

Goals:

The goal of this project is to provide you with an opportunity to apply your knowledge to solve an open-ended problem. The task is to design and build a machine that can play an interesting game against an opponent machine.

Purpose:

The underlying purpose of this project is to give you some experience in integrating all that you have learned. The avenue through which you will gain this experience is the design and implementation of an autonomous mobile robot that can compete in a game of skill and strategy against a machine constructed by another team from the class.

Your lab kit contains sensors, actuators and power transistors. Although you might be able to construct the electro-mechanical parts of this project using only the parts provided, you are not limited to this.

The Game:

The object of the game is to move the “flags” from the center of the field and position them in such a way as to end the game with more flags in your goal than in your opponent has in their goal.

Specifications

The Field:

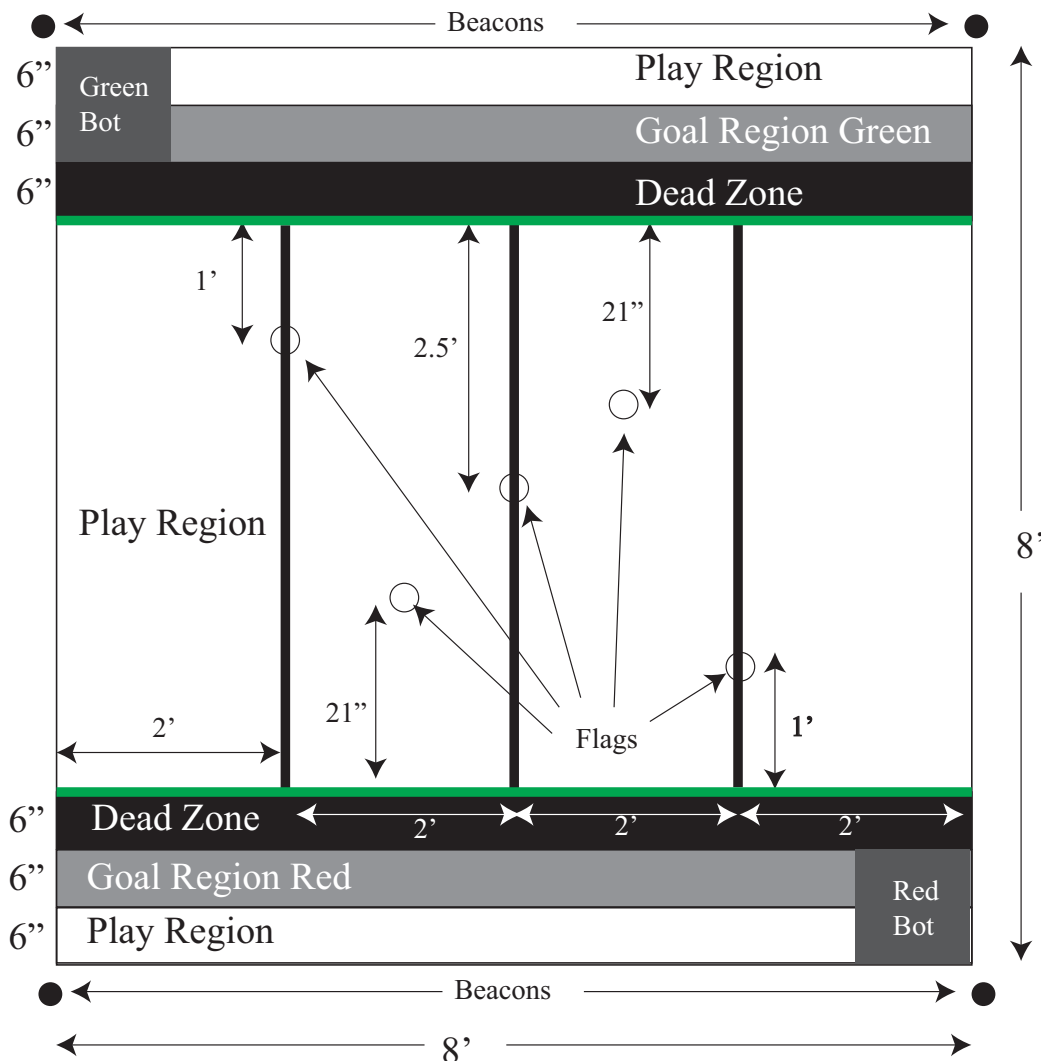


Fig. 1 Top View of Playing Field

- The total playing field measures 8'x8'. The field is divided into seven regions. There is a large central play region that on two sides (at the top & bottom of Fig. 1) is adjacent to a pair of dead zones. The dead zones are followed by the goal regions which are in turn followed by another pair of play regions. The playing field is bounded by a 3-1/2" high wall.
- At the back corners of the two ends of the playing field will be beacons with IR emitters mounted at a height of 12" off the playing surface. The beacons on the Red end of the field will emit at 1250 Hz with a 30% Duty Cycle. The beacons at the Green end of the field will emit at 1250 Hz at a 70% Duty Cycle.
- The boundary between the central play region and the dead zones will be marked by 1" green tape.
- The vertical lines shown in the central play region will be 1" black tape.

The Flags:

- The flags will consist of a 3.94" diameter, 3.25" high base carrying a 1" diameter pole that terminates in a platform at a distance of approximately 9" off of the playing field..
- The platform of the flag will carry beacons emitting IR modulated at 1250Hz modulated to 50% DC. The emitters for the beacons will be LTE5208A IR LEDs.
- The base of the flag will be wrapped with a 2" band of reflective tape with its bottom edge 1.5" off the field..

The Robots:

- Your robot must be a stand-alone entity, capable of meeting all specifications described in this document. Battery power is required. Your robot must execute from code contained in Flash on the processor.
- Robots must be autonomous and un-tethered.
