Line Following

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Problem
A solid black line (approximately 1 inch wide) must be approached and followed to a yellow square at the end of the line. Then, it must locate a corner of the arena by responding to human-generated auditory stimuli only.

Method
With a single sensor, we calculate a numerical value representing the alignment of the ligh sensor with the desired position on the edge of the line. The robot reacts to this 0 to 1 value by turning left when the value is greater than 0.5 and right otherwise. The speed of the turning is related to the distance from the desired value. This relation is expressed as a piecewise function utilizing different proportionality constants to best stabilize the robot on its line following venture.

We implemented the single sensor line following using hysteresis thresholding, but our robot performed poorly. Sensor variations on the same surface did not seem to affect our robot's performance at all. Without hysteresis thresholding, this implementation of line following is extremely stable and smooth at low speeds. While its performance deteriorates with increased speeds, the stability granted by the low speeds allows the overall performance of the robot to become fairly comparable to that of our two sensor version.

Our two sensor implementation utilizes a seven-state algorithm in order to stabilize the robot based on calculated values based on our single sensor computation. These states include straight line behavior and varying degrees of turning that are detected.

For the auditory-reactive behavior, our robot turns in place with low rotational velocity until the sound sensor detects sound waves exceeding an empirically determined threshold. Upon sound levels breaking our barrier, the robot locomotes in a forward direction until it has not detected movement-inducing sound for 500 milliseconds. This allows the robot to continue uninterfered with in the event of brief pauses in auditory stimuli. When a lack of high loudness sound is detected, the robot re-enters its rotation behavior in the opposite direction. This procedure allows us to intuitively control the robot and make small corrections to its movement in order to quickly approach the target location.

Results
In our peer demonstration, our robot performed second best at 37.091 seconds to go from the initial position to the home location. This performance in the contest reflected our trial runs.