LEGGED ROBOT OBSTACLE RACE

1. OBJECTIVE

To design a Legged Robot to travel to the end of a designated track by either walking, running or hopping and return to the start point.

2. SPECIFICATIONS OF ROBOT

2.1 The robots must be completely autonomous. It should contain the controller, power units and navigation sensors. The robot must not weigh more than 10 kg.

2.2 The maximum length and maximum width of the robot is restricted to a 0.6m x 0.6m square area in the starting zone. There is no height restriction on the robot. There is no restriction on the dimension and geometry of the robot once it started each race attempt (i.e., once any part of the robot crosses the starting line.)

2.3 Radio-frequency (RF) control is strictly prohibited in the robot design except for start/stop operation of the robot (i.e., remote push button to start and stop the operation of the robot.)

2.4 Each leg of the robot must consist of a minimum of two active, independently controllable degree of freedom. Each leg must demonstrate independent actuation with respect to other legs of the robot to realise a walking motion. An actuator that does not actively actuate the walking / hopping motion will not be considered as a controllable degree of freedom (e.g. solenoid to switch function of the motor).

2.5 The legged robot is allowed to have any number of legs, but each leg must conform to paragraph 2.4.The legs of the robot must include some means of controlled motion to realise the walking, running, and/or hopping action for the robot.
The following are some examples NOT considered as a true legged robot:

- Rotating wheel with spokes or other structure sticking out radially to represent 'feet'.
- Traction belt with studs or roller chain with 'feet' mounted in any orientation.
- Robot, with feet or any floor contact point, mounted with motion-assisted roller wheel(s) is strictly prohibited.
- Legs that are mechanically synchronized/coordinated with it other legs to perform walking.
- Figure 1 refers to the various configurations which are and not acceptable.

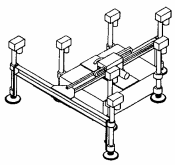
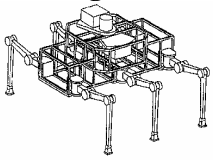
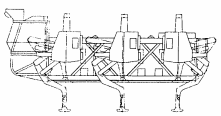
Moving Beam Configuration	**Insect Leg Configuration**	**Mammalian Leg Configuration**
		
Not accepted	**Accepted**	**Accepted**

Figure 1

2.6 The robot CAN ONLY use its legs for the locomotion and negotiating the obstacles. Except the feet of the legs, there should not be any other parts of the robot touching or sliding along any part of the race track.

3. SPECIFICATIONS OF RACE TRACK

3.1 The race-track is a raised platform of a fixed width of 1 m and a maximum length of approximately 10 m (not inclusive of starting zone and finishing zone.) It comprises of straight and circular sections connected together to make up the entire length. The circular section consists of a one-eight circular path (45-degree sector) with radius of 1m (with respect to the longitudinal centerline of the path). The straight segment consists of 1 m

straight paths. There will be a 1m blank zone (no track) along the path. There will be a 1 m **Starting Zone/ Finishing Zone** at one end of the race-track.

3.2 The track is constructed with 1/4-inch plywood with circular and/or straight sections raised about at either 50 mm or 100 mm off the ground. It will be lined with 3 mm thick black rubber mat. Each section of the track is not expected to be perfectly level and it may be slightly uneven. Track sections at the same elevation may be joined with a maximum step difference at the joints of 5 millimeters. There is a 50 millimeters wide retro-reflective tape (3M Scotchlite - Industrial Grade) in the middle of the track for navigation purpose.

Fig.2 shows a top view of an example of a competition race-track. It consists of a 4 straight segments (A) (excluding the Starting and Finishing Zones) and 8 circular segments (B). The 'obstacle' segments will be at different elevations of 50 mm or 100 mm off the ground. The final track layout will be decided by the judges after the caging of the robots.

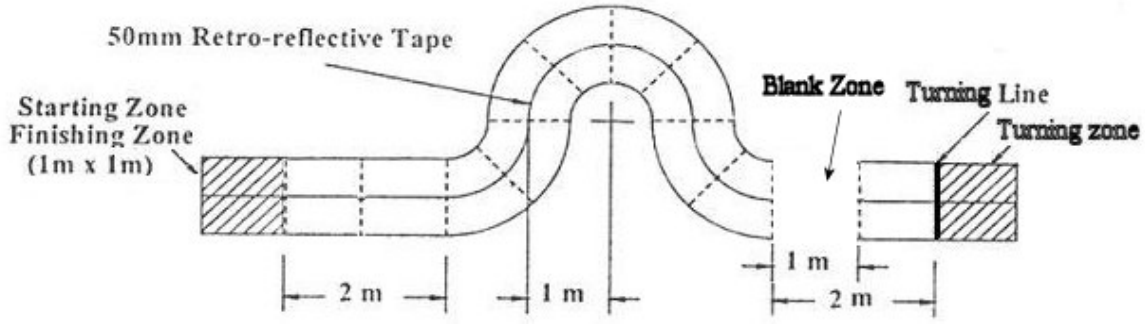


Fig.2 - Sample Legged Robot Race Track

4. RULES OF COMPETITION

4.1 The robot will be "caged" at 30 minutes before the start of the competition. Once the competition starts, no individual is allowed to access the robots in the "caging" area. Charging of batteries is not allowed in the caging area.

