L1 Task: Virtual Robot Development

Scenario

Often complex, integrated engineering systems must be developed by a team working to a tight timescale in difficult circumstances with limited resources. Simulation is often used as a tool to allow rapid development and reduce project risk before anything is physically implemented. However, simulation also carries a risk that the simulation does not faithfully replicate reality due to the simplifications and assumptions which must be made.

This task requires you to design and simulate a robot team comprising two robots and a controller. The two robots are to collect red and blue blocks which are randomly placed over a 2.4 x 2.4 m area. The red blocks are to be collected by the red robot and the blue by the blue robot. The design of the robots should be such that they could be implemented using parts generally available for IDP using rapid prototyping tools (laser cutting, 3D printing), and the design de-risked through simulation.

Throughout the process you must consider the simplifying assumptions you are making to allow simulation, whether these are realistic and how the assumptions could be validated.

Deliverables

Description	Deadline	Responsibility
Initial report detailing project management and approach to problem	Week 1	Team
Webot files which specify the robot (world file)	Final competition	Team
Source files which specify the robot controller and master controller	Final competition	Team
Robot build documentation (drawings and schematics)	Documentation deadline	Team
Final report including sub-team approach, analysis of the simulated success and plan for physical implementation and testing to validate simulated results	Documentation deadline	Individuals to report on their own contributions to the simulated robots and implementation / testing strategies for these aspects.

Specification

- 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
- Red boxes are to be delivered to the red square, blue boxes to the blue square. 'Delivery' will be evaluated at the end of the test.
- A complete set of mechanical drawings and electrical drawings are required of a standard which would allow fabrication of the robot.
- The simulated mobile robot shall only use the following sensors:
    - distance sensors with look up tables to replicate the range of the ultrasonic transductors or IR distance sensors (up to 2),
    - Camera sensors with single pixel and a 'far' setting of 0.1m to replicate a colour sensor (x2)
    - GPS sensor to emulate computer vision from overhead camera
    - Emitter and Receiver to emulate wireless communication

- A software flow chart is required

Resources Provided

- An example world file with a 2.4m x2.4m area and 4 red and 4 blue blocks. The mass of the blocks and their frictional properties with respect to the area floor can be assumed to be realistic.
- An example 2 wheeled robot which can be modified

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

Simulated Task

Teams will be given 5 minutes (as recorded by the webots simulation clock) to complete the task.

You should provide a PROTO file for your robot, along with the source code of your controller which will be tested against a world file similar to the one provided for testing.

Scoring

Action	Score
Box found and colour detected, indicated by console output	+10
Red package delivered to red square	+20
Blue package delivered to blue square	+20
Robot contacts box of wrong colour	-5
Robots collide	-20
Robot finally returns to a start/end box and stops such that at least 50% of the robot is within the box. *The robot must have made a sporting attempt to move parcels on to targets*	+20

World

An example wbt file will be provided.

The simulated test will be carried out in an identical world, but with a different random arrangement of the blocks.

The red square and blue square show where the red and blue robots will start and where the red and blue blocks should be delivered.

The initial positions of the red and blue blocks will be random, but they will not be within the red or blue square.