# Student Robotics 2014 Rulebook

Revision 1

October 11, 2013

The following defines the rules and regulations of the Student Robotics 2014 competition.

## 1. Game Rules

1.1 The game, called **Slots**, will be played in the arena defined in section 3.3. The objective of this game is to achieve as many points as possible by placing your tokens in slots and zones to capture them.

1.2 Before a match begins, participating teams must:

    a) Present their robot in the staging area, adjacent to the arena, at least 2 minutes before the scheduled start time. The staging area will be clearly marked on the day.

    b) Attach four robot badges. These badges will be provided by Student Robotics officials in the staging area. Section 3.2 provides more information about these badges, as well as their dimensions and mounting requirements.

    c) Place their robot in the starting corner that they are assigned. The robot must be placed such that it is entirely within this starting corner, with no parts overhanging its boundary.

    d) Place one of their tokens in/on their robot if they so wish. The token must be taken from one of the rows nearest the robot's starting corner.

    e) Vacate the arena 40 seconds before the scheduled start time. During the 40 second period prior to the start of the match there must be no interaction with the robot.

Teams that fail to comply with this rule may forfeit the match, at the discretion of the judge.

1.3 A match lasts 180 seconds.

1.4 There will be a maximum of 4 robots in a match.

1.5 Robots will be started by teams leaning into the arena to press the start button on their robot[1] when instructed to do so.

1.6 A match may be terminated prematurely if all teams participating in that match state to the judge that they are happy for the game to end.

---

[1]A wireless match-starting solution may be provided by Student Robotics.

1.7 At the start of a match, tokens will be in an upside down orientation.

1.8 At the end of a match, 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:

   a) **1 point** will be awarded for initial movement outside the starting corner, defined as when the trailing edge of the robot passes over the marked corner boundary.

   b) **1 point** will be awarded for owning a zone. Ownership of a zone will be determined as follows:

   i. If one robot has more tokens in the zone than any other, that robot is deemed to have captured the zone.

   ii. Otherwise, the zone is deemed unclaimed.

   iii. A token is deemed to be in a zone if the majority of the token is within the inner edge of the line delineating the zone. The judge's decision is final.

   c) **1 point** will be awarded for having a token in a slot. A token that is in a slot is not in any zone. A slot can be occupied by at most one token, but robots may remove tokens placed by others. A token positioned in an already occupied slot is in neither a slot or a zone.

   d) **1 point** will be awarded for having a token in an upright orientation anywhere in the arena.

   e) **Bonus points** will be awarded for occupying two or more adjacent slots on the same side of the zone wall. The bonus will equal the number of adjacent occupied slots. For example, having three tokens in a row on one side of the wall will yield a bonus of 3 points.

1.9 At the end of a game, league points will be awarded as follows. The team with the *most* game points will be awarded 4 points towards the competition league. The team with the second most will be awarded 3. The team with the third most will be awarded 2 points, and the team with the fewest game points will be awarded 1 point. Teams whose robot was not entered into the round, or who were disqualified from the round, will be awarded no points.

Tied robots will be awarded the average of the points that their combined positions would be awarded. Thus, three robots tied for first place would receive 3 points each (since this is $(4 + 3 + 2)/3$).

1.10 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 matches. The top teams from the league advance to the knockout. The number of teams progressing to the knockout will be announced before the start of the league matches. In the event of tied league positions, the team with the greatest cumulative game points in the league will go through.

Each match in the knockout competition involves up to 4 teams. The teams that come $1^{st}$ and $2^{nd}$ in each knockout match will continue to the next round of the knockout. In the event of a tie in a knockout match, 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. The number of league and knockout matches will be announced on the morning of the competition.

## 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, slot boundaries, the zone wall, 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 penalised, including disqualification from rounds and deduction of league points.

2.4 Student Robotics reserves the right to examine your robot software and hardware at any time.

2.5 Assistance from Student Robotics Engineers is provided without any guarantees.

2.6 All kit deployed by Student Robotics remains the property of Student Robotics. All electronic kit **must** be returned to Student Robotics after the competition. Appendix A details the parts of the kit that must be returned. After the competition, the kit that is not specified in Appendix A becomes the property of the team.

