection & restarting the *telop* software, we continued to map the floor. On compiling the map we saw this result. We believe that this is due to the robot losing track of it's pose between crashing and restarting, thus, forcing it to see the remainder of the floor as new data in a different direction to where it had explored previously.

5 CONCLUSION

To conclude, I think our final map (*Fig. 2.*) is detailed and complete enough to be used in the coming assignments revolving around automated robot motion & localisation. However, we may find certain issues, such as the crooked corridor. These issues can be resolved if and when they arise either by producing a new map or by using *GNU* to further enhance/ edit the map.

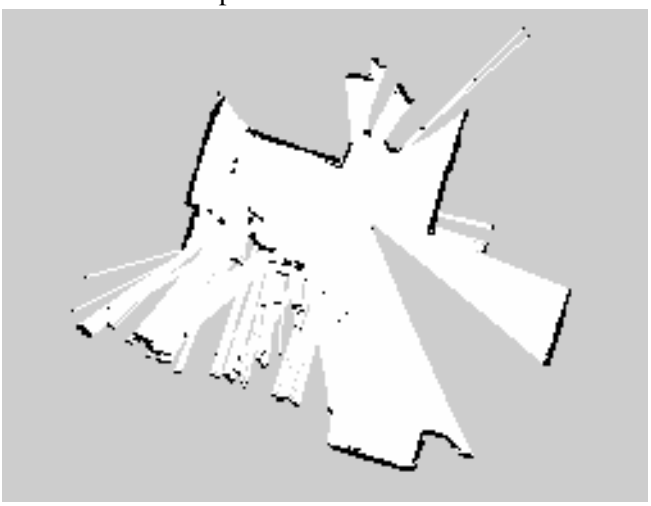

Fig. 3. Initial map of robotics lab

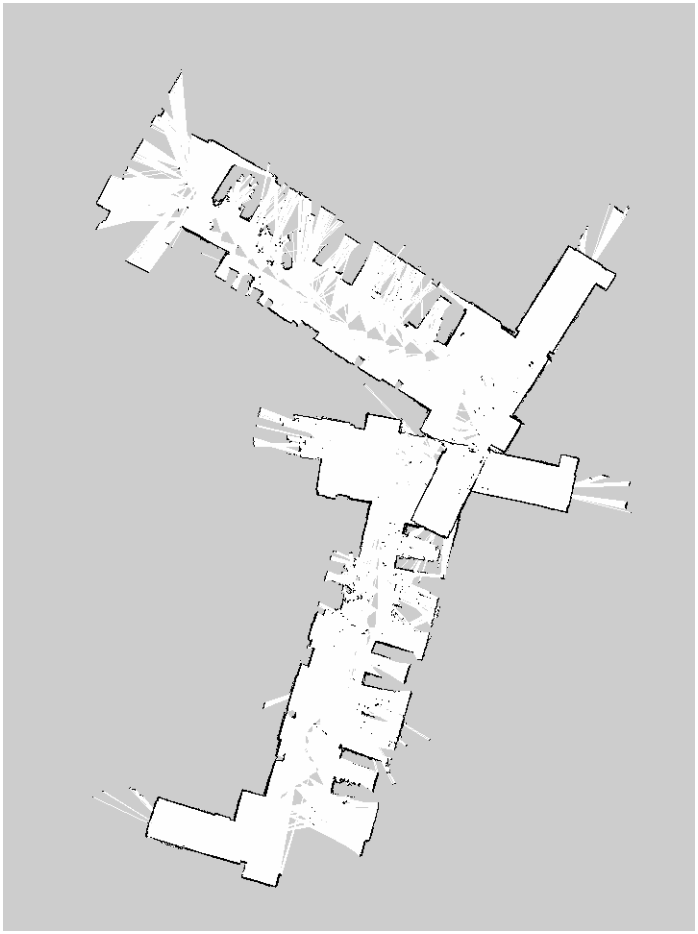

Fig. 4. Initial attempt at mapping the Lower-Ground floor