University of Connecticut

ECE 4901 Fall 2015

Trinity International Robot Contest - Firefighting Robot

Team 1617

Katherine Drogalis, Electrical Engineering

Zachariah Sutton, Electrical Engineering

Chutian Zhang, Engineering Physics
Statement of Need

The aim of this project is to create a fully autonomous robot that can navigate a model home in search of a fire, in the form of a burning candle, and then extinguish it. This project is in conjunction with the Trinity International Robot Contest which takes place April 1-3 2016 and is a not-for-profit event that promotes innovation and creativity in the STEM field. Ideally, the principles we use in the design could be extended to a more robust system that could be used to combat actual fires in residential or commercial settings.

In the contest, the model home is represented by an eight by eight plywood maze. The robot will start at any arbitrary position in the maze and when prompted, will navigate the maze to find and extinguish the candle. There are a number of potential obstacles to be avoided such as walls, animals, and even ramps or rugs on the ground. The robot must be able to safely avoid these obstacles in search of the candle, doing so in a timely manner.

There are three levels of the competition. The first level is the most basic maze with minimal obstacles, the second is slightly more challenging, having more obstacles, and the third is a level that incorporates a “search and rescue” component and has stricter robot requirements. Some of the main points the robots are judged on are the ability to find and extinguish the candle, the amount of time it takes to accomplish the goal, searching efficiency, obstacle avoidance, and robot uniqueness. The contest is also separated into two categories, customized robots and unique robots. Customized robots are built from a kit while unique robots are designed and created by the user. Whether or not a robot is unique is determined by the contest judges. Our robot will most likely be unique since we are ordering individual parts and designing the entire system.
Preliminary Requirements

The main requirement of this project is to create a robot that is fully autonomous. By that, it means that once the robot is started by the user, it navigates, searches, and extinguishes the fire on its own, with no assistance or input from the user. The judge will place the robot in the maze and press the start button. The robot will then listen for the sound (a certain frequency) signaling to begin. Each robot must meet these requirements in order to compete in the competition. There are also strict rules about each robot having a carrying handle, a start button, a flame-detect LED, a mic, and a kill power plug. Finally, the robot must also accomplish the goal in the allotted time, which varies depending on the maze level.

Basic Limitations

The main limitation for this project is time. The competition is the weekend of April 1st, 2016, so anything we do must be finished by then. Some other limitations are that the robot must not exceed a certain size, specified in the contest rules, and that the start button must be located at its highest point. Having the start button located above all other components limits where we can place our sensors. As a team, we have decided to focus on accomplishing levels one and two of the competition to the best of our ability. The ability to search and rescue an infant, as described for level three, would require additional systems to be added to our fire fighting robot. Designing and incorporating a system to recognize, lift, and carry the infant out of the maze would take time away from the main focus and greatly increase the scope of the project.

Other Data

There is no budget for this contest however there is an award for the most cost effective robot. There are also a number of “extra credit” opportunities to boost your robot’s score. Some
of these include the ability to make a return trip back to the starting point and having a non-air extinguisher.

Questions

Some questions that have arisen in team meetings are: What language do we want to program in? Is the arduino powerful enough to use for our robot? How do we want to go about extinguishing the flame? What sensor(s) will work best for navigation, obstacle avoidance, and flame detection? What is the most efficient method for searching a random test arena? Most of these questions can be answered by testing once the robot is built.

Additional Information

Key technical areas/skills used in the project are microcontroller programming, control system analysis and implementation, and data processing. Basic mechanical design/build skills and familiarity with electromechanical components will also be necessary.