

Block Stacking-Bots – are you faster than a pre-schooler?



Vs.



Vancouver, BC - UBC Child Care Services is looking to expand its available services on campus, and are keen on having robo-playthings available to play with the children in their care. Engineering Physics has been contracted by the group to construct the first round of robots, with the goal of designing autonomous block-stacking robots capable of performing as well as some of the youngest kids at Child Care. The robots should be capable of identifying blocks from a common pile, carrying them over to their individual build-site, and stacking as high as they can to impress the kids. Interfering directly with others in the play area is to be avoided – but you can try to build fast to use as many blocks from the site as possible. Good luck!

Revision History

2012 April 10 - v1 – initial draft

2012 April 18 – v2 – no robot interactions. draft for TA's

2012 May 5 – v3 – first day of classes.

2012 May 24 – v4 – removal of wall at build site

2012 May 24 – v5 – resolve IR blockage by tower

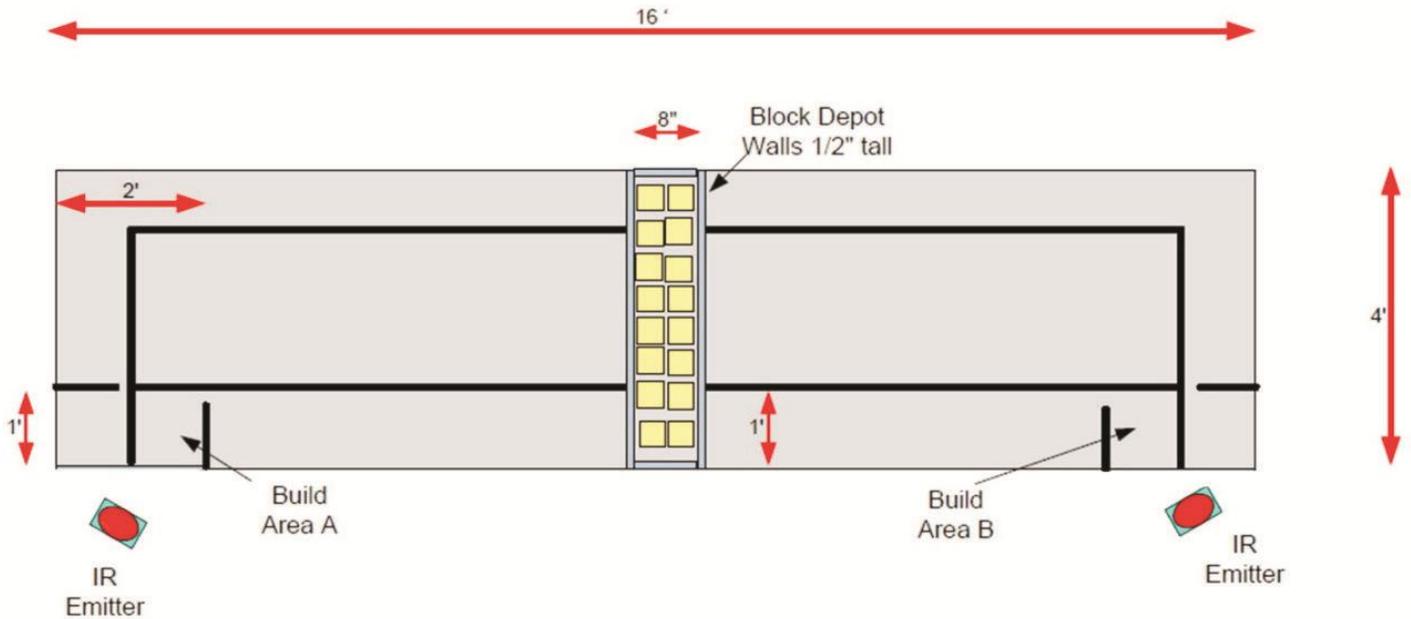


Figure 1 –Playing Surface

Part 1: COMPETITION RULES

1. **Playing Surface Overview** - The playing surface is 16 feet wide and 4feet deep. The track is marked out with black tape. Two robots will run simultaneously, each of which has a designated Build Areas, and one common Block Depot.
2. **The Build Area** - The Build Areas are 2' x 1' zones marked for each robot using black tape. The Build Area tape will be at least 2" away from the Black Tape to minimize the chance of interfering with the Robot's black tape sensors.
3. **Infrared at the Build Area** - An infrared (IR) emitter will be mounted on the surface at each Build Area, 12" from the playing surface. These emitters will emit a 10 kHz sine wave, and will be angled at ~30 degrees to the edge of the Playing Surface.
