

# Rules and Discipline of the Playing Field of the Smart Car Race

All racing teams should use the car model suite designated by Freescale Semiconductor, using HCS12 Microcontroller from Freescale Semiconductor as the core control unit. They should design control scheme and racing car system themselves, including sensor signal collection and processing, drive motor, rudder control and control algorithm software development, etc. Then, they should carry out car production and commissioning, and participate in the racing pre-final at the designated place and date looking to obtain qualification for the final racing. Place in the competition of each racing team will be determined primarily based on time taken by each racing car to finish the racing on the designated racing track, meanwhile taking technical report and quality of production into account. Car models using lens imaging to identify the racing track will be classified into the camera group while the remaining car models belong to the photoelectricity group.

The committee of the event stipulated the following racing rules for the preliminary round and the final competition. Equity and fairness will be ensured as much as possible on the condition of actual feasibility. The committee will invite independent notary to supervise the racing on site as well as the rank judgment process.

## **I. Requirements on Equipment**

1. Car model designated by Freescale Semiconductor should be used.
2. HCS12 processor from Freescale Semiconductor should be used as the only microcontroller.
3. Racing teams of photoelectricity group cannot use lens imaging for track detection. However, racing teams of the camera group can use photoelectric tube as an auxiliary method for track detection.
4. Miscellaneous
  - If any component of the car model that is not allowed to change is damaged, then replacement part of the same model should be used;

- After reengineering, dimensions of the car model should not exceed 25 cms (W) x 40 cms (L).

## **II. Stipulations Related with Racing Track**

1. Refer to Annex 3 for basic parameters of the racing track (excluding number of corners, location and overall layout);
2. Actual layout of the racing track will be published on the competition day. Test racing track made from the same material with the actual racing track will be provided within the racing field for the participating teams to use for commissioning.

## **III. Referee and Technical Judgment**

The entire racing event is divided into two phases: preliminary and the final competition. The final should be carried out by the undertaking universities under direction of the organizing committee of the event. The undertaker should set up a Racing Executive Committee with subordinate technical group, referee group and arbitration committee to solve various issues encountered during the racing.

Workers of the organizing committee of the event, including workers from technical judgment and referee, should not participate in coaching or training for any specific racing team (except for microcontroller training) and should not disclose any information that might compromise fairness of the competition.

In preliminary, referee and technical judgment method should be determined by the organizing committee in accordance with the above stipulations for the final.

## **IV. Racing Rules for Preliminary and the Final**

Preliminary and the final competition use same racing rules and both of them are divided into two groups (photoelectricity group and camera group). The two racing groups compete on the same racing track and abide by the same rules. Racing teams of each group will be ranked separately.

The racing rules listed below apply for both preliminary and final competition:

## 1 □ Racing Rules for Preliminary and Final

### 1) Rules for Preliminary Phase

- i. There are two same racing tracks in the racing field.
- ii. All the racing teams will be divided into two groups by drawing lot evenly and racing order within each group will also be determined by drawing lot.
- iii. The racing will be divided into two rounds and the two groups will compete on the two tracks simultaneously. After the first round, the two groups will exchange the racing track and compete for the second round.
- iv. In each racing round, each racing will run for two laps on the racing track. Time will be calculated when the racing car leaves the starting line. After running for two laps, racing cars should stop within the racing track in 3 meters after the starting line. Otherwise, 1 second will be added to the racing time of the car.
- v. Shorter time taken for a single lap will be calculated as the time for that round. The shortest time of the two rounds will be taken as the final time of the racing car.
- vi. Based on number of participating teams, the organizing committee of the event will select certain percentage of racing teams to participate the final based on their scores in preliminary.
- vii. The technical judgment group will perform on-site technical inspection for all the winning cars eligible for the final. Qualification for final of racing car that are not compliant with related equipment requirements (article 1 of the rule) will be cancelled and replaced by the next car;
- viii. List of finalists will be submitted by the referee group to the organizing committee of the event for approval and announcement.
- ix. After preliminary, car prototype and software can be improved (compliant with competition rules) but changes should be reported in the Technical Update Sheet.

