M1 Task: Waste Sorting

Scenario

Robots have been taking on many low skilled tasks which traditionally have involved a high degree of manual labour as well as those which are hazardous. One example would be sorting hazardous waste for recycling or disposal.

Task

A technology demonstrator robot should be built to show the potential of robots for sorting pre-packaged waste for further processing. Clean waste has no metallic content and should if delivered to a different area from waste which contains ferrous metal (steel) and requires additional processing.

Deliverables

Description	Deadline
Initial report detailing project management and approach to problem	Thursday week 2
Robot for assessment of build quality	Weds Week 4
Robot build documentation (drawings, schematics, software doc and code)	Monday Week 5
Final report including sub-team approach, analysis of the simulated success and plan for physical implementation and testing to validate simulated results	Monday Week 5

Standard Specification

- The robot must not have any sharp edges and must be safe around humans.
- The robot must display a flashing amber light (2Hz±10%) whenever it is moving.
- The robot must be of modular construction and use standard components where possible to allow easy maintenance and repair in the field e.g. access to exchange motors, modules have plugs/sockets, fixings accessible
- The robot must be well constructed i.e. not held together with tape and glue, unsupported/protected cables, parts not fixed down
- The robot must be started in a controlled manner by pressing a push button switch or entering a command on the workstation.
- The robot must clearly display the team number on top (visible to the overhead camera) for all testing in black Arial font on a white background no smaller than 50mm high for all testing.
- All cabling must be neatly installed
- Cable colouring must conform to the site regulations: red power +, black power -, all other colours can be used for signal/control
- A complete set of mechanical drawings and electrical drawings are required of a standard which would allow another engineer to replicate the robot, or carry out repairs
- A software print out and flow chart is required
- The robot must fit entirely in the start/finish area

Task Specific Specification

- Blocks should be clearly identified as containing metal or not before they are transported. This should be indicated by illuminating a red LED for metal containing blocks and a green LED for non-metal containing blocks. The LED should clearly illuminate for >5 seconds.

- The colour of the blocks is for demonstration purposes only, and must not be used to determine if they contain metal or not.
- The robot may traverse between the two sides of the table by either navigating around the obstruction or making use of the ramp over the obstruction.
- Metal containing blocks should be delivered to the red square, blocks with no metal should be delivered to the blue square.
- Blocks will be scored for delivery at the end of the task.

Evaluation

This will be judged upon the following:

- Teamwork and Time management
- Meeting the specification
- Simulated testing
- Alignment of simulated robot and build documentation.
- A test and build plan for the final robot to be physically implemented and tested.
- Staged and final reporting

Demonstration Task

Teams will be given 5 minutes to complete the task.

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.

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 every time this happens. The timer will not be reset. The run with the highest score will count.

The only interaction permitted is between the robot and the workstation. No information may be entered at the terminal during a run, except for a single instruction for the robot to return. The same program must be run after each restart.
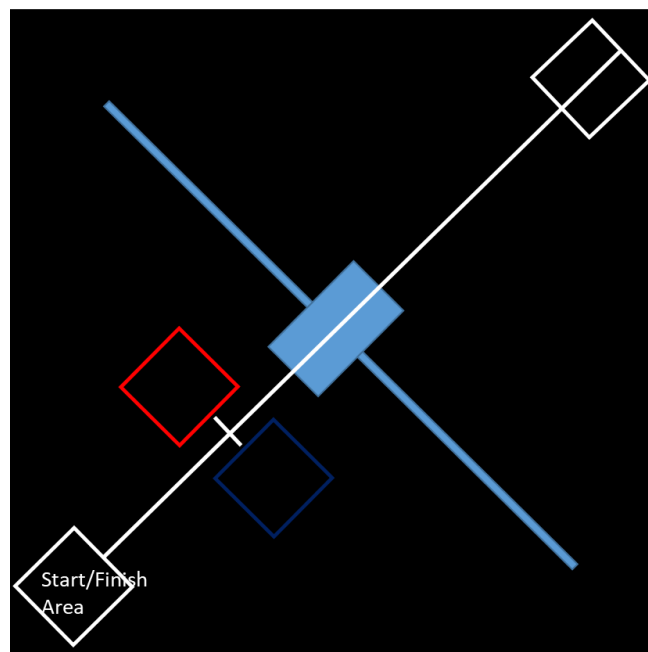
The robot will start in the start finish area and a single block will be placed collection area.

A new block will be placed into the white collection area when there is no block in the collection area (no part of a block inside the lines) and the robot enters the other diagonal half of the table.

A maximum of 6 blocks will be placed, after 6 blocks have been sorted the robot should return to the start/finish.

The first block will be placed just inside the collection area in line with the approaching white line, subsequent blocks will be randomly placed

For ease of testing, example blocks with and without metal content are provided. Metal is present in the Red blocks, and absent in the blue blocks. The robot must not make use of the colours.

Scoring

Action	Score
Robot reaches collection side of the table (scored once)	+10
Robot reaches collection area (scored once)	+20
Metal / Non-metal status correctly displayed (per block)	+10
Each new block placed in collection area	+5
Block delivered to correct area and completely inside lines (per block)	+20
Robot finally returns to a start/end box and stops such that robot is entirely within the start finish area. *The robot must have made a sporting attempt to move parcels on to targets*	+20 (+10 for ground contact points within area)

Where teams score equal points, the team with the shorter time will be ranked more highly.

The expectation for standard credit is that teams will at least reach the collection area by the 1st competition.

Component restrictions

Teams are limited to the quantity of the following major components and sensors which can be used in the robot:

1 battery pack
1x Arduino Uno Wifi v2
2x Small Motor (18RPM) – do not remove metal plates
2x Large Motor (40RPM) – do not remove metal plates
2x Standard servo
4x Optoswitch OPB704
2x Transmissive Photo interrupter
1x TSOP4838
2x Ultrasonic Transducer
1x IR distance sensor 200-1500mm
1x IR distance sensor 100-800mm

Other components in the IDP Parts List are not restricted in quantity (within reason).