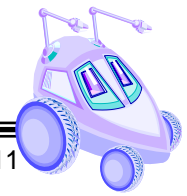
**Lab 6 Topological Path Planning****Reading:** *Introduction to AI Robotics (Ch. 9), Lecture 6-1*(Demonstration due in class on *Thursday*)(Code and Memo due in Angel drop box by midnight on Sunday)

Purpose: The purpose of this lab is to use topological navigation to move the robot to a goal position. The student team will design behaviors and perceptual schema for identifying gateways in an artificial environment. Recall that a gateway is a landmark or distinctive place in the world where the robot makes a navigation decision. The robot will be given a list of navigation commands based upon the world's topology and use a parsing routine and a sequencer to move the robot from a start point to a goal point. For example, if the robot is given "SLRT" (S = Start, L = go Left, R = go Right, T = Terminate) then it would start, go straight, turn left at the next gateway, turn right at the next gateway, then stop at the last gateway. The robot should continue to move forward until a gateway is encountered or until the stop command is encountered. In order to extend the robot's topological path planning capabilities, the navigation commands could be modified to include numerical information such as "3L" (make the third left) or "1L" (make the first available left). This would mean that the robot must keep track of the type of gateway encountered, the number of hallways passed or if the robot encounters a hallway on the right it would continue to move forward until it could make a left.

Equipment: Base Robot
IR/Sonar Sensors (use both for redundancy to account for sensor error)
Servo Panner

Software: Microsoft Visual Studio.NET 2008 with C#
Serializer.NET library and firmware

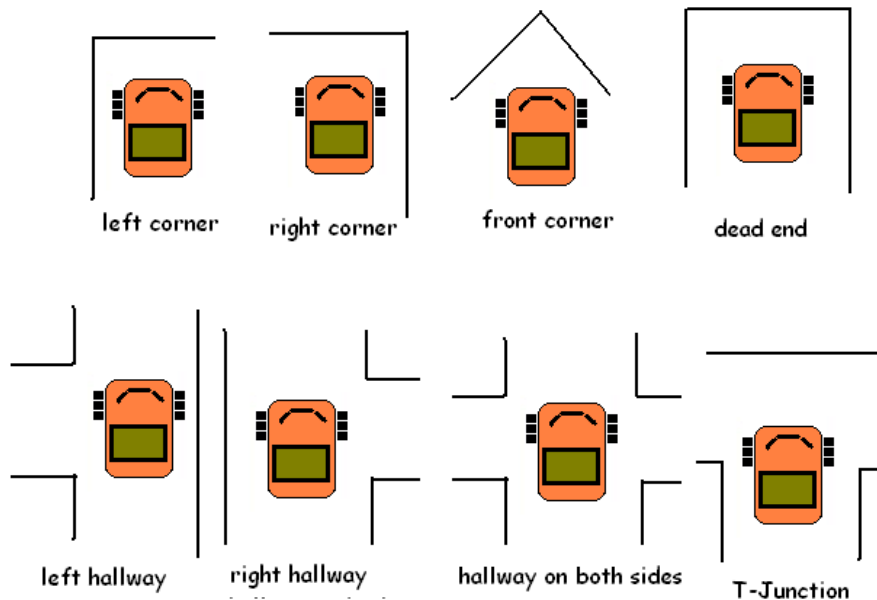


Bluetooth transmitter

LAB PROCEDURE

Part 1 – Perceptual Schema

1. The student team should place the robot in several corners and intersections of hallways in the artificial environment and determine the perceptual schema to identify these gateways and distinctive places.
2. It would be advisable to use a combination of the IR and sonar for sensor redundancy to identify these locations in the world. There will be some sensor error, this is a standard problem in mobile robot navigation and the program should be designed in such a way to minimize the effect of the error. Figure 1 provides descriptions of the possible world landmarks.



