IET Birmingham Young Professionals

IET Robot Triathlon Date:

11th March 2017 (TBC)

Venue: The Silk Mill, Derby, Derbyshire, DE1 3AF (TBC)

Team Participant Pack

1. 3 Steps to Registration
2. Team Participant Registration Form
3. Robot Triathlon Aims, Objectives and Rules
4. Base Build Component Specification.

3 Steps to becoming a participant

1 – Register for the Event.

Firstly you will need to register by filling out the registration form. Send your completed copy back to robottriathlon@gmail.com. You can also pass this on to your nearest IET Birmingham Young Professionals representative.

2 – Obtain equipment and build your robot.

Once your registration is complete and you have been issued with an applicant number you are then fully registered. The Robot Drive train (Motors and Gears) will be provided by the IET for free[1] to teams from schools only. However, extra parts will need to be sought by yourself to complete your robot.

Competitors should use standard drive trains for the competition which will need to be completed by the time of the event, as there will be no provision on the day to complete any work and only minor modifications will be allowed. Please see the rules section for aims and objectives.

3 – Take part in the event on the 11th March 2017 at The Silk Mill, Derby, Derbyshire, DE1 3AF (TBC) under the competition rules.

Applications will arrive 30 minutes before the event starts and each applicant will be given 1 trial run of each course, there will be a notification once the competition begins and from that point forward all participants must adhere to the rules. The judging panel is to be confirmed although will all be professionals within the engineering industry. During the event the judging panel's word shall be final with no exceptions. (Please see the rules section for more clarification)

If you have any queries relating to any of the information within this document please do not hesitate to contact us on the following email: robottriathlon@gmail.com.

[1] School teams may submit a claim form with receipt for the cost of their drive train. Contact robottriathlon@gmail.com for a claim form.

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Participant Registration (return by 30th January 2017)

Team Contact Information						
Team Name						
Age Group	13 – 18	18 – 25	25 – 30	30 – 50	50+	(Please Circle)
Contact Name						
Contact Address						
E–Mail Address						

Person to contact in case of an emergency	
Name	
Relationship	
Telephone Number	

Team Members' Names (please indicate teamleader)	

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Agreement and Signature	
By submitting this Registration, I affirm that I and my team will adhere to the rules and regulations of the competition and I understand that if my team is accepted as a contender, any false statements, omissions, or other misrepresentations made may result in immediate dismissal from the competition.	
Team Leader's Name (printed):	
Signature	Date

Equal Opportunities Policy

It is the policy of the IET to provide equal opportunities without regard to race, colour, religion, national origin, gender, sexual preference, age, or disability. All participants are expected to respect these values.

Thank you for completing this registration form and for your interest in taking part in the Robot Triathlon.

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Venue: The Silk Mill, Derby, Derbyshire, DE1 3AF (TBC)

Rules and Objectives

The Rules and objectives have kindly been written by Dr Tony Wilcox, of Birmingham City University, amended by Prof. Kate Sugden of Aston University for 2015 and amended by Chris Balmforth and Daniel Floyd for 2016.

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Aim of the IET Robot Triathlon Competition

To design and build a robot capable of competing in three events:

- Line Follower (Standard or Advanced course)
- Drag Race
- Time Trial (Standard or Advanced course)

Competition Classes

The competition shall be split into three classifications:

- Schools and colleges – for students under 19 currently attending a school or college
- Universities and Young Professionals – for students enrolled at university or IET Young Professionals under the age of 30
- All comers

IET Robot Triathlon Scoring

Points will be awarded for each event as follows:

- 1st place: 10 points
- 2nd place: 7 points
- 3rd place: 5 points
- 4th place: 3 points
- 5th place: 2 points
- Completion: 1 point

Teams electing to compete on the Advanced version of a course shall have their positions recorded separately, and shall receive double the points shown in the table above.

Each team has a Joker card which they may play before any one event. Any team playing their Joker card shall double their normal score for that event.

The points will be totalled from each event and the overall winner in each classification shall be the team with the highest point total.

There will be an award given on the day for innovation and aesthetics of the robot.

1. General Rules

1.1 The same robot must be used for all three events, however minor modifications and programming can be changed in between heats.

