Assignment2

"Landmines and unexploded ordnances (UXOs) are victim-operated weapons of mass destruction in slow motion that make no distinction between friendly or enemy, children or animals. While basic landmine detection and neutralizing theologies remain almost the same, landmine technology improved dramatically resulting in more than 2000 different types of mines around the world; among these, there are more than 650 different types of anti-personnel landmines. There is a serious need for innovative techniques that can provide an efficient, reliable, adaptive and safe solution for the problem of the landmine and UXO contamination. Robotics systems can provide an efficient, reliable, adaptive and cost-effective solution for this problem of humanitarian, environmental and economic dimensions that renders the sustainable developments in numerous countries in the world" (IROS, 2019)
In this assignment, you will build and program a robot to perform the two processes of humanitarian demining: detection and disposal. Your team's robot must be able to search for "buried" and surface-laid anti-personnel landmines and UXOs. The position of each mine is unknown prior to deployment in the environment. The detected surface landmines will need to be removed from the danger-zone perimeter, rendering them safe. The "buried" mines must be detected and detonated in-situ. Your robot must be able to navigate through a simulated environment in one of the lab pens that mimics a real minefield.
This assignment gives you the opportunity to put into practice the goal of the Minesweepers
(Links to an external site.)
academic competition that has been running within the AI community for the past 8 years. It also builds upon the strategic mission of the IEEE which is "to foster technological innovation and excellence for the benefit of humanity".
You will need to modify the build of your robot appropriately to tailor it to the task at hand. Spend a few minutes researching the design of mine sweeper robots prior to the task and one member of your group should spend no more than half an hour re-purposing your current EV3 build while the other begins work on Part 1.

Part 1 - Perform a complete sweep of the environment [2 marks]

Your robot will start in one of the corners of the pen and in this task you must ensure that it covers the whole of the area, ensuring no mines are left undetected. Please consider an appropriate potential sweeping motion (column-based movement/ spiral / etc) that your robot will follow. However, to simulate a real-world environment, there will also be a number of obstacles in the world, similar to those blocking the line in assignment 1, which your robot will have to navigate around.
N.B When your robot has completed the sweep, it must stop and report back on your robot's screen how many mines it has detected and made safe.

Part 2 - Detect danger zones [2 marks]

In this assignment, a red area of arbitrary size on the floor of the pen represents a "danger zone". Within this, there will be a single mine (buried or surface). Your robot must be able to detect when it has entered a "danger zone". To show that it has entered a danger zone, the light on the robot must flash orange. This must turn off when exiting the danger zone. There will be multiple danger zones in the environment, each containing either a buried or a surface mine.

You can use the following sample map in OR Labs to test your program:
example map.png

Part 3 - Detect buried mines [2 marks]

In a danger zone, there is the possibility that the mine within it is a buried mine. To represent a buried mine, a yellow marker, approximately 5cm x 5cm will be placed in the area. Your robot must find this within the danger zone. When found, your robot must stop to "detonate" the buried mine. This consists of a pause of 5 seconds, where your robot stops movement and sets its light to flash red. At the end of the five seconds, the robot must then make some noise to represent the explosion of the mine. Once this mine has been detonated, your robot should then leave the danger zone and carry on searching for other mines in the environment.

Part 4 - Detect and dispose of surface mines [2 marks]

In a danger zone, there is the possibility that the mine within it is a surface mine. To represent a surface mine, a black object of approximately 10x10x10cm will be used to represent this. If a surface mine is detected, it must be removed from the danger zone (e.g pushed) by your team's robot. Whilst doing this your robot should make a noise (e.g a warning siren) and a red-light on the robot should flash. These should stop when the mine has been removed from the danger zone. Once this mine has been removed, your robot should then leave the danger zone and carry on searching for other mines in the environment.

Part 5 - Creative extension of the task [2 marks]

To encourage your creativity in this assignment, the final 2 marks are dedicated to you working on an extension of your choosing. You could work on one of the following, or choose a suitably non-trivial extension of your own to work on.

Examples:

- Moving surface mines to a "safe" disposal area in the corner of the environment.
- Approaching this problem using multiple robots. e.g one danger zone detection, one detonation bot or two robots working in parallel to discover and detonate. You should primarily develop and demonstrate this in the simulator.
- Mapping and reporting coordinates of mines in the environment.

N.B

Please split this up into tasks that each member of your group works on. One person could focus on movement while the other focuses on the detection / detonation task.

When a mine has been discovered and detonated or removed, when marking this assignment, the TA will remove both the mine and the danger zone from the environment to represent that the threat has been neutralised.