

The Master Plan

MCHE 470: Robotics
Fall 2013 – Final Project

1 Introduction

Recently, the University of Louisiana at Lafayette has developed a Master Plan for the improvement and expansion of the campus. From the university website:

A comprehensive plan arose in the spring of 2013 from a vision to improve the University of Louisiana at Lafayette's environment and make it one of the most comfortable and inspiring academic institutions in America. The University undertook the task of developing a master plan, which is intended to guide the physical growth of the campus into the 2030s.

The plan has great promise, and some projects are already underway, but there will be numerous hurdles to overcome during its adoption. These include continuing to raise money to fund the plan, maintaining community support, and avoiding project delays. To help the University to overcome these hurdles, *MCHE 470* students will design and build devices that compete on the campus shown in Figure 1. The devices should:

1. **Remove Project Delays:** In any major endeavor there are a large number of factors that can delay completion. In each zone of the campus, there are two project delays (sponges) that must be removed. For each delay that is not completely removed, your team will be penalized **-10 points**. If the delay is only partially removed, your team will be penalized **-5 points**.

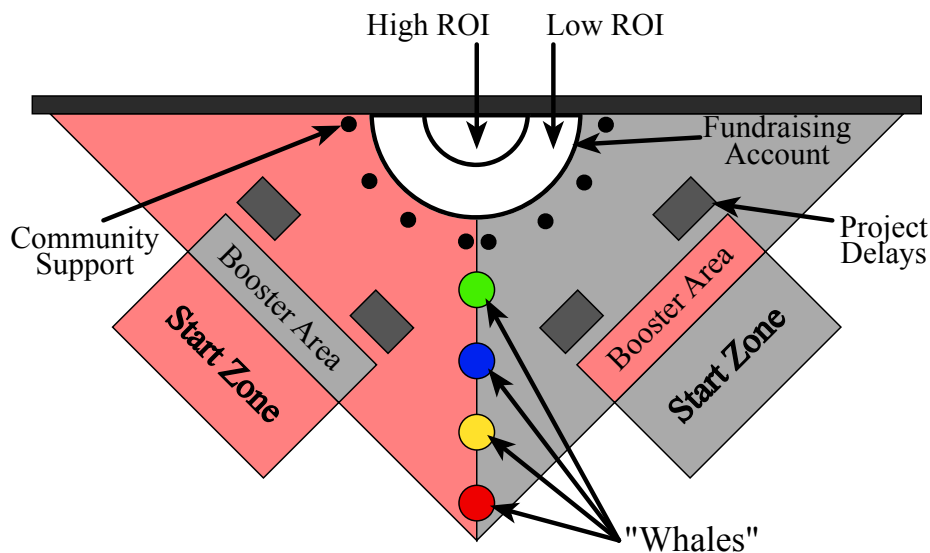


Figure 1: The UL Lafayette Campus

2. **Deposit Alumni Donations:** As you will soon find out, universities are quick to ask graduates for donations. Your machine must deposit these donations into the Master Plan fundraising account. This account has two methods of deposit, one of which has a high return on investment (ROI) and one of which has a low ROI. You will be given three donations (squash balls) to deposit into the account. Each one deposited into the high ROI account is worth **10 points**. Each deposit into the low ROI account is only worth **5 points**.
3. **Collect “Whale” Donor Support:** Alumni support is not enough to fund the entire Master Plan. Larger donations are needed. There are four whales (plastic bowling pins) that can be convinced to donate to the Master Plan. For each one that is completely collected into your zone, your team will earn **5 points**. However, if you do a great job convincing the “Whale” to support the plan (the pin is moved into your zone *and* is still upright), your team will earn **15 points**.
4. **Collect Community Support:** The community support of the Master Plan will be a key ingredient to its success. There are numerous community members (squash balls) that can be gathered into booster areas. For each community member completely collected into the booster area, your team will earn **5 points**.

2 The Competitions

You will need to demonstrate the capabilities of your machine on two different occasions.

2.1 Preliminary Competition

On November 7, your machine must demonstrate that it is able to remove project delays and deposit into the fundraising account. The machine must be electronically triggered and operate autonomously. During this initial phase, your machine will be alone on campus. You will have 7 minutes to run your machine at most 3 times. Your score will be the sum of the three attempts. **3 of the possible 25 total Final Project grade points will come from this competition.**

2.2 Final Competition

On November 21, the Master Plan contest will be held. There will be two events in this contest.