1.2 Robots must be self−contained and not externally operated by wire or by remote radio control during the race.

1.3 All components other than the motor (e.g. the chassis, sensors, batteries, and controller) will be specified by the teams, as an option the twin motor gearbox kit from kitronik.co.uk or the standard N20 style Micro Metal Gear Motors could be used.

1.4 All robots must cost no more then £100

1.5 The robots may be customised prior to the start of each event by additional or alternate sensor assemblies and by installation of new software.

1.6 For all events the robot shall not exceed 25 cm in overall length, 25 cm in overall width and 20 cm in overall height.

1.7 During any individual event the handler shall not make any addition, removal, replacement or change to the hardware of a robot except for the battery pack. It is however permissible to make minor repairs.

1.8 One minute (60 seconds) calibration time will be allowed prior to the start of each event.

1.9 The organisers may change certain parameters of the events e.g. number of runs, total run−time) in so far as the changes do not disadvantage any competitor.

1.10 The organisers reserve the right to disqualify teams for contravention or unsporting circumvention of the rules, or for unsporting behaviour.

1.11 When stopwatches are used times within 0.1 seconds of each other will be deemed to be a dead heat.

* Examples of N20Micro Metal Gear Motors can be found here:
https:ƒƒwww.pololu.comƒcategoryƒ60ƒmicro-metal-gearmotors

UK suppliers:

http:ƒƒwww.hobbytronics.co.ukƒ
http:ƒƒwww.technobotsonline.comƒ
http:ƒƒwww.active−robots.comƒ

Examples of the Twin Motor Gearbox Kit

https:ƒƒwww.kitronik.co.ukƒ2537-twin-motor-gearbox-kit.html

and others.

2. The IET Robot Triathlon Line Follower event

The aim of this event is for the robot to travel as fast as possible around a circuit consisting of a white line on a black baseboard. Robots will run one at a time around the course, starting at any point between the start and stop markers, which are on the right−hand side of the track on the start−finish straight. Markers will be placed on the left−hand side of the track to indicate changes in curvature. The run will be timed between start and stop markers and the robot will be allowed multiple runs.

The Advanced Line Follower course shall include a number of breaks in the white line up to 20 cm in length. The robot must pick up the line after the break and continue to follow it correctly.

2.1 General Rules

2.1.1 The Line Follower shall have a specified maximum number of attempts to run the track within a stipulated time limit (typically a maximum of 5 attempts, 5 circuits, or 5 minutes, whichever occurs first).

2.1.2 If the performance time limit is reached and the Line Follower is in the midst of a run, the Line Follower will be allowed to complete the run and the lap time will be valid if the run is successful.

2.1.3 Within the given performance time, the handler is allowed to replace batteries and for upload new program parameters to the Line Follower.

2.1.4 Line Followers shall start anywhere within the defined start−finish area, and shall go in the specified direction. After crossing the finishing line, the Line Follower must automatically come to a complete stop within the start−finish area, and remain stationary for at least two seconds, failing which the lap will be void.

2.1.5 If no part of the Line Follower is over the white line it will be considered to have left the line. If a Line Follower leaves the white line, and has not crossed the finishing line, it will be considered to have gone off the track, and that run shall be invalid.

2.1.6 The organisers will ensure that the track is located within a typical indoor environment in so far as is feasible. No request to adjust the lighting shall be entertained.

2.2 The Line Follower Track

2.2.1 The track is laid out using white 19 mm tape (Electrical Tape) on a matt black base, typically MDF and blackboard paint. Tracks may consist of small tiles or large boards. Refer to Fig. 1 for the range of shapes that will be used to build the track. Fig. 2 is an example of a possible competition racetrack.