2.7 The Judge's decision is final.

2.8 Robots must pass an inspection by a Student Robotics Inspector before competing in a match. This inspector will check that the robot complies with the rules and regulations of this game, and is safe to compete (see Appendix B). **Robots that have not passed inspection will not be permitted to compete**.

2.9 At the beginning of each match, robots must fit within a cube with $500mm$ internal sides. *During the match*, the robot may extend beyond this size. This only includes the size of the robot and not a token which may optionally be placed in or on the robot before the start of the match.

2.10 The power board, including its power switch, must be easily accessible at all times – including throughout the game. This is for everyone's safety, especially your robot's.

2.11 All custom electronics that require a connection to the battery must instead be connected to the motor rail. There are extra connectors on the power board for this purpose.

2.12 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 Student Robotics Engineer will approach any issues with their robot).

2.13 All electronics must be securely fixed to the robot, and should also be easily removable.

2.14 It must not be possible to directly or indirectly injure oneself on the robot. Exposed sharp edges and fast moving parts, for example, will be tested using a Frankfurter sausage to simulate a finger. Teams are encouraged to discuss any safety concerns about their robot on the Student Robotics forums.

2.15 Robots must feature four mountings for robot badges. These mountings must comply with the specification in section 3.2.

2.16 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.

2.17 If teams wish to use batteries other than the lithium-ion polymer batteries provided, then they must seek approval from Student Robotics through the Student Robotics forums 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 Student Robotics supplied battery through the power board. All electromechanical components **must** be powered through the motor rail provided by the power board.

2.18 Robots may not include radio transmitters or receivers. In exceptional circumstances, teams may request an exemption from this rule.

# 3. Specifications

## 3.1. Markers

The arena, tokens, slots, and robots 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 | $0 - 27$ | 250 |
| Robots | $28 - 31$ | 100 |
| Slots | $32 - 39$ | 160 |
| Token Top | $40 - 43$ | 160 |
| Token Bottom | $44 - 47$ | 160 |
| Token Side | $48 - 51$ | 160 |

Two sets of marker codes will be used: one for development purpose, and one for the competition itself. The competition set is only to be used inside the Student Robotics arena at the Student Robotics competition. This is so that people carrying markers past the arena do not confuse robots. The competition codes are 100 above the development codes. When run in competition mode (specifiable through the robot's GUI), the software provided by Student Robotics will subtract 100 from the detected marker codes, as well as ignore the development codes.

The markers can be printed on a black-and-white printer. Marker designs can be downloaded from the documentation section of the Student Robotics website.

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

## 3.2. Robot Badges

3.2.1 A "robot badge" is a removable identifier that will be attached to a robot throughout a match. It features the robot's assigned marker for the match, as well as human-compatible areas to allow spectators to easily associate a robot with its starting location. An example of one of these badges is shown in figure 1. The markings in the human-compatible areas are intentionally not specified.

3.2.2 A robot must feature four of the badge mounts shown in figure 2. These mounts must permit a flat $200 \times 100mm$ panel to be attached to them. The three areas of each mount must feature the illustrated areas of hook-type Velcro to allow this panel to be fitted.

3.2.3 The four badge mounts must be on the exterior of the robot, parallel with the vertical plane, and should be perpendicular to each other about the vertical axis[2] The orientation of the badge mounts is unimportant, but teams are encouraged to position them horizontally as shown in figure 1.

3.2.4 The mapping between a given robot and its robot badge is as follows:

---

[2]Teams can apply for a team-specific rule alteration to the required number of badges. Clear justification must be provided by the team with such a request.

| Corner | Marker Number |
|:------:|:-------------:|
| 0 | 28 |
| 1 | 29 |
| 2 | 30 |
| 3 | 31 |

### 3.3. Arena

3.3.1 The match arena floor, overall, is an $8m \times 8m$ square, as shown in figure 3. The tolerance of these two dimensions is $\pm 0.25m$.

