AUTONOMOUS MOBILE ROBOTS

LAB 7: Harvesting of "The Arachnid"

Team 9

Creators:
Juan Quiroz
Vincent Ravera

Thursday, October 27, 2005

Introduction:

The goal of this lab was to prepare and design a robot for the "Harvesting Contest". The contest consisted of two parts. The first part was the collection of food. The robot was to wander in the field and count the black, round pieces of tape scattered on the table in 60 seconds. The second part consisted of having the robot come back to its "home" which was defined by a strong source of light and go to it using the light sensors. The number of foods collected was to be maximized while the time it took the robot to return home to the source light was to be minimized.

Hardware & Software Design:

Our robot design was based on the Handy Bug described on <u>Robotics Explorations</u>, by Fred G. Martin. The robot was built out of Lego pieces and consisted of two motors, two touch sensors, two light sensors, and two reflective optosensors.

The motors were used for the robot's locomotion. The touch sensors were used for simple obstacle avoidance, the light sensors were used to track and seek the source of light, and the reflective optosensors were used to collect the food.

The reflective optosensors were mounted at the back of the robot, each sensor behind a wheel for protection. The optosensors were initially mounted at the front of the robot, but this design gave the deficiency that when the robot bounced against the wall it would count the dark table sidewalls as food. Another deficiency of this design was that the optosensors were near the robot's bumper, which was constantly hit against the walls and obstacles on the table. This made the optosensors move around and point at awkward angles, which made the robot miscount the food. Placing the optosensors on the back of the robot proved to be a more robust model, which kept the optosensors at a safe location and away from objects which might move them or make them point at weird angles.

The touch sensors were mounted on the front of the robot and were triggered whenever the robot's bumper was hit. The bumper included two plastic coils which protruded forward. These were used as shock absorbers. The need for these shock absorbers was due to the fact that the gear ratio for the motor was changed in order to make the robot faster. The old gear ratio was a small gear driving a large gear. The new gear ratio was 1:1, a medium gear driving a medium gear. This gear ratio yielded satisfactory results, but made the robot prone to breaking when bumping against the side walls of the table. The part of the robot that continued to break was the bumper. We tried numerous designs for the bumper, and all designs ended up breaking off. The more robust design was the one with the "whiskers", the shock absorbers, on front. We also added six more "whiskers", three on each side of the robot. The purpose of these whiskers was to make the robot maintain a fixed distance from the side walls and to reduce side collisions against the walls. These whiskers were also put in place to give the robot the appearance of a spider. For this reason we have come to name the robot for this lab "The Arachnid".

The two light sensors were mounted at the front of the robot, about an inch apart. By separating the light sensors we hoped to maximize the tracking of the source of light.

The two optosensors were calibrated independently by obtaining the readings of the sensors when over the black "food" and when over the white table. These readings allowed us to detect when the robot passed over food and collect it. The two light sensors were also calibrated independently in order to detect the source of light after the 60 seconds were up.

The program was implemented with the light wandering code from lab 5 as the base. The robot wandered for 60 seconds. When the robot bumped against a wall, it would make a random turn, and continue wandering. The first thread made the robot wander and also handled the obstacle avoidance. A second thread was used to count the food collected. The thread continuously checked the analog reading of the optosensors. If the sensor reading was above the calibrated threshold, then it would increment the food count and it would make a short beeping sound. Finally, a third thread was used to keep track of time. After 60 seconds the timer thread would set a flag which enabled the robot to start seeking light. If the robot saw light, then it would speed toward it.

The wandering algorithm was very simple. The robot moved in straight lines, and when the robot hit a side wall it would turn at a random angle greater than 45 degrees. We reached the conclusion that having a robot with complete random behavior would be prone to redundant seeking, covering the same area more than once. Instead, by going on straight lines and making turns greater than 45 degrees guaranteed that the robot would explore the majority of the table.

Problems:

The biggest challenge of the lab was making the robot seek the source of light effectively. Usually the robot would detect the source of light and would head towards it, but if it bumped against a wall before it got too close to the source of light, then it would usually turn in the opposite direction. At first we made the robot go full speed after the 60 seconds. This made the robot find the source of light faster, but if the robot ever hit a wall it broke its bumper. We then tried changing the robot behavior so that it would go full speed if it was directly in front of the source of light. The robot would also go at a moderate speed if it saw no light, and it would speed up as its light reading increased.

This made the robot find the source of light in a moderate amount of time and it yielded the best results.

During the final testing of the robot's behavior, it did not perform as was expected. The robot usually passed very close to the food, but missed it by a small distance. A lot of times the food would go through the middle of the two optosensors undetected. The final testing of the robot led us to conclude that it would have been better to have the sensors closer together. Also, our concern for the robot breaking during its test run led us to make the robot move at a moderate speed. Yet, having the robot move at a faster speed would have increased the area covered by the robot. This consequently would have improved its harvesting of food performance.