SETTING THE SCENE

It would be great to cross the 900 kilometres between Windsor, Ontario, and Montreal, Quebec, in less than an hour without even having to fly. Theoretically, this is could be done if a Hyperloop link was made between the two cities. Transport by Hyperloop tube is the equivalent of a high-speed train suspended above a rail and inside a long, low-pressure tube measuring hundreds of kilometres. The Hyperloop would be beneficial in terms of door-to-door travel time as well as noise level and energy consumption.

Teams of engineers are working to develop prototypes to test the feasibility of this new mode of transport at high speed.

Your team has been asked to design a robot responsible for transport shuttles for passengers wishing to travel in the Hyperloop. For this you must move the shuttles containing the passengers and put them inside a Hyperloop tube for departure.

GENERAL FUNCTION OF THE ROBOT

You will need to design a robot that can take the four shuttles (two blue balls and two red balls installed on pedestals) and place them inside of a tube resting on supports. Because the tube was installed on a slope, gravity will cause the inserted balls to pass through the tube and reach the other end of the playing surface.

The Hyperloop tube is formed of two separate cardboard tubes installed end to end and properly aligned so that the balls can pass from one to the other during the journey.

In the Black level, the robot must first realign one of the tubes before inserting the shuttles.

DESCRIPTION OF THE ROBOT:

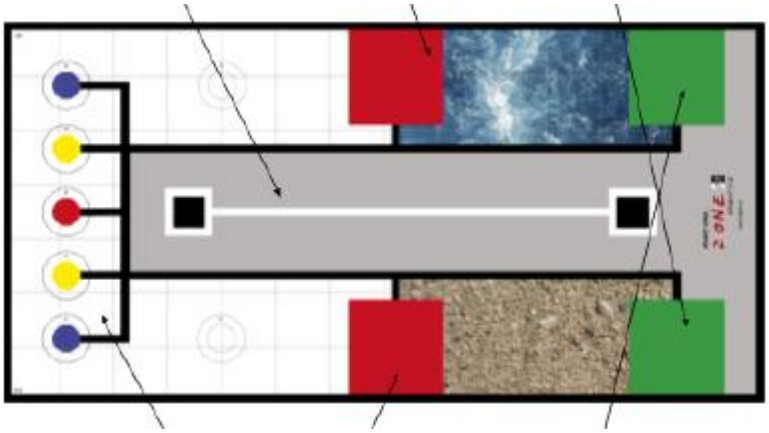
The dimensions of robots participating in this challenge must not exceed the following limits:

A. Initial length: 30 cm
B. Initial width: 30 cm
C. Height: no limit
D. Mass: no limit

DESCRIPTION OF THE SURFACE AREA:

