Continental Technical Competition 2019

Connected Electric Vehicles Challenge

Rules and Regulation Booklet

1. GENERAL ASPECTS

a. Target group

- The competition is addressed to all active students (including master programs) from technical faculties (Computer Science, Electrical Engineering, Electronics, Mechatronics, Robotics, Electro mechanics, etc.)

b. Competition team

- Formed by 2-4 students regardless the technical area of expertise.

c. Competition description

- The teams participate to a vehicle on track competition. All preparations will be made during the event (no need to build anything from home).
- Using an already pre-built vehicle and a base software library, compete in 3 phases, to complete challenges on the track. Each challenge rewards points. The winner will be the team with most points.
- The 3 phases are:

- Design, develop and optimize a motor driver + power supply using only parts available in the provided BOM (Bill of Materials) on site.
- Using the provided pre-built vehicle + the motor driver + power supply developed in phase (a), your team must navigate our virtual city with a limited energy supply. The optimized driver and an optimized motor control software will make all the difference in the world. But you will have to hurry up, as the time is limited, and there are perils along the way. Carry extra load to gain multipliers for the driven distance.
- Using multiple provided pre-built vehicle + the motor driver + power supply provided by Conti, together with an existing communication API in the provided base software library, you must drive as much as possible during a fixed period of time in order to:
    - Resolve intersections through communication.
    - Resolve possible collisions through communication.
    - Optimize traffic through communication.
    - Fluidize traffic using either central communication, decision hub or car-to-car communication.

You don`t have to worry about not completing one of the stages, as each stage is an independent part of the contest. The driver designed by you in challenge **"a"** will only be used in challenge **"b"** Challenge **"c"** will use a standard driver provided by us. **See chapter 3 regarding Contest Rules for more details.**

d. Project idea presentation

- For the pre-selection the teams should prepare a presentation document with **maximum** 10 pages written in English, that will include:
  - Project description / architecture
  - Details of all technical aspects involved in the projects
  - Other aspects that proves the fulfillment of the contest requirements
  - Deadline for sending the presentation: **6th of March, 2019**

- Registration should be made prior to the presentation described above, until **22nd of February, 2019**
- Previous already done projects with the same functionality are forbidden
- The pre-selection ends on **12th of March** based on project presentation

e. Financial aspects

- Accommodation and meals will be ensured by Continental Sibiu

Continental will offer the materials needed and the line following vehicles.

f. Deadlines

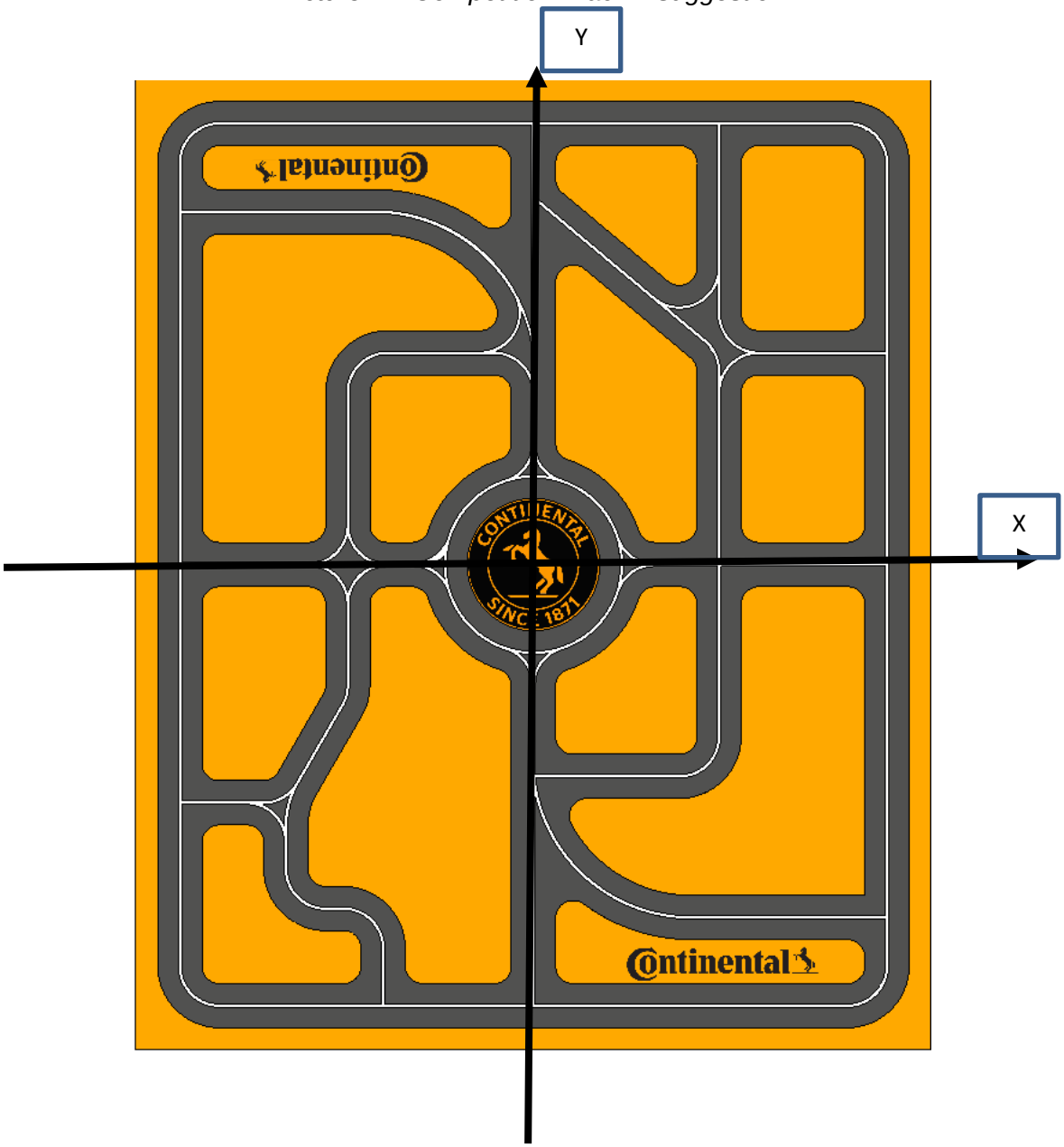
- **Application deadline: 22nd of February, 2019**
- Deadline for sending the project presentation: **6th of March, 2019**
- Final selection deadline & Results communication: **12th of March 2019**
- In the days of the contest, teams are allowed to bring with them the equipment needed for final adjustments.

