

Hills Road Sixth Form College

ROBOCON 2018

BUCKET BONANZA

RULE BOOK



BUCKET BONANZA

Revision 2.0 February 3rd, 2018

The following defines the rules and regulations of the Hills Road RoboCon 2018 competition.

1. GAME RULES

- 1.1 The game, called **Bucket Bonanza**, will be played in the arena defined in section 3.2. The objective of this game is to achieve as many points as possible by collecting tokens, placing them in your bucket, and moving tokens into your zone.
- 1.2 Before a round starts, the teams participating in that round will be given some time to set their robot up in the arena. During this time, they must place their robot in the zone that they are assigned. The robot must be placed such that it is entirely within this zone, with no parts overhanging its boundary. Once all robots and buckets have been arranged, 20 tokens will be randomly placed in the area bounded by the zones.
- 1.3 A round lasts 180 seconds.
- 1.4 At the end of a round, each team's "**Game Points**" will be calculated. These are used to rank teams before competition league points are awarded. Game points will be awarded as follows:
 - 1.5 1 point will be scored by a robot if it moved out of its starting zone.
 - 1.6 1 point will be awarded for each token that the robot is controlling, as defined in section 1.11.
 - 1.7 2 points will be awarded for each token that is entirely within and in contact with the floor of the team's zone,

This also includes tokens that are on top of a token that is valid for this point total.
 - 1.8 5 points will be awarded for each token that is inside a team's bucket.
 - 1.9 If a token is being controlled by more than one robot, the token is removed from the field and does not score.
 - 1.10 Tokens can only score once, and will score the greatest point total they are valid for.
 - 1.11 A robot will be considered to be controlling a token if it is touching a robot, or token is within the perimeter of the robot. Appendix B explains what constitutes the perimeter of the robot.
 - 1.12 At the end of a game, **League Points** will be awarded as follows:
 - 1.13 The team with the most game points will be awarded 8 **League Points** towards the competition league. The team with the second most will be awarded 6 **League Points**. The team with the third most game points will be awarded 4 **League Points**, and the team with the fewest game points will be awarded 2 **League Points**.

1. GAME RULES (CONTINUED)

- 1.14 If teams are drawn on Game Points, they both receive the average League Points score of their two places. For instance, if two teams come joint first on Game Points, they are both awarded the average of 8 and 6 League Points, so 7 League Points.
- 1.15 Teams whose robot was not entered into the round, or who were disqualified from the round, will be awarded no points.
- 1.16 Once the league has completed, a knockout competition will begin. The positions of the teams in the league will seed the positions of teams in the knockout rounds. Each round in the knockout competition involves up to 4 teams. The teams that come 1st and 2nd in each knockout round will continue to the next round of the knockout. In the event of a tie in a knockout round, the team that ranked highest in the league will go through. If there is a tie in the final, then a rematch will be played.
- 1.17 There will be a maximum of 4 robots in a round.
- 1.18 Robots will be started by teams leaning into the arena to press the start button on their robot when instructed to do so.
- 1.19 There must be no team members in the arena during the 1 minute before a round is scheduled to start. Robots must be installed and oriented before this deadline. During this minute there must be no interaction with the robot. Teams that do not meet this rule will forfeit the round.
- 1.20 The buckets must not be knocked over. The Judge may disqualify a team from a round should their robot knock a bucket over.
- 1.21 A round may be terminated prematurely if all teams participating in that round state to the Judge that they are happy for the game to end.
- 1.22 A token will be considered to be in a bucket if the token is fully supported by the bucket, and no part of the token is touching a robot, or any other part of the arena.
- 1.23 Token scoring begins 10 seconds after the round ends. Should any further movement of the token occur after this point, the token is removed from the field and does not score.