4.2 During the caging, the legged robot entries will be inspected to ensure that they conform to the legged robot specifications. Legged robots not meeting the legged robot specifications will be disqualified.

4.3 The robot is to start from a stationary position in starting zone at one end of the track. It has to travel along the designated track either by walking, running or hopping, or any other motion not identified as wheeled motion. While walking on the track, the walking robot has to clear a blank zone (see Fig 2.) When it reaches to last square at the far end of the track, the robot has to make a 180deg turn in the turning zone and return to the starting point. The trailing edge of the robot must cross the turning line (see Fig 2) before it is allowed to make a turn. The turning line will be the same 50 millimetres wide retro-reflective tape placed before the start of the last square. To make the indication of the zones clearer, the start/finish zone and the turning zone will have a height 50mm lower then the adjacent track section.The robot is not allowed to walk back to the start point in reverse. A valid Record Time is measured from the instance any part of the robot crosses the starting line to the moment when the last part of the robot (trailing edge) crosses into the finishing zone. If any parts of the robot that drop of during a run, that run time will not be counted.

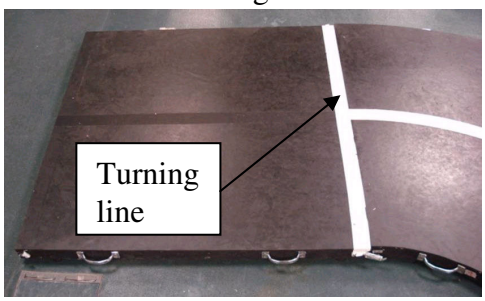


Fig 3. Example of the turning zone at the end of the track
(50mm step down before turning zone is not shown)

4.4 The robot need not stop after crossing the finishing line.

4.5 The robot must keep within the designated track during the race. The run is void if any part of the robot touches the ground (outside side the track) or the robot fell off the track before it has fully crossed the Finishing line. Only the 'feet' of the legged robot are allowed to touch the track (horizontal surface). The designated feet size should proportionally be less than 1/5 in volume of the whole robot leg. If the undercarriage or any other part of the robot (except the feet) of the robot is seen to touch the track surface while overcoming an obstacle, that run will not be valid. It is the handler's responsibility to ensure that the robot has sufficient ground clearance and components securely held together when moving over the track and obstacles.

4.6 When a robot approaches a step obstacle, if any part of the robot touches the vertical wall of a step, the run will not be disqualified only if the judges determine that this action does not give the robot an advantage in climbing over the step.

4.7 Each robot is given 5 minutes **Competition Time** to produce its best result (this include setup time). Team may withdraw temporarily within the 1st minute of competition and all successful runs during the 1st minute (before they withdraw) will be voided. In this case, they will then re-start their entry at a later time, but will be given only 4 minutes competition time to produce its best result. (Depending on the final number of entries on the day of the competition, the judges may change the competition time for each entry.) The request to temporarily withdraw will depend on the reasons given to the judges. Only minor repairs to the robot will be allowed (The following examples are allowed; Tightening of a loose gear/joint or repluging a connector. The following examples are not allowed; Change circuit boards or replace memory chips or motors or realigning the leg drive mechanism etc...) Modification of robot during competition is STRICTLY PROHIBITED.

4.8 Handlers of legged robots are allowed only one set of battery change to their robots during their competition time. The time they take to change the set of battery is taken as part of the competition time. This spare battery has to be caged beside the robot during the caging of all robot entries.

4.9 Winning is based on the shortest time to complete the FULL competition track. If all robots failed to achieve any single complete run within the Competition Time, the longest distance travelled at any single attempt will be recorded instead. As for the single attempt which started just before the lapse of the competition time, it will be allowed to continue till it crosses the Finishing line or step out/fall off the track, and the result will be recorded.

4.10 All robots should be returned to the caging area after its run. The teams are not allowed to take back their robots before the whole competition is concluded.

4.11 Incentive for legged robots designs with 4 legs or less: their individual run time will be divided by 3.

5. CLONING

5.1 In accordance with the spirit of the competition, clones among the winning entries will only be awarded one prize. Clones will be identified during the "caging" procedure and the handlers will be notified by the judges if their robot has been identified as a clone.

5.2 Clones are robots with substantially identical physical appearance and walking mechanism. As a guide, for robots not to be considered clones, there should be significantly more differences between robots than there are similarities. (Shifting a battery position by a few mm or shortening a component by a few mm will still be considered as being similar). Please refer to the SRG main rules on classification of clones and procedure for appeals.

5.3 The decision of the Judges will be final when implementing the rules of the legged robot obstacle event.