2. TECHNICAL REQUIREMENTS

a. Racing track and robot / vehicle provided by Continental

- The robot/vehicle will be able to drive independently (no external intervention during the official attempt) on a designated area
- The road will be covered by robot/vehicle projection at all time. The road is **250 mm** (+/- **5**) mm width and the road's central line is **20 mm** (+/- **5**) mm width.
- The robot/vehicle will be able to:
    - Follow the road's central line
    - Take direction commands
    - Take speed commands
- The color of the lane is dark grey, the central line is white, and the background is green (exception for the logos)
- The racing track exact model and complexity **will be revealed on the competition day**. The following figure represents a mock-up of the racing track and could be different from the racing day track layout.

Picture 2.1 *Competition Track – suggestion*



- For orientation purposes, the map can be viewed as being split up in 4 quadrants of cartesian coordinates, and the 10 start position magnets will have fixed places on the map, with coordinates.
- The track will contain 10 points where a magnet will be placed, and the vehicle will contain an analog hall effect sensor that will read out that position and identify where it is on the map.
- Robot/Vehicle dimensions:
    - The robot / vehicle projection fits into a **170** mm x **160** mm shape
- At intersections, every bot will stop and the main MCU will give the possibilities (left – forward - right) and the application must choose the next direction to go
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b. Communication protocol

- Wi-Fi communication protocol be used using ESP8266 SoC and a library to transport data and perform read/write operations in a data storage.
- Communication shall be done using a local router (between ESP8266) using a server with a MySQL database. Each team **must have** at least 1 table in the MySQL database containing the status, position and all relevant data of the vehicle.
- The MySQL Table structure will be IMPORTED in the local server on site, so you can prepare your tables beforehand, but they will be Empty when imported.
- A recommendation is to have your tables in MySQL under the same database OR have the tables with the form of *_teamName_tableName*
- Position for each bot will be calculated at every cycle from kinematics and initial position
- Collision must be avoided at all cost through communication only. No proximity sensors are allowed.
- Through communication, robots must stop at intersections, let others pass, choose the time to enter and exit intersections

3. CONTEST RULES

a. Preparation time

- 1 day before the contest, each team will be granted a preparation and testing time.
- Adjustments are only allowed between rounds.
- Modifications regarding the vehicles' behavior (HW and SW) are NOT allowed during the round.

b. Competition – construction phase

- Each team must build **on site** a motor driver + power supply according to the documentation, BOM and reference design in order to control the robot/vehicle.
- Building a working and usable motor driver + power supply will lead to an analysis phase by our technical experts.
- If motor driver + power supply is validated, points will be won.
- Each team will test out its motor driver + power supply.
- If no motor driver can be designed or testing proves that it does not work, no points allocated for the motor driver will be assigned and a default motor driver will be given to said team to use during the competition. The Conti provided motor driver **will not be subject to hardware optimization and/or additional tampering.**
- **Points awarded for this phase shall be 0 points if the team is unable to design, develop and test a functional motor driver + power supply or maximum amount of points for this challenge if the electronics is correctly designed, developed and working.**

c. Competition – optimization phase

- Only one robot / vehicle can be placed on the track at any given time for each team.
- Each team will have **3 trials** consisting of **TBD** minutes each.
- Before and after each run, batteries will be measured to determine the overall performance distance-to-weight ratio and award points.
- Each trial run will generate an amount of points. These will be added after the end of the phase.
- The robot / vehicle consists of:
    - The Conti Framework Kit (line follower) containing a PSoC Cypress as a main MCU, a ESP8266 MCU for WiFI Communication connected to the Main MCU and an Arduino Uno that will be programmed by each team.
    - The Motor Driver (HW part) shall be done only using Conti parts provided in the BOM.

