World Robotics League®

CHALLENGE 2: ELECTRICAL ASSEMBLY BOT

INSTRUCTIONS BOOKLET

Revision 1.0	Initial Release

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1 IMPORTANT NOTES

For World Robotics League®, the constitution and Manifesto which describes the acceptable behavior of help from Parents, Coaches and Mentors is present here.

In addition to the drawings and figures, the challenge field computer model is provided in eASM format. You can look at multiple views, rotate, look at details and measure using eASM files. We strongly recommend you to install free eDrawing and eAsm viewer provided by Dassult/solidworks, from following site: http://www.solidworks.com/sw/support/edrawings/e2_downloadcheck.htm

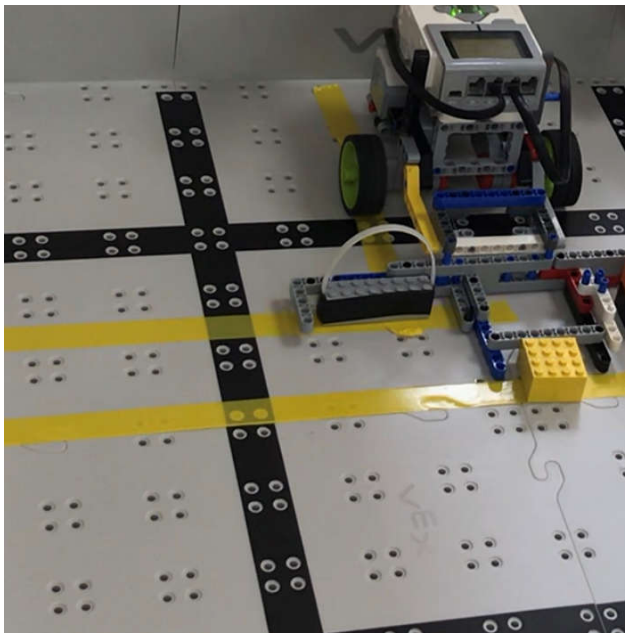


Figure 1 : An example of how tape is used to mark regions.

As described in Figure 1 different regions of the field can be marked using masking tape or electrical tape. Avoid using thick fabric-based tape or tapes that may spill glue since this may alter behavior of the robot. For marking purposes, you may use tape of any color.

For the Boundary of the competition area, you may use 2 by 3 (Actual dimension 1.5 in x 2.5 in). Alternatively, you may use tape to represent the wall. If you are using tape to represent wall and when recording the video for competition, please record at an angle that it is obvious beyond doubt that robot does not overlap in the walled area. In case the robot's mode of engagement with wall is not clear, Referees decision will be final.

This challenge is suited for RoboNINJA™ Craftsman Bronze skill level ONLY. For explanation of the levels, see the **Levels and Progression** page on the World Robotics League website.

The challenge is offered in two categories, Teleoperated and Autonomous. Please specify if you are attempting teleoperated mode or Autonomous mode. In teleoperated mode you have not more than 1 minutes (60 seconds) to attempt the challenge. In autonomous mode, the total time to attempt the challenge is 2 minutes (120 seconds).

All units are specified in inches

The Blocks are built using Qty 4 of 2x4 Lego bricks. As shown in Figure 3, you may arrange other smaller Lego bricks to build the block. Alternatively, you, may use cardboard box or wooden box to the specified block size. Note that the competition field will use Block built using Lego bricks. The friction and total weight of cardboard and wooden box may differ from Lego brick-based block.

