6.111 Final Project Abstract
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One of the greatest obstacles in human/machine interaction is the communication barrier. We, as humans, speak a different language from machines. In the past, we have overcome this barrier by inventing language structures such as programming languages, which allow us to speak in a finite vocabulary that is easily translated into machine language. The problem with this is that it requires anyone who wants to communicate with computers to learn and be familiar with programming languages and concepts. We compromise by having programmers write user interfaces intended for most users, so they can use the computer without 'speaking it's language.' This allows people to use a computer, but only to the level of complexity that the programmer designs the interface, and so there are some intrinsic limitations in this system.

This project will create a new language structure that is more intuitive for humans to use. Users will use gestures to describe a path for a robot to take, as well as conditional reactions for the robot(i.e. go straight. If you hit a wall, turn left. Otherwise, keep on going straight). An FPGA will interpret these gestures using a video camera, and then direct a physical robot according to the user's instructions.

In this project, an analog color camera will be pointed at a user. The camera will output a NTSC composite signal to the FPGA, which will interface to it via the onboard ADV7185 video decoder. The FPGA will track the user's gestures by tracking a finger, which will be uniquely colored, and store the set of (x,y,t) triplets in RAM. It will also identify gestures signifying conditionals, and then compile the user's gestures and traced paths into a sort of program, which it will then "run" on a two-wheeled robot.

The robot itself has two drive wheels and two balancing castors. Position feedback is given by an optical mouse mounted on the robot slightly off the floor, communicating with the FPGA via the PS/2 protocol. Batteries are included on the robot, as well as a small H-bridge and a larger brushed motor amplifier for each motor. The robot will be tethered to the FPGA (with lots of slack). Each motor will only require two wires to control.

The project will be implemented in three stages:
(1): Path tracing. The user will mark a series of (x,y) points and the robot will travel to each of them.
(2): Contour tracing. The user will trace a curve, and the robot will travel the curve, including scaled time points.
(3): Conditional implementation: The robot will have a simple sensor on board, and the user will be able to specify a course of action to take if the sensor is triggered.

This project is an implementation of a new concept for human/computer interaction.

Using this gesture language, someone could easily create a robot with behavior such as wall-following in a few minutes, rather than learning a new set of programming commands and then writing equivalent code for the robot. By implementing it in harware, we can have a fairly sophisticated system running on a single FPGA and a few interface chips, rather than on a full PC. This could lead to a small, cheap system that allows intuitive gesture-based programming, that can be added on to existing robot systems.