

M1 Task: Fruit Harvesting

Scenario

Robots have been taking on many low skilled tasks which traditionally have involved a high degree of manual labour. Fruit picking is one such task where only the ripe fruit should be collected, and the unripe fruit left to ripen further. This is a challenging area for robotics due to the complexities of navigation, finding the fruit, manipulation of the fruit, identifying ripe/unripe fruit etc.

Task

A technology demonstrator robot should be built to show the potential of robots for fruit picking by demonstrating many of the functions which will be required. The focus of the demonstrator is in the identification of ripe fruit by colour, navigation using a line as well as finding fruit in an unstructured environment.

The robot should collect the 'ripe' fruits (red blocks) while leaving the 'unripe' fruits in position (blue blocks). The ripe fruits should be placed in the collection area. The growing area is access via a tunnel and a white line is provided to guide the robot through the tunnel and around the growing area.

Specification

- The robot must not have any sharp edges and must be safe around humans.
- The robot must display a flashing amber light ($2\text{Hz} \pm 10\%$) 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.
- The robot must not collide with any fruit. When approaching a fruit, the robot must stop within 5cm of the fruit and switch the flashing amber LED to continuously lit for 1 second.
- The robot must have onboard electronics to detect which fruits are ripe and which are unripe. When a ripe fruit is detected a green led should be displayed for not less than 5 seconds, when an unripe fruit is detected it should display a red led for not less than 5 seconds. When no fruit is within range ($> 5\text{cm}$) neither LED should be lit.
- The red, amber and green indicator LEDs should be clearly visible from the overhead camera.
- More than one fruit may be transported at a time.
- 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

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.

This will be judged upon the following:

- Teamwork and Time management
- H&S awareness and application
- Meeting the specification
- Physical testing
- Build quality
- 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.

Scoring

Action	Score
Robot first traverses tunnel (no part of robot in tunnel)	+10
Fruit approached (<5cm) and robot stops	+10
Fruit correctly identified as requiring ripe or unripe	+10
Ripe fruit transported back through tunnel	+10
Ripe fruit placed entirely within delivery area (not touching lines)	+10
Robot touches unripe fruit.	-5
Robot finally returns to a start/end box and stops such that at least 50% of the robot is within the box. <i>The robot must have made a sporting attempt to collect fruit before returning.</i>	+20

Should more than one team collect all 4 ripe fruit samples correctly and return to the starting area, teams with matching score will be ranked by time taken.

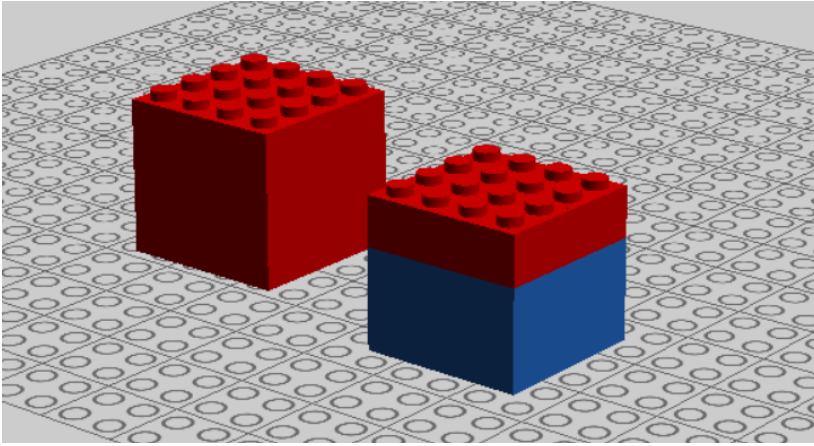
Component restrictions

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)
- 2x Large Motor (40RPM)
- 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

Fruits

Each team will be provided with a single ripe (left) and single unripe (right) example.



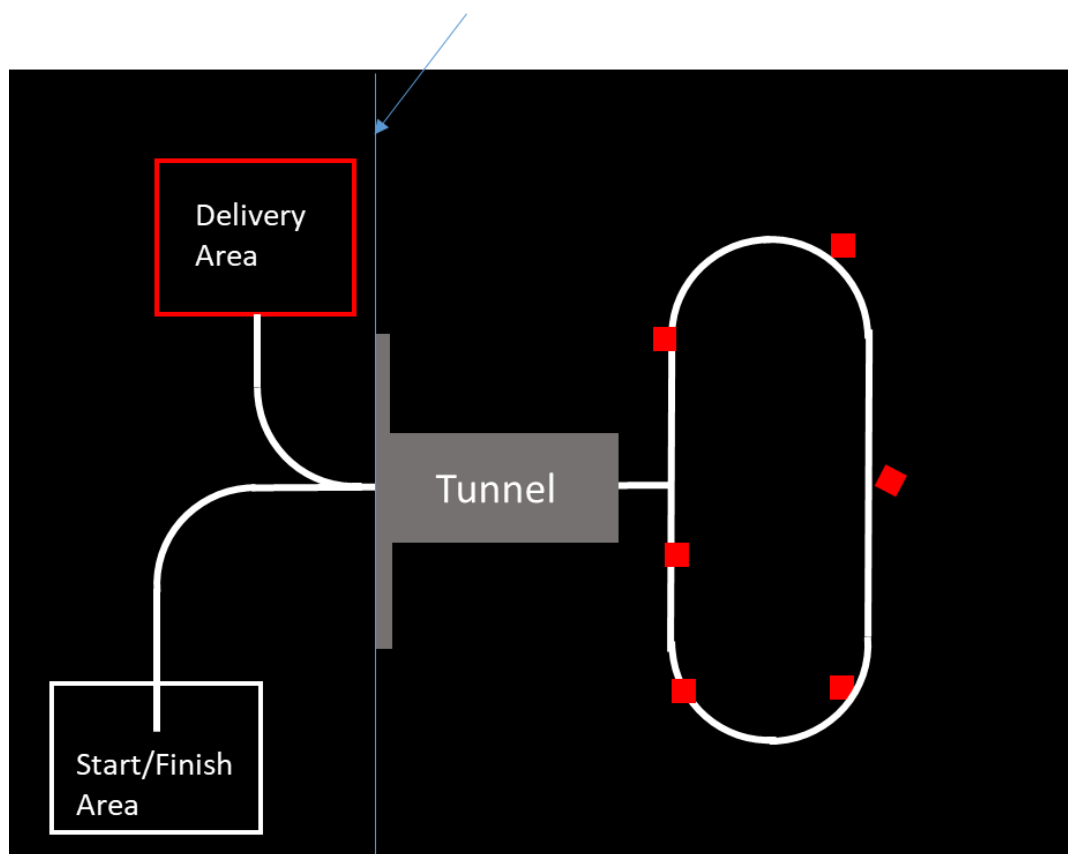
An additional set of 6 fruits should remain on each table. They should be wiped down before and after your teams allotted testing time.

Table Layout

Not to scale – a scale drawing will be provided.

Lines are approximately 19mm wide

Obstruction across table



6 blocks located on or touching
line

Fruits which are on the line will be randomly positioned and oriented such that some part of the fruit touches the line.