S

Figure 1: Distinctive Places

3. Include a table similar to Table 1 that includes the test data and perceptual schema for each of the landmarks.

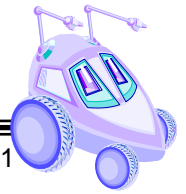


Table 1: Perceptual Schema Data Table

Landmark	Front IR	Left IR	Right IR	Front Sonar	Left Sonar	Right Sonar	Servo Setting (if applicable)
Corner in front							
Corner on left							
Corner on right							
Hallway on both sides							
Hallway on left							
Hallway on right							
T-junction							
Dead End							

Part 2 – Sequencer

1. The program should open and read a .txt file that includes the instruction set for the robot’s waypoints. You will be given some sample code in Angel for file handling in Visual C# if you would like to use it.
2. The code should parse the text file and the list of instructions for the sequencer should be displayed on the GUI or on the console.
3. The commands will include S = Start, #L = Left, #R = Right, T = Stop and the robot should sequence to the next step at each distinctive place or gateway. See Figure 2 for an example of the robot’s path execution. The robot should continue to move forward until the stop command is encountered.

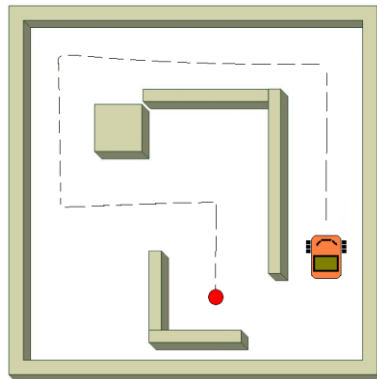
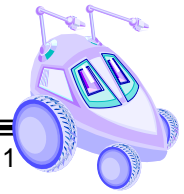


Figure 2: Topological Navigation Example (“SLLRT”)

**Part 3 – Move to Goal**

1. There should be a command button placed on the GUI that sends the list of instructions to the robot.
2. When pressed the robot should move through the list of gateways to a goal point.
3. The robot's current state and navigation progress should be displayed on the GUI or console.

Demonstration:

The demonstration of the program for lab 6 will include three parts. In the first part, the robot will navigate in the environment using behaviors and indicate when it has reached a gateway or distinctive place (i.e. intersection of hallways or corner). In the second part, the program should display the instructions for the sequencer on the GUI. In the third part, the robot should move from a start position and move through the topological path instructions to a goal point.

Program:

The program should be properly commented and modular with each new behavior representing a new function call. The design of the subsumption architecture should be evident from the program layout. You should use the GUI, keypad, LCD and speech module as needed to illustrate robot state, input and output data.

Memo:

The following list provides the basic guidelines for writing a technical memorandum.

- ✓ Format
 - Begins with Date, To , From, Subject
 - Font no larger than 12 point font
 - Spacing no larger than double space
 - Written as a paragraph not bulleted list
 - No longer than three pages of text
- ✓ Writing
 - Memo is organized in a logical order
 - Writing is direct, concise and to the point
 - Written in first person from lab partners
 - Correct grammar, no spelling errors



✓ Content

- Starts with a statement of purpose
- Discusses the strategy or pseudocode for implementing the robot paths (may include a flow chart)
- Discusses the tests and methods performed
- States the results including error analysis
- Shows data tables with error analysis and required plots or graphs
- Answers all questions posed in the lab procedure
- Clear statement of conclusions

Questions to Answer in the Memo:

1. What did the hybrid architecture for your final design look like?
2. What were the results of the analysis for the perceptual schema? What type of errors did you encounter? How did you attempt to minimize the error in your design?
3. How did you correct for the robot's odometry error? Were you able to use the landmarks to localize the robot and correct for this error?
4. How did you communicate the robot's current state to the user?
5. How could you improve the topological path planning algorithm?

Grading Rubric:

The lab is worth a total of 30 points and is graded by the following rubric.

Points	Demonstration	Code	Memo
10	Excellent work, the robot performs exactly as required	Properly commented, easy to follow with modular components	Follows all guidelines and answers all questions posed
7.5	Performs most of the functionality with minor failures	Partial comments and/or not modular with objects	Does not answer some questions and/or has spelling, grammatical, content errors
5	Performs some of the functionality but with major failures or parts	No comments, not modular, not easy to	Multiple grammatical, format, content,



	missing	follow	spelling errors, questions not answered
0	Meets none of the design specifications or not submitted	Not submitted	Not submitted

Submission Requirements:

You must submit the lab memo and code by midnight on *Thursday*. You must also submit a memo for Lab 6 by midnight on Sunday.