Smart Car Racing Rules

The organizing committee rules shall customize this document as needed. This document serves as a template and standard practices for Smart Car participant rules and regulations.

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Participant Rules

I. Only undergraduate and/or post-graduate students from a valid University may participate.

II. Cars will be designed and constructed by students only. This includes the car kit, sensor mounting, signal collection and processing, drive motor, steering control, software development, etc.

III. Students are required to submit a final report regardless of participation in the racing event.

IV. Only students and judges may be present on the racing field during the event.

V. Participants are expected to exhibit good sportsmanship. Any inappropriate or cheating behavior may result in disqualification.

Equipment Usage

I. Each team will be provided the same car kit and architecture to build their smart car. The following rules are in place to keep the playing field level. The spirit of the game is demonstration of excellent hardware integration and superior programming and control algorithm control.

II. The following original and unaltered equipment must be used in the design.
   a. Tires
   b. Drive - DC motor
   c. Transmission Ratio of Drive Motor
   d. Servo Motor
      1. Excludes connection component on output axis of the rudder
   e. Battery (7.6V, 2000mAh)
      1. Only one (1) battery at a time may be used to power the vehicle
   f. It is not allowed to reengineer ball bearings
   g. If any standard component of the car model is damaged, then a replacement part of the same model should be used.
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II. To ensure smooth running of the car model, additional circuit and sensors can be installed.

III. The following equipment can be modified, with some restrictions:
   a. Chassis
      1. The footprint of the frame may not be altered
      2. You may not change the distance between wheels
      3. No part of the car shall exceed dimensions of 250mm/9.85in (W) x 400mm/15.75in (L)
      4. It is allowed to open holes or install auxiliary racks on the chassis
   b. Control Boards
      1. Must use a preselected microcontroller from Freescale Semiconductor
      2. Teams are allowed to create custom control boards, however, the primary MCU must remain the same as that provided to other teams.
      3. No auxiliary processor or other programmable device is allowed besides the microcontroller
      4. DC power supply should use the vehicle battery
      5. DC-DC boost circuit cannot be used to power drive or steering motors

IV. To ensure fairness the following limits on hardware will be enforced per vehicle.
   1. One (1) microcontroller in the control board
   2. Three (3) servos
   3. Sixteen (16) sensors
      a. Transmitter/Receiver pair is 1 sensors
      b. CCD sensor is 1 sensor

V. Total capacity of all capacitors should not exceed 2000 uF; the highest charging voltage of capacitors should not exceed 25 V.
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VI. Development software can be CodeWarrior IDE software or selected separately

VII. Hardware can use the BDM tools provided or can be selected separately

VIII. Type and quantity of components used for circuit (sensor, signal processing, interface and power devices, etc.) can be selected freely by individual racing team.

Race Divisions

I. Each school may have up to four racing teams

II. Schools with more than one team must equally divide teams into Camera and Photoelectric Divisions.

III. Teams competing in the photoelectric division may not use camera vision in car design. Likewise, teams competing in the camera division may not use photoelectric components in car design.

IV. Racing teams of each group will be ranked separately.

Scoring

I. Equality and fairness will be ensured as much as possible on the condition of actual feasibility. Disputes will be resolved by a vote of organizing committee and judges.

II. Racing events may have qualification rounds as determined by the organizing committee.

III. Time will be calculated when the racing car leaves the starting line.

IV. Each vehicle must complete two (only one in some cases) laps.

V. Vehicles may not leave the track (deviate more than 0.25m/9.85in from line).

VI. Times will not be recorded for vehicles that leave the track.

VII. Fouls (see below for definition) will result in the addition of one second to the car’s best time.

VIII. Time will be calculated using electronic timer and displayed on electronic
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display in real time.

Awards

I. Time: Awards will be given to the top three teams who have the lowest time during the finals from each division.

II. Report: Student reports will be judged for technical competency and completeness. Judges will score reports based on <X,Y,Z>

III. Quality of Production: Judges will score cars on quality of construction, appearance, and design creativity.

Track Layout

I. The two racing divisions (camera and photoelectric) compete on the same racing track

II. A reference for building a private test track will be available to all participants

III. The actual layout of the final racing track will be unknown until competition day.

IV. On race day a test track made from the same material will be available on a first come, first serve bases for test programming and design modifications.

V. Width of the racing track shall not be less than 600mm/23.65in.

VI. Specific specifications for materials used for surface of the racing track will be provided on the web site of the event.

VII. Surface of the racing track is white, with a continuous black line (25mm/1in wide) drawn in the middle as the pilot line.

VIII. The minimum bending radius of the racing track shall not be less than 500mm/19.7in

IX. The racing track can intersect with a crossing angle of 90°.

X. Any slope must be equal to or less than 15 degrees in straight section of the racing track, including upgrade and downgrade.

