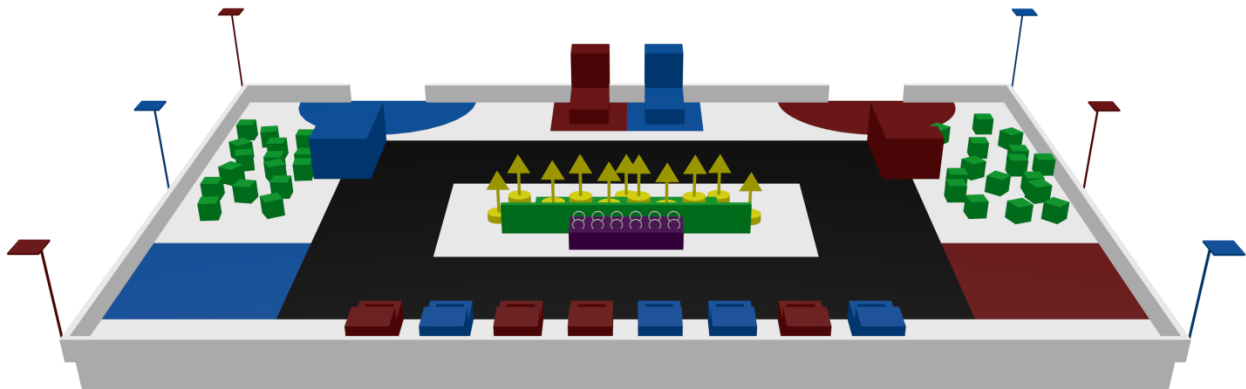


# Roadside Assistance

Robots will help as roadside assistants – refill batteries in cars, deploy traffic signs and help load cargo



## 1. Contest description

Gradually more and more robots are used to help people in everyday life. For example, autonomous cars are to be massively used in near future. But who will help them when something goes wrong? That may be robots, perhaps!

After being started, the robots will perform as roadside assistants. In the competition, two robots will compete on the same playing field to show which of them is better. There are three task areas where the robots can show their capabilities:

- a) Fill fuel cells (or batteries) into cars;
- b) Help to remove broken truck from the road and protect that area by placing traffic signs around;
- c) Load cargo spilled after an accident onto a replacement truck.

In our robot game, these three tasks will be of course simpler:

- a) The batteries will be represented as small cubes which have to be transported and inserted to a predefined pocket in a car model;
- b) A model of a broken truck will have to be pushed away from the playing field. On the border of the destination area, traffic signs will have to be placed;
- c) Spilled cargo, represented as cubes, will have to be moved to a specific area on the playing field and possibly placed onto a truck model.

## 2. Robot

The robot is fully autonomous and must not be dangerous or excessively annoying.

Throughout the game (including the start) no external connection is allowed except communication between the robot and the beacons. From the moment the robot and its beacons are prepared for start, they must not be touched or interfered with in any way except starting until the referee allows so.

On the robot's top side, an emergency switch must be located. By pressing it all actuation must be switched off. The switch must be big enough and well distinct so that it can be easily recognized, reached and used.

A 10x7 cm solid flat space for marking must be reserved on the robot's top side.

Convex envelope of the robot\* must not be larger than 150 cm at any time. Maximum height of the robot is 35 cm excluding the beacon stand and sensors under it. The robot must fit into the starting area.

\* i.e. the circumference of the projection from the top

Robots must have a beacon stand on their top side, 8x8 cm solid platform at the height of 43 cm, covered with Velcro (hook side). Sensors may be mounted below the beacon stand in its vertical projection (but this should be kept to minimum). The beacon stand must be as close to the robot centre as possible.

Robots must be safe to each other. Therefore they must avoid collisions with the opponent. Furthermore, robots must not be dangerous to people (all the standard safety regulations apply) or the playing field (damage will be assessed by referee). If the robot fails to comply with these security rules, it will be disqualified from the match. Any further breaking of security rules may lead to complete disqualification of the team from the competition.