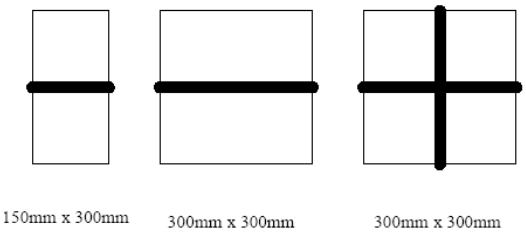


Fig.1. Example track

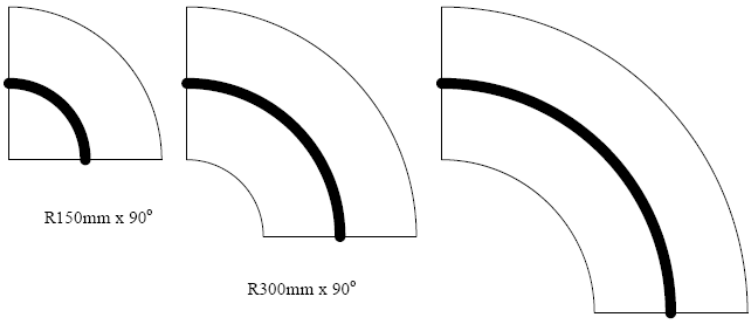
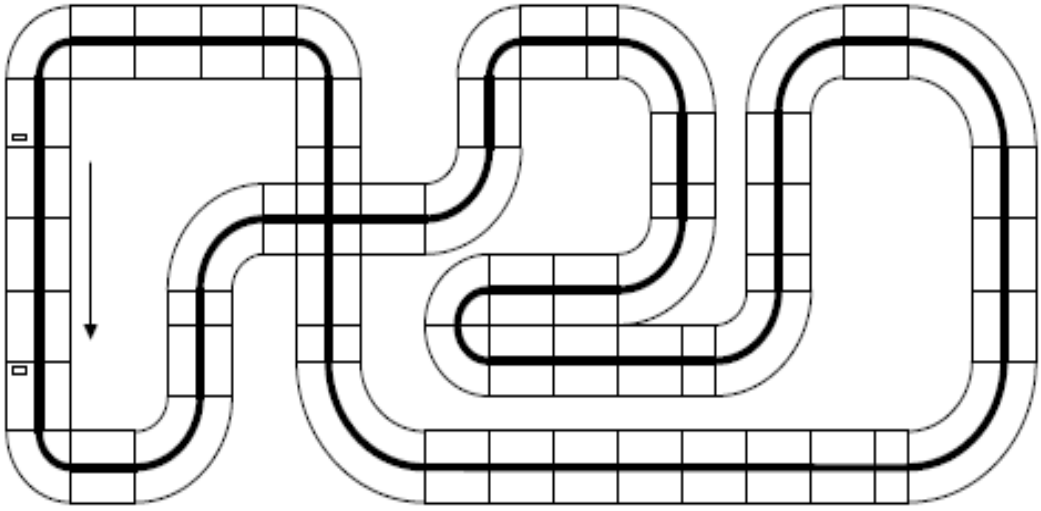


Fig.2. Example racetrack – corner markers not



2.2.3 The racetrack shall comprise straight lines and arcs within the confines of the base−board(s). The baseboard must be large enough to contain a 1.5m start straight.

2.2.4 The radius of the arc shall be fixed at 15 cm, (19 cm,) 30 cm and 45 cm. The angle of the arc shall be 90, 180 or 270 degrees, however please be aware that this may vary slightly.

2.2.5 The length of a straight shall not exceed 6 metres.

2.2.6 Crossovers are permitted, but will be at right angles only. Line Followers shall not turn left or right at a crossover.

2.2.7 The starting line and the finishing line are to be located in the straight section of the circuit. The finishing line is to be located 1m behind the starting line. A starting marker and finishing

marker are to be affixed at the starting line and the finishing line on the right side of the track pointing in the direction of the race. The area between the starting and finishing line shall be called the "start−finish area". See Fig. 3.

2.2.8 The track shall be straight for 25cm either side of the start−finish area, and either side of a crossover.

2.2.9 A corner marker shall be affixed on the left side of the track in the direction of the race at each point where the curvature of the track changes (beginning and end of the arc). See Fig. 4 and Fig. 5.