3.3.2 The floor of the arena is carpeted with blue carpet tiles.

3.3.3 The arena walls are $600 \pm 30mm$ high, the interior surfaces of which are white plastic-coated hardboard.

3.3.4 Each wall of the arena features seven $250mm$ libkoki markers. Figure 4 shows the positioning of these markers, whilst figure 5 shows the numbering of these markers.

3.3.5 Each robot will be assigned a corner at the start of every match to indicate its starting position. Corner starting positions are $1000 \pm 20mm$ square and will be marked by $25mm$ paper-based masking tape. The mapping of these corner numbers in the arena is shown in figure 5.

3.3.6 Student Robotics reserves the right to have up to three match officials in the arena during games.

### 3.4. Zones

3.4.1 There are four zones in the centre of the arena. The arrangement of these zones can be seen in figure 3, and is shown in more detail in figure 6.

3.4.2 Each zone is $1500mm$ wide and $1000mm$ deep and is marked with $25mm$ wide paper-based masking tape.

3.4.3 A single $180 \pm 10mm$ high, $180 \pm 10mm$ deep wall splits the four zones in two. The position of the wall can be seen in figure 6.

### 3.5. Slots

3.5.1 There are eight slots in the arena. Two slots appear in each zone, as shown in figure 6.

3.5.2 Each slot is identified by a unique $160mm$ libkoki marker (see section 3.1). Slot markers are affixed to the zone wall, each centered in their corresponding slots, and $20 \pm 5mm$ above the floor.

3.5.3 Slots are attached to the zone wall.

3.5.4 The boundary of each slot is constructed using square cross-sectioned wood with a side length of $25 \pm 5mm$.

3.5.5 Externally, each slot is $300 \pm 20mm$ wide and $300 \pm 20mm$ deep.

### 3.6. Tokens

3.6.1 Tokens are cubic corrugated cardboard boxes with side $200 \pm 15mm$. *Each team's kit contains two of these.*

3.6.2 Each robot has eight identical tokens associated with it, two in each corner.

3.6.3 A token for a given robot will be labelled with three distinct $160mm$ libkoki markers: one for the top, one for the bottom, and four identical markers for the remaining sides.

3.6.4 Token side markers are oriented such that the top left corner of each marker (identified by a small grey dot) is affixed to the top left of a token's side face, with the top and bottom markers affixed accordingly.

3.6.5 Tokens will be styled to match the human-compatible area of the robot badges on their associated robot, allowing spectators to follow game play. See section 3.2.

3.6.6 The mapping between a given robot and its associated markers is as follows:

| Corner | Top Marker | Bottom Marker | Side Markers |
|--------|------------|---------------|--------------|
| 0 | 40 | 44 | 48 |
| 1 | 41 | 45 | 49 |
| 2 | 42 | 46 | 50 |
| 3 | 43 | 47 | 51 |

3.6.7 Tokens will initially be positioned to the left and right of the robot as shown in figure 7.

# 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 $1^{st}$, $2^{nd}$ and $3^{rd}$ place will receive awards.

## 4.2. Rookie Award

The Rookie Award will be awarded to the rookie team[3] that places highest in the league.

## 4.3. Committee Award

The Committee Award will be given to the team that displays the most extraordinary ingenuity in the design of their robot. It will not be awarded for complexity of design, rather the implementation of a simple and elegant solution to a problem.

## 4.4. 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.

## 4.5. First Robot Movement

The first rookie team[3] that demonstrates a moving robot to the community will be awarded with an edible prize at the final competition.

4.5.1 The robot movement must be controlled by software running on the Student Robotics kit.

4.5.2 The robot must move 2 metres, pause for 2 seconds, turn 180° ($\pm 20°$), return to its starting position ($\pm 0.5m$), and come to a halt without interference.

4.5.3 This must be demonstrated by a video on the web (e.g. on YouTube, flickr, etc.) and linking to this video from a post on the Student Robotics forum.