### 3. Localization beacons

To help the robot with localization, it is possible to place several beacons around the playing field. A team will be allowed to put a beacon on the stand located in the middle of the short side where its robot starts, on two stands located in the corners of the opposite short side, and on a stand on the opponent robot. It is allowed to connect the beacons around the playing field by wire (such wire must go around the playing field, not across). Beacon stands will be square platforms 8x8 cm covered with Velcro (hook side) at 35 cm above the playing field and will be placed outside of the playing field. The beacons must be placed onto these stands so that they do not extend inwards the playing field (looking from above).

The beacon placed on the opponent robot must be max 8x8x8 cm big. All beacons must be constructed so that their weight is reasonable; the beacon to be placed onto a robot shall weight definitely under 500g. There shall be Velcro (loop side) on the beacon bottom side and preferably also Velcro (hook side) on the top, if possible, for attaching coloured identifying hat.

### 4. Playing field

Playing field size\* is 2x3 m. Its ground is basically white with coloured areas for different activities. The playing field is bordered; height of the border is about 7 cm.

Starting zones for the robots are 50 cm squares located at short sides close to the front corners.

A symbolic black road runs around the centre of the playing field. In the very centre, some playing elements are located (batteries and traffic signs, see later).

At the front long side, small cars are parked; these have to be filled with batteries.

In the middle of the back side, two trucks for cargo loading are parked.

There are two gaps in the back long side border and two circular areas nearby. These are the "push-off" zones for the broken trucks (see scoring conditions in Section 9).

### 5. Playing elements

For each team, there will be the following playing elements available:

- 4 batteries to be inserted into the cars,
- 1 broken truck to be pushed away off the road,
- 16 cargo boxes to be loaded onto a replacement truck,
- 5 traffic signs to be deployed around the broken truck.

The batteries and traffic signs will be placed at the centre of the playing field. Cars to be filled with the batteries will be randomly mixed at the long edge so that one of team's colours is at the closer side of the playing field, three at the other side (selected by a draw before the match). The cars for the two teams will be placed symmetrically.

The broken truck will be lying in the corner of the "road", partly on the road, partly off. Cargo boxes will be randomly spilled near the broken truck.

There may be more traffic signs and batteries placed in the playing field centre than necessarily needed.

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\* The dimensions of playing field and its elements are for orientation only. The actual dimensions may slightly differ due to manufacturing; however we will still aim for reasonable precision. For example, if the playing field is built of several pieces, some small level differences might occur between them. Such imperfections will not be allowed to be challenged.

The dimensions and shape of main playing elements are:

Battery: a cube with 6 cm edge and a metal ring of diameter about 4 cm mounted on its top; the ring may be partly buried (plunged) in the cube.

Cargo box: a cube with 6 cm edge.

Traffic sign: a cylindrical base (diameter about 7.5 cm, height about 2.5 cm) on which a pole (a stick) is attached and a triangular sign mounted on its top, not wider than the base.

Car for placing battery: about 12x22 cm. The battery pocket will be located at its back side (towards the playing field) and will be at least 8x8 cm big, open from the top (its depth is not important). The back side will be 6 cm high.

Truck for loading cargo: The truck will have flat back side of 15x24 cm, located about 6 cm above the ground.

## 6. Colours

Colours of individual parts are:

Playing field base and the borders are white.

One team colour is blue, the other's red. Crashed truck, truck to load, cars to deploy battery in, starting zone and push-off zone is blue for one team, red for the other.

Batteries are violet with a bare metal ring on their top.

Traffic signs have black base with yellow pole. The triangular sign on the top is yellow from one side; the other is marked as a warning traffic sign (red borders, white background, black symbol).

Cargo is green.

Road is black.

All playing elements may also feature some other markings (e.g. a text or drawing) but the prevailing colour will be as stated above.

The way of colouring the objects is not important. They may be made from coloured material, painted, taped as well as cut from a foil.

The colours are stated in words as in this document, not defined by any industrial colouring scheme. We also advise teams to take into consideration that sun or stage lighting may shine onto the playing field as well as photographers may use their flashes.