## 2□Rules for Final

- x. The racing teams eligible for the final will be ordered based on their scores in preliminary and compete in reverse order of their scores in preliminary.
- xi. The entire final will occur on a same racing track. The racing track for the final is different from that used for preliminary in shape and will be larger.
- xii. Each finalist can only compete for one time. Each racing will run for two laps on the racing track. Time will be calculated when the racing car leaves the starting line. After running for two laps, racing cars should stop within the racing track in 3 meters after the starting line. Otherwise, 1 second will be added to the racing time of the car.
- xiii. The shortest time taken to run a single lap will be taken as the final time of the racing car.
- xiv. Score in the preliminary will not be included in score of the final; instead, it is used only to determine racing order in final. For racing teams failed to participate in the final, time in preliminary will be their ultimate time will be used to determine their rank in individual group.

## 2. Rules for Racing Procedure

Referee will direct all the racing teams enter the playing field in accordance with the racing order. There should be only one team on the playing field at any given time.

After being called by the 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. After the referee announces starting of the racing, the racing car should leave the starting area within 30 seconds and run for two laps continuously. After the racing car finishes the racing (2 laps), a member of the corresponding team should take the racing away from the playing field and hand it to the Jury Committee to perform Technical Inspection.

After successful competition, a screen will display the best time for a single lap.

### 3 □ Rules for Fouls and Failure

During the racing, the on-site referee will judge whether the racing car runs out of the racing track according to applicable rules. After the racing car runs out of the track for the first 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 out of the track.

Any of the following conditions will be considered as running out of the track for one time:

- The racing team fails to enter the playing field and get prepared for the racing in 1 minute and 30 seconds after being called by the referee;
- The racing car fails to leave the starting area within 30 seconds after beginning of the racing;
- The team member can rearrange the car during the race, only if the referee gives consent and time will not be stopped.

Any of the following conditions will be considered as failure in the racing:

- The racing car runs out of the track for more than two times;
- The player touches the racing car after beginning of the racing without consent of the referee;
- The racing car fails to pass the technical inspection after the race.

No score will be given for a failed team.

### Forbidden Behaviors

- No auxiliary lighting equipment or other auxiliary sensors are allowed around the racing track;
- After entering the playing field, players cannot modify any hardware and software except for changing battery;

- Only referee and 1 player are allowed in the playing field;
- Any behavior that might interfere with movement of the racing car is not allowed;
- No plagiarism is allowed in design of the car model, hardware and software of car models of different teams of same university should be different clearly.

#### 5□Event Organization Description:

- 1) Before commence of normal racing, each racing team can test the racing environment on site. Test racing track is different from the actual racing track in shape but their material and environment is same.
- 2) Before actual competition, all car models will be collected and placed in a same area by the organizing committee until end of the competition. In this course, racing teams are not allowed to modify software and hardware of the car model.
- 3) During the racing, 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 entitled to cancel qualification of corresponding team.

#### **V. Miscellaneous**

- 1□Racing qualification will be cancelled for any other cheating behavior during the competition;
- 2□The rules should be interpreted by the secretariat and the organizing committee of the event.

### **Annex 1: Requirements on Intelligent Racing Car Model**

- 1) It is not allowed to change structure of the chassis, distance between wheels, radius of wheel and tire;
- 2) It is not allowed to change the components provided in the car kit.
- 3) It is not allowed to change drive motor and battery, the car model has to be powered by the DC motor and battery of the car model itself;
- 4) To ensure smooth running of the car model, additional circuit and sensor can be installed. It is allowed to open holes or install auxiliary racks on the chassis.