2. REGULATIONS

- 2.1 No remote control systems may be used.
- 2.2 This is a non-contact sport, but accidental bumps and scrapes are inevitable.
- 2.3 Robots must not intentionally damage anything – including tokens, buckets, the arena or other robots. At the discretion of the Judge, teams who deliberately engage in collisions or take insufficient precautions against collisions may be disqualified from rounds until the issue is resolved.
- 2.4 Robots must not intentionally move the buckets.
- 2.5 Robots may not deliberately leave any debris in the arena.
- 2.6 **Hills Road RoboCon** reserves the right to examine your robot software and hardware at any time.
- 2.7 Assistance from **Hills Road RoboCon** is provided without any guarantees.
- 2.8 All kit deployed by **Hills Road RoboCon** remains the property of **Hills Road RoboCon**. The kit must be returned to **Hills Road RoboCon** after the competition. Appendix A gives an inventory of the kit.
- 2.9 The Judge's decision is final.
- 2.10 Robots must pass an inspection by a **Hills Road RoboCon** Inspector before competing in a round. This inspector will check that the robot complies with the rules and regulations of this game. Robots that have not passed inspection will not be permitted to compete.
- 2.11 At the beginning of each round, robots must fit within a cube with 300mm internal sides. During the round, the robot may extend beyond this size up to a height, width, or length of 500mm.
- 2.12 The power switch must be easily accessible at all times – including throughout the game. This is for everyone's safety, especially your robot's.
- 2.13 You may use additional Raspberry Pi hats or custom hardware to enhance your robot's electronics but all power must be derived from the power board supplied.
- 2.14 All custom electronics that require a connection to the battery must instead be connected to the power board. There are extra connectors on the power board for this purpose.
- 2.15 The power board and motor control board supplied in the kit must not be disconnected from each other.
- 2.16 All wires connected to the robot's ground (0V line) must be black. Black wires must not be used for anything else. It is strongly recommended that all wiring is neat and easily removable, as this will reduce the time required to debug problems on robots (teams may be asked to tidy their wiring before a member of **Hills Road RoboCon** will approach any issues with their robot).
- 2.17 All electronics must be securely fixed to the robot, and should also be easily removable.
- 2.18 It must not be possible to injure oneself on the robot. This will be tested using a Frankfurter sausage to simulate a finger. For example, high-speed rotating parts that could cause injury must be suitably shielded.

2. REGULATIONS (CONTINUED)

- 2.19 The lithium-ion polymer batteries provided in the kit must be shielded from mechanical and thermal harm. This includes mechanical protection from accidental impact with other robots. Teams found to be in violation of this rule will have their batteries confiscated until they have demonstrably rectified the identified issues.
- 2.20 If teams wish to use batteries other than the lithium-ion polymer batteries provided, then they must seek approval from **Hills Road RoboCon** through info@hr-robocon.org first. Additionally, if teams wish to add systems powered by separate batteries then they must seek approval through the same channel first. In general, teams are encouraged to power everything off the power board supplied with the kit. All electromechanical components must be powered through the motor rail provided by the power board.
- 2.21 Robots may not include radio transmitters or receivers.
- 2.22 Attaching a Go-Pro or similar small video recorder to your robot to record the round is permitted, but it should be powered from its own internal batteries and may not be connected to any other electronics in the robot. It must fit within the overall dimensions contained in rule 2.11.
- 2.23 Robots must obey the Three Laws of Robotics.
1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
 2. A robot must obey orders given it by human beings except where such orders would conflict with the First Law.
 3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

3. SPECIFICATIONS

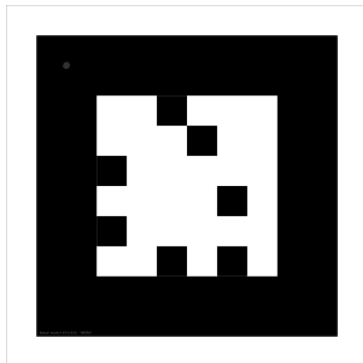
3.1. MARKERS

The arena, tokens, and buckets involved in the game are labelled with *libkoki* markers. Each marker pattern encodes a number. Each marker number is associated with a particular feature within the arena, and also has an associated size. The marker numbers and sizes are as follows:

Item	Marker Numbers	Marker Size (mm)
Arena boundary	0 – 23	250
Tokens	32 – 71	100
Bucket side	72 – 75	100
Bucket end	76 – 79	100

The markers can be printed on a black-and-white printer. Marker designs can be downloaded from the documentation section of the **Hills Road RoboCon** website.

Unless specified otherwise, all markers described in this document are oriented vertically such that the principal corner of the marker (which is indicated by a dark grey dot in the black marker border) is on the higher edge.



An example *libkoki* marker is given above; this one is *arena-0*.