## 4.6. Online Presence

The team that is judged to have the best online presence will be awarded with an edible prize at the final competition. An online presence is a publicly available set of web pages detailing the team's progress, it can involve blog posts, pictures and videos of the team and the robot. *Hint: Useful sites include blogger.com, wordpress.com, flickr.com and youtube.com*

4.6.1 When detailing activities online do not post any private information concerning yourself or others.

4.6.2 Notify your mentor or email the location of your online materials to info@studentrobotics.org

---

[3]A rookie team is one from a school, college or independent group that hasn't competed in Student Robotics before.

# 5. Clarifications

Requests for rule clarifications may be sent to `info@studentrobotics.org`. Requests received within one month of the competition are unlikely to be processed.

# Appendices

## A. Return of Kit

Each kit issued by Student Robotics 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

- Really Useful Box
- Power Board
- Motor Board ×2
- Servo Board
- Ruggeduino
- Screw Shield
- $1m$ CAT5 (SRIC) cable
- $0.5m$ CAT5 (SRIC) cable ×2
- $0.3m$ CAT5 (SRIC) cable ×2
- USB Hub ×2
- USB Memory Stick
- Webcam
- USB A to USB B lead ×3
- USB A to USB Micro-B lead ×2
- Lithium Polymer Battery ×2
- Battery Cable (used for connecting a battery to the power board)
- Battery Charger (IMAX B6 or HobyKing E4)
- Charger Power Supply and Mains Cable
- Battery charging bag
- 7.5mm Green Camcon plugs ×10
- 5mm Green Camcon plugs ×5
- 2.5mm Slotted Screwdriver

### A.2. When and How to Return Kit

The kit should be returned at the competition. If you wish to keep the kit beyond the competition, then this **must** be arranged with us, before the 30<sup>th</sup> of March 2014, via email to info@studentrobotics.org.

# B. Safety regulations

To maintain safety at the competition, all robots at the event are required to pass the safety regulations that are listed below. Robots that do not comply to these rules will not be permitted to compete.

These regulations are intended to identify a base level of safety — the inspector will use their own judgement and common sense when assessing your robot, and your robot may be judged to be unsafe for reasons or features not listed here.

We recommend that you bear these regulations in mind during development too, although it's not always possible to meet them while building and testing your robot.

## B.1. Regulations

The following procedure will be used when testing a robot:

- Check that there is a battery installed in the robot.

- Check that any additional power sources have already been authorised.

- Check that the battery cable originally provided by Student Robotics is being used to connect the power board to the battery. If not, check that the replacement has suitable rating and quality.

- Leaving the battery physically installed, unplug the deans connector.

- Check the battery's mounting holds the battery securely, and does not expose the battery to sharp edges.

- Check that the battery's casing is rigid, and strong – i.e. bubble wrap is not suitable.

- Locate the large green power connector that connects the battery to the power board. In turn, give each of the wires that enter it a gentle tug. The cables must not move.

- Check that there is not an excessive amount of unshielded wire protruding from the large green power connector.

- Check that the cable between the large green power connector and the deans connector is not damaged. The sheath must not have any holes in etc.

- Check that the cables between the power board and body of the battery do not pass through areas of the robot that could cause them to be damaged by moving mechanical parts.

- Check that only the power board is connected to the battery (if the deans connector were currently connected).

- Check that the power switch on the power board is easily accessible.

- Check that all electronics are securely fixed to the robot.