## 7. Competition phases

The competition will be phased as follows:

1. Check-in which is the latest time to submit the poster and information material in electronic form.
2. Homologation, where the robot has to show:
  - a. It complies with all regulations stated in the rules and standard safety norms (if applicable).
  - b. It is capable to score in the game without an opponent.
3. Qualification held in groups based on number of homologated teams. In this phase, there will be two robots from different teams competing on the playing field during every match.
4. Single-robot match against a dummy robot opponent.
5. Play-off finales.

## 8. Match procedure

Before the start, colour of the team will be assigned by the referee. This colour will determine some of the playing elements and actions with them (e.g. red team will start on the red starting area and score by placing the batteries in red cars etc.). The participants will place the beacons and prepare the robot so that it is fully inside its assigned starting area and ready to start. Teams shall prepare their robots and beacons in less than 256 seconds. Since then, no intervention, communication or any other information passing to the robot is allowed. After the preparation, the referees place the playing elements onto the playing field, some of them at random places, selected by draw. Then, the participants start their robots on a referee's signal by pulling off a starting cord. The game time limit is 128 seconds and the robots must stop not later than that. The points will be counted after the game is over.

Hiding, holding, removing, blocking or any other manipulation with playing elements which may negatively affect opponent's scoring is prohibited.

## 9. Scoring

The actions will be rewarded as follows:

1. Battery inserted in a car: 5 points
2. Broken truck pushed off the road: 3 points
3. Accident sign deployed: 2 points (max. 5 signs per team)
4. Cargo box placed near the truck: 1 point
5. Cargo box loaded onto the truck: 3 points

Special bonuses:

1. Complete fulfilment of a task<sup>\*</sup>: 5 points for each task
2. Handling one of each playing elements and scoring with them: 10 points
3. Both robots ending in their starting zone: 5 points both (the robots must leave the starting area and score at least 1 point).

Conditions for scoring:

1. A battery will be considered validly deployed if it is inside the pocket in the car (only 1 per car).
2. The broken truck is considered validly pushed off the road if it is fully on the coloured circular push-off zone at the long edge of the playing field; it may be optionally pushed off the playing field via the border gap in this zone (partially or fully).
3. A traffic sign will be considered validly placed if positioned at the edge between the push-off zone marked by the team's colour and the free space on the playing field (i.e. it has to be standing on both).
4. Cargo will be considered validly placed near the truck if it is fully in the coloured zone surrounding the truck.
5. Cargo will be considered validly loaded on the truck if it is lying on the truck and touching only the truck or other loaded cargo. More cargo cubes may be stacked one atop another.

All playing elements will score for the team of the colour where the elements are placed, i.e. a battery filled into a red car will score for the red team regardless on the robot which placed it there etc.

Batteries and traffic signs are the same for both teams and the robots may pick any to attempt scoring. Although the cargo boxes are the same as well, the robots shall manipulate the cargo on its own side of playing field, not that on the opponent side. Also, robots shall not manipulate more elements than needed for scoring.

## 10. Poster and information material

The teams will bring a poster of A1-A0 size describing the work and the team. This poster will be on display for the whole event duration. Secondly, the teams will provide this poster, at least 2 photographs/images and 2 paragraphs of text concerning the work in electronic form for publishing purposes at latest during the check-in.

## 11. Power of officials and liability

If a robot or a participant violates the rules, the referee may disqualify them from the match. He may also disqualify the participant or the robot for further matches.

No objections against the decisions of the referee or the organizers are allowed.

The organizers may change the rules without prior notice, e.g. based on number of participants, local conditions etc.

The participants are responsible for their robots and their safety and will be liable for all damages caused by them, their robots or their equipment.

The organizers will not be under any circumstances held liable or responsible for any accidents of the participants or any damages caused by the participants, their robots or their equipment. The organisers hold no responsibility for theft or damage of participants' belongings.

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<sup>\*</sup> As set in Section 1, there are three tasks: a) all team's cars loaded with battery, b) broken truck pushed off and surrounded with 5 signs, c) all cargo loaded on the truck or placed on the coloured area nearby.

## Appendix

The following images are meant for basic orientation. They represent some possible situations (not exhaustive). The playing elements are shown only schematically. In real life, they may be more decorative.

