Introduction

Autonomous vehicles have applications in every walk of life. I wanted my project to have a strong base in reality. I chose to design a model autonomous car not only because it is practical, but also because it is needed. The technology and information derived from my research will be forward compatible and can serve as a stepping stone to produce an even more complex autonomous vehicle.

The design goals of Trans Am were to create an autonomous vehicle capable of performing navigation in common traffic situations while still preserving many components of a car. Turn signal and brake signal systems are modeled. Ackerman's steering is also modeled.

To be practical the car Trans Am would have to perform tasks that a normal car would have to perform. I call these the behavior criteria. The major behaviors Trans Am performs are obstacle avoidance, lane/ track acquisition, track following, lane changing based on track conditions, and lane re-acquisition. Also included in Trans Am's logic are routines to know which lane the car is in, and to also know when to begin searching for the track again. Trans Am continually responds to physical collisions, and gives visual indications of turning and speed change on its turn signals and brake lights.

The integrated system of Trans Am consists of the the lighting system board, IR emitters and detectors, the CDS array, the CDS illumination array, the collision detectors, the actuators, and the Mekatronics MTJPRO11 board which contains the microcontroller, and the memory.

The mobile platform was developed using AutoCAD release 14. Two preliminary designs were tested before the final design was decided upon. The frame is constructed of balsa wood. The front steering system designed to follow Ackerman's steering principles was designed using a spindle housing from a hobby supplier mounted in a wooden support rig. The back wheels are mounted directly to the drive motors.

Actuation of Trans Am is controlled directly by the microcontroller. Pulse width modulation is used to turn servos, which in turn are the direct controllers of locomotion and steering. Trans Am is a simple design. Its servos, or actuators, are all the same model. They have been modified to perform differently.

The sensors like the actuation system were designed to be simple. IR detection is present in the system for short-range object detection. It is utilized by emitting focused IR light and using a detector tuned to the emitted light frequency. An analog signal is then extracted from the detector, and a range can be calculated. The track acquisition/ following sensor system is composed of a shielded array of CDS cells accompanied by an array of ground illuminating lights. A triangular shape array gives nose and two extremes (left and right). These reading can be used to center on a track. The last simple sensor is the momentary contact collision switch. It is used to sense moving collisions.

Trans Am performs as a real car under the criteria cited. The results I have found indicate that large-scale navigation systems of unprecedented capability are possible. I would like to be involved in the development of such a system. Currently programs like PATH at the University of California, Berkeley, and Carnegie Mellon University are working on similar research.