

**The international robotics competition "ROBO-VEHICLE PILSEN 2020"  
held as part of the "Future autonomous urban mobility" challenge  
(working title of the competition "ROBO2022"), 28. 2. – 3. 3. 2022**

### **Annotation**

The goal of this competition is for the robotic vehicles to transport a cup containing a certain amount of water (50 ml) around the track in the shortest time possible without spilling the water. The vehicles will pass through an elevated section and must not hit the noise barrier.

The track is made up of a curved black line on a white surface (tarp); it does not intersect anywhere, and the starting point is also the finish line. There is one elevated section and one noise barrier section with barriers on either side of the track. The vehicles must start autonomously on a black line intersecting the track and must complete the track within the 7-minute limit.

The vehicle is controlled using a camera system. There is the option of using color-coded information points placed on the elevated spot to control vehicle speed before and after this section.

### **Team description**

Participating in the competition are 2-member student teams, no more than 6 teams from the Czech Republic, a maximum of six teams from Germany, a maximum of six teams from Croatia, a maximum of six teams from Slovakia, a maximum of six teams from Liechtenstein and the same maximum number of teams from China. Other countries may join the race (the same limit in terms of the number of teams applies). The students are between 17 and 21 years of age. During the competition, the teams work independently, without interference from their teacher or another adult.

**Complete documentation** is available at <https://www.souepl.cz/robo2022>

#### **Track parts:**

- 1 pc noise barrier (2 parts) – from 2021
- 1 pc water cup placed on the vehicle – from 2021
- 1 x cup – from 2021
- 1 x elevated section – from 2022
- 2 x information points/signs (1 x red, 1 x green)

The elevated section and information points will be sent to the participating schools.

## **Contact information for submitting questions regarding the organization of the competition**

### **Organizational issues:**

Mr. Jaroslav Sokol, Head of the Education Department at the Regional Authority of the Pilsen Region  
[jaroslav.sokol@plzensky-kraj.cz](mailto:jaroslav.sokol@plzensky-kraj.cz)

### **Contact with schools:**

Ms. Alena Altmanová, an officer in the Education Department at the Regional Authority of the Pilsen Region  
[alena.altmanova@plzensky-kraj.cz](mailto:alena.altmanova@plzensky-kraj.cz)

### **Contact for The University of West Bohemia, the Best Presentation in English category:**

doc. Ing. Luděk Hynčík, Ph.D., UWB Vice-Rector for Research and Development  
[hyncik@ntc.zcu.cz](mailto:hyncik@ntc.zcu.cz)

## Technical conditions

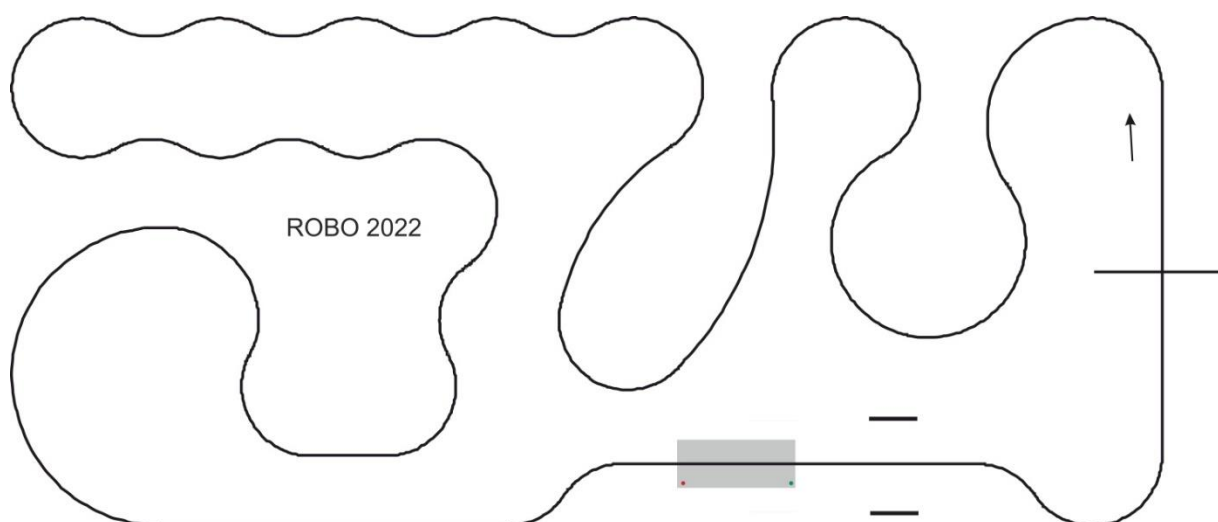
### Track specification

The surface of the track is made up of a flat white sheet 2,000 mm by 3,000 mm in size, on which there is a curving black line (15 mm wide) forming a closed loop. The black line does not intersect anywhere, is not interrupted at any point, and the start and the finish line are formed by a black line which intersects the black guiding line. The track includes one elevated section and a two-sided 150-mm long noise barrier.