- Check for unreasonably sharp edges and dangerous moving parts.
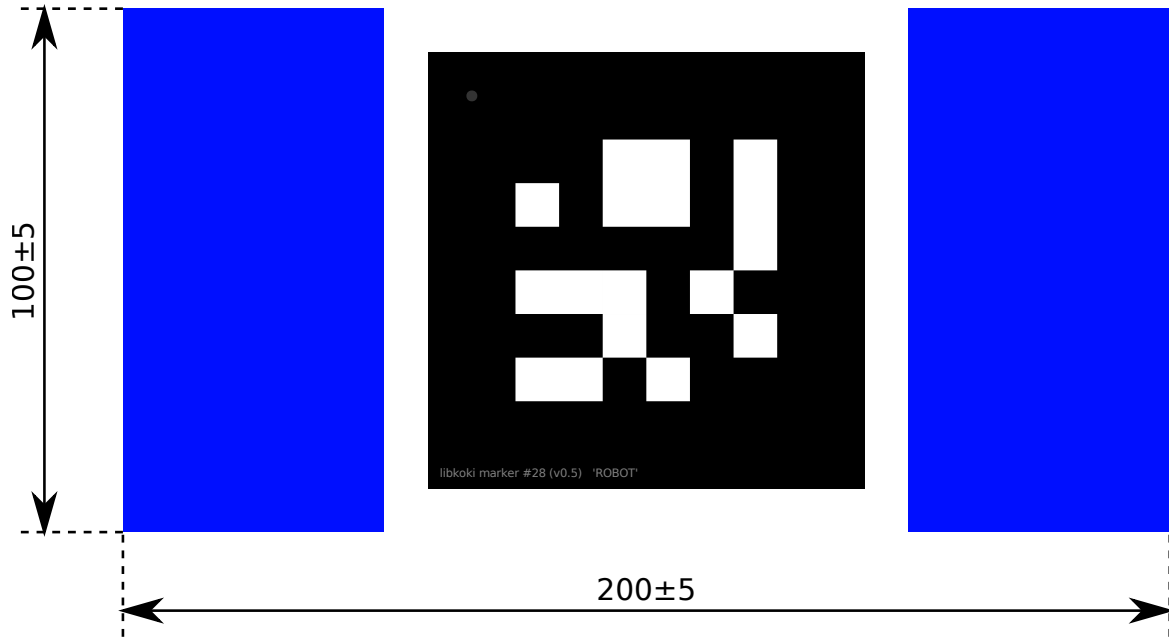
Figure 1: An example robot badge. The blue areas shown are the human-compatible areas. All dimensions are in millimetres.
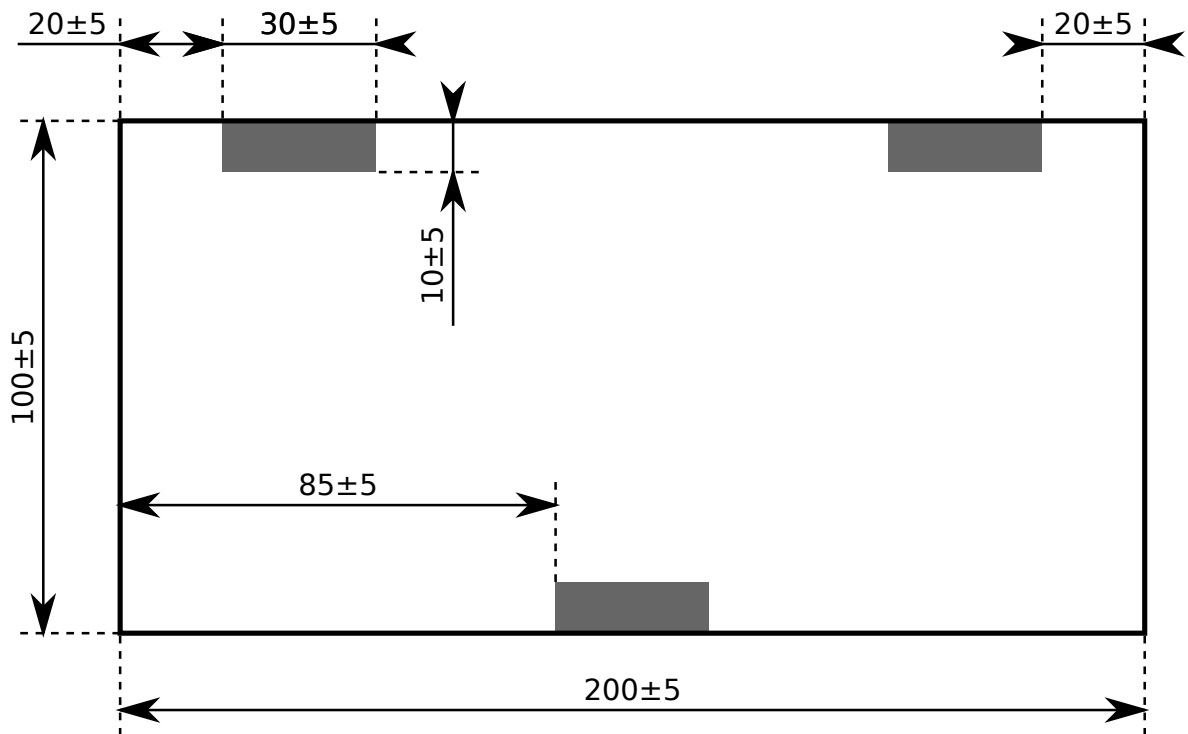