Design Review: A panel of judges will perform a design review of your machine. You will need to describe your machine quickly and clearly to the judges that visit your machine. The judges will evaluate your team on aesthetics, ingenuity, and presentation. **5 of the possible 25 total Final Project grade points will come from this design review.**

Master Plan: Your robot will compete in a head-to-head competition with other robots. Each machine will compete at least two times during the initial round-robin portion of the contest. If your machine wins at least once during this time, you will advance to the single-elimination phase. The single-elimination phase will continue until there is a winner. **7 of the possible 25 total Final Project grade points will come from this competition.**

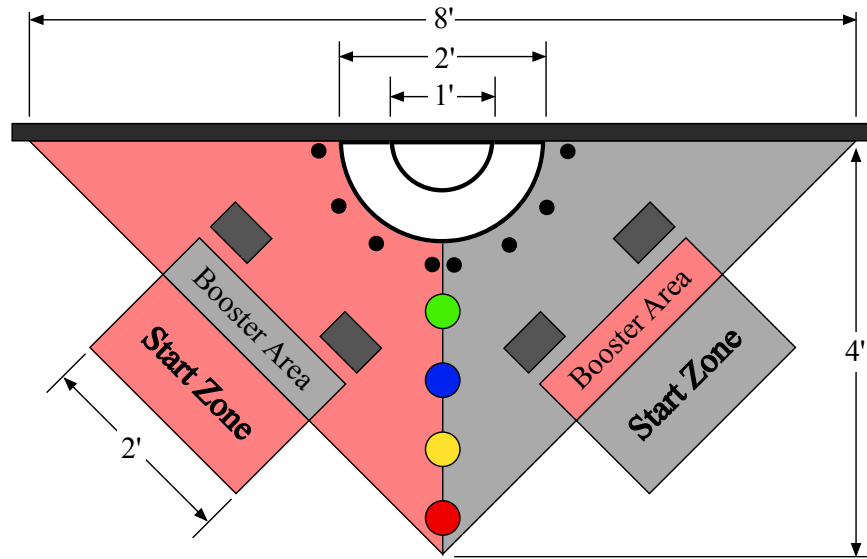


Figure 2: Approximate Campus Dimensions

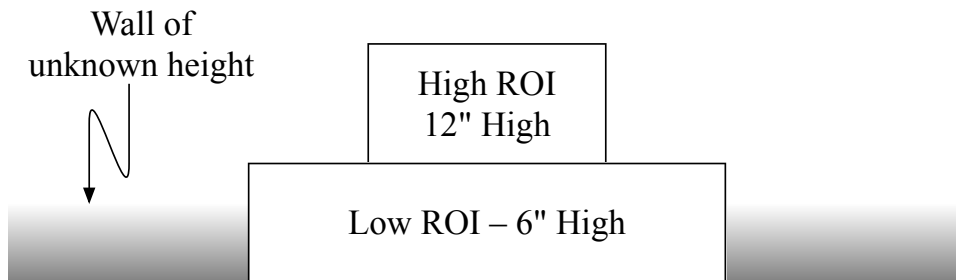


Figure 3: The Fundraising Account Dimensions

3 Details

3.1 Campus

The approximate dimensions of the campus are shown in Figure 2. The fundraising account dimensions are further detailed in Figure 3. Note that these dimensions are approximate and that your device should be robust to uncertainties in them. Any significant deviation from the dimensions in Figure 2 during its final construction will be reported.

3.2 Construction Materials

Given the funding constraints of the Master Plan, your device cannot be expensive or overly complicated. Your team is permitted to use one Arduino controller and the sensors and motors contained in three kits. Your team is also allowed to purchase additional motors, construction materials, and sensors, but you may not exceed \$100 of total expense. You are required to submit

a bill of materials in your final report to document these costs.

3.3 Tie Breaker Procedure

In the event of a tied contest, the following tiebreakers will be used in order until a winner can be determined:

1. Number of donations into the High ROI account.
2. Number of donations into the Low ROI account.
3. The highest amount of community support collected.
4. The highest number of “Whales” collected.
5. A coin toss.

3.4 Grading Summary

The performance of your machine will determine 15 of the 25 points available for the final project. The division of these points is summarized in Table 1.

Table 1: Grading Summary

| Maximum Available | Event |
|-------------------|---------------------|
| 3 | Preliminary Contest |
| 7 | Final Contest |
| 5 | Design Review |

3.4.1 Preliminary Contest

The preliminary contest tests your robots ability to remove project delays and deposit into the fundraising account. Your score will reflect your ranking within the class. The maximum score will receive 3 points and the minimum score will receive 1 point. The grade points for scores between the minimum and maximum will be linearly interpolated between these values. Failure to compete in this contest will result in 0 grade points. This round of competition also determines the initial seeding for the final contest.