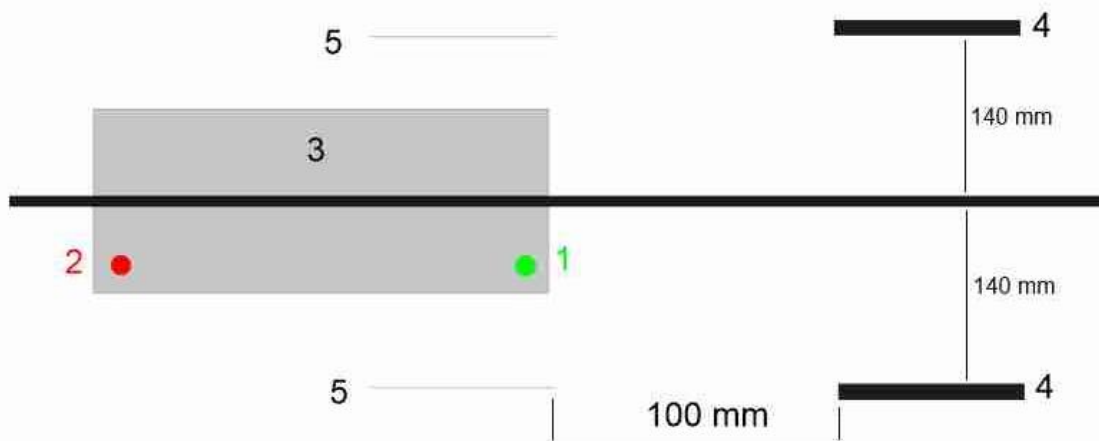
Teams may use the option of utilizing the color-coded information points/marks to control vehicle speed before and after the elevated section.

The guiding line is followed by a camera system placed on the robotic vehicle.

### Track shape



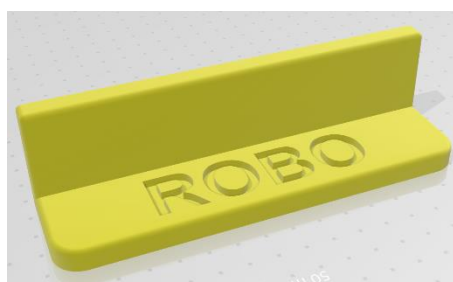
### Placement of the elevated section, information points/marks and noise barriers



1	color-coded information point – green (R:0; G:255; B:0), a circle 15 mm in diameter; the point is placed at the point of intersection 20 x 20 mm measured from the on-ramp onto the elevated section and its edge
2	color-coded information point – red (R:255; G:0; B:0), a circle 15 mm in diameter; the point is placed at the point of intersection 20 x 20 mm measured from the off-ramp/downward slope from the elevated section and its edge
3	an elevated section made of Styrofoam
4	2 x noise barrier, the distance from the guiding line to either side is 140 mm
5	lines on the track – the elevated section will be placed at the end of the lines

### Noise barrier specification

- material: 3D printed plastic, 150 mm in length, 2 pcs
- the noise barrier is made of up of 2 plastic walls 150 mm in length on either side of the guiding line; the edge of the wall is placed 140 mm from the center of the guiding line.



Placement of the noise barriers – the teams will place the noise barriers on the thin lines (3-mm wide)

### Elevated section specification



- material: Styrofoam with a 15-mm wide guiding line, the length of this section is approx. 400 mm (390–410mm tolerance), its width is 250 mm, and its height in the middle is 15 mm, 1 pc
- the elevated section is placed at the end of the lines on the track, 100 mm from the edge of the noise barriers, and is firmly attached to the track using double-sided adhesive tape
- there will be 2 color-coded information points on the elevated section

### Specification of the color-coded information points

The teams may use the option of utilizing the color-coded information points to control the speed of the vehicle before and after the elevated section (to slow the vehicle down before the elevated spot and accelerate after it). The information points are paper circles with a sticky bottom that will be placed in specifically defined locations and will be a permanent part of the track. The information points (circles will be 15 mm in diameter and the set of 2 points will include one red point (R:255; G:0; B:0) on the front of the elevated section and one green point (R:0; G:255; B:0) on the back side of the elevated section, meaning in the direction of the track.

