

SOURCEBOTS

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ELECTRONICS AND COMPUTER SCIENCE
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THE SMALLPEICE TRUST

SETTLERS: RULES

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COMPUTING, ELECTRONICS, AND ROBOTICS

1 Game Rules

1. The game, called *Settlers*, is played in the arena defined in Specification 1. The objective is to collect tokens and deposit them in scoring zones.
2. The arena contains 24 tokens.
3. There are nine scoring zones in the arena, arranged in a 3×3 grid. The central scoring zone is raised.
4. A scoring zone is considered to be 'controlled' by a team if and only if:
 - (a) the team has tokens in the zone.
 - (b) no other team has a greater 'weighting of tokens' in the zone.
5. The 'weighting of tokens' in a zone for a team is calculated from the sum of token weights in the zone. Token weights are determined as follows:
 - (a) A token 'fully in' the zone has a weighting of 2.
 - (b) A token 'partially in' the zone has a weighting of 1.
6. A 'controlled region' is defined as follows:
 - (a) A 'controlled region' is a group of directly adjacent scoring zones controlled by the same team.
 - (b) The value of a 'controlled region' is calculated by summing the value of all zones within the 'controlled region'.
 - (c) All scoring zones have a value of exactly 1, with the exception of the central raised zone which has a value of exactly 2.
7. At the end of a match, robots earn points as follows:
 - (a) 1 point for moving entirely out of the starting area.
 - (b) n^2 points for each 'controlled region' where n is the value of the 'controlled region'.
8. A token is considered to be 'fully in' a zone if the vertical projection of token is entirely within the scoring zone.
9. A token is considered to be 'partially in' a zone if the vertical projection of token is partially within the scoring zone.
10. During a match, a robot may move or interact with any token in the arena.
11. Participating teams must present their robots to match officials before the start of matches, as regulated by the match officials. Non-compliant teams may be disallowed from participating.
12. There will be up to 4 robots in each match.
13. SourceBots may have any number of match officials within the arena, including during the course of matches.

14. At the start of each match, robots must be entirely within their starting areas.
15. Each match lasts 120 seconds.
16. Teams may be disqualified from one or all matches by match officials, for non-compliance with regulations, lateness to the match, or any other reason at the discretion of the judge. Teams disqualified before the start time of a match will not be permitted to enter a robot.

2 Regulations

1. The Judge's decision is final.
2. All robots must be safe.
 - (a) This is defined considering safety concerns including, but not limited to:
 - i. sharp edges;
 - ii. the effects of impact at speed;
 - iii. fire risks from the battery (see Regulation 10).
 - (b) No robots will be permitted to compete without passing a safety and compliance inspection.
 - (c) Smallpeice Trust staff and volunteers may reinspect your robot and invalidate previous inspections at any time.
3. Any assistance from Smallpeice Trust staff and volunteers is provided without guarantees.
4. Competitors are expected to behave within the spirit of good sporting conduct.
5. Competitors must take reasonable measures to avoid their robot damaging the arena, or anything within it, including other robots. This is a non-contact sport.
6. Competitors are not permitted in the arena during the competition, except to lean in to start robots or where directed by match officials.
7. All robots must be fully autonomous once started. No remote control systems are permitted.
8. If you request your robot be turned off by marshals, you will be disqualified from that match.
9. At the start of each match, all competing robots must fit within a cube with edges of length 500mm. Expansion beyond this limit during the course of a match is permitted.
10. The Lithium-Polymer battery is the most dangerous part of the electronics kit and must be treated accordingly. Whenever a robot is in operation its battery must be:
 - (a) securely held in place;
 - (b) adequately protected from damage even in the presence of damage to the rest of the robot;
 - (c) connected only to the main input of the power board.
11. A robot's main power switch must be easily accessible and on the top of the robot whenever the robot is powered.
12. A spare USB port to be used for competition control must be easily accessible.
13. All electronics on a robot must be:
 - (a) securely held in place;

(b) easily removable.