- Each robot will carry a switch to designate the 'bot as the Red or Green robot. This switch will, at the least, control a display to visibly indicate to the audience which side the 'Bot is playing for.
- The only parts of the Robot that may ever touch the playing field surface are wheels, balls or slippery supports used to balance the Robot.
- Robots may not use reflective tape or other highly reflective material on any visible surface.
- All parts of the robot must fit within the bounds of a 12" square 11.5" high at the beginning of the game.
- All robots must present a continuous perimeter covering the entire region between a height of 0.5" and 3.5" off the playing field. This perimeter must represent the outermost extent of the robot's platform.
- Each robot will carry an easily accessible toggle switch on the top of the robot. The purpose of the switch will be to cut power to the 'bot in case of a software or hardware malfunction.
- No part of the robot may touch the floor outside the initial footprint.
- Each Robot must be constructed as part of ME218b. It may not be based on a commercial or otherwise pre-existing platform.
- Any exterior corners on the robot must have a radius of at least 1/4".
- You are limited to an expenditure of **\$150.00/ team** for all materials and parts used in the construction of your project. Materials from the lab kit or the Cabinet Of Freedom do not count against the limit, all other items count at their Fair Market Value.
- Bot speed must be kept low enough to be safe to the other 'bot on the field. We reserve the right to disqualify any 'bot for excessive speed. If in doubt, get an assessment from Ed before proceeding.

- The supplied motors must be used to drive anything that transfers force to the ground.

Game Play:

- The game is a head-to-head match up between Robots as they attempt to move the flags into their goal region. The initial positions of the Robots on the field will be as shown in Fig. 1.
- At the beginning of each game, the flags will be placed as shown in Fig.1.
- The game will be started by a single flash from an electronic flash unit.
- When a flag fully enters a dead zone, it will shut down its IR beacon.
- When a flag fully enters a scoring region, its IR emitter will increase in brightness.
- A flag removed from the dead zone or the scoring region will resume emitting based on its current field position.
- Flags that are tipped over will be replaced manually by the judges
- A game will end after two minutes have elapsed.
- At the end of two minutes the 'bot must stop all motion.
- At the end of two minutes, the team with the most flags in their scoring zone wins.
- In case of a tie at the end of a round, a sudden-death playoff match will be run. In the sudden-death playoff, the first 'bot to move a flag into its scoring region will win the round.