3.2. ARENA

- 3.2.1 The arena floor, overall, is a 6m x 6m square, as shown in figure 1. The tolerance of these two dimensions is $\pm 0.25\text{m}$.
- 3.2.2 The floor of the arena is carpeted. A close pile industrial carpet will be used.
- 3.2.3 The arena will be surrounded by low walls. No competitors or members of the audience will be allowed beyond the walls onto the arena during a round.
- 3.2.4 The arena features four zones. These areas are delineated by different coloured carpet. These extend from the barrier walls 0.5m into the arena. The dimensions and numbering of these zones is shown in figure 3.
- 3.2.5 Each wall of the arena features six 250mm libkoki markers. Figure 4 shows the positioning of these markers, whilst figure 3 shows the numbering of these markers.

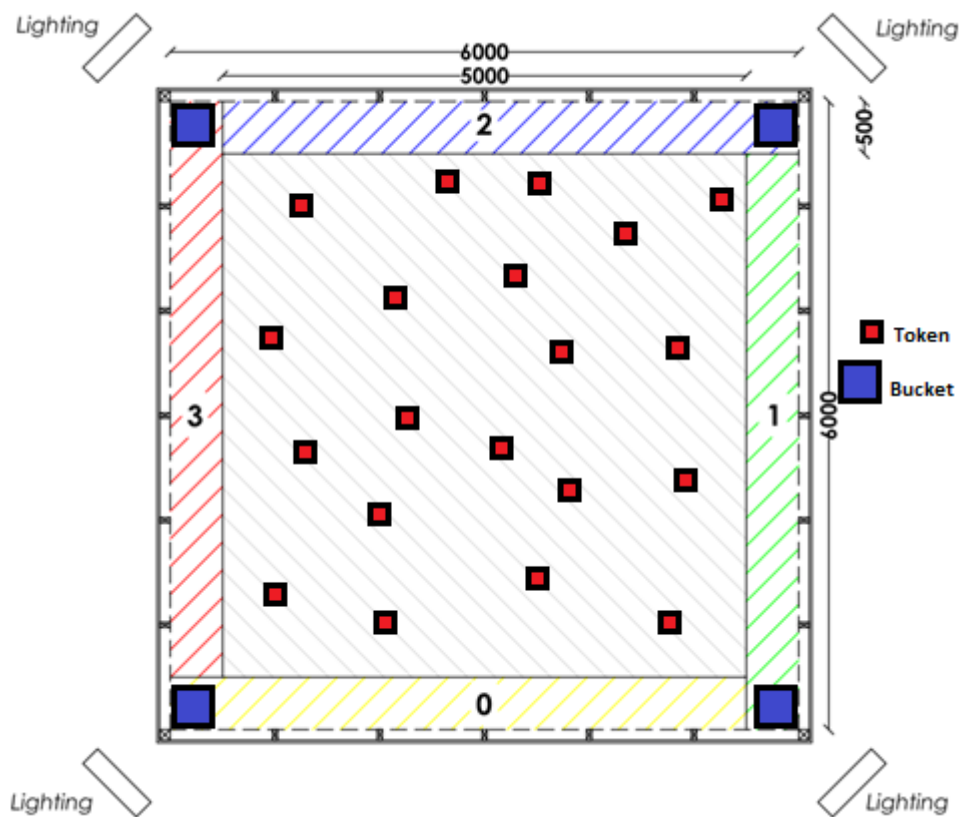


Figure 1: A bird's-eye view of the arena.

3.3. TOKENS

3.3.1 Tokens are cubic corrugated cardboard boxes with side $110\pm 10\text{mm}$. Each team's kit contains four of these.

3.3.2 Each token is associated with its own libkoki marker number. Each token is labelled with six identical 100mm libkoki markers – one on each face.

