General Rules and Game Rules

WRO College Category

2013 Pilot

Version 1 – April 2013

General Rules

1. The rules of competition at WORLD ROBOT OLYMPIAD are constituted by the WORLD ROBOT OLYMPIAD Advisory Council.

2. Qualification for participation and team composition

Age of participants: <21 years old, but ≥ 17 years old in the year of competition.

Team composition: 2 or 3 students.

Team coach: one coach, older than 21.

3. Material

The only parts and materials allowed in the construction the Robot are listed below. No other parts and materials are permitted.

3.1. Any part from the LEGO®, MATRIX™ or TETRIX™ system with the following constraints:

3.1.1. No more than eight (8) DC drive Motors.

3.1.2. No more than eight (8) Servos.

3.1.3. No more than two (2) Rechargeable Battery Packs, which are identical to those supplied in the kit of parts.

3.1.4. You may modify metal parts to any size.

3.2. Any LEGO building element with the following constraints:

3.2.1. Exactly one (1) NXT Controller must be used.

3.2.2. The NXT controller must be powered either by the NXT rechargeable AC battery (W979798), NXT DC Battery (W979639), or six (6) AA batteries.

3.2.3. LEGO Motors may be used with the following constraints (per NXT motor port):

- One (1) NXT Interactive Servo Motor (LEGO Part # W979842)
- One (1) XL Power Function Motor (LEGO Part # W778882)
- Two (2) E Power Function Motors (LEGO Part # W979670)
- Two (2) M Power Function Motors (LEGO Part # W978883)
- One (1) E Motor and one (1) M Motor

- You are allowed to use any number of NXT conversion cables to connect the Power Function Motors with the NXT (LEGO Part #s W770323, W778886, or W778871)
- You are NOT allowed to use any of the Power Function Battery Packs (LEGO Part #s W778881 or W778878)

3.2.4. LEGO pneumatic elements are allowed. Teams may not modify LEGO pneumatic elements to attempt to change the working pressure limits of the elements.

3.2.5. Any LEGO Approved NXT sensor (as indicated by the LEGO Mindstorms NXT Certified – Hardware label) is allowed.

3.2.6. Any NXT compatible sensor from HiTechnic, including the NXT Touch Sensor Multiplexer, NXT Sensor Multiplexer and the NXT prototype boards (both solderable and solderless) is allowed.

3.2.7. The HiTechnic 9-volt Battery Box that is sold as part of the NXT Sensor Multiplexer set may be used in conjunction with each NXT Multiplexer (i.e. one Battery Box per Sensor Multiplexer). It may be used only in conjunction with and to power the NXT Sensor Multiplexer(s).

3.2.8. LEGO-Approved NXT extension cables are allowed. Approved cables are currently only available from LEGO and HiTechnic.

3.2.9. Non-NXT electrical elements not specified above are not allowed, with the exception of RCX sensors.

3.2.10. LEGO Duplo products are not allowed.

3.3. Plastic-coated wire rope with a bare wire diameter of 0.03125” (0.08cm) or smaller. Compatible compression sleeves, clamps and hardware may also be used only in conjunction with the plastic-coated wire rope.

3.4. All mechanical fasteners (nuts, bolts, screws, etc.) of any length, any thread type, up to 3.5. 0.375” (0.9525cm) diameter. The intent of this rule is to allow teams to use fasteners from any supplier that are substantially the same as MATRIX/TETRIX fasteners. Compatible fasteners are characterized by using the same thread characteristics as MATRIX/TETRIX fasteners. For example, for MATRIX standard metric (M3, M4) screws are an acceptable substitute. For TETRIX 6-32 thread, 1/2" length socket head cap screw is a 6-32 thread, 3/4" length, button head cap screw purchased at a local hardware store. Any other non-metal parts are allowed with maximum thickness 0.2cm.

3.5. No additional components may be used, however functionless components used only for decoration and are easily removable as wanted are allowed.

3.6. Teams should prepare and bring all the equipment, software and portable computers they need during the tournament.

3.7. Contestants may write their program beforehand.

3.8. Control software must be LabVIEW for LEGO MINDSTORMS from National Instruments.

4. Robot Regulations

4.1. The maximum dimensions of the robot before it starts the "mission" must be within 30cm x 30cm. After the robot starts, the dimensions of the robot are not restricted.