4. **Block Depot** - The Block Depot is an 8" wide area along the middle of the playing surface, with a 1/4 " wall along the perimeter of the Block Depot. 16 blocks will be placed into the Block Depot at the start of the competition. Blocks will not be replenished during each heat, except for those that are judged to be accidentally out of play (eg fallen on the floor).

5. **The Blocks** - The Blocks will be unpainted wood cubes 7cm on a side, weighing ~ 160g.
6. **Block Handling and the Build Areas** – The Robot may only manipulate one block at any time outside of their Build Area or the Block Depot. For the competition, “manipulate” means purposefully moving a block, even if the Robot is only in physical contact with one block. Any handling of multiple blocks outside the Build Area or Block Depot will result in the judges removing all blocks from the Robot.

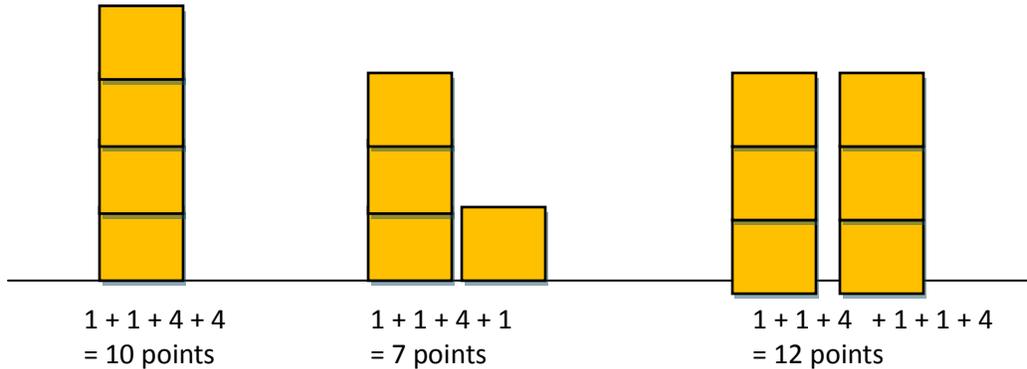
The Robot may handle multiple blocks inside of its Build Area or Block Depot. A block is considered to be inside the Build Area or Block Depot if any part of the Block breaks the vertical plane defined by the boundaries of the Build Area or Block Depot.

Towers and blocks contacting the tape defining the build area are considered inside the build area. Judges discretion will apply to blocks on robots where the block is in contact with a robot which is inside the build area and where the block is near but not explicitly inside the build area.

7. **Lost /realigning Blocks** - Blocks that have been lost on the surface will not be moved or replaced by the Judges. Blocks will not be re-aligned in the Block Depot. Blocks which fall off the surface may be replaced in the Block Depot, at the Judges’ discretion.
8. **Start Positions** - The two Robots will be started in their respective Build Areas. Sides will be determined immediately prior to the run by coin flip or at the Judge’s discretion.