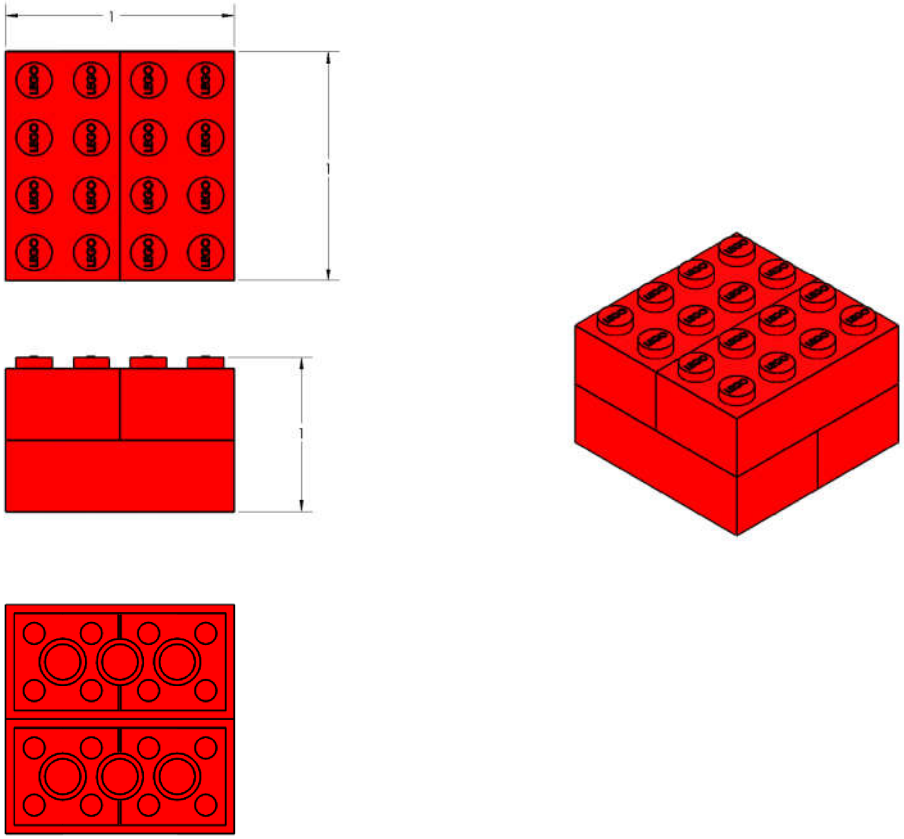


Figure 2 Details of a block (Units in Inch)

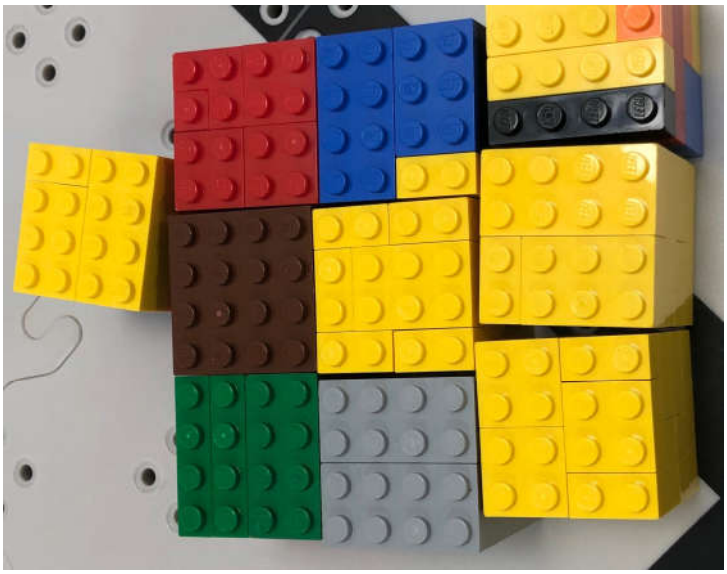
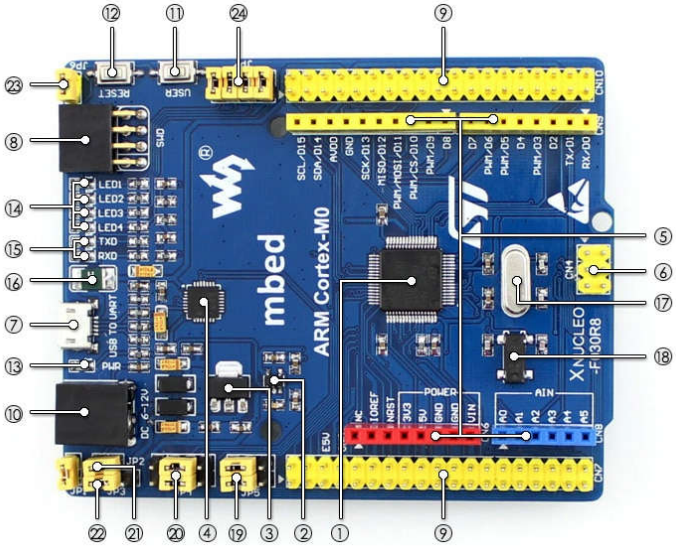