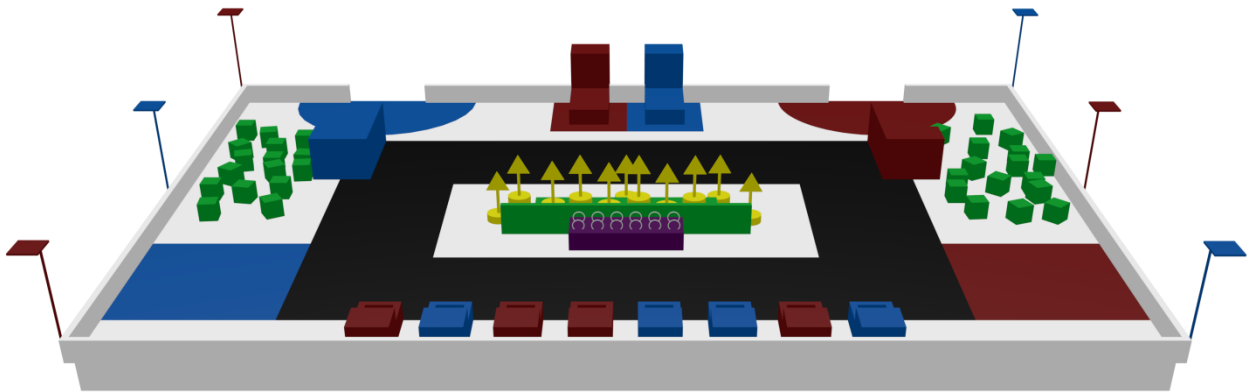


Fig.1. Front view

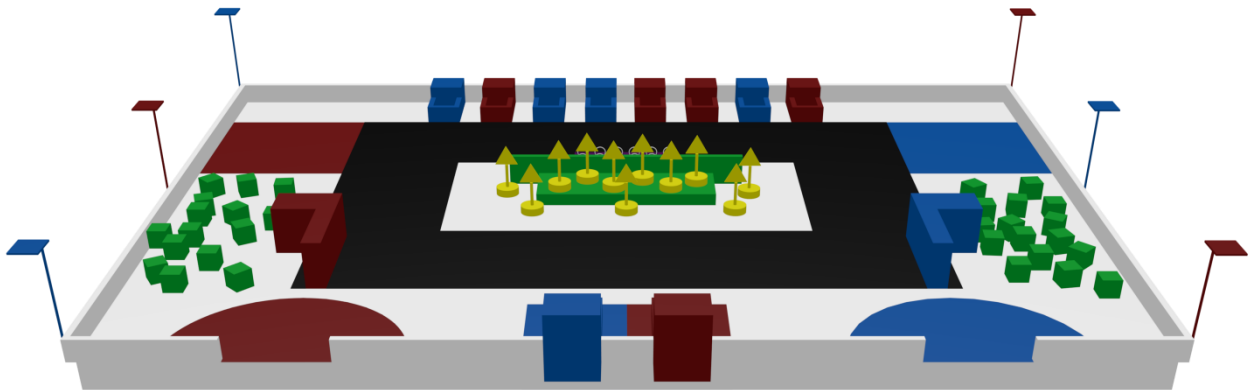


Fig.2. Back view

