Practical Robotics Olympiad tasks (Arduino category)

Task 1. Sorting Manipulator

There was a rise of output products on the packaging factory, so the automated sorting process of poor-quality products by color parameter is now needed.

You need to construct a working prototype of a manipulator, which has to identify poor-quality production and put it away from conveyor. Conveyor is a static platform, where there is a place to set base of manipulator (13x13 cm size) and also a place to set 7 products (e.g. cubes) with a size from 3,5x3,5 to 4x4 cm. Manipulator must have two degrees of freedom, move in horizontal and vertical ways. All degrees of freedom should be calculated in that way, so manipulator in its assembled way could reach the center of the cell, where the cubes are set. And the length of the manipulator must be enough to put these cubes away from their positions. Manipulator platform should not project beyond the borders of the manipulator base zone.

The poor-quality cube is the black one. The fine-quality cube is the white one. There are **7 positions** on the conveyor to place the cubes.

There has to be **2 launches** of manipulator. At the beginning the manipulator should be in the start-position. Before each launch the lots are drawn to choose the scheme how to place the cubes on the conveyor.

When the button «start» is pressed - manipulator goes offline (independent mode) and searches for poor-quality product, then puts away this product so neither of its parts rests on the conveyor platform. Robot should put away all poor-quality products, after that the stopwatch runs out. **180 seconds** are allotted for each attempt. If the robot accomplished the task 100%, the amount of saved seconds is divided by 10 and added to the earned points. If the robot cannot put away all the poor-quality cubes because of design features, the judge decides whether to stop the timer and to count the maximum time of attempt, or not.

- When neither of parts of the poor-quality cube is situated on the conveyor platform: **+10 points**.
- When neither of parts of the poor-quality cube cross in the cell: **+7 points**.
- When half of the poor-quality cube or more is moved from the cell: **+5 points**.
- When less than half of the poor-quality cube is moved from the cell: **+3 points**.
- When the poor-quality cube is touched: **+2 points**.

There are penalty points when fine-quality cubes are touched:

- When neither of parts of the fine-quality cube is situated on the conveyor platform: **-10 points**.
- When neither of parts of the fine-quality cube cross in the cell: **-7 points**.
- When half of the fine-quality cube or more is moved from the cell: **-5 points**.
- When less than half of the fine-quality cube is moved from the cell: **-3 points**.
- When the fine-quality cube is touched: **-2 points**.

The minimum amount of points - **0 points**.

Extra points:

1. The manipulator has the rotable part: **+20 points**.
2. The manipulator has one segment: **+10 points**.
3. The manipulator placement on the conveyor: **+10 points**.
4. The hydraulics is assembled to the manipulator: **+7 points**.
5. There is a mechanical gripper: **+20 points**.
6. Control block of manipulator: **+10 points**.

Task 2. Slalom in a city

You need to build, program and launch a robot on the field where there are two rows with white walls. In one row there are 3 walls. The size of the wall: 25x20 cm. The width is from 0,5 to 1,5 cm. Walls are set along the line on the field. It is allowed to install the wall within one cell at an angle relative to the robot. The walls are installed in a such way that there can be gaps between the walls with a distance of 1 to 5 cm. One of the walls has vertical lattice holes with a width of 0.5 cm. The rows of walls can be offset relative to each other within the field. The size of the field is 159x105 cm. The field is divided into 13 sectors. Each sector has a size of 30x30 cm, but there are two sections 90x3 cm in size at the polygon, where walls are installed.

The maximum size of the robot is 20x20x20 cm.

The robot is set to its starting position on the field. The judge places the walls on the field. By clicking on the "start" button, the countdown begins, the robot must begin to move along a strictly defined route right to the finish line.

Here is the robot rout: the first row of walls robot has to move along the left side, when the robot passes the first row of walls - it must turn and continue moving between two rows of walls, guided by the second row of walls, reach their end, turn around and the last part of the track robot must move along the right side of the second row. After the robot crosses the finish segment, the timer stops. Traveling beyond the borders of the field for more than 3 seconds is prohibited.

