Vision-Based Autonomous Security Robot: The Vision System

Kevin Farney, Joel D. Schipper
Bradley University - Electrical and Computer Engineering Department
1501 West Bradley Avenue
Peoria, IL 61625
jschipper@bradley.edu

The goal of this project is to develop a computer vision system that enables a robot to navigate the hallways of Bradley University's engineering building using a generic webcam as the only sensor. OpenCV2.0 programmed in C++ is the primary programming tool used to develop the vision system.

Two algorithms have been developed to identify the center of the hallway and guide the robot in the correct direction. Both algorithms use a Gaussian blur followed by edge detection and corner detection on the edge detected image. The first algorithm finds the strongest vertical lines on an image by partitioning the image into several regions and counting the number of corners located within each partition. A threshold operation based on the number of corners reveals the partitions with the strongest vertical lines. Averaging the horizontal coordinates of the vertical lines indicates the location of the center of the hallway relative to the robot. The second algorithm utilizes the trapezoidal shape of the hallway formed by where the floor meets the walls, from the perspective of the robot. The algorithm averages the vertical coordinate of each corner found along the legs of the trapezoid within the boundaries of the lower right and lower left sections of the image. These averages are then compared and the difference between them estimates robot orientation with respect to the walls.

Preliminary tests indicate that these algorithms can identify the direction a robot must turn to remain in the center of the hallway, however, neither algorithm appears sufficient by itself. By combining the results of the two algorithms, it is believed that a more robust vision algorithm will result. The vision system architecture is designed to execute various algorithms in parallel. Such a structure enables the addition or removal of algorithms without adversely affecting the system as a whole. Further algorithms may be developed and easily added to improve results. Additionally, the system may intelligently ignore results from algorithms that are recognized as inappropriate for certain situations.

Note to reviewer: This abstract presents the preliminary results of a senior project at Bradley University. The project is actively being developed and significant advances are expected before April 30, when the final paper is due. Thank you for your consideration.