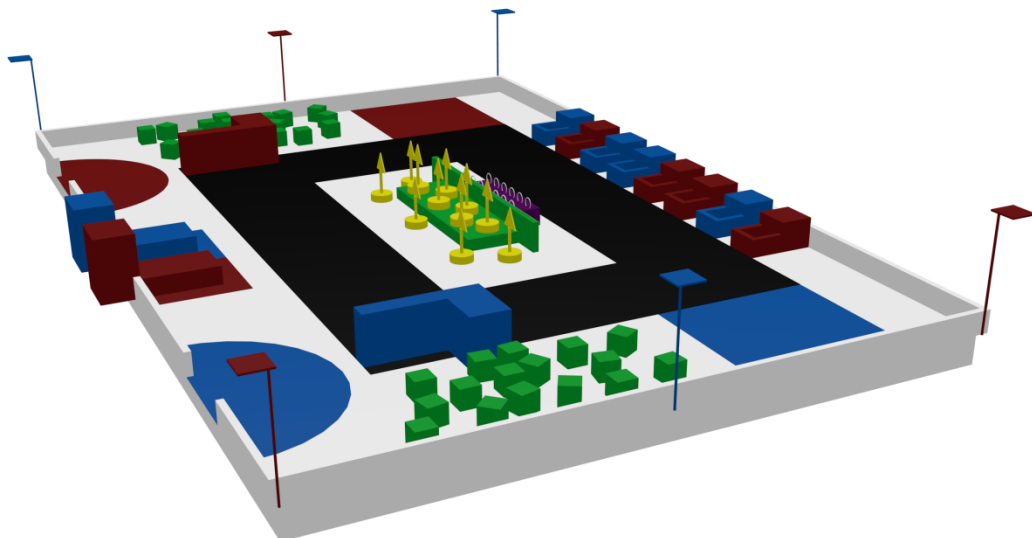


Fig.3. Angled view

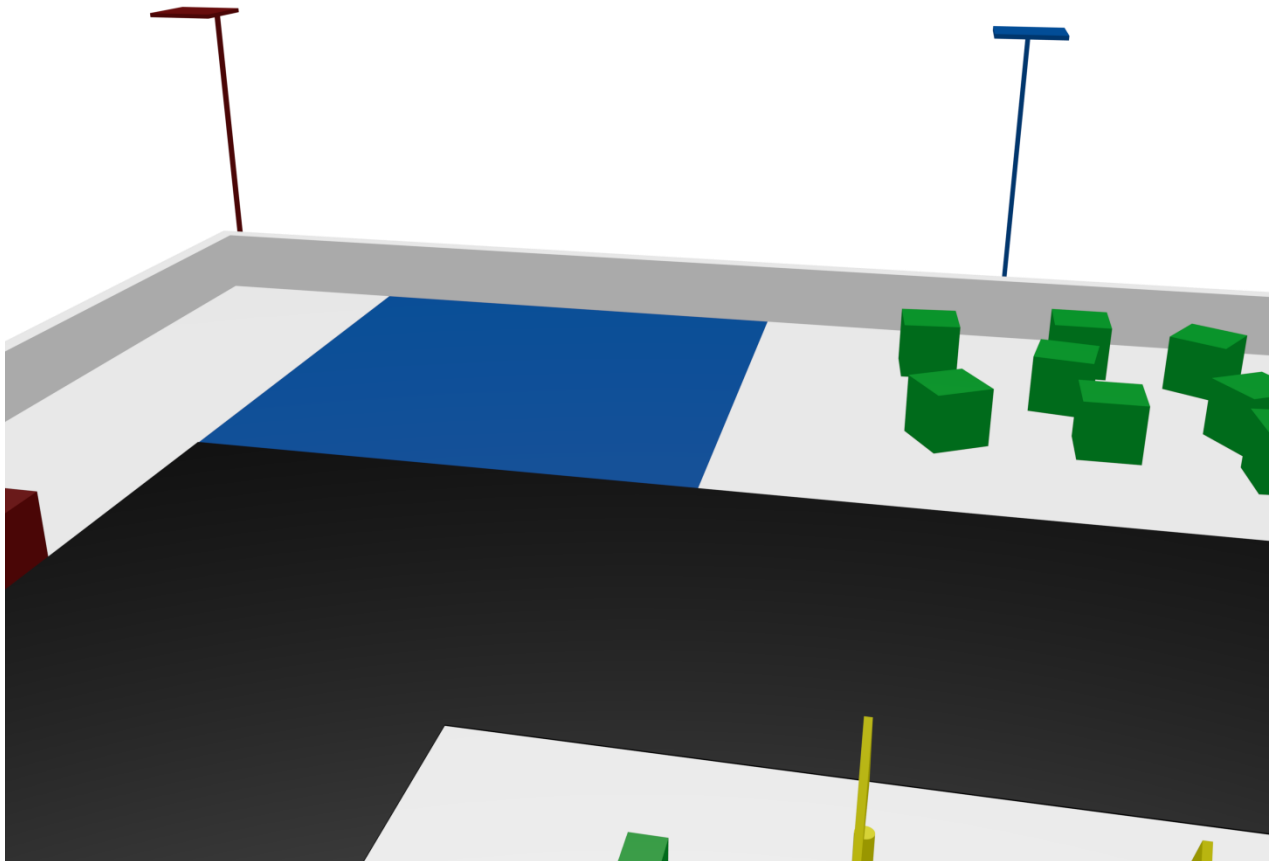


Fig.4. Blue Start zone

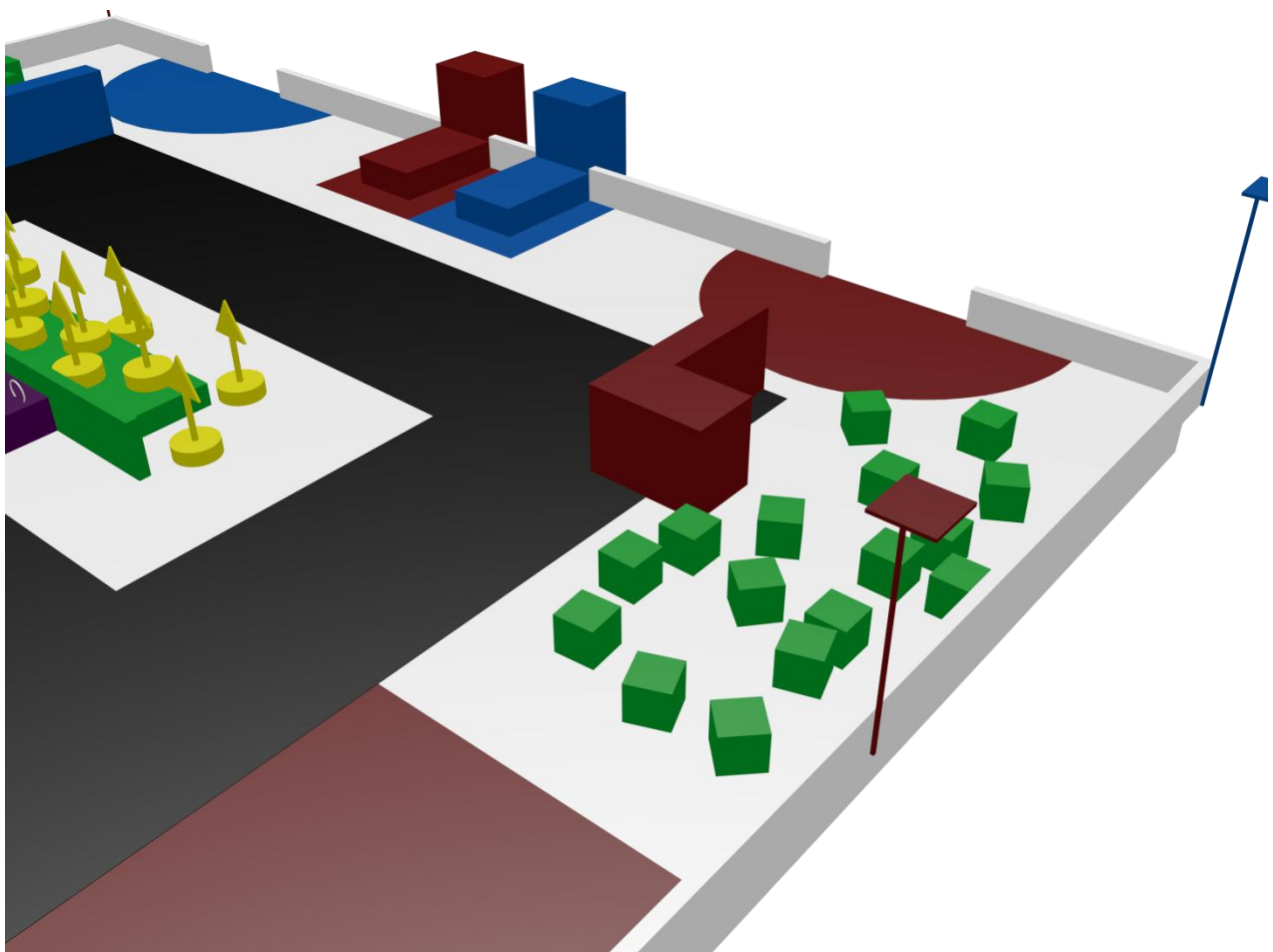


Fig.5. Red "crash area" corner with red and blue replacement trucks nearby and traffic signs in the playing field center