3.4. BUCKETS

3.4.1 The buckets will be 12L "Really Useful Box". The robot kit is supplied in one of these boxes.

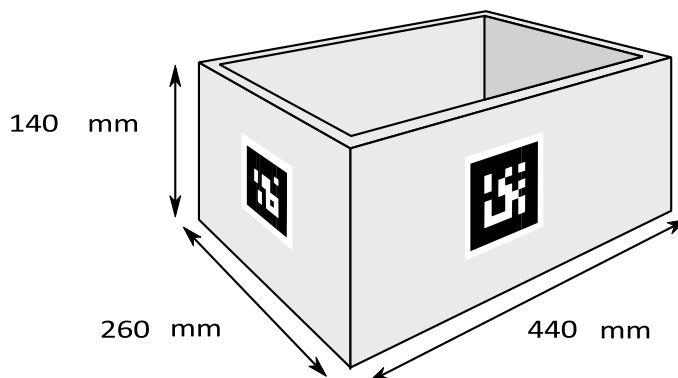


Figure 2: Dimensions of the bucket. The height shown is the height from the floor. Dimensions $440 \times 260 \times 140 \pm 10$ all dimensions in mm. These are the external dimensions of the box without its lid.

3.4.2 Each bucket features two marker numbers: one which is used on the shorter sides of the bucket, a.k.a. "the bucket ends", and one that is used on the other vertical sides of the bucket, a.k.a. "the bucket sides". The markers on a given bucket will have the same offset (the difference between a marker's number and the number of the first marker in the group), for example markers #73 and #77, (both with offset 1), will be on the bucket of team 2. These markers are 100mm in width, and are placed in the centre of the bucket faces that they occupy.

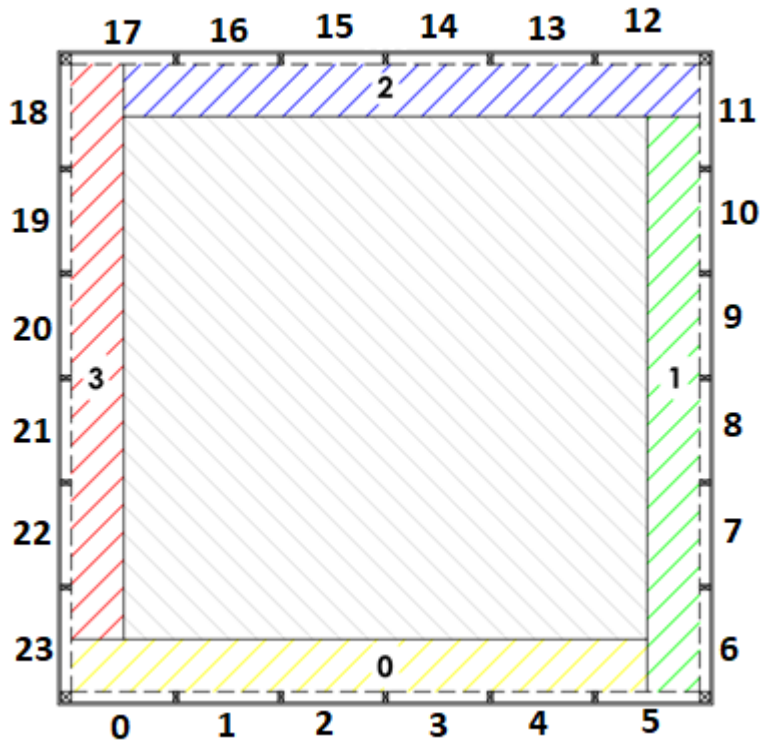


Figure 3: The positions of the four zones in the arena. The numbers shown around the perimeter of this diagram are the numbers of the markers positioned on the wall.

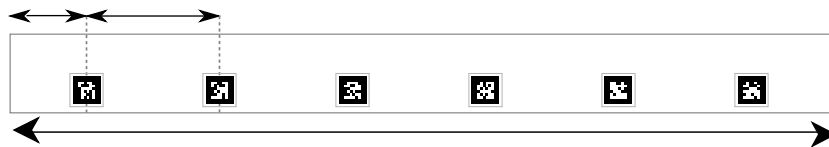


Figure 4: Six 250mm wide markers are spaced evenly along each 6m arena wall. The markers are placed 50mm above the floor.

4. AWARDS

4.1 MAIN COMPETITION AWARDS

Prizes will be awarded to the teams that are placed highest at the end of the competition. The teams in 1st, 2nd and 3rd place will receive awards.

4.2. JUDGES' AWARD

The Judges' Award will be given to the team that displays the most extraordinary ingenuity in the design of their robot. This award is entirely at the discretion of the judges.