3.4.2 Final Contest

The grade points for the final contest are based on the number of victories scored by your machine. The team with the most victories earns 7 grade points; teams with zero wins get 2 grade points. Other teams’ grade points are scaled linearly between these values proportionate to their win count.

3.4.3 Design Review

The judges' scores will be summed and divided by the number of judges that evaluate each robot. These resulting, average scores will be ranked across the class. The maximum score will earn 5 grade points, and the minimum score earns 1 grade point. All other scores will be scaled linearly between these two according to their average score.

3.5 Contest Rule Details

1. If a team is disqualified for a rules violation, then they lose the current match in which they are competing. If the team can eliminate the violating offense, then they are eligible for future matches.
2. For the design contest, your device will be assigned to a 7-minute time block. All competing devices will be automatically activated at the 4-minute mark, and must be removed from the track by the 7-minute mark. Thus, you will have 4 minutes to setup your device and then it will compete for one minute. The next two minutes will be used for scoring and cleaning up. By the end of the 7-minute period, you must remove your device (and any bits and pieces) and clean up the competition track. Disqualification can be imposed for taking longer than your allotted time.
3. Once it has been activated, you may not touch the device or enter the competition area until the field official indicates it is time to clear out your machine. Doing so results in a disqualification.
4. It is your responsibility to be on time with a working machine. If you are not present during your assigned time, you are disqualified for that match.
5. The device must be launched from within the 2×1 foot starting zone. You may place your device in any configuration or orientation within the starting zone; however, it must be completely contained in the zone. It also must be less than 18 inches tall. One in place, you can only reposition your device after it has been checked for size; you cannot set triggers, adjust components, turn on your controller, etc.
6. A three-foot perimeter around the campus, marked off by tape, will be off limits during the competition.
7. The device must be safe. It must not injure bystanders or yourself. It must not damage, stain, or permanently change the competition area or its surroundings. It must not scratch the floor. The faculty will disqualify any device they deem unsafe.
8. Each team may not spend more than a total of \$100 on the device. You will be required to document the cost of your materials by submitting your receipts, as well as a table of materials and costs in your final report. Material may be prorated for costs. The cost of an object is defined to be that which Joe P. Citizen must incur in obtaining the object. For donated, recycled or scrounged material, an equivalent price must be specified.

9. The cost of your SparkFun kits is *not* included in the \$100. The \$100 is out of pocket expense; you will not be reimbursed.
10. The costs of any aesthetic materials (e.g., paint) and fasteners (*e.g.* staples, tape, and glue) are not included in the \$100 budget.
11. Any and all supplies provided to you (extra electronics, motors, etc.) must be returned in good working order.
12. The device shall not be permanently bonded in any manner to the competition track or its surroundings in any way.
13. The device must be activated by using the start plugs near the starting zone. The start plug circuits will be closed during the one-minute competition and open otherwise. Your control code must sense the closed circuit and activate its actions.
14. Power to your device will be available from outlets near the starting zones. If your robot travels far out into the competition area, you must supply your own extension cord.
15. Your device cannot have active (powered applied) components prior to triggering. (i.e. solenoids and motors must be in the dead state).
16. The device must shut down (i.e., no electric motor operating) at the end of the one minute competition when the start-plug circuits are opened. Failure to do so will result in disqualification.
17. The device must operate autonomously. No remote control is allowed.
18. The device may touch or otherwise utilize any part of the arena or its surroundings. It may not utilize or interact with any living person or living object, such as trained alligators, during the competition.
19. False starts that disrupt the playing field such that it cannot be reset in time for the scheduled start will result in a disqualification of the offending device.
20. While machines may go outside of the playing field, there are no guarantees as to what will be located outside of the track, e.g., a wall or motor or people may be located outside of the track area. No part of the machine may leave the three-foot perimeter, nor should the machine cause any object to leave the playing arena such that it crosses the three-foot perimeter (either a projectile or track component). Any violations will result in a disqualification due to safety considerations.
21. Teams will remain constant for the duration of the project. The faculty has the right to remove or otherwise penalize disruptive members of any team.
22. Wanton destruction of the opposing devices and/or the course is strictly prohibited.
23. If you don't play, you can't win. If your device does not make any noticeable movement, you lose that round of competition or score zero points if this occurs in a preliminary competition.
24. The faculty's rulings on any clarification or dispute of these rules are binding and final.

Revisions

- 11/5/13 – Corrected start-zone size error in rule 5. The measurements in Figure 2 were correct.
- 11/7/13 – Made requirement of 18-inch maximum-height more explicit.