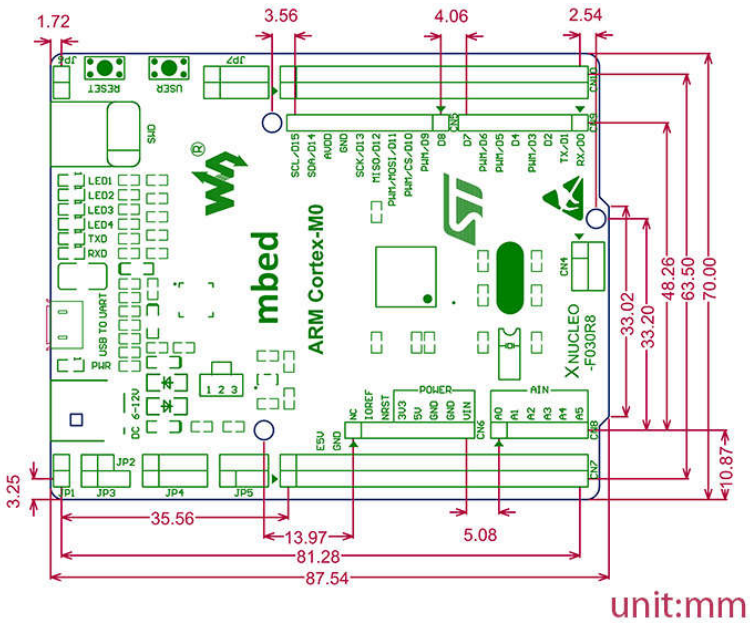
Figure 3 : Example to show how different sizes of bricks can be stacked to build similar block size

2 THE CHALLENGE

Robots are extensively used in precision assembly such as electronics assembly. In electronics assembly, a Printed Circuit Board (PCB) is populated with various components such as Integrated Circuits, Resistors, Capacitors, connectors etc. Then the components are permanently attached to the PCB with help of soldering material.



(a) Sample PCB with components, (Picture Source : https://www.waveshare.com/wiki/XNUCLEO-F030R8)



(b) Component placement coordinates on PCB, (Picture Source : https://www.waveshare.com/wiki/XNUCLEO-F030R8)

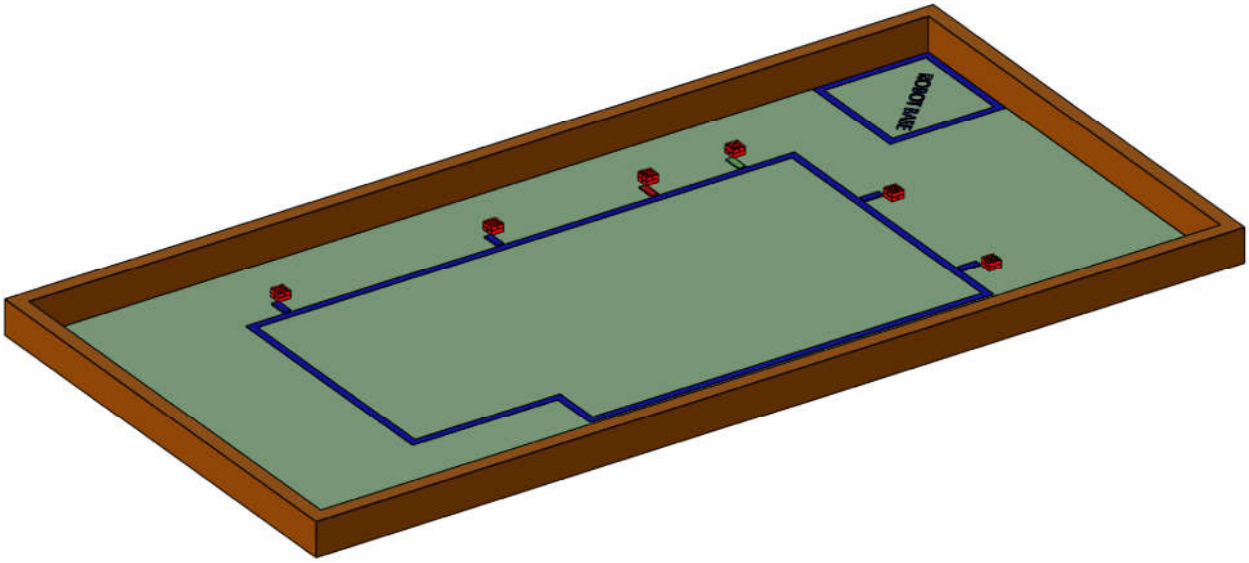
Figure 4 : Sample of PCB and component coordinates

As an example, refer to the Figure 4 . The figure shows a sample PCB and coordinates for some of the components.