4.3. ROBOT AND TEAM IMAGE

The team that presents their robot and themselves in what is judged to be the most outstanding way will receive this award. Your online presence will also count towards this category.

5. CLARIFICATIONS

3/2/2018:

Rule changes to:

1.9

1.11

2.3

Rules added:

1.23

Appendix B was added for clarification.

Requests for rule clarifications may be sent to info@hr-robocon.org.

Requests received within one month of the competition are unlikely to be processed.

APPENDICES

A. RETURN OF KIT

Each kit issued by **Hills Road RoboCon** contains a manifest which lists the parts and part numbers issued to each team. Each team is responsible for ensuring that they return the items listed on their manifest.

A.1. ITEMS TO BE RETURNED

A.1.1. CONTAINERS

- 1 x 12L Really Useful Box

A.1.2. ELECTRONICS KIT

- 1 x Raspberry Pi 3 + SD card
- 1 x Raspberry Pi Camera
- 1 x PiBorg Thunderboard motor drive board:
- 1 x BlackJack board
- Custom designed power and interface board,
 - 4 x GPIO,
 - 4 x servo PWM,
 - 12 V

A.1.3. POWER AND START SWITCHES

- Battery lead with in-line (10A) fuse
- Red switch, black connector: ON/OFF (latching)
- Black switch, green connector: Start (momentary)

A.1.5. BATTERIES:

- 2 x 12 V LiPo battery:
- 1 x Turnigy E3 Compact 2S/3S Lipo Charger:
- 1 x Charger Lead (U.S.)
- 1 x Lithium Polymer Charge Pack:

A.1.5. TABLET COMPUTER

- Windows operating system, paired with electronics for programming and WiFi download

A.2. WHEN AND HOW TO RETURN KIT

The kit should be returned, if possible, at the competition, but in no case longer than 14 days. If you wish to keep the kit beyond that, then this **must** be arranged with us, before the competition date, via an email to info@hr-robocon.org.

B. PERIMETER OF THE ROBOT

Tokens inside the perimeter of the robot are considered to be being controlled by the robot. The perimeter of the robot is defined by a virtual “thread”, wrapped around the furthest extremities of the robot. The images below are provided for clarification.

B.1. TOKENS WITHIN THE ROBOT

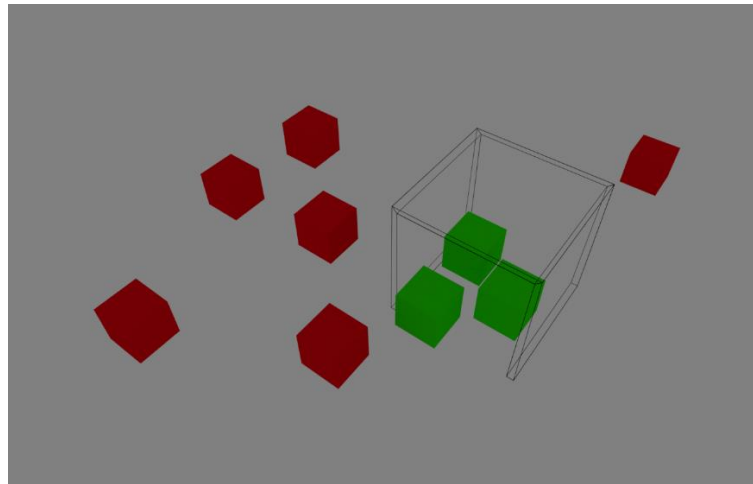


Figure 5: Tokens contained by a wireframe robot.

The red cubes represent tokens that are not considered to be controlled by the wireframe robot, and the green cubes represent tokens that are being controlled by the wireframe robot. While not all the green cubes are touching the robot, since they are at least partially contained within the perimeter, they are considered to be controlled.

