

LAB 1
ESE 112
MouseCapades



Sept 04, 2007

Introduction:

In robotics navigating new domains in a very difficult task; walking in circles, getting stuck on obstacles etc are problems that robots often encounter in domains such as earthquakes, biological spills, etc. In these situations it is often the case that many sensors no longer work. For example, in a fire, a vision system is often rendered useless. In the animal kingdom, different species employ many different strategies to solve this problem. Mice, which are almost blind, tend to use their whiskers and cautiously run along baseboards and walls using a very simple yet very effective wall-following algorithm. In this lab you will build a simple “robotic” mouse and conduct some basic tests on your robot.

Prelab questions (to be handed in before the lab starts):

- 1.) How many screws should there be in your kit?

- 2.) Wall-following robots are great, but in many instances you would like to put a robot in a room and have it explore every non-occupied (that is where there are no obstacles) part of the room (say for vacuum cleaning). Describe an algorithm (an algorithm is a recipe or set of steps, or more formally “A step-by-step problem-solving procedure, especially an established, recursive computational procedure for solving a problem in a finite number of steps”) that a robot could use to accomplish such a task? You may use the internet to search what current robots do and/or use any other resource available to you, please include citations if you do. Your algorithm should try to minimize the time it takes to cover the entire room and may assume the use of any reasonable sensor. Will your algorithm work in any shaped room? If yes, try to prove it will, if not explain for which type(s) of room(s) the algorithm will fail.

Lab Instructions:

1. Before you get started with the lab you should first check that you have all the parts you need to build the robot mouse, they are:
 1. A hard plastic chassis.
 2. Four white plastic pieces, namely two rims and two ends for the tail.
 3. Two rubber tires.
 4. Black plastic nose
 5. Nylon whiskers
 6. Sensor with red, white and blue wires.
 7. Metal sensor rod.
 8. Metal sensor encasing.
 9. Switch with two red wires.
 10. Two gear shafts.
 11. Two gear-shaft mounts.
 12. Two DC motors.
 13. Two worm gears.

14. Battery encasing.
15. Two battery contacts and two battery terminals.
16. A metal rear stay
17. A front metal hook
18. A body cover (part of the package, has to be cut out with scissors).
19. Eight 3mm x 4 screws, four 2mm x 4 screws, two 2mm x 10 screws and two slot screws.

2. Assemble the robot:

Determine where each part goes and what they are for.

- a) Assemble the wheels and attach them to the chassis: the wheels need to be moved by the gears, which should be attached to the motors.
- b) Assemble the motors and attach them to the chassis: the motors should be attached to the mount with the slot screws.
- c) Assemble the battery case and attach it and the rear of the chassis: the battery encasing should have two metal contacts coming out of each side through the holes in the case as well as two battery terminals, which must correspond to the polarity marked in the outside of the case
- d) Attach the sensor and the switch: Draw a schematic of it and make sure that you understand what it does and why it does it. When attaching the sensor rod, make sure that it lies between the sensor and the metal sensor cover.

3. Wire the mouse up:

Now that the robot mouse has been assembled, you will have to wire it up with the following specifications:

- a) The mouse should start moving when switched on,
- b) The mouse should follow the contours of any straight wall located to its left,
- c) The mouse should be able to follow the perimeter of a room.

4. Once you are done with the engineering part of this project, it is time to make it look aesthetically like a mouse:

Cut the body out of the package and add its nose, whiskers and tail. The nose should be pushed through the hole on the mouse's face into the metal hook. This hook will be used to secure the body to the chassis as well as to provide a smooth, friction-less surface for the mouse to move around the room. The tail, consisting of a metal coil and two plastic ends, secures the body to the chassis. Now your robot mouse is ready to be used.

Lab Report (Due in 1 week from start date) :

Write a lab report, describing all the steps you took in this lab and including a discussion of the following issues and questions:

Note: You may use any resource (internet book etc) you want to help with the following questions. Once again make sure to cite any sources used.

- a) Explain the electrical circuits in the mouse with special attention paid to their functionality. Use a DMM (digital multi-meter) to determine the voltage across the motor terminals. How else could you use your DMM to debug your mouse?
- b) Could you make this robot move backwards retaining at least some of its functionality? Explain fully and provide a schematic for the circuit.
- c) If you can't make it operate backwards while retaining its functionality explain why not?
- d) What design changes would you have to make to have this robot mouse move around a room freely, avoiding walls no matter on which side they are? Explain fully and provide a schematic of the circuit. Feel free to add new hardware if necessary.
- e) Measure the velocity of the robot. (Explain how you measured this and remember to use good scientific procedures for measurement and accuracy)
- f) What changes could you make to the gearing to make it move faster?
- g) What changes could you make to the gearing to make it climb hills better?
- h) Is the mouse you built a robot? If so explain why, if not what would have to be added to qualify as a robot?
- i.) Show your working mouse to the course staff (you can do this anytime during office hours before the due date).
- j.) Extra Credit: Can you make the mouse move twice as fast while retaining all its functionality. For credit show course staff the mouse moving twice as fast.