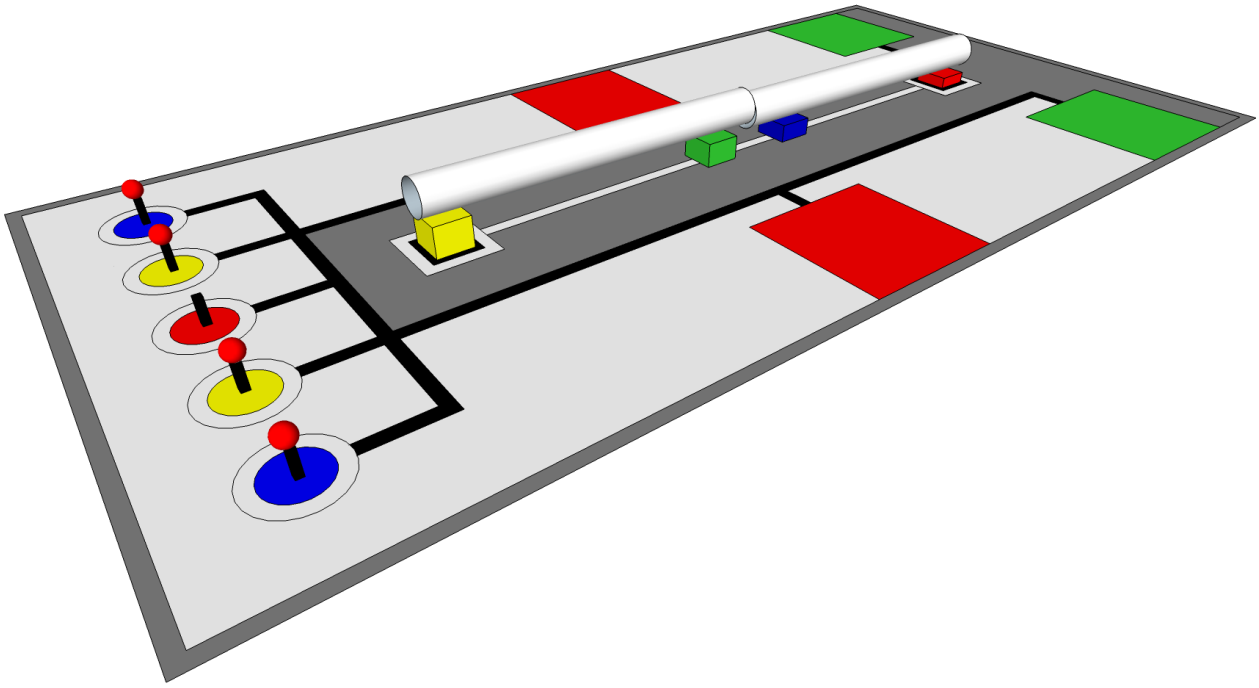
Surface used: Z01-F mat

Hyperloop tube area Start area / finish

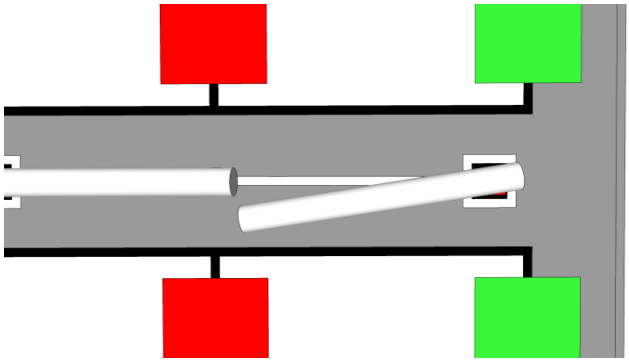


Shuttle zone Start area/finish

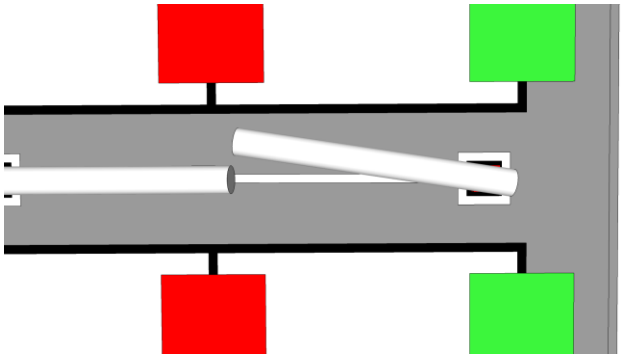
Surface view in 3D



Black level, tube misalignment at start (2 possibilities)



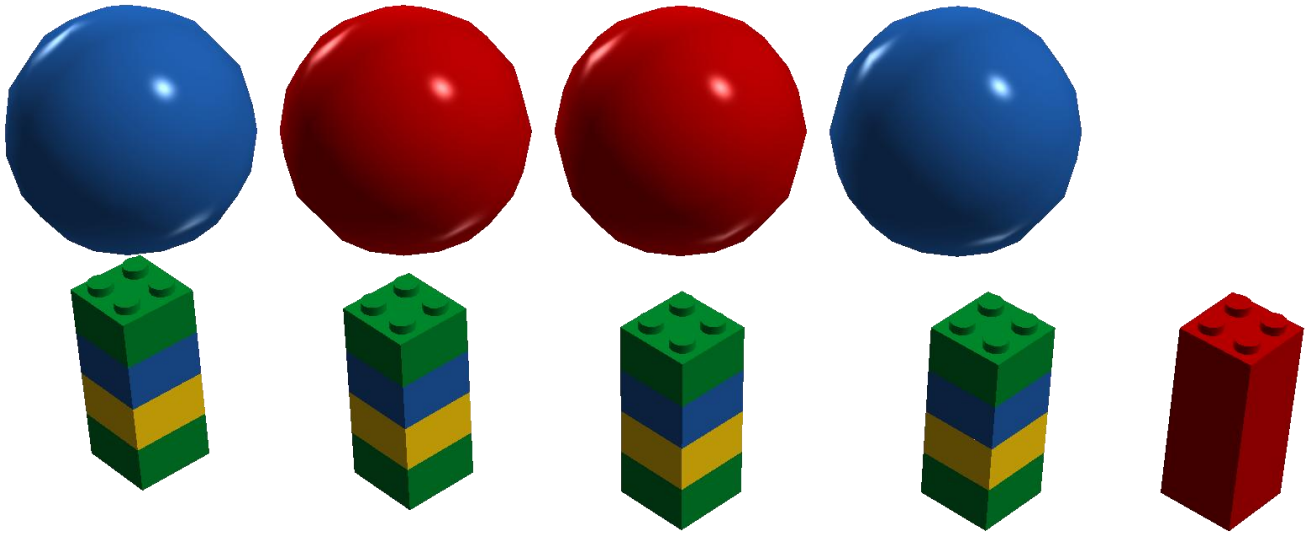
Misaligned tube and support (counterclockwise)



Misaligned tube and support (clockwise)

