Group Members: Julian Hird, Pete Wharton, Charles Clarke

Formative Assessment Template

1. *Briefly describe the modifications (if any) you made to the provided baseline solution*

Since the obstacle avoidance solution was unreliable, we made two changes to improve performance. Firstly, we implemented a reversing state for when actively avoiding obstacles (rather than simply reducing forwards component of speed). This ensures that the robot cannot edge towards an obstacle if a series of poor random turning motions is observed, it instead reverses which is generally safer, since the robot has just travelled from that space. Secondly, we noticed that the robot would often fail to detect obstacles that were slightly offset from the forwards direction (since it only has the single forwards pointing IR sensor). To counter this we added an oscillating component to the forwards motion, producing far better coverage whilst still only using the one IR sensor. We also implemented a method of keeping the robot within the mapping boundary by treating the edge of the map as an obstacle to be avoided. Finally, empty spaces the robot has travelled through, according to it odometry data, are logged in the map.

2. *Describe the purpose of the experiment you conducted – what were you trying to measure?*

Our experiment is designed to measure the percentage of the map that the robot can explore within a fixed timeframe (two minutes), under different movement schemes. The original solution was using the random walk scheme, though in later experiments we will test other schemes for comparison.

3. *Describe the methodology of your experiment – how did you collect the data?*

The robot was started in the centre of the map with the random walk motion prepared. When triggered with two button presses it begins travelling and maps the 25x25 grid in real time, marking the grid squares as either explored, obstacle (using IR), line (using line sensor, or RFID (using the RFID sensor).
The robot is left to run for 2 minutes, after which it is switched off. The map is retained and the percentage of the map covered can then be calculated.

4. *Introduce the metric(s) you used for your experiment – briefly discuss strengths and weaknesses*

The metric we used in the experiment to measure exploratory performance is the percentage of the map covered during a fixed time (two minutes). This is a good general indicator, however, at present it is measure from the robot's own map and not an objective source. This means that accumulated odometry errors will cause mapping errors. There is still some value to the results because it at least proves algorithm concept in simulation, though to avoid this being an issue for further experiments we will move to a real grid and manual measurement of squares covered for later tests. We also took video footage of the runs to verify results.

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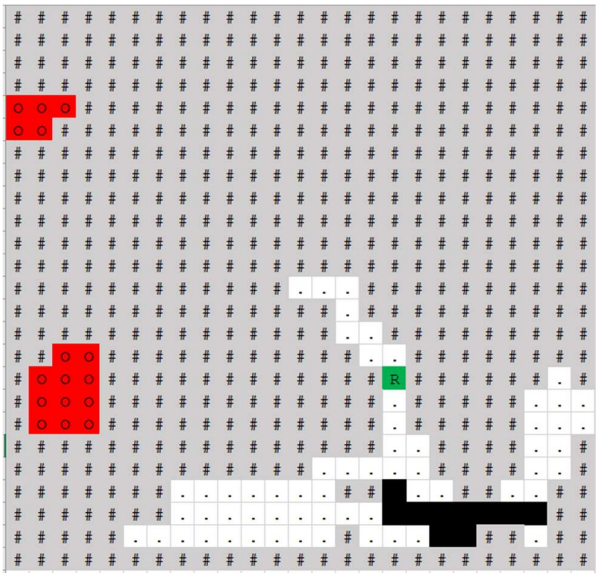
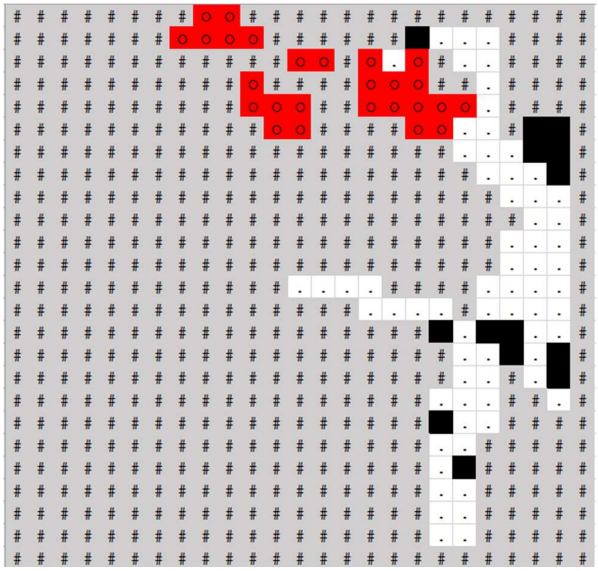
5. Present the results of your experiment

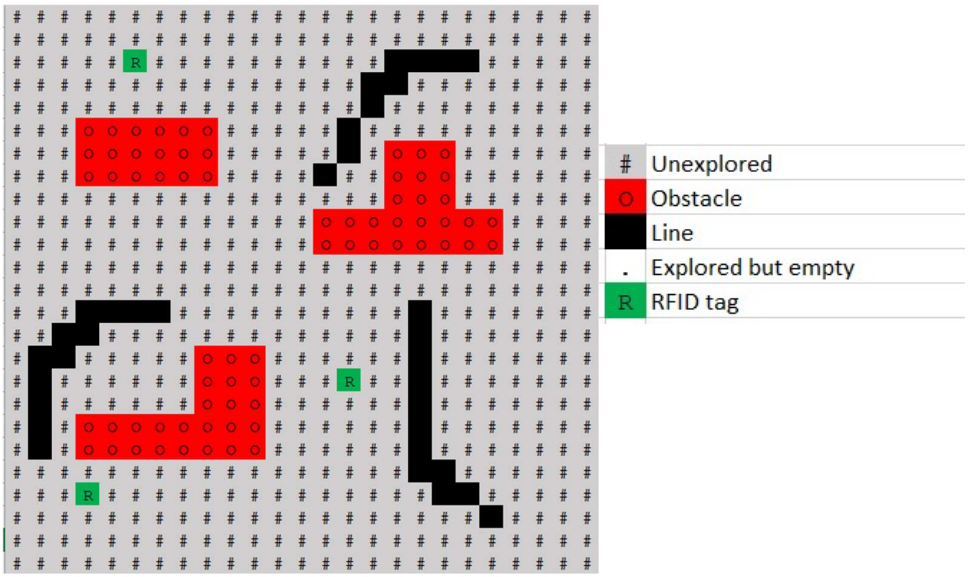
Below the results of the experiment are shown including the output map and percentage coverage. Within the time frame we managed two separate tests, each with two minutes run time. The ground truth is also displayed.



Map 1 -14% Coverage



Map 2 -17% Coverage



6. Discuss the results you presented above – what do the results tell us?

Overall the exploration percentages were quite poor (as expected from the random walk movement schemes). Additionally, the mapped positions of obstacles and lines did not correlate with the ground truth, indicating a failure of odometry. This was confirmed with visual inspection as the robot could easily became stuck on the edge between the two sheets and subsequently span wheels with no resulting motion.

It is clear from viewing the videos of the experiment that random walk motion results in a very large proportion of the time spent covering already explored space, this should be something that can be improved on significantly by implementing different movement schemes which avoid explored grid squares or target unexplored areas.