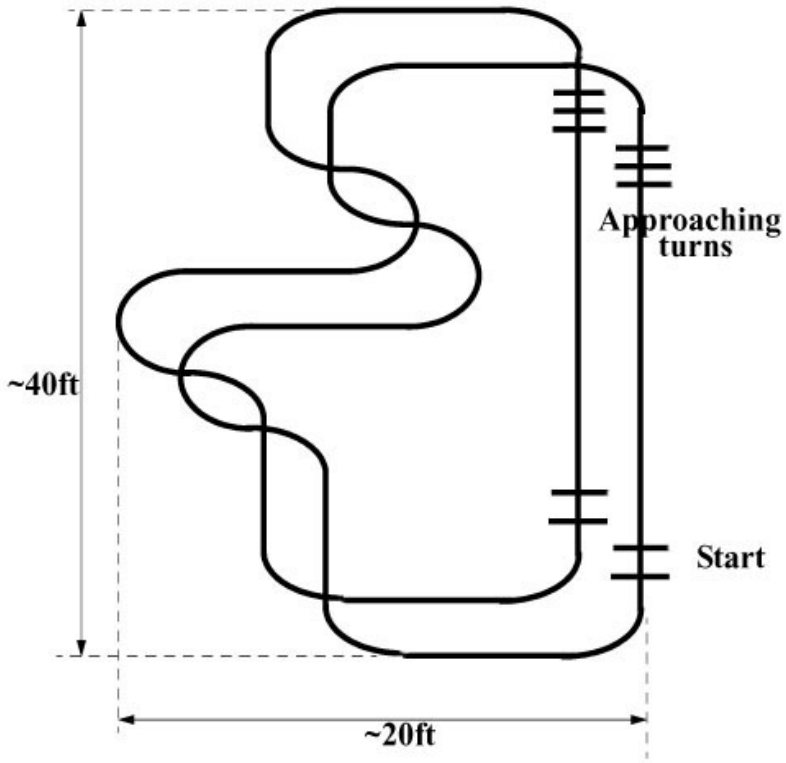
ELE 302 Project 4 – Grand Prix

Spring 2010

This project must be demonstrated between 1:00 pm and 4:30 pm on “demonstration day,” Thursday, May 6, 2010. In addition the **ELE 302 Annual Race** will be held on Monday May 10 at 1:30 pm for the entire EE department. Official “winners” will be determined at this race, but the Thursday event is the one that counts for the course. Since Monday is only one day before Dean's Date, I don't expect you to spend all Reading Period tweaking the car at the expense of your other courses.

You must design and build a system to make your car follow a track without external control (i.e. you are not allowed to steer the car). The track consists of a 3/4" wide piece of black electrical tape on a large white vinyl tarp. The road takes the shape shown approximately in the diagram:



All the turns have a 3 foot radius. There will actually be two intersecting tracks, and your car should stay on the correct course (the intersections are all right angles, and they did not seem to cause much difficulty in previous years). Your car may go at any speed you want --- on Monday, the fastest car wins the race, but just making it around the track is challenging. However, you may not resort to any physical "tether" device to keep the car from careening out of control on turns or to stop the car at the end of a lap.

The formal minimum course requirements are:

(1) Make two complete laps on the track; your car must operate autonomously, including coming to a stop after two laps have been completed. Ignore the "Start"

and “Approaching Turns” labels shown in the Figure; a starting position will be selected on demonstration day so your car must be able to complete two laps from any starting point.

(2) Attempt to complete one lap on the track while avoiding an obstacle placed on the track at a point to be selected on demonstration day.

(3) Using wireless communication, give a real-time tracking report of your vehicle’s position on the course. The report should indicate, at a minimum, the position by “track segment” where segment A is the long straight segment (on the right of figure), segment B is the short straight segment following the left turn after segment A (at the top of figure), segment C is the curving part of the course (on the left of figure), and segment D is the short straight segment leading toward segment A (at the bottom of figure). Regardless of the starting position, the tracking report should correctly report the position when the vehicle unambiguously enters the first “new” segment. When the obstacle is encountered, a special report of “obstacle in segment x” should transmitted.

You are encouraged to demonstrate one optional capability such as: (a) ability to follow the course in reverse (you may need to reconfigure your track sensing system); (b) ability to follow the course when a “tunnel” covers some portion of a straight course segment; (c) ability to complete one lap of the course in a coordinated fashion with another vehicle using wireless signaling between vehicles; (d) parallel parking. Other options will be considered for approval at the instructor’s discretion.

You'll need some sensors for “seeing” the black tape and the obstacle. It has become the norm to use a single-chip TV camera that is available upon request; other digital camera chips could be investigated by an ambitious team. There are a variety of infrared (IR) LEDs and phototransistors in the vending machine that can be used to build a linear sensor array. Unfortunately, you can't see IR, so we'll set up a TV camera and TV that can. That way you can get some idea of where the light from your LEDs is going.

One challenge of the real track is that the tarp has wrinkles. They may be as much as an inch or more high. The cars can generally get over them OK (although your speed control will have to be working), but they may cause problems with sensors. I haven't seen any sensors knocked off, but a scheme that relies on an accurate spacing between the track and the sensors may have trouble.

We will have design reviews on April 28. Don't wait until then to get started, however. You'll want to report on your basic design ideas, such as what kind of sensors will be used, what kind of circuits are required, how to run the A/D converter in the processor (if necessary), and what sort of algorithms will be used.