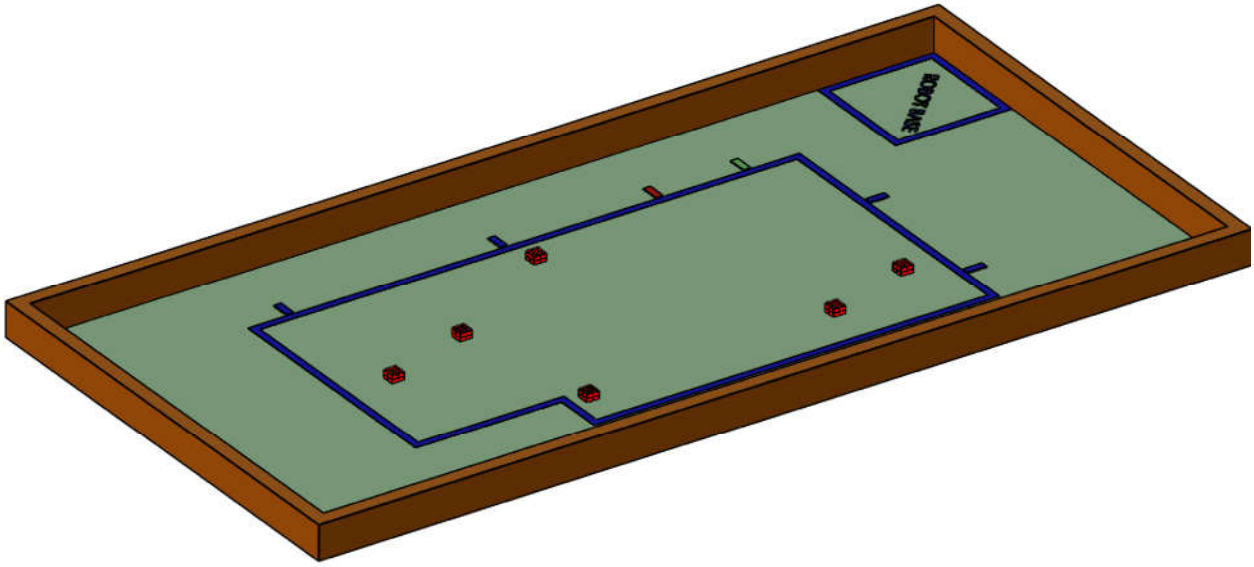
For electronic assembly, the Robot picks up the components and places them at the specified location.

In this challenge, your task is to design a novel mobile Robot and Its attachment that picks up electronic components and places them at specified position.

As described in the Figure 5 (a) and Figure 6, the Blocks B1, B2…B7 represent various electronic components before the assembly placement process. Your Robot needs to move the components at specified location as described in final configuration Figure 5 (b) and Figure 7. Your Robot may pick and place, push, or drag the components. However, ensure that during movement of the components, not two components ever touch each other.