Figure 2: The dimensions of the required robot badge mountings. The shaded areas are hook-type Velcro. All dimensions are in millimetres.
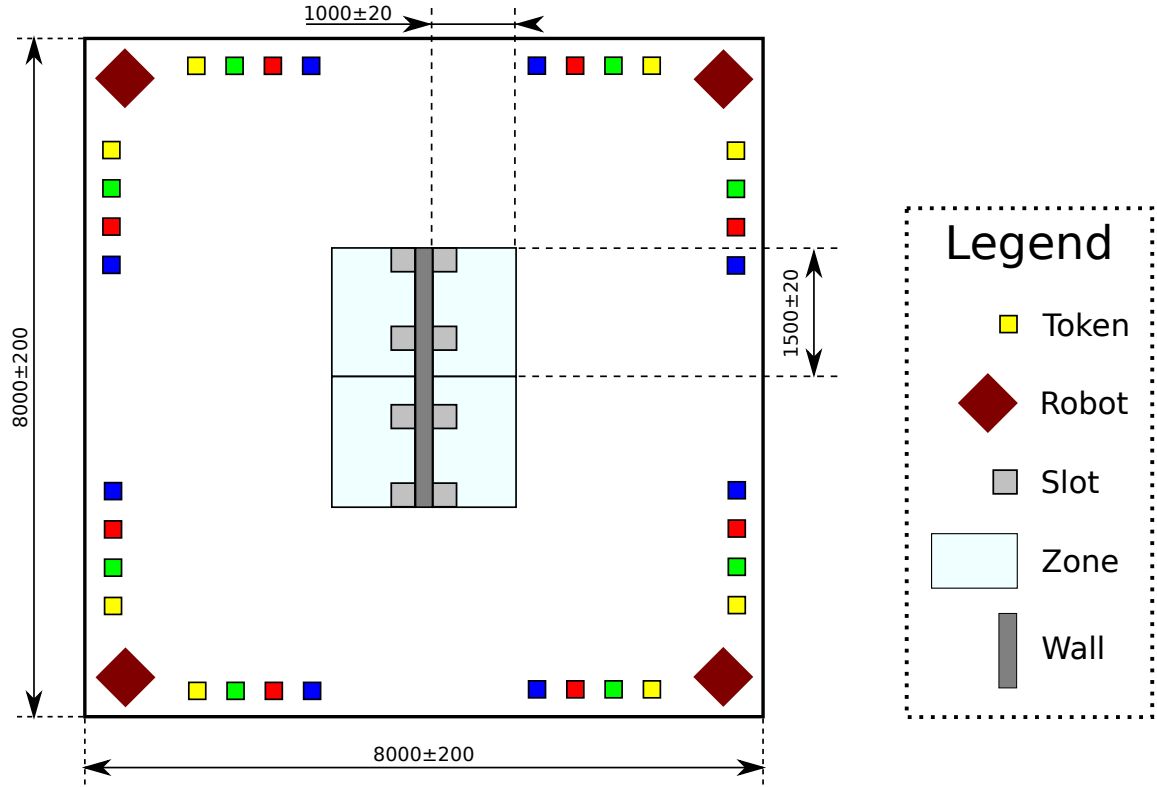
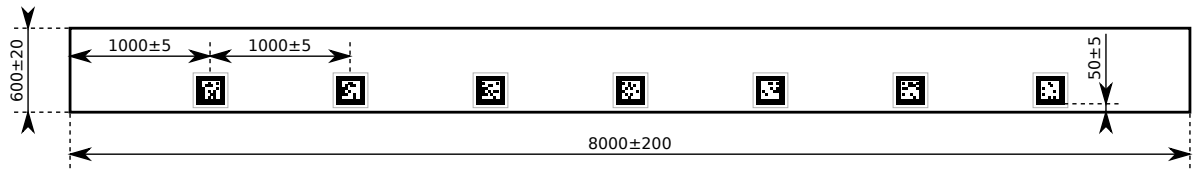Figure 3: A bird's-eye view of the arena. All dimensions are in millimetres.



