Michael Slutskiy
Paul Nguyen
ECE533 Project Proposal

The purpose of this project is to develop a robust image analysis system that would allow vision based autonomous navigation and object avoidance. This package will be part of the control software used on the IEEE Robot Team's entry into the Intelligent Ground Vehicle Competition[1]. Motivated by the fact that humans can easily perform this task relying entirely on vision, we wish to use digital image processing techniques to achieve the same capability.

For the competition the vehicle must avoid any obstacles it is faced with (cones, construction barrels, barriers and potholes) while staying within a lane indicated by solid or dashed lines. In the past, objects and lines were distinguished from the background simply by using adaptive threshold segmentation performed on the blue plane of the image and a few noise-reducing filters. However, this had its shortcomings, particularly if the surface material or color changed (going from a grassy surface to a simulated sandpit, for example). Moreover, there was no way to prevent the robot from viewing a gap in the dashed lane marking as an acceptable path which would result in the vehicle going out of bounds.

Ideally we wish to design a "black box" that takes the latest frame from the camera and outputs a point toward which the bot should navigate. Analysis of the image will include several techniques covered in lecture: threshold and color based segmentation[2], Canny edge extraction, noise reduction by filtering, Hough transform line extrapolation[3] and possibly others with the goal of recovering as much information about the path and obstacles in front of the bot. Furthermore, the processed image data will be evaluated to determine a valid path for the bot to follow based on the dynamics of the vehicle and surrounding conditions.[4]

---

[1] Additional information about the competition is available at http://www.igvc.org/deploy

[2] Gonzalez, J.P. and Ozguner, U**. "**Lane detection using histogram-based segmentation and decision trees,**"** Intelligent Transportation Systems, 2000. Proceedings. 2000 IEEE, 1-3 Oct. 2000, pp. 346 –351.

[3] Yu, B.; Jain, A.K**.; "**Lane boundary detection using a multiresolution Hough transform," International Conference on Image Processing Proceedings, 26-29 Oct. 1997, pp. 748 -751 vol.2.

[4] Bertozzi, M. and Broggi, A**. "**Real-time lane and obstacle detection on the GOLD system," Intelligent Vehicles Symposium, 1996. Proceedings of the 1996 IEEE, 19-20 Sept. 1996, pp. 213 –218.