4.2. Teams are allowed to use only one NXT controller.

4.3. Any actions or movements by the participants are not allowed to interfere or assist the robot while it is running (performing the "mission"). Teams that violate this rule will be disqualified for that round.

4.4. A robot must be autonomous and finish the "missions" by itself controlled only by its program. Any radio communication, remote control and wired control systems are not allowed while the robot is running. Teams in violation of this rule will be disqualified for the duration of the competition.

4.5. The NXT controller's Bluetooth function must be switched off. Downloading programs must be done through USB cable.

5. Competition

5.1 The tournament will generally follow this agenda:

- Team Check-in
- Robot Hardware and Software Inspection
- Qualification Matches
- Elimination Matches
- Awards

5.2. The competition consists of a number of qualification matches (as decided by the Host Country) then elimination matches. Qualifying Points (QP) will be awarded using the following criteria:

- Winning teams of a qualifying match receive two (2) QP.
- Losing teams of a qualifying match receive zero (0) QP.
- If a qualifying match ends in a tie, all teams receive one (1) QP.
- If a team is disqualified, they receive zero (0) QP.

Game Rules

I. Game Story

a. Your robot has landed on Mars to represent your country in the lucrative trade of delivering materials to the colonies spread across the planet. Each colony needs certain materials more than others. Your robot's job is to maximize the time it has in a single battery charge by delivering goods for maximum profit. Buy low and sell high is your mission. You will receive and extra bonus for precious metal (i.e. gold) that you place in the company return vehicle (shared waypoint). Hurry back to the recharge station before your 5 minute battery charge run's out. Happy roving.

II. Game Description

a. The objective is to get the highest score possible in the shortest amount of time.
b. A round or match is 5 minutes long.
c. Two opposing robots compete on the field in opposite directions to harvest and deliver different colored Duplo balls that represent delivering minerals to factories on the surface of Mars. An optional shared waypoint can be completed for an additional bonus.
d. Points are awarded for deliveries made, modified by the time to complete the course and the shared waypoint bonus.
e. The robot contestant starts in the green start zone and ends in the red end zone.

III. Rules & Regulations

a. At the beginning of a Match, each Robot must not exceed a volume of 30 cm wide by 30 cm long. An offending Robot will be removed from the Match at the Head Referee's discretion.
b. Each contestant is required to program a 5 second timer at the beginning of their program. This allows the contestant to start the program and get out of the way. The official clock will start at the end of the wait period.
c. It is up to the referee(s) to determine whether or not there has been a false start (one robot starting before the other) to the round. It is up to their discretion to restart the round in the even that this happens.
d. Contestants are prohibited from making contact with the robot, playing field or any game or field object. Any instance of a team member or coach touching the playing field or robot during a round will result in their immediate disqualification for that round.

e. Robots may not deliberately detach parts, or leave mechanisms on the playing field during a match. In the case where this does happen it is up to the discretion of the referee to determine if it was deliberate or accidental. If deliberate or seen as trying to inhibit their opponent, the team will be disqualified for the round or possibly even the game in a severe case. Play nice. If deemed accidental the part will be removed and game play will continue.

f. Unexpected Robot behavior in and of itself will not result in a Match replay. Team induced failures, such as low battery conditions, processor sleep timeouts, mechanical/electrical/software failures, etc. are NOT valid justifications for a rematch.

g. A team may never enter their opponent's side of the field with the exception of the Cooperative Waypoint area. (in yellow on the summary sheet)

h. Robots may only carry up to 3 balls at any one time.

i. A robot is considered finished with its round when it is completely in the red "finish zone" square and at a complete stop. The time bonus will be calculated from this point.

IV. Scoring

The Following scores are recorded by the Referees at the end of the game.

a. Each waypoint will award different points for each colored ball as follows:

1. **Waypoint 1** (Difficulty: Hard)
    a. Buys- Red Balls: 40 points, Blue Balls: 20 points
    b. Supplies: Red Balls x 2, Blue Balls x 4 (in random order)
2. **Waypoint 2** (Difficulty Medium)
    a. Buys - Red Balls: 20 points, Blue Balls: 40 points
    b. Supplies - Red Balls x 4, Blue Balls x 2 (in random order)
3. **Waypoint 3** (Difficulty Easy)
    a. Buys - Red Balls: 10 points, Blue Balls: 10 points
    b. Supplies - Red Balls x 3, Blue Balls x 3, Yellow Ball x 1 (in random order)

b. **Travel time** = 300 less time to complete, in seconds (round up to nearest integer)

c. **Cooperative Score Modifier** = 100 to the player that completes the task of putting the yellow ball in the shared waypoint. An additional 50 points will be awarded to both teams if they both complete the task.