(a) Initial Configuration



(b) Final Configuration

Figure 5 Challenge Filed -isometric View, Initial and Final configurations

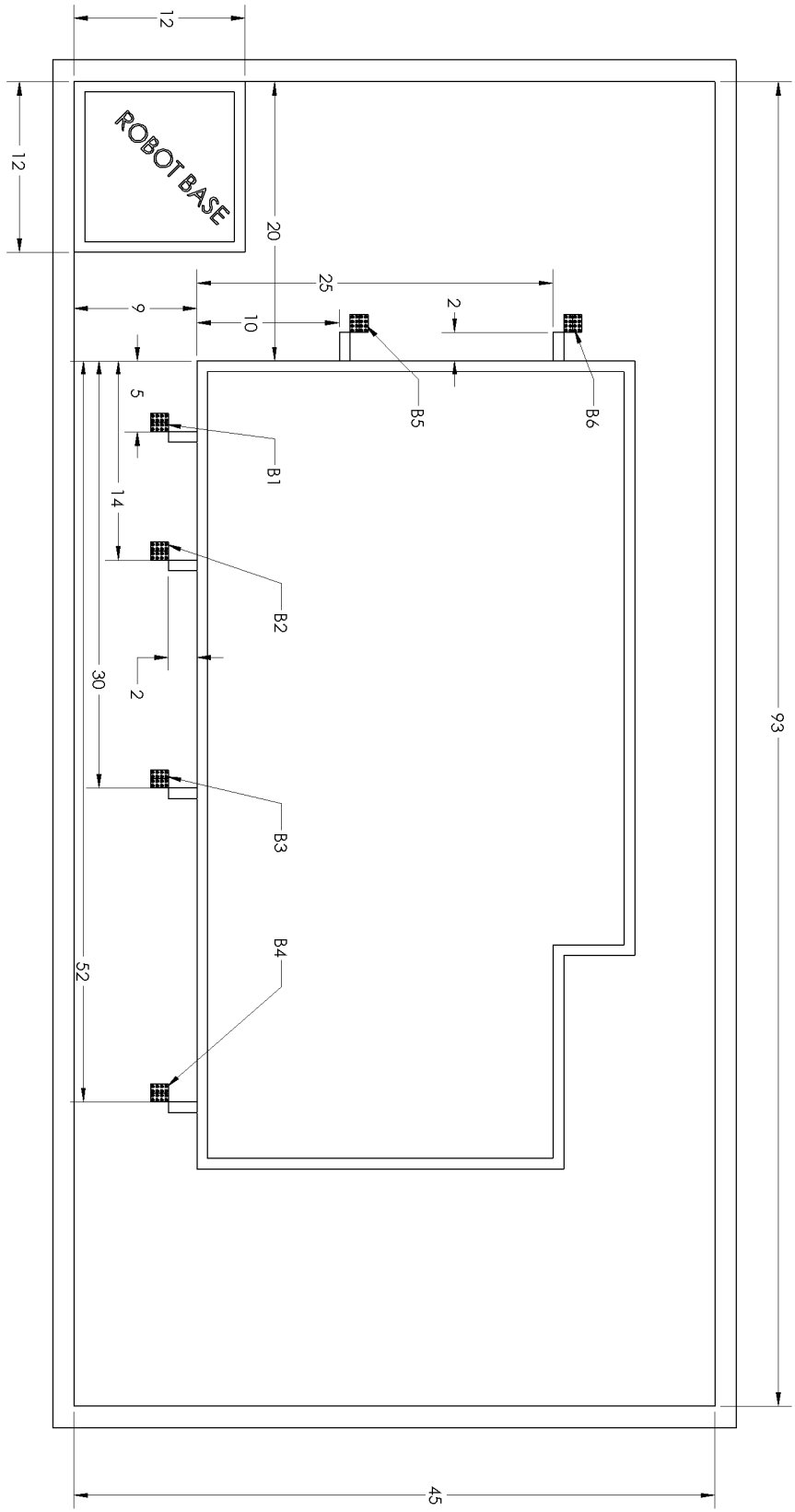


Figure 6 : Detailed Tope view of field (Initial Configuration)