9. **Scoring** – At any point during the competition, the score for the block-stacking will follow the table below. The blocks must be free-standing for ~5 seconds or more to count for score:

| | |
|--------------------------------------|----------|
| Block at level 1 (ground) or level 2 | 1 point |
| Block at level 3 or above | 4 points |



10. **End of Competition** – The competition ends when either Robot reaches 10 or more points, or when the maximum Time Limit is reached. In later rounds of the competition, the Judges have the option of extending the competition to a full 2 minutes and award the win to the team with the maximum number of points.
11. **Time Limit** – At the end of two minutes, the competition will be called in favour of the robot which has, in the judge’s opinion, performed best during the 2-minute run. At the judge’s discretion, the race may be also called before the end of 2 minutes and awarded to one of the two teams based on overall robot performance.
12. **Robot-to-Robot Interference** – All Robots are expected to avoid any purposeful physical interfere with each other. Robots must be designed to accept a “reasonable” amount of interference from other robots (by avoidance or recovery).
- Judges may disqualify and remove robots from the Playing Surface that are actively attempting to impede the success of the competing Robots through contact.
13. **Restarting Robots** – At the discretion of the judges, Robots must be recovered by the team and brought back to the Start Area if any of the following occurs:
- Robot falls off the competition surface
 - Robot becomes stuck, incapacitated, or lost on the surface.
 - Robot hits (or is hit by) the other Robot and is unable to continue.
 - Robot actively or accidentally interferes with the other Robot.

Robots which are brought back to Restart will have all the blocks in their Build Area removed and returned to the block depot.

Part 2: GENERAL RULES

- A. **Autonomy:** Robots must be completely autonomous – no form of remote control is allowed.
- B. **Size:**
 - a. At the start of the run, the Robot must fit inside an 9” x 9” x 12” cube (in any orientation), Except IR detection sensors may extend out of this envelope if needed.
 - b. Once the race begins, the Robot may expand in any direction, with the robot not exceeding 18” along any dimension at any time.
 - c. During any re-start, the Robot must return to its original start size.
 - d. The Robot may not intentionally leave any part of itself on the surface.
- C. **Power:** Robots may only be powered by one 14.4V battery pack provided, plus up to three 9V batteries intended for use for sensor circuits. The 14.4V battery is the only electrical power which may be used to drive any motors on the Robot.
- D. **Components:** All components outside of the list of allowed components provided in class or listed at the end of this document must first be approved by one of the Course Instructors. Teams which choose to purchase their own items will not be reimbursed, and are limited to a maximum of \$100 per team.
- E. **Damage to Surface:** Robots may not permanently modify or damage to the competition surface or any individual playing piece.
- F. **Start Mechanism:** Robots will initiate motion only when the START button on their controller is pressed by a team member at the start of the match (signalled by a referee).
- G. **Programming Starting Positions:** A sequence of button/switch presses on the controller or robot is allowed prior to pressing START to select operating code or parameters. Any mechanical changes to the robot (repositioning of arms) prior to start is allowed if the changes can be done in less than ~15 seconds.
- H. **Track Variations:** The surface is made of wood and will have some warp and slight bumps at the joints. Robots must be designed to accommodate for imperfections and irregularities in the surface.
- I. **Rules Finalization:** Rules and dimensions will change slightly between now and the competition. Finalized rules will be issued after completion of the competition surface construction in Hebb 42. Qualifying heats (with no opponent) will take place a week prior to the competition in Hebb 42.
- J. **Sportsmanship Rule:** Strategies or designs that obviate the design elements of the course or that do not follow the intent of the competition will be disallowed whether or not they explicitly break these rules. All strategies which have been designed specifically to come as “close to” violating any of the posted rules as possible must be presented to the course instructors during the design stage of robot building. **All decisions are at the discretion of the course instructors.**

ALLOWED MATERIALS

Approved:

1. Springs, elastics, and compressed air.
2. Wheels and hubs from existing RC or other small vehicles.
3. Solenoids

Restricted or Banned:

1. Discrete H-bridge driver chips.
2. Any components other than wheels from existing RC or other small vehicle chassis, including (but not limited to) suspensions, differentials, steering mechanisms.
3. Alternate battery power sources.