Description of accessories:

a. Passenger transport shuttles and pedestals

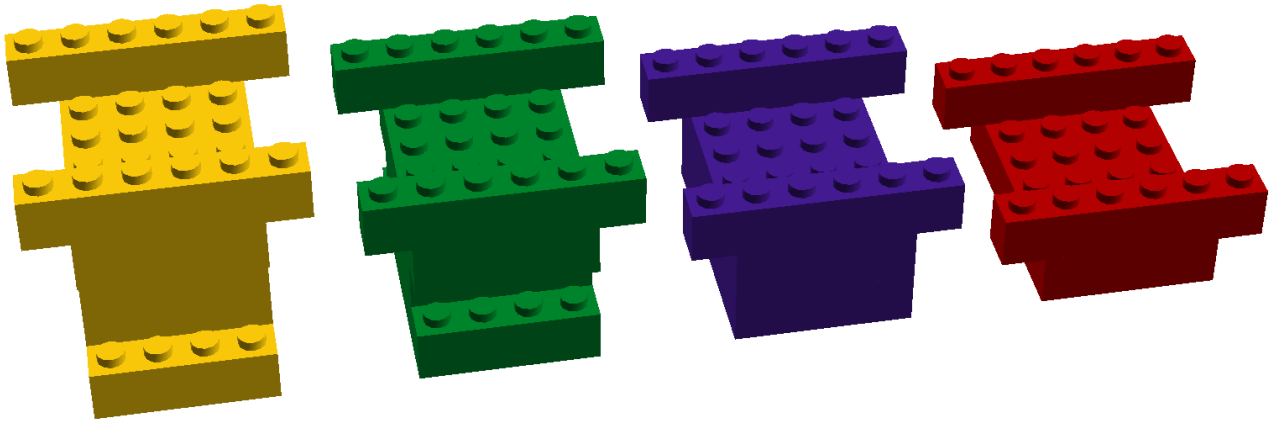


There are 4 shuttles represented by 2 red LEGO balls and 2 blue LEGO balls. These are plastic balls provided with LEGO NXT kits or are part of the LEGO WRO kit. The balls are placed on columns of 4 LEGO 2X2 bricks. The colours of the columns are not important.

b. Hyperloop tube and supports

The Hyperloop tube is formed of two rigid cardboard tubes 7.6 cm (3 inches) in diameter and 76 cm (30 inches) long installed on 4 supports made of LEGO bricks. These packaging tubes for plans are available in office supply stores such as *Staples*. Plastic lids are not required for the challenge.

http://www.staples.ca/en/NCR-Tube-d-exp-dition-et-d-entreposage-3-po-x-30-po-blanc/product_35660_2-CA_1_20001



The 4 supports (yellow, green, blue and red) for the tubes are made of LEGO bricks and are of different heights to create a slight slope.

DETAILED DESCRIPTION OF THE CHALLENGE

WHITE level	BLACK level
The White level of this challenge is for beginner teams. The challenge is kept as simple as possible by keeping the number of problems to solve to a minimum. For students with more experience, we recommend the Black level.	The Black level of this challenge is for teams with more experience. Students will encounter designing and programming challenges at their level.
Time allowed	
2 minutes	
WHITE level	BLACK level
Programming: □□□ Design:□□□ Strategy:□□□	Programming: □□□ Design:□□□ Strategy: □□□
Recommended hardware	
1. Colour sensor (minimum 1, ideally 2) 2. Distance sensor	

The challenge step by step	
WHITE level	BLACK level
1. The team places its robot in any one of the starting areas (red).	
2. The judge places a column of 2X2 bricks in each of the circles and places a ball on the bricks of circles A1, A2, A4 and A5.	2. The judge places a column of 2X2 bricks in each of the circles and drops a ball on the brick of circle A3 as well as randomly on 3 of the 4 other bricks A1, A2, A4, and A5. The judge misaligns the start of the second section of the tube by moving it 10 cm to one side or the other at random.
3. At the signal, the judge starts the timer and the team starts its robot.	
4. The robot leaves the start area.	4. The robot leaves the start area, heads toward the section of misaligned tube and replaces it correctly.
5. The robot then goes toward the shuttles (balls). It must seize one or two balls and drop them into the tube. It may not be in possession of more than 2 balls at once.	
6. A team member catches the balls when they come out of the tube to prevent them from falling to the floor.	
7. The robot continues its mission with the remaining balls.	
8. The timer is stopped when the robot reaches the finish area or when the team says STOP. If the robot leaves the surface before the timer is stopped, a penalty will be applied. The robot's wheels must be in the finish area for it to be considered in the area.	

SCORING

	MAX PTS
5 points per ball moved from its pedestal (4)	20
10 points per ball placed in the tube (4)	40
5 points per ball crossing the entire Hyperloop tube and caught by a team	20

member at the exit (4)	
2 points per column of 2X2 bricks that remains partially or completely in its colour circle (5)	10
10 points for reaching the finish area (green) on the side opposite to the starting area	10
Total	**100**

PENALTIES

If the robot has in its possession more than 2 balls at once	-25
If the robot leaves the area before the timer stops	-10

SUGGESTED STRATEGIES

WHITE level	BLACK level
1. Make sure you can control the rotations of the robot on itself. 2. Use the lines of the mat to guide you	1. Make sure you align the tubes to allow the shuttles to pass through