### Robotic vehicle specification

- maximum size of the robotic vehicle (length x width): 200 x 200 mm
- number of axles: no restrictions
- chassis: no restrictions
- motor performance: no restrictions
- vehicle powered by: electric motors
- the wheels/tracks and other technical mechanisms of the vehicle must not damage the track or its surface
- the vehicle will consist of one unit
- water cup placement on the vehicle: the cup will be placed in a round holder/ring
- controlling the vehicle on the track – using a camera system placed on the vehicle

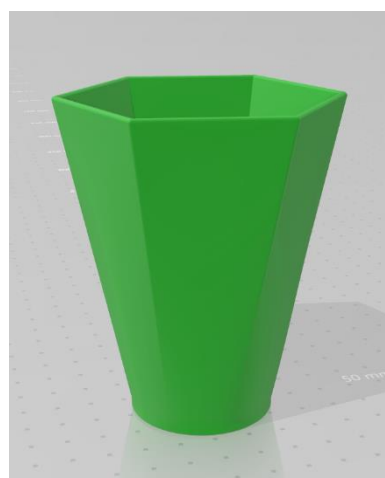
### The water cup and its placement on the vehicle

- placement of the water cup on the vehicle: the cup will be positioned on a round base whose inner diameter will be slightly larger than the outer diameter of the cup – the cup must stand freely on the base and must not be tightly gripped in the holder. The inner height of the base must not exceed 5 mm.

The cup base has a slot for fastening it onto the vehicle using M3 screws; the slot allows for some clearance in fastening the cup base to the vehicle

- it is forbidden to change the shape of the cup base or otherwise modify the cup placement in any way

- it is forbidden to change the size of the cup or modify its shape (the color and the material from which the cup is printed do not matter - ABS, ASA, PET, ...)



### Vehicle control unit

- any platform (Arduino, Picaxe, Raspberry, ...)
- the vehicle must be fully autonomous and must not include any possibility of remote control (wi-fi, Bluetooth, etc.)
- vehicle control on the track – by a camera system placed on the vehicle

### Assessment criteria

The evaluation panel will assess and choose winners in the following categories:

- 1st to 3rd place in overall Best School category (certificates, cups)
- 1st to 3rd team in the Best Performance category (prizes)
- 1st to 3rd team in the Best Design category (prizes)
- 1st to 3rd place in the Best Presentation in English category (prizes)

### Best Performance category

- **track time** (speed) – in the event that the vehicle moves off the black guiding line, the vehicle must be placed back at the start; if the vehicle returns to the black line by itself, it can continue in the race; if a vehicle is returned to the START repeatedly, all the individual times spent on track are added up to the limit of 7 minutes. The vehicle may be placed at the START no more than three times. The total time for the vehicle to cover the track, including repeated starts, is 7 minutes. The vehicle must cross the elevated section and pass between the noise barriers.
- **spilling water on the track** – in the event that the cup of water is knocked over, the vehicle must be placed back at the start and the cup must be filled with the prescribed amount of water
- the team may use the full time on the track (7 minutes) by having the vehicle run through the course multiple times; the fastest time to cover the entire track counts
- time will be measured electronically

### Best Design category

The evaluation panel monitors and assesses:

- original vehicle fairing (color, build quality and sophistication, ...)
- protection of the electronic components from water damage
- lighting effects (headlights, flashing lights, ...)
- untraditional sounds (siren, warning acoustic signals, ...)

### Best Presentation in English category

**An electronic presentation** (format .ppt; .pptx; .pdf) may be delivered by both members of the team.

A 10-minute presentation (longer presentations or those in a different format than .ppt; .pptx; .pdf will be penalized by lowering the final score) which shall contain:

- a brief description of the vehicle
- a description of the most interesting technical parts and their solution
- the greatest success in constructing the vehicle (electronics, design, mechanical construction, programming, fine-tuning, ...)
- the biggest problem in constructing the vehicle (electronics, design, mechanical construction, programming, fine-tuning, ...)
- the benefits for one's own professional development
- references to resources used (websites, publications, ...)

### Evaluation description

The evaluation panel shall consist of two representatives of the Pilsen Region, two experts from the University of West Bohemia, and two experts from Slovakia, Croatia, Germany, Liechtenstein and China (and possibly experts from other participating countries). The evaluators shall not take part in consultations regarding vehicle development. Each evaluator shall fill out an evaluation form, from which the assessment will be transferred to the overall score card.

### Prizes

- **1st to 3rd place in overall Best School category;** ROBO 2022 cups and certificates for the top 3 schools,
- **1st to 3rd team in the Best Performance category:** prizes for competitors
- **1st to 3rd team in the Best Design category:** prizes for competitors
- **1st to 3rd place in the Best Presentation in English category:** prizes for competitors
- **other competitors:** gifts
- **all competitors will receive certificates of participation**

*Note: both competitors from awarded teams shall receive the same prize*

### Competition organizers

The Pilsen Region

The University of West Bohemia

The Secondary Vocational School of Electrical Engineering, Pilsen, Vejprnicka 56