

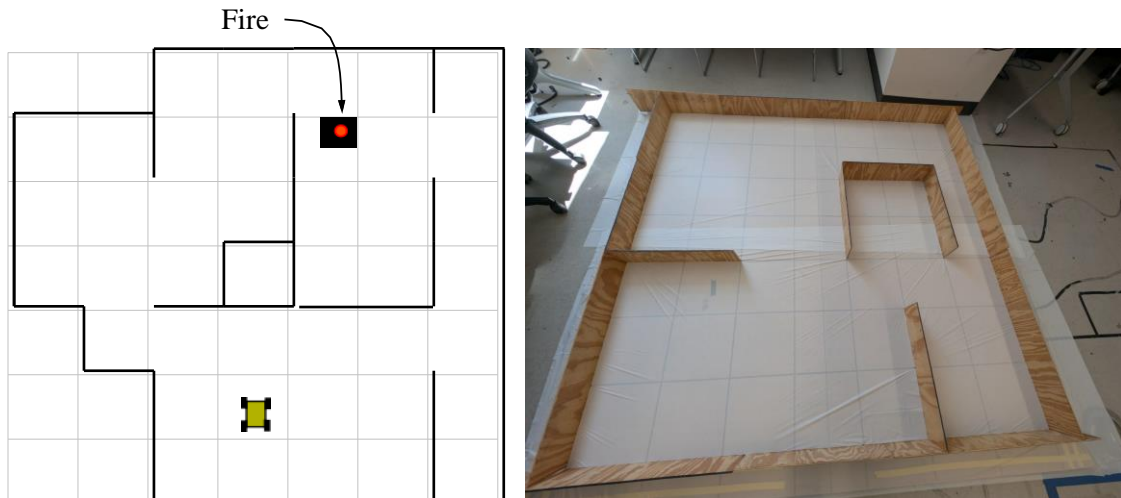
CSE 4360 / 5364 - *Autonomous Robots*

Project 2- Fall 2024

Due Date: November 12, 2024, 11:59 pm

Behavior-based Fire Alarm Robot

The goal of this project is to design a behavior-based fire robot that can move from an unknown position in an indoor environment, locate a fire, raise an alarm, and extinguish it. The robot should use a set of behaviors such as “wander/search” and “wall following”. The walls of the rooms are approximately 15cm high and the fire location will be indicated by a burning candle (in a glass candle holder) on top of a differently colored area the size of half a floor tile. The following figure shows a drawing and picture of possible environments.



The behavioral repertoire of your robot should include several modes: 1) “wander”, i.e. a behavior that enables the robot to move in the workspace looking for either a wall or the fire, 2) “wall following” should permit the robot to move along the wall (you might want to implement only one direction, i.e. clockwise or counterclockwise wall following), 3) “fire detection”, which should allow you to detect the fire, and 4) “extinguish”, which should permit your robot to extinguish the fire.

At the end of the project, each group will submit a report and give a demonstration of their robot. During this demonstration you should provide a short description of the robot and of the details of your behavior-based control system.

You may practice in the lab and use the maze environment. Please respect the other teams. Do not test with a candle in the maze environment due to fire risk of the maze. You may test with a candle in the area outside the maze if you take proper safety precautions.

Project Details

1. Build a mobile robot for this task (20 points).

Using the parts in your robot kit, build a mobile robot for the task. In this assignment, the robot must be able to detect and follow walls and to detect the fire. You may build as you see fit, but the following steps will be taken to assist you, and the following suggestions are a good place to start.

- 1) To make this feasible, the candle will be placed on a square of colored paper that you can detect with a downward facing color/intensity sensor. Samples of colored paper will be provided, and you can test which works the most reliably for you. You can also provide your own paper on test day.
- 2) One way to perform “wall following” in the given environment would be to use a touch sensor and distance sensor to that can detect a wall in front of the robot and keep track of the wall on the side.
- 3) Upon detecting the paper/flame, the robot must raise an alarm. This could be done with the hub speaker. It must then attempt to extinguish the flame. This could be done by building a fan with the third motor.

Your project report should include a short description of your robot design (including the critical design choices made).

2. Implement the necessary behaviors and behavior arbitration/coordination (80 points).

To address the given task, you must implement a “wander/search”, a “wall following”, a “fire detection”, and an “extinguish” behavior for your robot. You are free to develop the algorithm as

- 1) “Wander” is intended here to move the robot through the workspace. You could simply implement motion to a randomly or systematically determined location. A “lawn mower” pattern back and forth would effectively search the space, but might be hard to coordinate with wall following.
- 2) “Wall following” is intended to permit the robot to move between areas. Algorithms include maintaining distance to the wall or periodically checking with a touch sensor.
- 3) “Fire detection” is intended to locate the fire. As mentioned above, this can be done with a color/intensity sensor to detect the paper. An alarm should then be raised
- 4) “Extinguish” could be simply activating the fan, but since you don’t know where exactly the candle is with respect to the robot when you find the paper, some additional behavior is recommended.
- 5) To integrate these behaviors, you also must implement a behavior arbitration coordination mechanism (e.g. priority and subsumption, weighted averaging, etc.).

Your report should contain a description of the important components of your control system and the actual code for the robot.

Extinguishing the flame is unreliable and has an element of luck. If you successfully complete steps 1)-3) you will receive full points. If you successfully extinguish the flame,

you will receive 5 extra credit points. If you successfully detect the fire, you can try three times to extinguish the flame after detection. The instructor or TA will move the robot to a new location near the flame (so wander and wall following are no longer necessary) and the robot can try again.