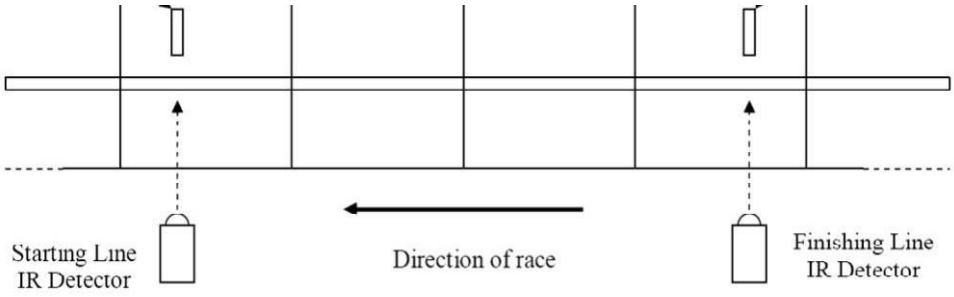


Fig. 3 Start – Finish Area

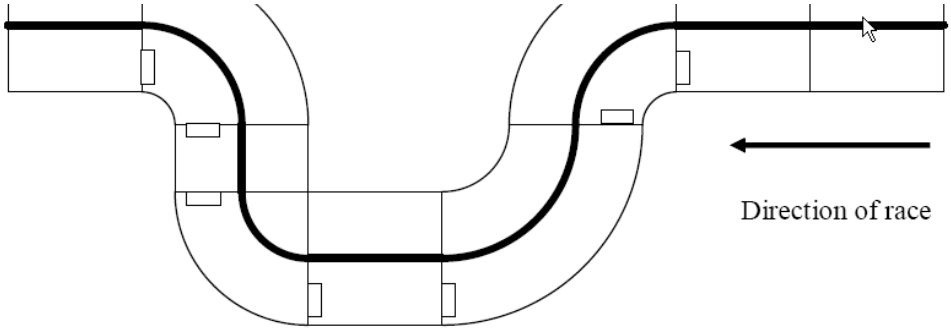


Fig. 4 Corner Markers Indicating Change of Curvature

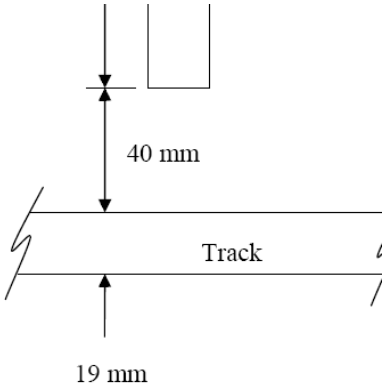


Fig. 5 Marker Position and Dimension

2.2.10 A track may have arcs with different curvatures linked continuously.

2.2.11 The surface of the racetrack shall be as level as possible, however:

- Portions of the track may be inclined at a maximum of 5 degrees.
- Differences in level of up to 1.2mm may exist at the joints between track segments.
- Gaps of up to 1 mm may exist at the joints between track segments.

2.2.12 Complaints about the grip on the track surface will not be entertained.

2.3 Timing of laps

2.3.1 The time it takes for a Line Follower to make the circuit of a track shall be the recorded lap time.

2.3.2 To determine the lap time of the Line Follower, the period from the time the sensor at the starting line detects part of the Line Follower body to the time the sensor at the finishing line detects part of the body of the same Line Follower shall be clocked. However, no measured lap time shall be regarded as valid unless the entire body of the Line Follower passes through the finishing line.

3. The IET Robot Triathlon Drag Race event

The aim of this event is for the robot to travel as fast as possible over a straight course rather like that used for full−size drag racing, then to come to a standstill before reaching the end wall. Two robots will race against each other in a knockout competition where the first robot across the line (allowing for time penalties) in the final will be classed as the winner. The timed run begins when the starting light changes to GREEN at which point the handler must start the run, by push− button or other means. The run finishes when the robot crosses the finishing line. Both robots will be timed independently.

3.1 General Rules

3.1.1 Robots must actively follow the white line down the centre of the track.

3.1.2 Robots will incur a time penalty of 5 seconds for:

- Crossing the end of braking area line
- Requiring manual intervention to continue (touch penalty)

3.1.3 Robots will be disqualified for:

- 'Jumping' the start i.e. they are over the start line when the start light is illuminated
- Falling off the edge of the course
- Touching the safety barriers (if fitted) at the edge of the course
- Interfering with the robot in the other lane in any way.