B.2. VIRTUAL THREAD PERIMETER

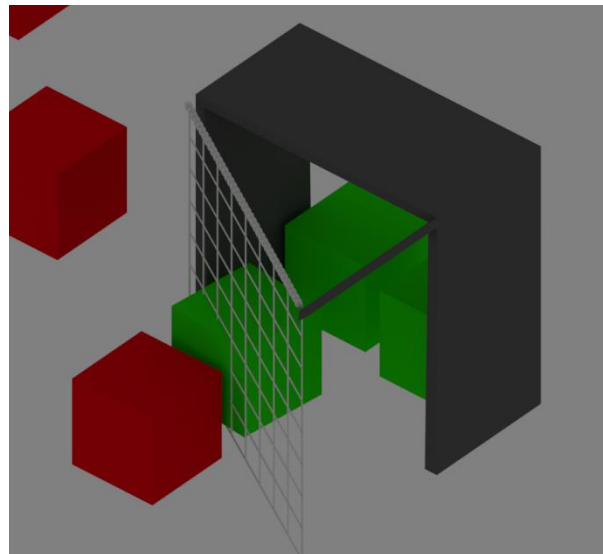


Figure 6: Tokens in and outside the virtual thread perimeter.

The virtual thread (marked by the thicker grey line) is wrapped around the furthest extremity of the robot, and defines its perimeter. The token that is partially within the perimeter, as shown by the grey mesh underneath the virtual thread, is considered to be controlled by the robot, but the red token next to it is outside the perimeter of the robot and does not count.

B.3. TOKENS CONTROLLED BY TWO ROBOTS

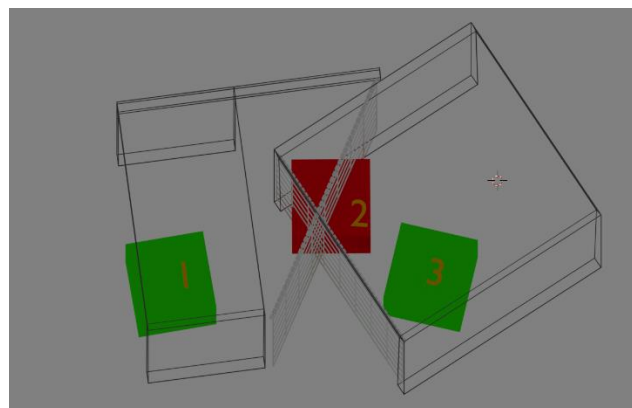


Figure 7: Two wireframe robots with overlapping perimeters.

When the perimeter of two robots overlaps (such as in Figure 7), tokens that are within the perimeter of both cubes are considered to be controlled by both, and therefore are removed from play and score for neither.

SPONSORS

Thanks go to our sponsors, without them we would not have been able to organise the **Bucket Bonanza** competition.



Cheffins is a market leading firm of auctioneers, surveyors, property advisors and estate agents. Established in 1825, Cheffins operates from six offices across the Mid-Anglia region, including Cambridge, Newmarket, Saffron Walden, Ely, Haverhill and Sutton; we also have an office in London. With a rich heritage in auctioneering, we host one of the world's largest monthly machinery auctions from our saleground in Sutton. We also hold regular fine art, antiques and interiors, and property auctions from our headquarters on Clifton Road in the heart of Cambridge.

Edward Dodson, Director, Cheffins comments: "This innovative event is reflective of the importance of the tech and robotics industries in our region. As some of the city's largest employers, this event will give students the opportunity to show off their robotics and engineering skills. Robotics are the next chapter in the tech industry and encouraging the next generation to hone their skills in this area is essential for the growth of Cambridge. Robotics companies continue to be the emerging influence on the Cambridge landscape and this important event for Cambridge schools will shed light on the tech industry and its significant contribution to the local economy."



We develop energy efficient technology.

Together, with our ecosystem of leading companies, we are creating technology that is connecting the world.

From smart meters helping people manage energy in their homes to digital controllers making wind turbines more productive, Arm technology is changing the way we use resources. Our products are connecting everyone together, enabling people and machines to use resources more efficiently.



Cambridge Medical Robotics was created to bring the benefits of minimal access surgery to millions more patients each year. Our aim is to make minimal access surgery available to all by delivering a robotic tool that empowers surgeons and delivers value-driven outcomes for healthcare providers.



"Robotics, cybernetics and artificial intelligence are some of the most rapidly changing fields of science and technology, with tremendous opportunities for future engineers. This generation of students are the ones who will write the next chapter in technology and this competition may be the starting point for their careers. Several Hills Road students who became interested in engineering and robotics through the Robotics group and entering competitions have gone on to degrees and careers in this exciting field" says David Massey, Leader of Hills Road Robotics.