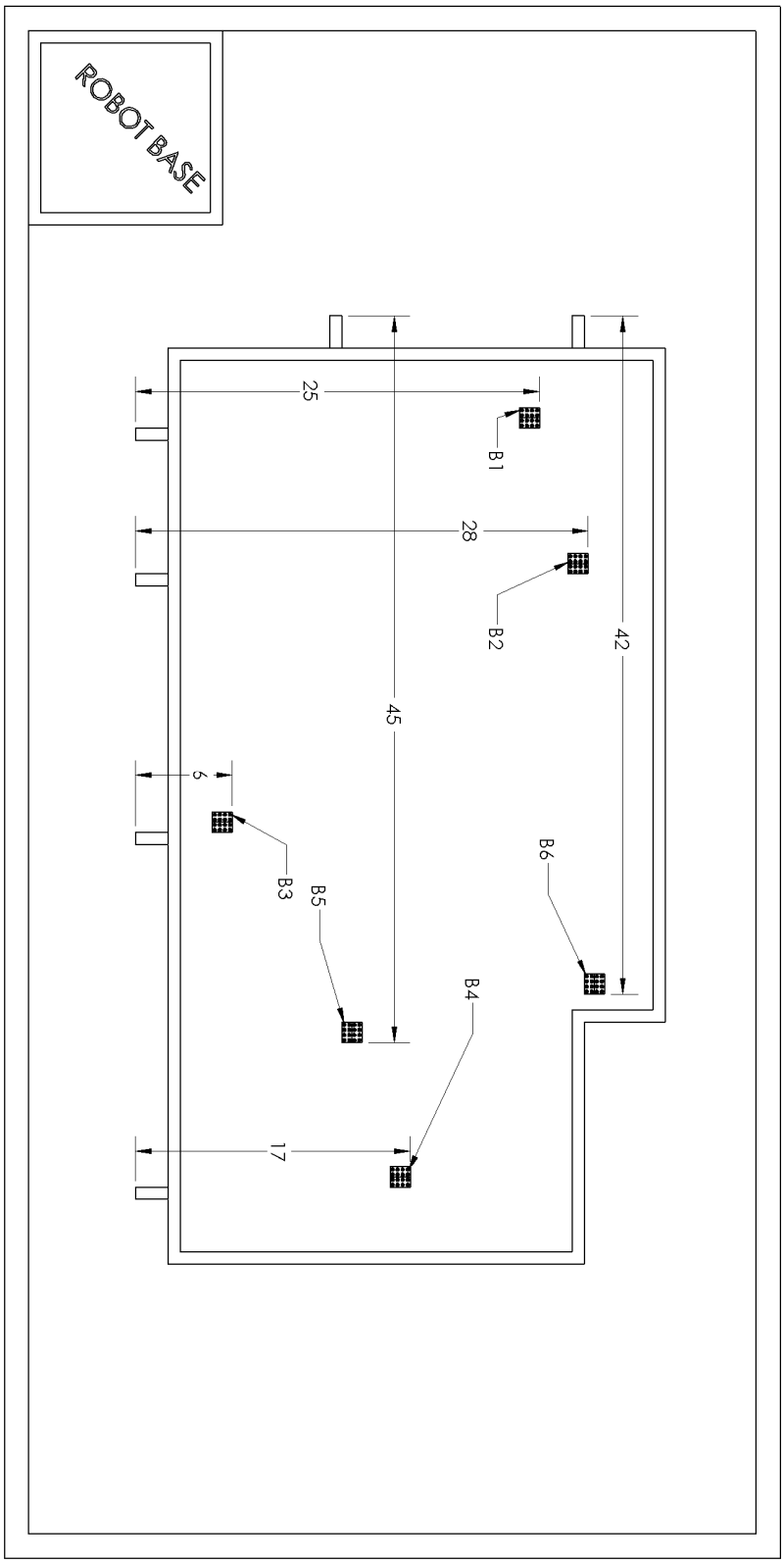


Figure 7: Detailed Top view of field (Final Configuration)

3 CHALLENGE CONDITIONS AND RULES

- All units are specified in inches.
- Size of the Robot shall not exceed 12in X 12in X 12 in. The robot area is marked 12in x 12in field. If you are submitting your challenge via video, the team shall include a top view of Robot area in their videos before the start of the challenge to confirm that no part of robot exceeds the specified boundary.
- Each challenge may be attempted in Autonomous mode or Teleoperated League. Awarding for the Autonomous or Teleoperated will be in different categories.
- For the teams competing in Autonomous mode league, Robot shall navigate and completes task without human intervention. Robot can be modified, realigned and alternate program may be run only when robot is in Robot area. Once the robot leaves the robot area, any intervention, and touching will incur penalty. Total time to complete the Autonomous mode Challenge is 2 minutes (120-seconds). The 2 minute clock will not stop when the robot is modified or reoriented in the Robot base.
- In Teleoperated mode robot shall navigates and completes task with the help of a remote-control device. Robot cannot be modified or realigned once the Robot leaves the Robot area. Total time to complete the Autonomous mode Challenge is 1 minutes (60 seconds).
- When multiple teams are competing at a common venue, each team will be given two opportunities., the Maximum of the two runs will be considered as the actual team score. For the submission by video, only one video per team is allowed.
- For this challenge, if your robot misbehaves, you may pick up the robot and restart the robot. There is a 5-point penalty for picking up the robot.
- The Robot may move the blocks to respective final position in any order.
- The blocks should be in final configuration within a positional error of +/- 0.5 inches.
- During the movement of the blocks if one block touches another block, it will be considered damage to both the components and a penalty of 10 points will be applied.
- You may use up to 4 motors total on the mechanism of any kind.
- You may use up to 4 sensors of any kind in this challenge.