Figure 4: Seven $250mm$ wide markers are spaced evenly along each $8m$ arena wall. The markers are placed $50mm$ above the floor. All dimensions are in millimetres.
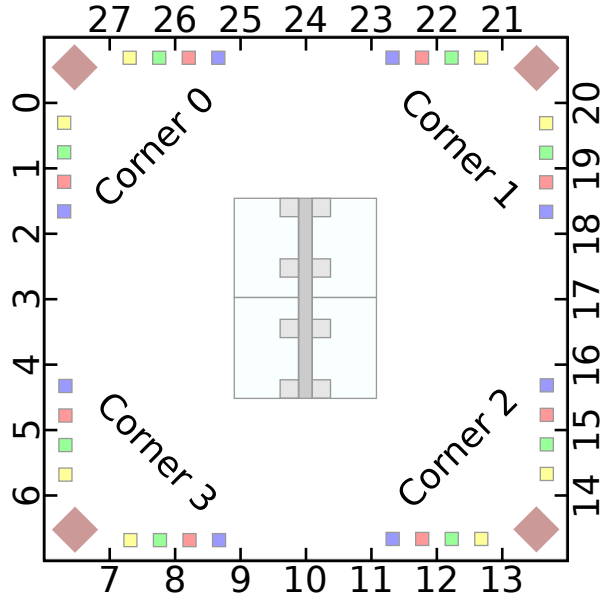
Figure 5: Twenty eight arena wall markers are positioned around the perimeter of the arena with the marker codes incrementing in an anti-clockwise fashion. The corners are counted in a clockwise fashion, with corner 0 being the corner closest to arena marker 0.
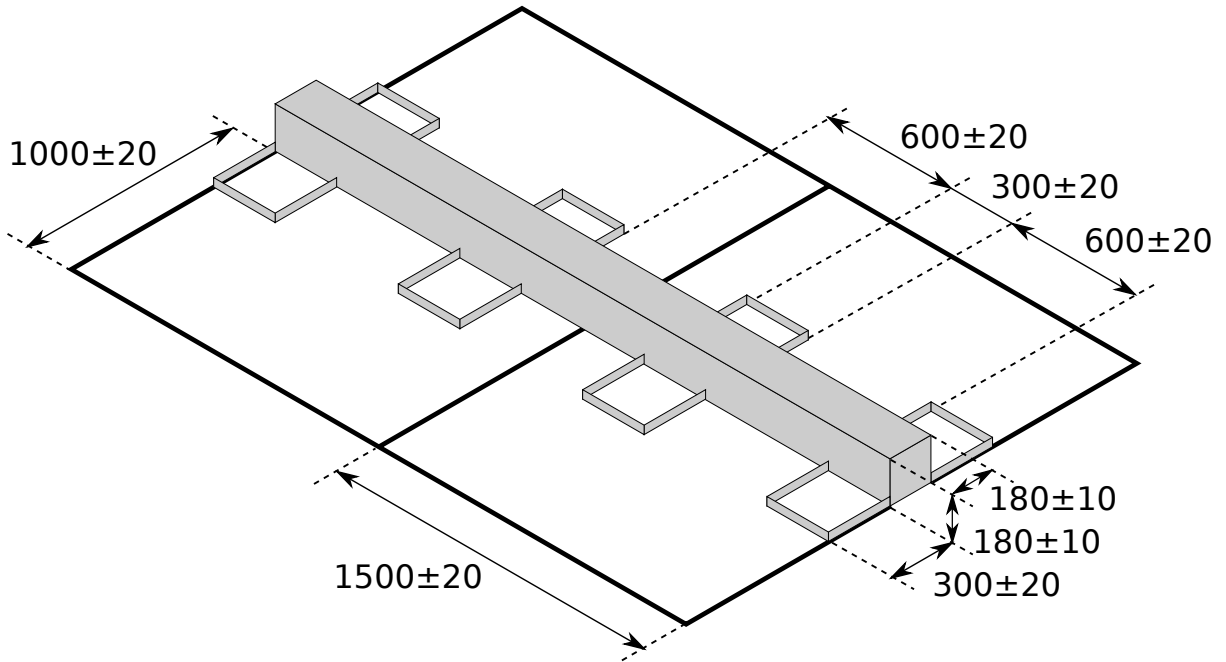