The robot is assembled on the basis of the Arduino UNO microcontroller using sensors and a platform from the kit, given to accomplish the task. There are 2 launches of the robot from different ends of the field. The ride is successful if the robot went through the whole field from start to finish. One drive takes 120 seconds. If the robot accomplished the task 100%, the amount of saved seconds is divided by 10 and added to the earned points.

Extra points:

1. Platform construction: **+30 points**.
2. Sensors assembly and connection with Arduino: **+7 points**.
3. Ride along one wall: **+2 points**.
4. Ride along the wall with vertical lattice holes: **+4 points**.
5. Robot enters the sector: **+2 points**.

Penalty points:

1. Touching the wall with robot frame: **-5 points**.
2. The downed wall with robot frame: **-10 points**.

Task 3. Little helper in a huge city

Robots are responsible for clean road surface in the cities of the future. Moving along the sidewalks, robots clean drain holes that are constantly clogged with leaves and some branches that have fallen from trees after a heavy rain. The mission for this ground assistant is to ride along the sidewalk and clean holes that are clogged with dirt.

There is a specially-designed «wall» imitating a part of the sidewalk with drain holes. The wall has a straight profile. The walls are white. Wall thickness is from 0.5 to 3 cm. The height of the walls is not limited. There are special pockets in the wall: wide enough for installing from 2 to 3 cans of 0.33 l, simulating clogs. Cans are installed in pockets so that the center of the can is on the same line with the center of the wall. Cans are divided by color into black and white. Black ones - insignificant clog, which can be pushed into the hole. White ones - serious clog, which is too big to be pushed into the hole, so robot needs to grab them outside the hole.

Robot cannot make any mechanical manipulations with the wall, which will bring down the cans, the exception are the pockets, where the cans are exposed. It is forbidden to take measurements with sensors located above the upper edge of the wall (measurements should not be made above this mark).

Robot is set in the start-position and after launch has to drive along the wall from start to finish. The aim is to clean all found holes. The robot is assembled on the basis of the Arduino UNO microcontroller using sensors and a platform from the kit, given to accomplish the task.

There are 2 launches. After the robot is set in the start position the lots are drawn to choose the scheme how to place the cans in the holes. The placement of the cans every time changes. The task is successfully accomplished if the robot cleans all cloges and gets to finish. **180 seconds** are allotted for each attempt. If the robot accomplished the task 100%, the amount of saved seconds is divided by 10 and added to the earned points.

- The can was pushed away in the right direction: **+10 points**.
- The can was partly pushed away in the right direction: **+7 points**.
- The can was touched: **+2 points**.

Extra points:

1. Platform construction: **+30 points**.
2. Sensors assembly and connection with Arduino:: **+9 points**.
3. One pocket was completely cleaned: **+15 points**.
4. Robot rode from start to finish: **+15 points**.

Penalty points:

1. The can was pushed away in the wrong direction: **-10 points**.
2. The can was partly pushed away in the wrong direction: **-7 points**.

The competition conditions:

1. Before proceeding with the task accomplishing, the teams must listen to the safety briefing and fill out the instruction sheet.
2. For safety violations the entire team should be immediately disqualified.
3. To program robots, participants use their own computers brought to the competition.
4. To complete the task, teams can only use the provided set of equipment and supplies.
5. Teams are allowed to use the Internet to search for reference information on the equipment used, including using libraries to work with electronic components.
6. When the team is ready to demonstrate the completion of the task, the team captain must inform the judge of their readiness.
7. Participants are given time to update the construction between the attempts. If they want, the participants can perform two attempts at once.
8. It is strictly forbidden:
    - to update construction during official breaks, such as: festival's opening, coffee break, etc.
    - to use any kind of internet-messengers (Skype,VK, Whatsapp, etc.) and pass a description of tasks or photographs outside the area of the Olympiad;
    - use the advices of people who are not part of the team declared for the competition.

For violation of this rule the whole team should be disqualified!

Result calculation system:

The results are determined by two criteria: by the points earned and by the time the task was completed. For each criteria a place is determined separately. The final place is determined by the average value of two criteria. If there are disputable places, the place is determined by the best time to complete the task.