### **Annex 2: Requirements on Circuit Device and Control & Drive Circuit**

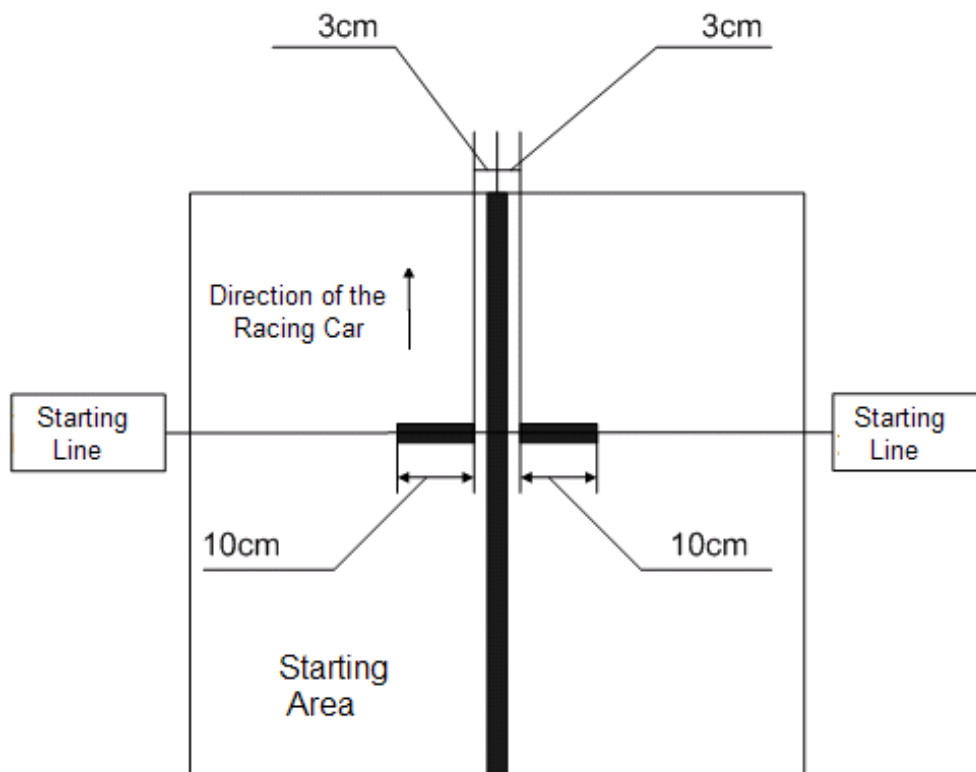
- 1) No auxiliary processor or other programmable device is allowed besides the HCS12 microcontroller;
- 2) Number of servo should not exceed 3;
- 3) Number of sensor should not exceed 16 (infrared sensor receiving unit considered as 1 sensor, transmitting unit is not calculated, CCD sensor calculated as 1 sensor);
- 4) DC power supply should use the battery provided by Freescale Semiconductor;
- 5) DC-DC boost circuit cannot be used to power drive motor and rudder directly;
- 6) Total capacitance of all capacitors should not exceed 2000  $\mu\text{F}$ ; the highest charging voltage of capacitors should not exceed 25 V.

#### **Optional parameters:**

- 1) Type and quantity of components used for circuit (sensor, various signal processing chip, interface chip and power device, etc.) can be selected freely by individual racing team.

**Annex 3: Basic Parameters of the Racing Track (excluding number of corners, location and overall layout)**

- 1) Surface of the racing track will use white base plate. For preliminary, total area of the racing car should not exceed 5 mts. x 7 mts. Width of the racing track should not be less than 60 cms. Area of the racing track can be increased during the final. Specific specification for material used for surface of the racing track will be provided on web site of the event;
- 2) Surface of the racing track is white, with continuous black line (25 cms wide) drawn in the middle as the pilot line;
- 3) The minimum bending radius of the racing track should not be less than 50 cms;
- 4) The racing track can intersect with a crossing angle of 90°;
- 5) Slope of less than 15 degree is allowed in straight section of the racing track, including upgrade and downgrade.
- 6) There is a starting area of 1 mt long in the racing track, as shown in figure below. In addition, there is a black starting line 10 cms long at both side of the starting point. Start time and end time should be determined when front part of the racing car passes the starting line.



***\*\* The rules and conditions are subject to change by Freescale if necessary. Freescale reserves the right in their sole discretion to cancel, suspend and/or modify the Smart Car Race at any time. These official rules are drawn up in the English language. If these official rules are provided in any other language and there is a conflict in the text, the English language text shall prevail.***

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