XI. There is a straight starting area of 1000mm/39.4in long in the racing track,
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as shown in figure below. In addition, there is a black starting line 100mm/3.9in long at both sides of the starting point. Start time and end time will be determined when front part of the racing car passes the starting line.

<Edit diagram to include customary units>

Referee and Judging

I. Event Organizer will set up a racing executive committee which oversees the technical group, referees, and judges.

II. The technical group is responsible for ensuring all cars meet the racing criteria. Including vehicle specifications, dimensions, and non-modifiable parts.

III. The referees are responsible for on-track activities. This includes race track management such as starting and stopping vehicles, as well as timing and scorekeeping.

IV. The judges are responsible for non-time based judging activities. This includes design judging and/or report judging.

V. Any racing disputes will be taken up and resolved by the racing executive committee.
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VI. Workers of the organizing committee or the event team shall not participate in coaching or training for any specific racing team (except for microcontroller training) and shall not disclose any information that might compromise fairness of the competition.

Preliminary (Qualifying) Race

I. Race order within each division will be determined by random drawing.
II. Each team is given two attempts to complete the track and post a time.
III. Teams that can not complete the track after two attempts do not advance to the finals.
IV. If there are multiple tracks, teams can not use the same track for the second attempt.
V. The vehicle must complete two laps on the racing track.
VI. The shortest time for a single lap will be recorded.
VII. The best time from the two attempts will be used for finals race order.
VIII. Based on number of participating teams, the organizing committee of the event may set a certain limit of racing teams that can advance to the finals based on the best times in preliminary.
IX. The technical judges will perform on-site technical inspection for all the winning cars eligible for the final.
X. Disqualified cars will be replaced by the next car in ranking.
XI. List of finalists will be submitted by the referees to the organizing committee of the event.
XII. After preliminaries races, cars will be kept by the organizing committee in designated area. Teams are not allowed to continue work on cars.

Final Race

I. The teams will be sequentially ordered based on preliminary times.
II. Teams with slowest (high) times compete first in the finals.
III. The final will occur on a same racing track. <contradictory with next
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IV. The race track configuration for the final is to be different from that used for preliminary. This can include shape, size, and distance.

V. Each finalist has one attempt to complete the track.

VI. Each vehicle must complete two laps.

VII. The shortest time taken to run a single lap will be taken as the final score of the racing car.

VIII. Score in the preliminary will not be included in score of the final.

Race Procedure

I. A referee will direct all the racing teams when to enter the playing field in accordance with the racing order.

II. There shall be only one team on the track at any given time.

III. After being called by a referee, each racing team should designate a member to take their racing car to the playing field and place it in the starting area of the racing track.

IV. Upon entering the playing field, a team has two minutes to setup the car and signal “Ready” to referee.

V. After the referee announces the start of the race, the vehicle should leave the starting area within 30 seconds and run for two laps continuously.

VI. After the race car finishes, a member of the team shall take the vehicle away from the track.

VII. Event displays will post the best time for a single lap.

Rules for Fouls and Failure

I. During a team’s racing, the on-site referee will judge whether the racing car ran out of the race track according to applicable rules.

II. If a racing car runs off the track two times, the referee should pick the car model up and hand it to the player to start the racing again from the starting area and score of the current lap will be considered invalid. Alternatively, the player can also give up the racing after his/her car runs
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out of the track.

III. Any of the following conditions will be considered as fouls and will result in time being added:
   a. The racing car fails to leave the starting area within 30 seconds after beginning of the racing [+1 second]
   b. The race car fails to stop 3 meters after the finish line, after completing the 2 laps. [+1 second]

IV. Any of the following conditions will be considered as failures and attempt being forfeit:
   a. The race car runs off of the track
   b. The racing team fails to enter the playing field and get prepared for the racing in two (2) minutes after being called by the referee
   c. The player touches the racing car after beginning of the race without consent of the referee
   d. The race car fails to pass the technical inspection before actual racing.
   e. The racing car fails to finish 2 laps within 120 seconds after leaving the starting area
   f. No time will be given for a failed team.

V. Prohibited Actions
   a. No auxiliary lighting equipment or other auxiliary sensors are allowed around the race track.
   b. After entering the playing field, players cannot modify any hardware and software except for changing the battery
   c. Only a referee and one player are allowed in the playing field.
   d. Any behavior that might interfere with the movement of the race car is not allowed.
   e. No plagiarizing is allowed in design of the car including, hardware and software. Cars from same University but different teams should be clearly different.
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Event Organization

I. A test racing track will be provided of the same material and environment as the actual track. The layout shall be different from the actual race track.

II. After the preliminary race, cars will be collected and placed in an inspection area. During this time, racing teams are not allowed to modify software or hardware of the car.

III. Before the finals, the technical group of the organizing committee will perform technical inspection for all car models participating in the competition. In the event of any violations, the organizing committee is empowered to disqualify any car.

IV. The rules should be interpreted by the organizing committee of the event.