Formal Design Proposal for the ENPH 253 2015 Robot Competition – “Fire at the SPCA!!”

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Executive Summary

The purpose of this document is to propose a robot design for the ENPH 253 robot competition for the year of 2015. This proposal will be outlining major components of the robot such as the chassis design, driver and sensor systems, as well as code and algorithms. The proposal will also be outlining non-technical information, such as the strategy our team has chosen to approach for the competition, any risk management and contingency planning in the event of slight or major deviations from the team’s primary strategy, a list of agreed upon responsibilities and tasks divided amongst the four team members based on workload, as well as a list of major milestones that are to be completed along the course of the design and construction process.

The competition will be held on August 6, 2015, which will give the team roughly 6 weeks from the time this proposal has been written to design and construct the robot. In the event of a milestone that is in danger of not being met all members of the team are to take drastic measures in order to meet this milestone, which will include, but not limited to: emergency meetings during non-lecture times, extra lab hours before or after the lab time set by the timetable given permission by lab supervisors, and any minor arrangements in personal schedule in order to make time to conduct work. Due to the nature of each team member’s timetable most courses will be finished around the end of June. This would mean that more time can be allocated to completing the robot and its design starting from late June and early July, and milestones can be met at more reasonable times and can be spaced out much less in order to accommodate minor milestones shifts in the milestone schedule, all of which have been agreed upon by all four team members.

The initial size of the robot will be determined by the dimensions of the doorway the robot must pass through, which is an archway that is 14” wide with an opening whose maximum height is 18” and radius curvature of 8”. Additionally, the size will also be determined by a box provided by the course with similar dimensions. However, in order to meet the strategy set out by the team, the robot’s design will incorporate an extending arm that may exceed the dimensions stated earlier, which will be used in later portions of the course after the doorway.

Materials to be used when constructing the robot will mostly be provided by the ENPH 253 course. No components outside of materials provided by the course has yet to be implemented into the robot’s design. However, after the time of this proposal’s completion, if any changes to the design that require materials not provided by the ENPH 253 course, and agreed upon by all of the team’s members, happen to arise at some point during the design process, then procedures for requesting and procuring outside materials will be followed, which include purchasing materials not above the worth of $50.

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# Preface

# Overview of Basic Strategy

The strategy our team will be approaching given the circumstances of the competition is as follows:

The robot will be using a tape following mechanism that uses a QRD1114 Infrared Reflective Optosensor in order to follow the path set out for the course. It will also be using these optosensors to detect tape markings that represent the location of a pet. The first three pets are located to the side of the path, directly beside the tape markings. Our robot will utilize an arm located directly above the optosensors in order to retrieve the pet. The arm is equipped with a piece of steel, which will be used to pick up the pet by the magnet on its head. A switch in the arm next to the steel piece will tell the robot to raise the arm and release the pet into a basket carried by the robot.

The basket itself is designed as two separate parts, essentially two baskets on top of one another. The first basket will be designed to carry the first three pets. After climbing the ramp, the robot will proceed to launch the first three pets towards the start/rescue area, which is located next to the top of the ramp and a level below, by using the first basket as a catapult. This would also, in turn, expose the second basket for the last three pets, with the first basket remaining attached and acting as a wall for the second basket.

At this point the operation of pet retrieval will be changed in order to accommodate each of the special cases of the last three pets. The fourth pet is located on the path in front of the robot, and marked with tape markings. Thus, once the robot locates the tape marking, as it did with the first three pets, it will attempt to grab the pet by reaching out in front rather than from the side. The pet will be carried on the second basket now exposed after the ejection of the first basket earlier. The fifth pet is not marked with tape markings, but it is at a known distance from the end of the tape. The robot will use wheel encoders to let it know when it has traveled the right distance to pick up the pet, and then raise the arm to the correct location and search a larger area than for the other pets (to account for the greater error involved).

After retrieving the fifth pet, the robot will use a QSD124 phototransistor backed by a filtering and amplifying circuit to detect the IR rescue beacon and locate the sixth pet buried in rubble made of soft foam. Once it reaches the container with the pet and rubble the robot will use sweeping motions in order to clear the rubble and locate the pet. Once the switch in the arm detects that a pet is grabbed the robot will proceed to release the pet onto the basket.

The robot should now be located under the zipline. The basket will be raised and will grab the zipline automatically with rollers mounted on bearings, separating it from the robot. The basket will travel down the zipline, either powered with a separate motor or not depending on materials available and tests that will be conducted later.

# Chassis

# Drive System

# Sensor System and Electrical Design

# Software Code and Algorithms

# Risk Assessment and Contingency Planning

# Major Milestones, Task List, and Team Responsibilities

Major milestones that must be met before Major Milestone Day include:

* Preliminary chassis, driver system and sensor system construction must be complete in order to start tape following/optimal speed tests
* Work on arm design and construction must be started

A detailed list of major tasks is as follows:

1. Design, construction, individual testing, and redesigning of major components
   1. Chassis – space claim tests to be conducted once all internal components are constructed
   2. Arm – must be tested for pet retrieval and deposit
   3. Driver system – overall must be tested for optimal speed when following tape on flat and ramped surfaces
      1. Wheels
      2. Motors and Gears
   4. Electrical system and code design
      1. Sensor and tape follower circuits – must be able to follow tape, and detect IR at the distances dictated by the course and team strategy
      2. Component communication circuit and codes/algorithms – code must be tested so that there is effective communication between components in the robot
   5. Basket – catapult mechanism must be able to consistently launch pets into rescue area, as well as be able to reach the zipline when it is raised
2. Integration of components
   1. Connection of two or more components, and performance testing
   2. Overall robot assembly
3. Overall system performance testing and redesigning based on results and time trial

A list of main responsibilities for each team member is as follows:

|  |  |
| --- | --- |
| Team Member | List of Major Responsibilities |
| Wilhelm Gavino | * Chassis Construction and Testing * Driver System Construction/Integration and Testing * Basket System Design |
| Riley Harney | * Sensor System Design and Testing * Electrical System Design and Testing * Basket System Construction and Testing |
| James Wasteneys | * Chassis and Basket Design * Driver System Design * Arm Design, Construction and Testing |
| Gregory Zhang | * Code/Algorithm Design |
| Shared | * Code Debugging * System Performance Testing * Must be able to cover or aid another team member with his assigned responsibility if help is required * Minor component and circuit board construction |

# References and Appendices