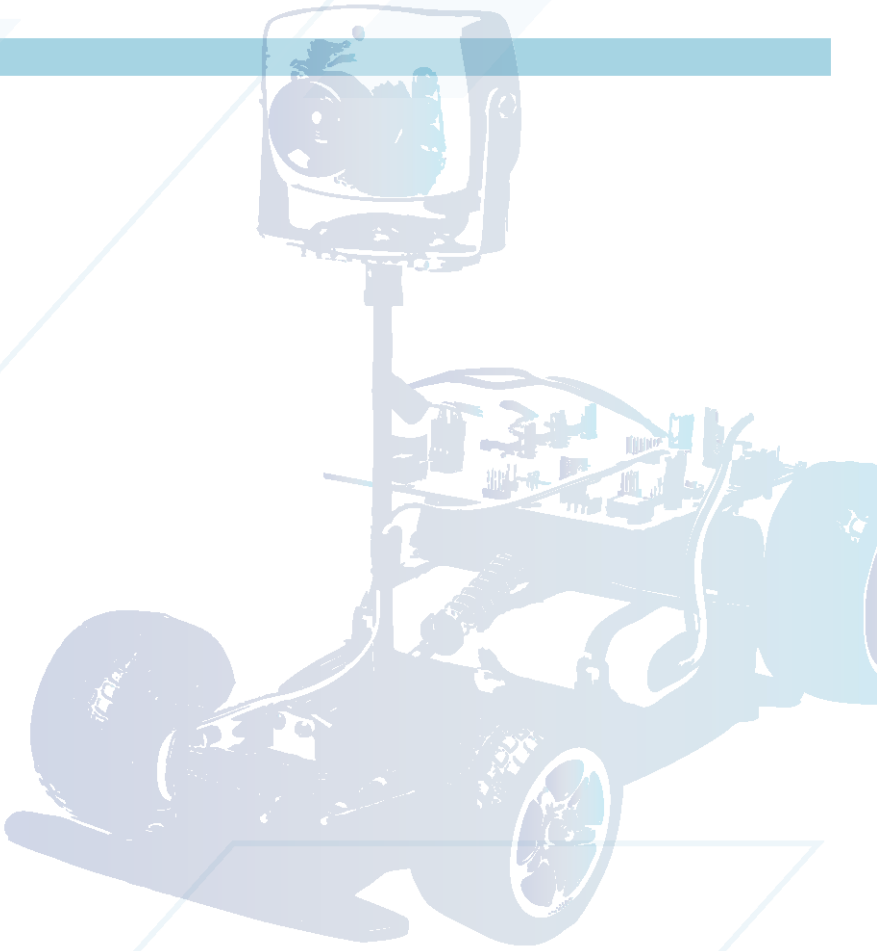

The Freescale Cup

2012 Rules – Mexico

Revised: March 16, 2012

freescale.com/thefreescalecup

Overview

All racing teams will use the car model suite designated by Freescale Semiconductor. The MPC5604B Microcontroller Board from Freescale Semiconductor is the core control unit. The teams should design the software control scheme and racing car system hardware themselves. The software includes sensor imaging collection and processing, drive motor control, and steering motor control algorithm development.

The judging committee of the event will rank using the racing rules contained in this document for the preliminary round and the final competition. Equality and fairness will be ensured as much as possible. The Freescale Cup committee will invite guest judges to supervise the racing as well during the competition.

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Section 1: Team Rules and Requirements

1. Only undergraduate students from a University or below may participate. At least one member must be in the last year before graduation. Master or PhD students are not eligible for this program.
2. The maximum number of people on a team is 3.
3. ALL work on the cars must be done by the team members.
4. Students are required to submit a final report regardless of attendance to the race event.
5. Participants are expected to exhibit good sportsmanship. Any inappropriate behavior or cheating may result in disqualification.

Section 2: Equipment Requirements

The following rules are in place to keep the race vehicles overall operating performance fair. The spirit of the game is to demonstrate excellent hardware integration and superior programming.

1. The following original and unaltered equipment must be used in the design. If any standard component of the car model is damaged, then a replacement part of the same specifications should be used.
    a. Tires
    b. Two (2) Drive - DC motors (2 DC car model)
    c. Transmission Ratio(s) of Drive Motor
    d. Servo Motor (Futaba S3010)
    e. Battery (7.2V, up to 2800mAh, NiCd)
        i. Only one (1) battery at a time may be used, this single source must power all on-board electronics.
    f. The chassis can be modified, with some restrictions:
        i. The footprint of the frame may not be altered
        ii. You may not change the distance between wheels
        iii. No part of the car shall exceed dimensions of 250mm (W) x 400mm (L)
        iv. You may drill holes or install auxiliary racks on the chassis
2. Additional external circuitry and sensors will be necessary
3. The main control board may be modified.
4. Teams are allowed to create custom control boards.
5. No auxiliary processor or other programmable device is allowed besides the MPC5604B microcontroller.
6. DC-DC boost circuit cannot be used to power drive or steering motors.
7. Total capacity of all capacitors should not exceed 2000 uF; the highest charging voltage of capacitors should not exceed 25 V.

