Follow the Line: Using Vision in an Autonomous Mobile Robot

ABSTRACT

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The goal of this project is to build an autonomous mobile robot that is capable of following a line1 in multiple environments. The configuration of the hardware system of a robot and environmental factors affect its ability to follow a line. Also different styles of lines have different effects on the robot’s ability to follow a line.

In this research project we have developed a solution to improve the performance of a robot in multiple environments. The program runs on a laptop computer that sits on top of the robot. There are four modules used in this project, a Vision module, a Motor module, a Motor Listener module and a Steering module. The laptop uses Microsoft’s Windows 98. The vision module acquires data from a commonly available web camera. The Motor module controls the motion of the robot. The Motor Listener module monitors the start of the motor by using a common PC microphone to detect the sound made by the robot when it runs. The Steering module controls the turning directionality of the robot. The Vision module captures the data of a black line, preprocesses the image and does the edge detection, direction detection and generation of the control command for the motor and steering. The generated command is passed to the Motor module and the Steering module. The Motor module and the Steering module execute the command received so that the robot follows the line. A web camera is used as a hardware component of the Vision module and is installed on the camera-mount on top of the front hood of the robot. It communicates with the laptop through a USB port.

Critical to the entire system is its final cost. The goal was to build a robot that could be used by other schools to teach subsumption and autonomy in the design of a mobile robot. Therefore the system was built using a child’s toy car and other commonly available equipment. The current development cost of the project is just under six thousand dollars and well within the affordable replication by smaller schools.

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1 “Line” in this paper means the particular line, which is a black strip of cloth for the robot to follow.