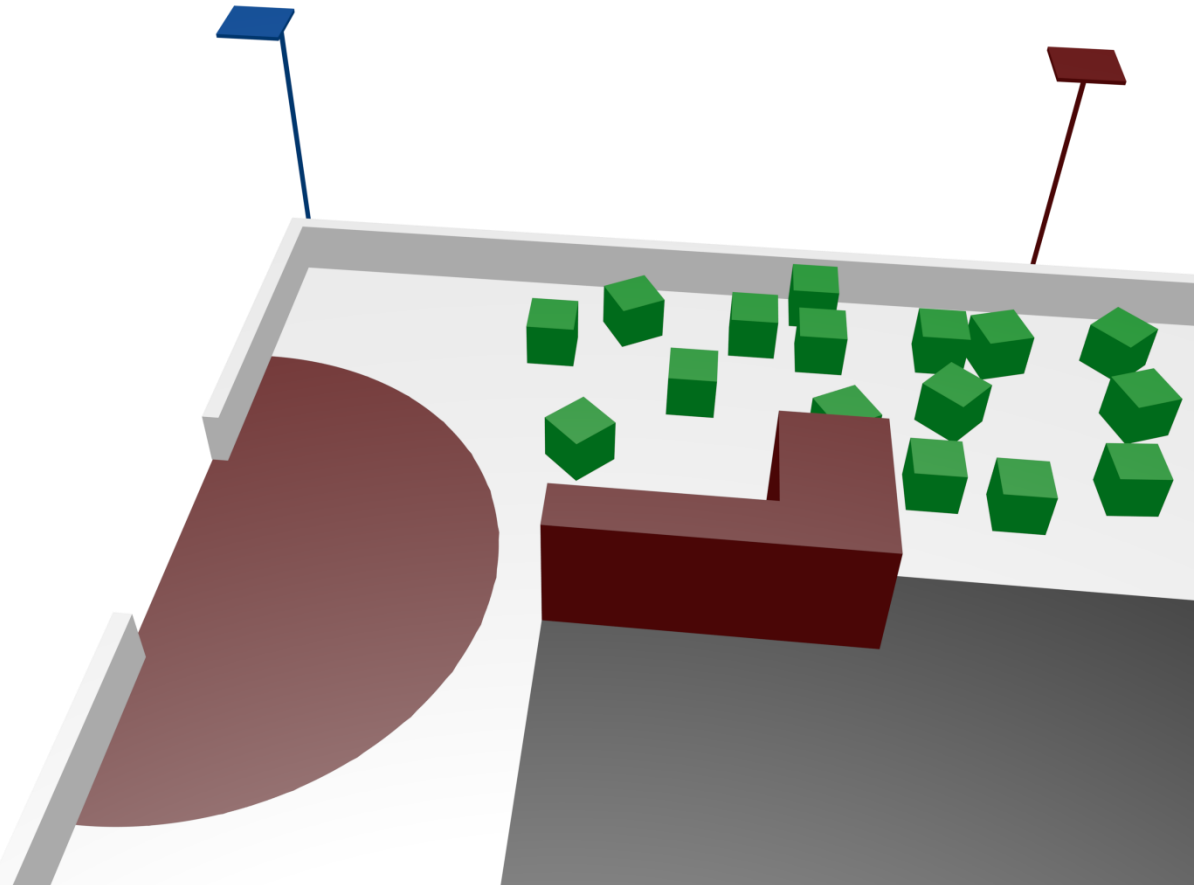


Fig.6. Red push-off zone on the left, crashed truck in the middle, spilled cargo on the top right.