8. The following limits on hardware will be enforced per vehicle:
    a. One (1) microcontroller in the control board
    b. Maximum of three (3) servos
    c. Maximum of sixteen (16) sensors
        i. IR Transmitter/Receiver pair is one (1) sensor
        ii. Any Camera is one (1) sensor
9. The software shall be created using CodeWarrior Development Tools and Rappid Initialization for Power Architecture.
10. NO REPRODUCTION IS ALLOWED IN THE DESIGN OF THE CAR MODEL. HARDWARE AND SOFTWARE OF CAR MODELS OF COMPETING TEAMS WITHIN SAME UNIVERSITY SHOULD BE ORIGINAL AND CLEARLY DIFFERENT.

Section 3: Referee and Technical Judgment

The Freescale Cup will be carried out by the undertaking universities at the direction of the organizing committee.

1. The submission of a Technical Report is mandatory to continue in the competition. Teams that do not turn in a Technical Report by the specified date will be disqualified.
2. 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.
3. The judges are responsible for non-time based judging activities. This includes design judging and/or report judging.
4. Prior to race, judges will perform a technical inspection of all entries. This includes vehicle specifications, dimensions, and non-modifiable parts. Violations may result in disqualification.
5. Any racing disputes will be taken up and resolved by the racing executive committee.
6. Workers of the organizing committee or the event team shall not participate in coaching or training for any specific race team (except for microcontroller training) and shall not disclose any information that might compromise fairness of the competition.

Section 4: Race Day Competition Procedure

1. Prior the race, each racing team can test the track environment on site. The test racing track is different from the actual racing track in shape but the material and environment will be the same. Final calibration may be made at this time.
2. Before each race series begins, all cars must be placed in the race staging area to be inspected. During and after this time, the teams are not allowed to modify software or hardware of the car.

3. The entire racing event is divided into two series: preliminary (qualifying) and the final competition.
4. A referee will direct each team when to pick-up car from the staging area and to enter the race track.
5. Only one team at the track at any given time.
6. After being called by a referee, each racing team should designate a member to take the race car to the track and place it behind the start/finish line.
7. Upon entering the playing field, a team has two minutes to set up the car and signal “Ready” to referee.
8. After the referee announces the start of the race, the vehicle should leave the starting area within 30 seconds and run for one (1) lap and stop 1000mm passed the finish line.
9. The designated member of the team has the opportunity to change the battery and adjust the car for a second attempt. Car must stay on the track. No software change/reprogramming can be done on the car. Teams can proceed in cleaning tires, adjust camera angle or adjust other mechanical parts during this pause of maximum 2 min.
10. Same car runs for a 2nd attempt of one (1) lap on the track. The car should stop 1000 mm passed the finish line.
11. After the race car finishes, a member of the team shall take the vehicle away from the track.
12. Event displays will post the best time for a single lap.

Section 4.2: Preliminary (Qualifying) Race

1. Race order will be determined by random drawing.
2. Each team is given two attempts to complete the track and post a time.
3. Teams that cannot complete the track after two attempts do not advance to the finals.
4. The vehicle must complete one (1) lap on the racing track to be qualified for the finals.
5. The shortest time for a single lap will be recorded.
6. Disqualified cars will be replaced by the next car in ranking.
7. List of finalists will be submitted by the referees to the organizing committee of the event.
8. After the preliminary round, the car hardware or software can be improved until inspection time for finals.

Section 4.3: Final Race

1. The technical judges will perform on-site technical inspection for all the cars eligible for the final.
2. The teams will be sequentially ordered based on preliminary times.
3. Teams with slowest times compete first in the finals.

4. The race track configuration for the final may change from the preliminary race. This can include shape, size, and distance.
5. Each finalist has two (2) attempts to complete the track.
6. Each vehicle must complete at least one (1) lap.
7. The shortest time taken to run a single lap will be taken as the final score of the racing car.
8. The score in the preliminary will not be included in the score of the final.

Section 5: Scoring and Awards

1. 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.
2. Time starts when the race car crosses the start/finish line.
3. Time will be captured using an electronic gate or handheld timer.
4. Technical report judging will be scored on quality of content, design approach, and concept understanding.
5. The score from the preliminary round will not be included in the score of the final round.
6. Top three teams are determined by the time score.

Section 5.2: Fouls, Fails and Disqualifications

1. During a race, the on-track referees watch for and determine fouls.
2. Any of the following conditions will be considered a foul and will result in the addition of time:
    a. The race car fails to leave the starting area within 30 seconds after beginning of the race [+1 second penalty].
    b. The race car fails to stop within 1000mm after crossing the finish line. [+1 second penalty].
3. A failure forfiets the current attempt. Any of the following conditions will be considered a failure and no time will be scored:
    a. Three or more wheels leave the race track.
    b. The race team fails to enter the field and ready to race within two (2) minutes after being called by the referee.
    c. Any team member touches the race car after the start of the race without consent of the referee.
    d. The racing car fails to finish 1 lap within 120 seconds after leaving the starting area.
4. Disqualification eliminates team from the competition and no attempts will be given or scored. Any of the following conditions will be considered a disqualification:
    a. Any auxiliary lighting equipment or other auxiliary sensors around the race track.

b. Modifications of the hardware or software after the cars have been inspected.
c. Any behavior that might interfere with the movement of any teams car.
d. Any cheating during the competition.
e. Plagiarizing the car design including hardware or software. Cars from the same University but different teams must be clearly different.
f. Failure to pass the technical inspection.