4 SCORING

Points are scored when Robot touches a block and moves the block. The points are assigned per follows:

Table 1 Score details

Block	Touch Score	Move Score
1	5	20
2	10	20
3	10	25
4	10	30
5	15	30
6	15	40
7	15	40

5 TEAM REGULATIONS

1. Teams must be at least 1 person and at most 2 people.
2. At most two of the team members may be at the table before starting the run; they will be designated as “Robot Drivers”.
3. Everyone else must stand back at least 12 inches from the table.
4. During the three runs, every team member must be the robot Driver in at least one round to ensure everyone is fully engaged and they have participated in the process of design, development and programming.

6 AWARDS

- Highest score Award: 3 awards for the top three scores.
- Repeatability: (Applies to the challenges attempted at by multiple teams at a common venue) The robot with most repeatable runs. We want to ensure that the skill of the kids is the largest part of the robot run. The robot that produces the highest scores in a consistent manner will get this award.
- Referees choice (flexible criteria): If a design, program or teams’ approach is found to be exceptional in any manner; Referees may recognize the team.
- One team may win multiple awards.

7 ROBOT RUN RULES

1. One team can use ONLY one robot during the entire challenge. They must finish with the exact same robot that they started with.
2. If you are submitting video entry:

   a. Your video must describe the team name/number, Season (WRL 2020), Challenge Number and Category (Bronze 1, Teleoperated or Autonomous) on a A4 size paper.
   b. At the start of the video, you must show a top view to ensure that the robot is within the specified size and no part of the robot is extending beyond 12in. Additionally, the height of the Robot shall be confirmed by placing a ruler next to the Robot. It is participants responsibility to submit the evidences for Robot size in a manner that ascertains robot size beyond doubt. Should there be any doubt, referee's decision will be final.
   c. The video must be continuous unedited through the Robot run duration.
   d. The angle of video recording must ensure beyond doubt that robot does not interfere with the walls. Should there be any doubt, referee's decision will be final.
3. For the teams competing in Autonomous mode league, Robot shall navigate and completes task without human intervention. Robot can be modified, realigned and alternate program may be run only when robot is in Robot area. Once the robot leaves the robot area, any intervention, and touching will incur penalty. Total time to complete the Autonomous mode Challenge is 2 minutes (120 seconds). 2-minute clock will not stop when the robot is modified or reoriented in Robot base.
4. In Teleoperated mode robot shall navigates and completes task with the help of a remote-control device. Robot cannot be modified or realigned once the Robot leaves the Robot area. Total time to complete the Autonomous mode Challenge is 1 minutes (60 seconds).
5. If a robot misbehaves and needs human intervention, a Robot Driver may intervene. Touching the robot disqualifies the run i.e. score from any previous runs will be discarded unless the game specific rules say otherwise.
6. *If a robot or mechanism created by the participating team starts destroying any fragile mechanisms, the referees will stop your mechanism. You may reattempt the challenge if the rules allow and if you are still within the allotted time.
7. The robot runs can be attempted indefinite number of times within the allotted time frame. *The referee will stop the run if the robot is not finished by the end of the allotted time.
8. *There will be two referees on either side of the table, and their combined decision will be final.
9. *There will be 2 rounds for each team. Each team will get 1 run in each round. There will be a 5-minute break between rounds for kids to tweak their programs or robots.
10. Adult help should be limited to non-competitive elements. Adults may help with video recording and time keeping, laying out team details on A4 page as specified in previous sections. We want kids to do the work themselves demonstrably.

11. Referees and Judges may ask the participants to explain their programs and design before the run to ensure that they have done original work by themselves. Each member of the team must be able to answer questions about the program and design. If a team member cannot answer questions satisfactorily, that team will not be eligible for any awards no matter their score.

    * Should there be any doubt, referee's decision will be final.