Figure 6: The arena contains four zones, each $1500 \pm 20mm$ wide and $1000 \pm 20mm$ deep. The rectangle described by the four zones is split in two by a $180 \pm 10mm$ high, $180 \pm 10mm$ deep zone wall. Eight $25 \pm 5mm$ high slots—two in each zone—are attached to the zone wall. All dimensions are in millimetres.
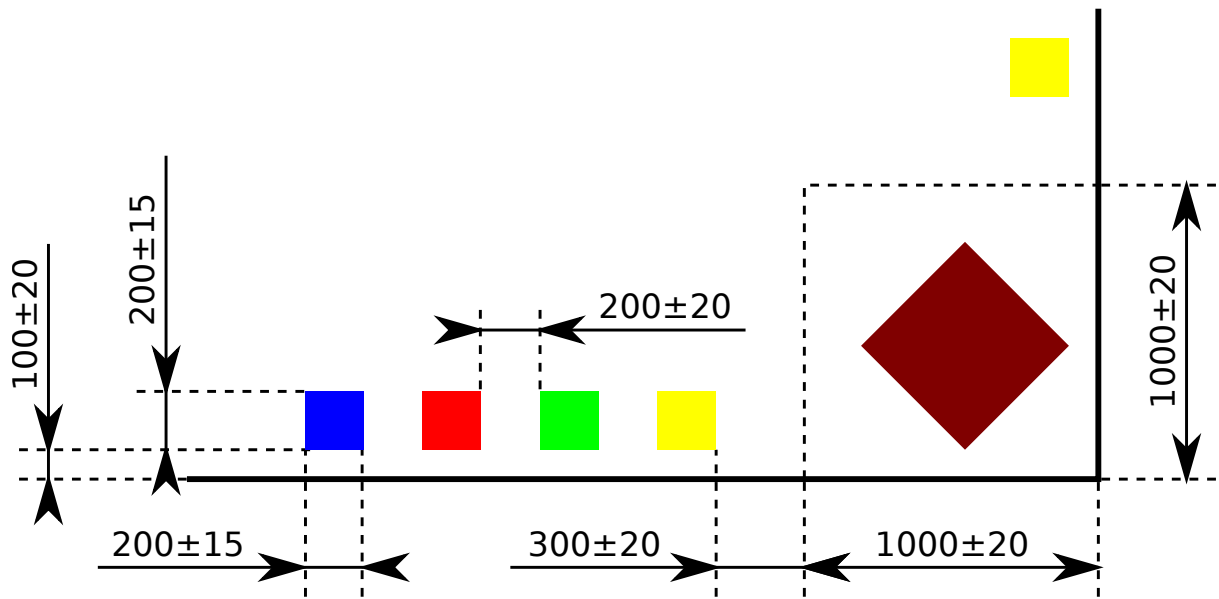
14

Figure 7: Two perpendicular rows of four $200\pm15mm$ wide tokens are spaced evenly $300\pm20mm$ to the left and right of the robot's starting boundaries, along the arena walls. The tokens are placed $200\pm20mm$ away from each other, and $100\pm20mm$ from the arena wall. All dimensions are in millimetres.