Rules:

- Intentional tipping of the flags is not allowed. Bots that repeatedly tip flags will be disqualified.
- A flag must be entirely in the scoring region to score a point.
- Each Robot must start and remain in one piece during the round.
- Your Robot may not alter the playing field **IN ANY WAY**.
- Intentional jamming of your opponent's senses is prohibited.
- Your Robot may not mar the walls or the floor.

Safety:

- The Robots should be safe, both to the user and the spectators. The teaching staff reserves the right to disqualify any Robot considered unsafe. This also applies during testing, so keep the 'bot velocity low enough so as not to cause problems.
- Robots must be stable in the presence of a 30MPH wind.
- No part of the machine may become ballistic.
- All liquids, gels and aerosols must be in three-ounce or smaller containers. All liquids, gels and aerosols must be placed in a single, quart-size, zip-top, clear plastic bag. Each 'bot can use only one, quart-size, zip-top, clear plastic bag.
- Robots may alter the Space-Time continuum only during the public presentations.

Check-Points

Design Review:

During class-time on 02/10/09 we will conduct a design review. Each group should prepare a few sheets of paper

showing your idea(s) and a preliminary software design. These should be scanned into a no-frills powerpoint file (landscape format) for projection in 556. You will have 5 minutes to walk us through your ideas. The other members of the class, the teaching staff and coaches will be on hand to hear about your ideas and provide feedback and advice.

First Check-Point:

On 02/13/09, you will turn in a set of Protel schematics, textual descriptions and software design documentation that describes the state of the design *at that point in time*. The designs need not be tested at this point. It must be turned in as soft copy. Only one team member needs to submit your checkpoint.

Second Check-Point:

On 02/19/09, you must demonstrate your motorized platform moving under software control.

Project Preview:

At the **Project Preview** on 02/26/09, each Robot must demonstrate 1) the ability to move and 2) the ability to sense and identify the beacons and 3) sense black and green tape and respond to all sensed inputs. The platform used for the Project Preview, must be the platform used in the grading session.

Grading Session:

During the **Grading Session on 03/03/09** each Robot will be required to demonstrate the ability to move at least two flags into their goal region. If your bot fails at its first attempt to demonstrate its ability, it must then demonstrate the ability two times in succession at its next attempt. These increases continue after repeated failed attempts to a maximum of 4 required successive demonstrations. This evaluation will take place without an opponent. Evaluation for grading purposes will occur only during these sessions. At the time of the grading session, you must submit a copy of the .S19 file that you run during the grading session to your Reports folder for archiving.

Public Presentation:

Will take place on 03/04/09 starting at 7pm in Annenberg Auditorium.

Report:

Draft due on 03/09/09 at 4:00pm. Final version with revisions due by 5:00pm on 03/12/09.

Evaluation

Performance Testing Procedures:

One or more of the team members will operate the Robots during the performance evaluation. A competition among the class's Robots will take place after the performance evaluation.

Performance Evaluation:

Performance evaluation will take place twice during the project duration, at the Project Preview and at the Grading Session. Everyone will participate at this level.

The Competition:

On the night of the public presentations, a tournament will be held. Performance during the tournament has no impact on your grade.

Grading Criteria:

- Concept (15%)** This will be based on the technical merit of the design and coding for the machine. Included in this grade will be evaluation of the appropriateness of the solution, as well as innovative hardware, software and use of physical principles in the solution.
- Implementation (15%)** This will be based on the prototype displayed at the evaluation session. Included in this grade will be evaluation of the physical appearance of the prototype and quality of construction. We will not presume to judge true aesthetics, but will concentrate on craftsmanship and finished appearance.
- Preliminary Performance (15%)** Based on the results of the performance testing during the **Project Preview**.
- Performance (20%)** Based on the results of the performance testing during the **Grading Session**.

- Report (20%)** This will be based on an evaluation of the written report. It will be judged on clarity of explanations, completeness and appropriateness of the documentation.
 - Report Review (10%)** These points will be awarded based on the thoroughness of your review of your partner team's report. Read the explanations, do they make sense? Review the circuits, do they look like they should work?
 - Housekeeping (5%)** Based on the timely return of SPDL components, cleanliness of group workstations as well as the overall cleanliness of the lab. No grades will be recorded for teams who have not returned their tool kit and E128 & C32 boards.
-