Section 5.3: Awards

1. A special award will be given to the team with the best report.
2. The competition winners will be the top 3 cars with the smallest recorded time to complete one lap in the Finals.

Section 6: Technical Report Requirements

Technical reports will be reviewed and rated by the experts invited by the organizing committee of the event. The Technical report must be delivered by **September 7th, 2012**. Technical reports should be clear with detailed text, diagrams, and bibliography. Technical reports must contain a brief description of major concepts and specific technical implementation schemes for design and production of car models including:

1. Description of mechanical design of car model.
2. Description of control circuit design.
3. Description of the electronics design
4. Description of control software design:
    a. SW architecture and module interaction block diagram.
    b. SW Design per module.
    c. All code source files and project files.
        i. Module naming conventions should be observed.
        ii. Use of version control tool (e.g. subversion) must be observed, repository delivery is required.
        iii. Use of variable naming conventions must be observed.
        iv. Use of scheduler must be observed.
5. Total weight and dimensions of the reengineered car
1. Power consumption
2. Count and type of sensors used
3. Number of servo motors besides the existing driving motors and rudder motors of the car model
4. Written in English
5. Formatted for either Microsoft Word or PDF
6. ZIP file with version control tool repository.
7. Submitted via email to the Freescale contact two weeks prior to the race

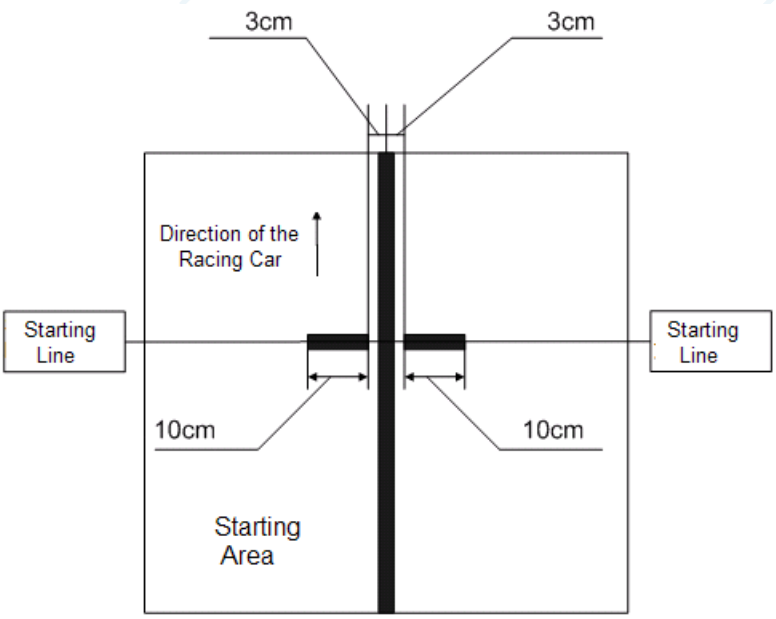
Upon arrival at the final competition, each team must submit a CD, complete with the

University Name and Team Name, with the following content:

a. The Technical Report previously submitted via email.
b. A technical update document reporting changes or improvements in the car prototype and software since the technical report was submitted.
c. All related raw documents like mechanical design, circuit design, and MCU software project of car models.

Section 7: Parameters of the Race Track

1. Each University should create their own test track for the students to use during development. Track drawings are provided at freescalecupwiki.freescale.com.
2. The actual layout of the final racing track will be unknown to competitors until competition day.
3. For a limited time on race day, a test track made from the same material will be available on a first come, first serve basis for calibration and design modifications.
4. Width of the racing track shall not be less than 600mm.
5. Material specifications regarding the surface of the racing track will be provided on the web site of the event.
6. Surface of the racing track is matte white, with a continuous black line (25mm wide) drawn in the middle as the pilot line.
7. The minimum bending radius of the racing track shall not be less than 500mm.
8. The racing track can intersect with a crossing angle of 90°.
9. Any slope in the track will be equal to or less than 15 degrees in a straight section of the racing track, including upgrade and downgrade.
10. There is a straight starting area of 1000mm long in the racing track, as shown in figure below. In addition, there is a black starting line 100mm long at both sides of the starting point. Start time and end time will be determined when the front part of the racing car passes the starting line. The car must be able to automatically stop within three meters of the starting line after finishing the race.



Section 8: Questions or Clarification

Prior to the race, please post any questions regarding the rules to your regional Streetsmarts community [streetsmarts.freescale.com]

During the race event, all interpretation of the rules will be at the discretion of the on-site executive event team members.

Section 9: Document Revision History

Date	Notes
March 16, 2012	Original Release
March 16, 2012	Tech Report requires use of Continental Trainings

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 Freescale Cup 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.