14. A robot must not have any devices designed to make sound, other than where provided directly by SourceBots.

3 Specifications

3.1 Arena

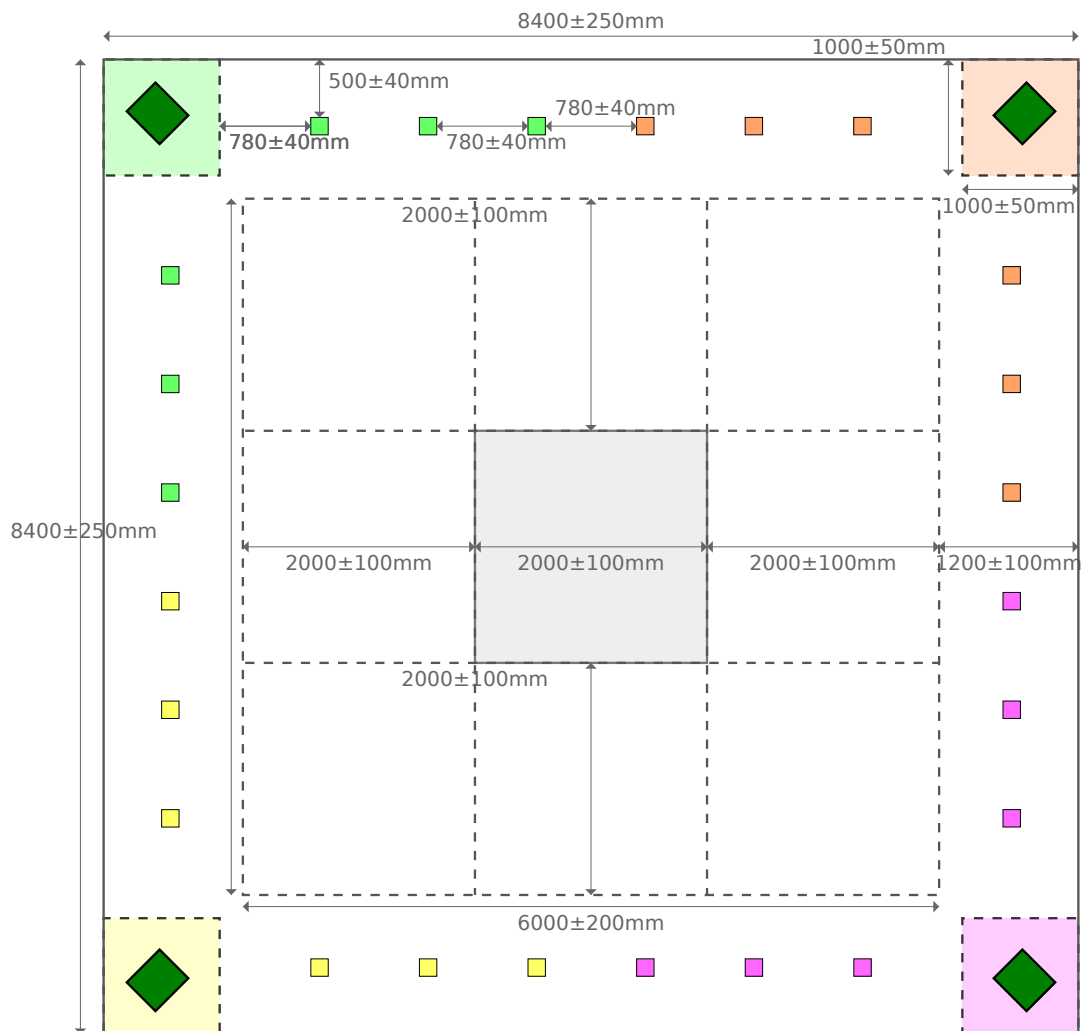
1. The arena floor is an $8.4\text{ m} \times 8.4\text{ m}$ rectangle. The tolerance of these two dimensions is $\pm 250\text{ mm}$.
2. The floor of the arena is carpeted.
3. The layout of the arena is given in Figure 1. This figure is to scale.
4. The outer walls of the arena are at least 350 mm high, and the interior surface is white plastic-coated hardboard.
5. Each scoring zone is $2\text{ m} \times 2\text{ m} \pm 100\text{ mm}$, resulting in a total size of $6\text{ m} \times 6\text{ m} \pm 200\text{ mm}$ for the nine scoring zones.
6. Scoring zones are bounded by tape around the perimeter and internal boundaries on the floor. The inside edge of the tape marks the outside edge of the scoring zone.
7. The raised area in the centre of the arena is $2\text{ m} \times 2\text{ m} \pm 100\text{ mm}$, with a height of $???\text{ mm} \pm 10\text{ mm}$.
8. Each wall of the arena features seven 250 mm AprilTag markers. The positions of these markers is given in Figure 2. The marker numbering is given in Figure 3.
9. Each robot will be assigned a corner at the start of every match to indicate its starting area. Corner starting areas are $1000\text{ mm} \pm 50\text{ mm}$ square and will be marked by tape.