      OR

    - The Conti Motor Driver (HW Part) provided by Conti (least optimal design)
- The robot / vehicle must drive in a continuous way on the track, to reach a minimum distance driven of **20 linear meters per run. In order to measure out the distance and avoid repetitive distance runs, a measurement system will be implemented in the vehicle itself in order to regulate this. A fail-safe mechanism will prevent the distance count if:**
    - **Vehicle must pass over 4 different checkpoints using the magnets embedded in the track. The Checkpoints will be assigned on the day of the contest and they will be the same for all contest teams.**
- The robot / vehicle must not damage any component of the track. If any component is damaged, the team takes a penalty of **TBD** points.
- **X** payloads will be available on site, with different weights that will act as multipliers for the total amount of points gathered in this challenge. The multiplier will be valid only for the turn the payload is carried, not the total amount of points. There is no possibility to carry the same payload twice.

c. Competition – connected vehicles phase

- 3-10 line-follower bots will be put on the track, all with the same code from the team. The number of bots to be put on the track is at the team's decision.
- Each team has the right of **3 trials** attempts, consisting of **TBD** minutes each.
- The robots must drive the longest distance in the given fixed time: **TBD** minutes.
- The attempt is over after the second collision.
- The robots must drive in a continuous way on the track, no stopping for more than 20 seconds for any car. If a vehicle has stopped for more than 20 seconds
- The robots must not damage any component of the track. If any component is damaged, the team takes a penalty of **TBD** points.
- The robots will be put on the track at specific positions, according to the number of robots chosen by the team.
- Robots can accept commands from central hub, if it is involved, or can take on decision from car-to-car communication.
- It is not allowed to hardcode speed, direction, plan the route for the bots. Decision must be taken at real-time. To prevent this, the route will be changed after each trial with blocked routes, marked accidents etc.
- Each vehicle should drive without collision. At the second collision, **the trial run is over.**

4. POINT SYSTEM AND HOW TO WIN

a. Phase a) for design, development and successful test of a motor driver will bring a total of maximum **TBD** points as follows:
   i. Phase participation: **TBD points.**
   ii. Design, development of a working motor driver: **TBD points.**
b. Phase b) for software development of a software capable of driving the vehicle and reaching a total sum of minimum total of 60 linear meters from all 3 official runs will bring a maximum **TBD** points as follows:
   i. Phase participation: **TBD points.**
   ii. Design and develop the code that enables the vehicle to navigate from 3 trial runs a minimum of 60 linear meters in distance, meaning a minimum of 20 linear meters per run: **TBD points.**
   iii. Carrying a [x] weight will bring a [XX] multiplication for the distance driven in that run. This weight may **not be used again for this team regardless if challenge is completed or not, meaning the minimum distance of 20 linear meters reached or not.**
c. Phase c) for software development of a software capable of driving a minimum number of 3, maximum 10 vehicles simultaneously on the track without crashes, offering vehicle priority etc. will bring a total of **TBD** points as follows:
   i. Phase participation: **TBD points.**
   ii. Using minimum 3 vehicles simultaneously by the same team, communicating via a central hub and driving continuously for **TBD** minutes with no collision or minimum 1 collision: **TBD** points.
   iii. Using 4...10 vehicles simultaneously by the same team, communicating via a central hub and driving continuously for **TBD** minutes with no collision or minimum 1 collision increase the overall driven distance. Every **TBD driven centimeter** will transform to points and they will be added to the total amount of available points.
d. The team with the most points at the end of the contest from all 3 challenges is declared the WINNER.
e. If 2 or more teams have the same amount of points, the team that has driven the longest total distance is declared a winner.
f. If 2 or more teams have the same number of points and of total distance driven, the team with the highest number of simultaneous vehicles used in Phase c) is declared winner.
g. **We reserve the right to add criteria's and topics that provide additional clarification and unambiguity during the contest.**
h. **No points shall be awarded for foul play, library or hardware hacking of any kind or any disregard for the rules. We play fair or we don't play at all.**

All elements marked **TBD** will be available at a later time **through an updated version of the Rulebook.**

To discourage foul play, we reserve the right to add, remove or modify topics related to the Rules & Regulations also during the contest. It may happen that certain topics are not explicitly covered by the rules and regulations as they are now explained. Certain clarifications, questions, topics or restrictions may not be present in the rules and therefore they can be added during the contest or when the Contest Administrators see it fit and necessary.

a. Selection criteria

- Presentation of the project idea and design
- The evaluation will be made by the Continental technical team

b. Appeals

- The appeals can be submitted to the organizers only when all the participants finished all the rounds

5. CONTACT

If you have any questions, feel free to contact us via e-mail on the following address:
technical-competition@continental-corporation.com

*all replies will be distributed to all participant teams