Example Game Scenario:

The robot leaves base and goes to Waypoint 1 and draws 3 balls - Red, Blue and Blue. He inserts the Red Ball into the hopper of Waypoint 1 for 40 points. He draws one more ball - Blue. A minute and half has passed and he moves to Waypoint 2 to deposit his 3 Blue Balls for 40 points

each bringing his total up to 160 points. He draws three new balls from Waypoint 2 and gets both Blue Balls available at the waypoint and deposits them back in for a total of 240 points. With half of his time gone he fills up with 3 balls, all blue, and heads for Waypoint 3 to find the Yellow Ball so he can get his bonus from the Shared Waypoint. When he gets to waypoint 3 he drops his 3 balls for 20 points each for a total score of 300. Now with only 2 minutes left he draws 3 balls from Waypoint 3 and hoping for the yellow ball. Sadly he draws 2 Blues and a Red. With only 2 minutes left he feels he might not have time to deliver the them back to the more lucrative Waypoints 1 & 2 so he deposits them back for 20 points each bringing him to 360. He draws one ball and it's Yellow! He turns and dashes for the shared waypoint and places his Yellow Ball there for his 100 point bonus hoping his opponent on the other side has done the same so he can get the additional 50 point bonus. With just under 1 minute left he decides to head back to the finish for the remaining time bonus. He ends at 4 minutes 10 seconds receiving an additional 50 points, one point for each second under the maximum allotted 5 minute time.

Balls Deposited = 360 points

Waypoint 1: 1 x Blue Ball (40 pts. ea.) = 40 points

Waypoint 2: 5 x Red Balls (40 pts. ea.) = 200 points

Waypoint 3: 5 x Blue Balls (10 pts. ea.), 1 x Red Ball (10 pts. ea.) = 60 points

Time Bonus = 50 points (300 seconds - 250 seconds)

Shared Waypoint Delivery = 100 Points

Opponent Completes Shared Waypoint Delivery = 50 points

Final Score = 500

V. Waypoints

Each Waypoint will consist of a Ball Dispenser and Hopper for ball deposit.

a. All dispensers and hoppers will be in the exact same spot on the waypoint mat making their location predictable.
b. Each dispensing mechanism will have a piece of color contrasting tape that leads to dispense mechanism.
c. Each dispenser will have a different mechanism for that will require different actions to activate it.
d. Each Hopper will be of a different size and height.
e. All waypoints will deposit balls at the exact same height.
f. Balls are placed in random order in the dispenser before the start of the round.
g. Waypoint attributes are as follows:

1. **Waypoint 1** (Difficulty: Hard)

   Mechanism: Crank

   Hopper Size: Small

   Hopper Height: High

   Buys - Red Balls: 40 points, Blue Balls: 20 points

   Supplies: Red Balls x 2, Blue Balls x 4 (in random order)

2. **Waypoint 2** (Difficulty Medium)

   Dispense Mechanism: Pull

   Hopper Size: Medium

   Hopper Height: Medium

   Buys - Red Balls: 20 points, Blue Balls: 40 points

   Supplies - Red Balls x 4, Blue Balls x 2 (in random order)

3. **Waypoint 3** (Difficulty Easy)

   Dispense Mechanism: Push

   Hopper Size: Large

   Hopper Height: Low

   Buys - Red Balls: 10 points, Blue Balls: 10 points

   Supplies - Red Balls x 3, Blue Balls x 3, Yellow Ball x 1 (in random order)

4. **Shared Waypoint** -

   +100 points for placing the Yellow Ball in the waypoint.

   +50 points to both teams if both teams accomplish the task.

VI. Playing Field

a. The field consists of 18 2’ x 2’ foam floor tiles in a 3 x 6 configuration.

b. Black tiles consist of open field. Colored tiles will host waypoints for scoring points.

c. A white foam border surrounding the field will act as a virtual border.

d. The two sides of the field are separated by a 2 x 4 painted black to keep robots from wandering onto the other playing field.