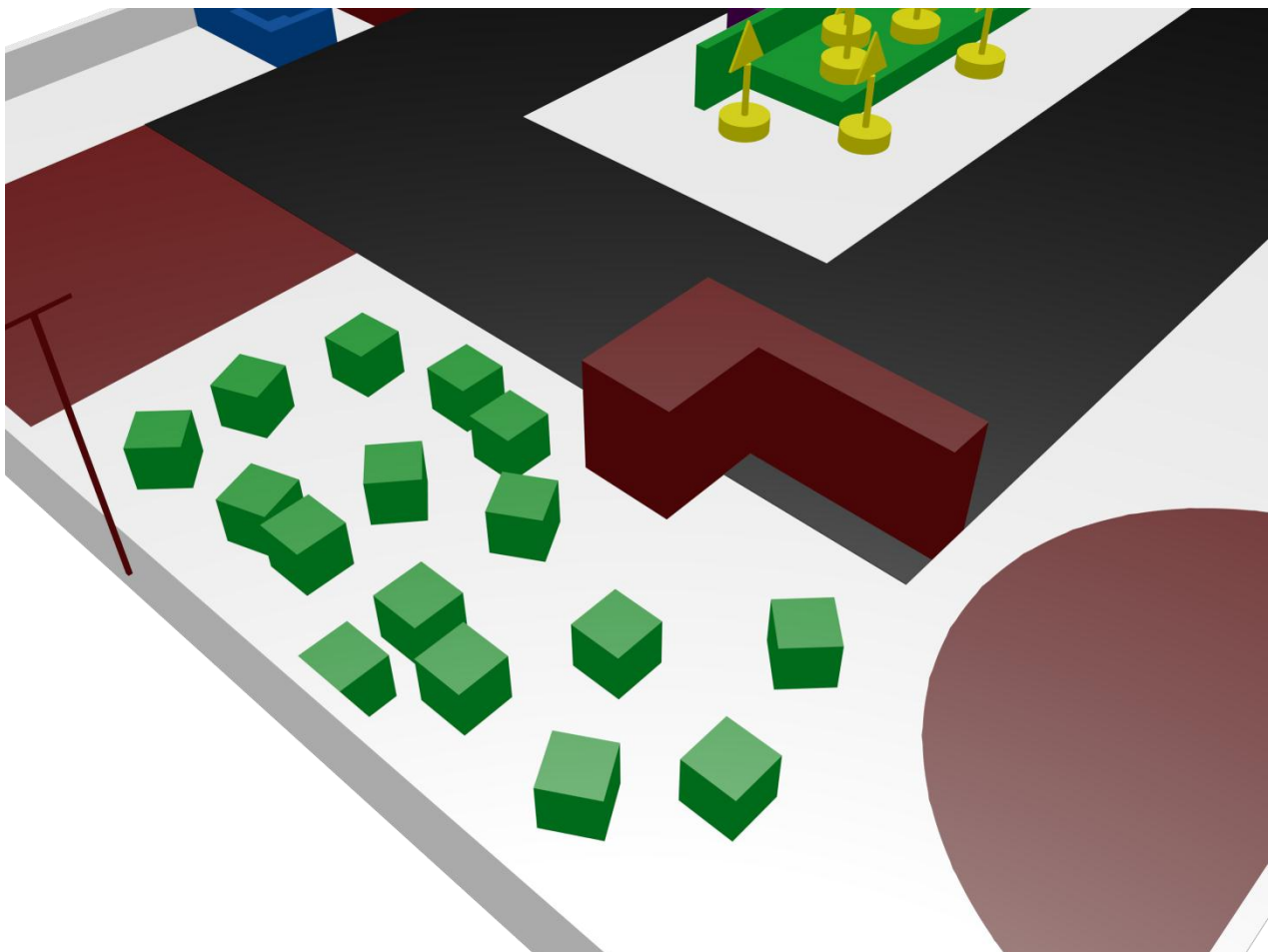


Fig.7. Another view over the red crash area (red starting zone on the top left and push-off zone on the bottom right)