3.2 Tokens

1. Tokens are cuboids with side length $150\text{ mm} \pm 25\text{ mm}$.
2. The exterior surface of a token has an AprilTag marker printed upon it. The marker is identical on all faces.
3. All tokens belonging to the same corner will have the same marker ID.
4. Tokens are arranged as indicated in Figure 1.

3.3 Markers

1. A 'marker' is a square fiducial marker that is a member of the AprilTag 36H11 marker set.
2. Every marker has a numeric identifier.
3. Marker IDs are assigned according to Table 1.







-  Robot starting area
-  Raised platform
-  Token starting position
-  Scoring zone

Figure 1: Layout zones and tokens in the arena.

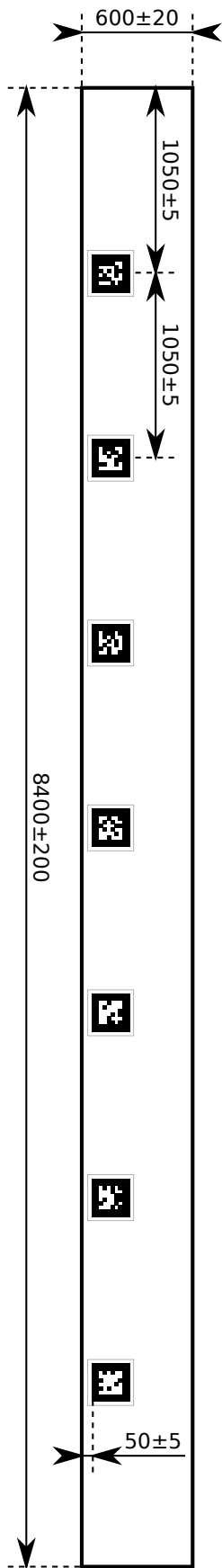


Figure 2: Layout of markers along each arena wall.

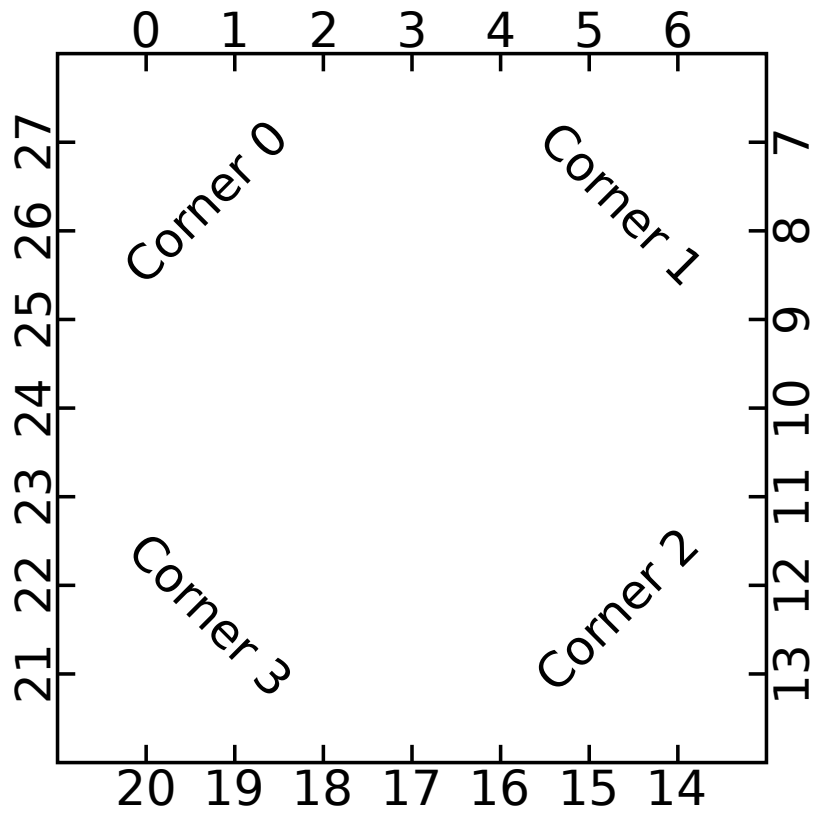


Figure 3: Layout of markers on the arena walls.

Item	Marker Numbers	Marker Size (mm)
Arena boundary	0 – 27	250
Corner 0 tokens	28	120
Corner 1 tokens	29	120
Corner 2 tokens	30	120
Corner 3 tokens	31	120

Table 1: Marker types, and the corresponding IDs and sizes.