



The Heat-Seeking Robot

A Design Project for Introduction to Engineering

Developed by Dr. Antonio Garcia

(adapted from Dr. Chell Robert's ECE 100 robot assignment)

Arizona State University

Overview:

In this project, student teams design and build a robotic device, which they will use to compete against other teams. This robotic device will search a 20 foot wide hexagonal area to find a heat source in the least amount of time. The students will also design the control logic (program) for their devices.

Learning Objectives or Student Outcomes:

By the end of this lesson, students will be able to

1. work with a team to design and build a heat-seeking robotic device for use in a class competition.

Length of Lesson:

This project is generally one of two or three in the semester. The length of the lesson will depend on a few factors: the amount of in-class time devoted to the project, the out-of-class time deemed necessary by the instructor, and what other activities will be taking place during the duration of the project.

Team Size/Composition:

Teams of four work best; if necessary, a few teams of 3 or 5 students each may be formed. Teams stay together for the length of the project.

How is *positive interdependence* ensured?

Each team is given only one kit, or set of materials, with which to build a robotic device. Teams must collaborate cooperatively in order to be successful in the project.

How is *individual accountability* built in to the project?

Each team member is required to turn in a concise written report about the project—the design, the trials, the final outcome, the successes, the failures, etc.

Basis or Components of Assessment:

1. The actual product and its demonstration
2. A "Design Notebook," which documents the design process
3. A succinct report on the final design that also includes the testing and final outcome of the project

Team Skills Needed for Success:

Students need to have the ability to cooperate, communicate, and collaborate with other group members regarding their ideas and concerns.

Materials Needed by Students:

Each team will be provided a kit. The kit includes a micro-processor, a bread-board 3.75"x1.75"x0.25", two 60 rpm servo motors, several sensors, all the electrical components to control the servo motors, and a battery pack (2.75"x2.50"x .75") that will hold 5 AA batteries. These components together weigh approximately 0.25 Kg. Students are not confined to the components in the kit.

Instructions to Students:

1	Project Description Your team is to design and build a robotic device that will search a 20 foot wide hexagonal arena to find a heat source in the least amount of time. You will also design the control logic (program) for your device. You will use this heat-seeking robot to compete against other teams during the final class meeting. This project offers your team a chance to pass through all the stages of the problem-solving and the design process in a structured way. As you go through this process, it is expected that your team will begin to understand more fully how this problem-solving process works (i.e., you will begin to really understand why the steps are ordered the way they are, how the results of one step lead to the next step, why it is often necessary to go back and repeat an earlier step in the process, etc.). Your team members will be allowed to solve this problem much as they see fit. It is expected, however, that your team will use each step in the design heuristic as presented in class and in your text. All the work done on this project will be documented and will be placed in the team's Design Notebook.
2	Minimum Requirements for Design Notebook <ul style="list-style-type: none">• Notebook organization—well structured with a table of contents, page numbers, etc.• All major design steps—addressed and documented• Excel spreadsheet with data from trial run• Appropriate sketches and drawings• Team materials—team roles, team norms, meeting minutes, process check• Project management—schedule, Gantt chart

3	<p>Design Constraints and Conditions</p> <p>As with most design projects, there are certain constraints and conditions that you must follow. (See Constraints and Conditions handout.)</p>
4	<p>The Robot Competition</p> <p>There will be two robots in the arena for each trial and each team will be given more than one attempt to find the heat source in the minimum time. Each trial will last a maximum of 6 minutes.</p>
5	<p>Deliverables</p> <ul style="list-style-type: none"> • Design Notebook • Participation in Competition • Individual Written Report (a succinct report on the final design that includes the testing and the final outcome of the project; an assessment of the project outcome—successes, shortcomings, etc.;

Handouts:

- [Constraints and Conditions](#)
- [Heat-Seeking Robot Assignment Checklist](#) (Evaluation rubric)

Constraints and Conditions

1. The arena will be laid out on a relatively flat cement floor that will measure about 20 feet wide. There will also be obstacles: 3 inch diameter by 6 inch tall cylinders.
2. You are being supplied a kit for building your robot. You are not confined to the components in your kit.
3. The kit includes a micro-processor, a bread-board 3.75"x1.75"x0.25", two 60 rpm servo motors, several sensors, all the electrical components to control the servo motors, and a battery pack (2.75"x2.50"x .75") that will hold 5 AA batteries. These components together weigh approximately 0.25 Kg.
4. You will make at least one trial run and record sensor data in the provided HOBO data logger and analyze the data with graphs in Excel.
5. Previous experience indicates that a preferable target total weight should be around .5 Kg.
6. A toggle switch will be provided to turn on and off the robot.
7. Two bump sensors (small switches) will be provided.
8. An electrical diagram and some control subroutines will also be provided.
9. The force used to power the robot must be supplied (directly or indirectly) from the batteries.
10. The device may in no way harm the floor or anything in the lab.
11. You must not damage any robotic components on your device or on another team's device.
12. You may not use gasoline or chemical reactions.

Heat-Seeking Robot Assignment Checklist

Team _____

Date _____

Member Name _____

The Design Process	Unacceptable	Acceptable	Good	Excellent
Problem Identification and Information Gathering	1	2	3	4
Functional requirements, constraints and limitations	1	2	3	4
Identifying and evaluating alternatives	1	2	3	4
Modeling, analyzing, and refining the design.	1	2	3	4
The Solution, Timeliness, and Presentation				
Provide a drawing or sketch with basic details.	1	2	3	4
Originality and Creativity of the solution	1	2	3	4
Project Management	1	2	3	4
Written Report (Individual grade)	1	2	3	4
Oral Presentation	1	2	3	4
Comments				
Final Assessment				