3.2 The Drag Race Track

3.2.1 Each lane on the track is 7.2 metres long by 0.4 metres wide. The lane surface will be painted matt black. A 19 mm (nominal) wide white tape is laid up in the middle of the lane − this is typically white PVC insulation tape.

3.2.2 The start box occupies the first 375 mm of the track with the start line being defined by 19 mm white tape.

3.2.3 The track will be laid as flat as possible, but robots should be able to cope with a step of up to 1 mm across the track where the boards are joined.

3.2.4 The finish line is defined by 19 mm white tape.

4.1.1 The braking area comprises the final 1.2 m of the track. A line will depict the end of the braking area. If a robot crosses this line a 5 second penalty will apply. A catch net may be provided behind the polystyrene to arrest out−of−control robots. The organisers take no responsibility for damage to the robot caused by over−running or leaving the track.

3.2.5 The start and finish lines will be 40mm from the edge of the centre line, and will be 80 mm in length (as for the line−follower track), on both sides as indicated in Fig. 6.

3.2.6 At the organiser's discretion, a safety barrier up to 20 mm above the track surface may be fitted to the sides of each track.

3.2.7 The surface is MDF painted with blackboard paint. The general tolerance is 5% or 3 mm whichever is greater.

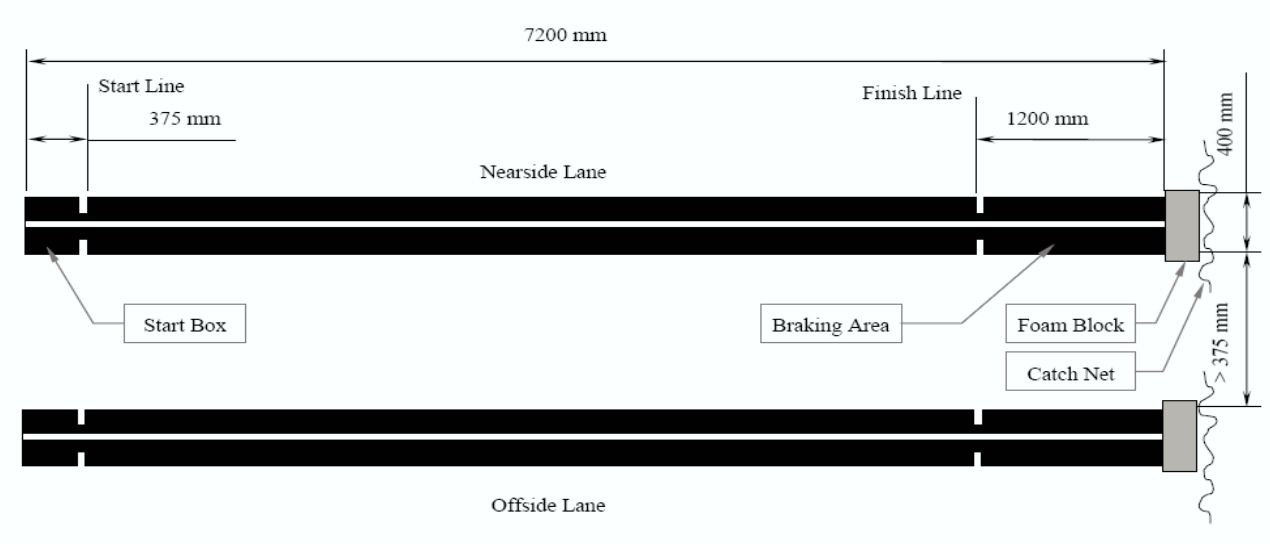


Figure 6. The Drag RaceTrack

3.3 Timing of Runs

3.3.1 The drag race will be timed by a laser timing system. It is the responsibility of the designers to ensure that their robot is not adversely affected. This may be accomplished by appropriate screening of line and marker sensors, software filtering techniques, or by other means.

3.3.2 The start beam will be aligned with the far edge of the start line.

3.3.3 The finish beam will stop the timer.

3.3.4 The finish beam will be aligned with the near edge of the finish line.

3.3.5 In the event that the electronic timing system fails a stopwatch will be used, participants will be given 3 runs and the best of 3 will be given.

