L1 Task: Nuclear Decommissioning

Scenario

Robots are invaluable in extreme environments as they can be used to perform tasks in areas where humans cannot safely work. The decommissioning of nuclear power stations is one area where robotics is expected to play a significant role in the next few years. Robots for decommissioning must be reliable, robust, allow detection of waste and also be able to manipulate radioactive waste to safe areas.

Task

A customer within the nuclear power industry is looking to develop robot systems to assist with decommissioning. They are asking for trials to be conducted using smaller scale robots with magnetic fields representing radioactive material. They require a robot which can:

1. Remove decayed fuel cells from known locations in the plant and move them to a collection point away from an active area
2. Search for active fuel cells which have been misplaced.

Specification

- The robot must not have any sharp edges and must be safe around humans.
- The robot must display a flashing amber light whenever it is moving
- The robot must start within (and fit within) one of the start boxes (400mm x 300mm).
- The robots must have onboard electronics for detecting the presence of the fuel cells (blue objects) and if they are active or not (magnetic field detection). These must be able to be tested without requiring a micro-controller, for example through indicator LEDs.
- The robot must indicate a fuel cell (of any type) has been detected by switching on a green LED
- The robot must display a flashing red when carrying active material
- Active material must not be taken out of the area lined in red
- Only non-active material is to be transported or placed in the green outlined area
- Fuel cells must not be carried more than 60mm from the ground to reduce risk
- All cabling must be neatly installed and must conform to the site regulations - red power +, black power -, green earth. All other colours can be used for signal/control
- A complete set of mechanical drawings is required of a standard which would allow another engineer to replicate the product
- A complete set of electrical drawings is required
- A software print out and flow chart are required

Teams may restart their robot as many times as they wish. However, their score will be reset to zero each time and the arena reset (i.e. blocks reset to random locations) every time this happens. The timer will not be reset.

The only interaction permitted is between the robot and the workstation. No information may be entered at the terminal during a run. The same program must be run after each restart.

Evaluation

This will be judged upon the following:

- Teamwork and Time management
- Meeting the key customer requirements
- Physical testing
- Build quality
- Staged and final reporting

Demonstration Task

Teams will be given 6 minutes to transport safely as many non-active fuel cells from the red outlined area to the green outlined area starting and finishing in the area shown.

5 fuel cells will be placed on the lines, 5 fuel cells will be randomly distributed within the red lined area. The minimum possible distance between fuel cells is 10cm.

Robots must fit within the white line of the start and finish area 300mm x 400mm.

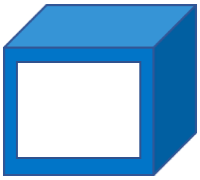
Teams must make a sporting attempt to complete the task – if in doubt about what is consider a 'sporting' attempt they should consult with the teaching staff.

Scoring

Action	**Score**
Fuel of any type detected (light shown). Each fuel item is only counted once.	+10
Fuel type correctly identified	+10
Incorrect fuel moved out of the red area	-20
Safe fuel moved out of the red area	+10
Safe fuel moved out of the red area and into the green area	+20
Robot returns to a start/end box such that at least 50% of the robot is within the box. *The robot must have made a sporting attempt to recover fuel before it can return to the starting box.*	+20

- If the correct lights signals are not implemented (see specification above) there will be a 30% reduction in the marks achieved.
- If the sensing can not be tested without a microcontroller there will be a 50% reduction in marks.
- No negative scores are allowed.

Fuel Cells



Fuel cell are all blue hollow cuboids. Magnetic tape is inserted in the internal recess to represent active cell. The 'empty' cells will not be fitted with magnets.

Table Layout

See tables for layout. Your robots should be capable of dealing with some variation in position of lines/surface defects.