4. *The IET Robot Triathlon Time Trialevent*

The aim of this event is to test the speed, acceleration, cornering and directional control of a robot (mouse) on a known course under ideal conditions, and to complete the course in the fastest possible time. The track is a simple rectangle, laid−out in a square formation maze, the figure of 8 formation will be constructed by taking out the middle section of the square maze. The winner will be the robot with the fastest time on any of the 5 laps.

4.1 *General Rules*

4.1.1. On the Standard course the robot must follow the outer wall of a maze in a clockwise direction.

4.1.2. The Advanced course shall be a figure eight, formed by opening a path across the maze approximately half way along the first straight. The robot must detect the opening to the right after negotiating the first eight cells, turn right and cross the maze, then turn left at the end of the cross path and continue in a figure eight.

4.1.3. The wheels of the robot must be stationary when it is put in the maze.

4.1.4. Robots must use non−contact sensors as their means of tracking the walls, and of sensing when to turn. Under 19 teams are allowed to use contact switches to navigate their way through the maze.

4.1.5. The judges may prevent a robot from competing if it is anticipated that it may damage the maze, and it may be retired if it causes damage.

4.1.6. Robots may normally run only 1 session, consisting of a maximum of 5 minutes or 5 laps, **subject to judge's ruling**. Multiple sessions may be permitted if time allows.

4.1.7. Slow robots may be asked to retire and the deaccession of the IET.

4.2 *The Time Trials Track*

4.2.1. The track will follow standard Micromouse dimensions with walls of 1.2cm thickness, 5cm height, on 18cm x 18cm cells. Specifically, the track will be a rectangle 16 cells x 8 cells (see diagram below), fully bounded by walls on each side, thus forming corridors with a space of 16.8cm between walls.

4.2.2. The start square will be in the bottom left−hand corner of the maze, with a straight run ahead.

4.3. ***Timing of Laps***

4.3.1. A stop watch will be used to measure successive passes of the mouse in a clockwise direction. The timing system will use stop watches, times within 0.1 seconds of each other will be deemed to be a dead heat.

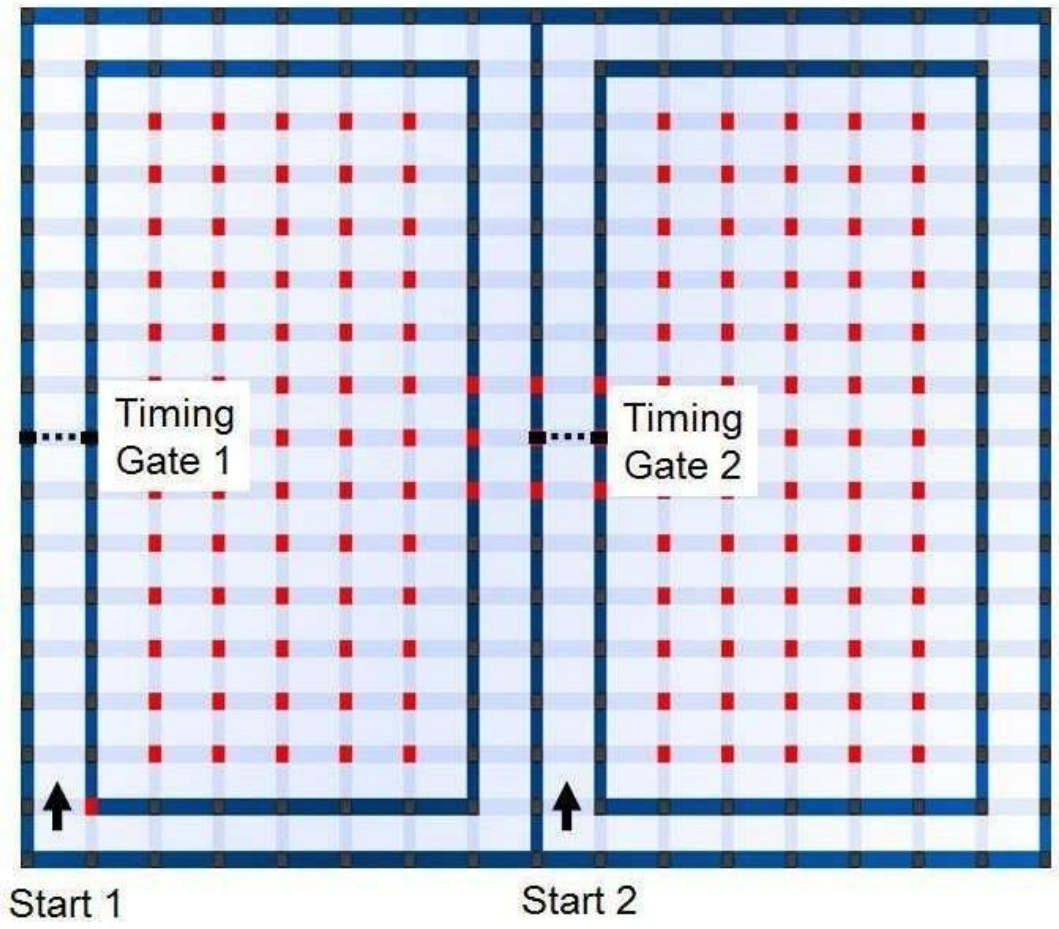


Fig 7 Indicative Layout for the Time Trial maze.

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Competition surfaces.

Some pictures of the 2016 competition surfaces which will be used again in 2017.

Fig 8 Time Trial (Maze)

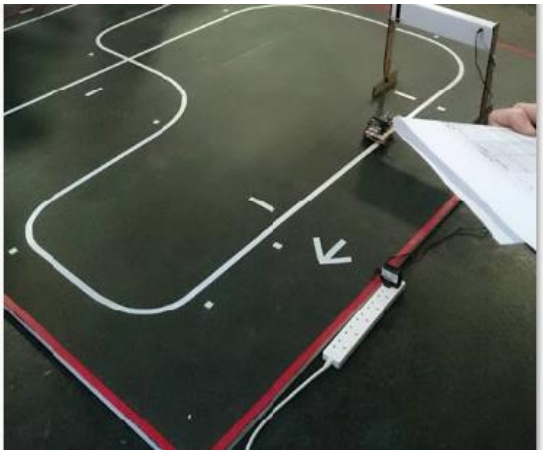

Fig 9 Line Follower

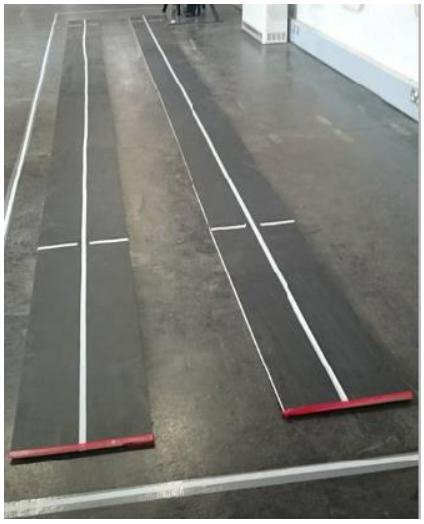

Fig 10 Drag Race

Component/ Base Build Specification

Competitors can use N20 style Micro Metal Gear Motors for the competition. Examples of these motors can be found at:

- https:ƒƒwww.pololu.comƒcategoryƒ60ƒmicro-metal-gearmotors
- http:ƒƒwww.hobbytronics.co.ukƒ
- http:ƒƒwww.technobotsonline.comƒ
- http:ƒƒwww.active-robots.comƒ

Competitors can also use similar motor kit to the following:

- https:ƒƒwww.kitronik.co.ukƒ2537-twin-motor-gearbox-kit.html

All other components and motors will be at the competitor's discretion.

School teams looking for a quick start to the project may wish to consider using Arduino boards such as:

- http:ƒƒwww.rapidonline.comƒelectronic–componentsƒarduino–uno–a000066–board–r3–73–4440
- http:ƒƒwww.rapidonline.comƒelectronic-componentsƒarduino-motor-shield-a000079-rev3-73-4455

Please note that there is a £100 limit on the cost of all robots.