PROGRAM FOR INDIVIDUALIZED LEARNING
UNIVERSITY OF MINNESOTA

NARRATIVE TRANSCRIPT FOR: Alan E. Kilian

PROJECT TITLE: Design and Construct a Phase Difference LASER Range Sensor

PROJECT DESCRIPTION: This project will produce a Phase Difference LASER Rangefinder capable of determining the distance to an object by using a beam of light and measuring the light reflected off the object. This project will demonstrate proficiency using the knowledge and tools required to design, build and test a Phase Difference LASER Range Sensor. A 5-7 page paper will be written addressing the process used to design build and test the Phase Difference LASER Range Sensor.

PROJECT DURATION: April 2001 – December 2013

PROJECT EVALUATOR: *Joseph J. Talghader, Professor, Department of Electrical and Computer Engineering, University of Minnesota, Minneapolis, MN.

I would evaluate this project as satisfactory on an S/N scale.

The report discusses on design parameter, the modulation frequency, from the point of view of the suggested application, parking a car. This is necessary, but the author does not discuss the frequency ranges of the componenets he is using, which is definitely important and would show an understanding of the technology involved. For example, a diode laser of the type used in a laser pointer has fundamental speed that ranges well into the GHz scale; however, external and internal capacitances can make that much lower, even down in to the scale that the author uses, and I wonder if some of the waveform imperfections he sees in his plots have anything to do with this issue. Also, many other parameters go into the design that were not even mentioned. Just with the laser, these are wavelength, intensity, materials, etc…, and there are many other components as well. The author's statement that there is only one design parameter is a bit naïve.

When the author discusses his XOR, he simply quotes a paragraph or two from Wikipedia on what it does. I did not get the impression that he would have been able to answer the question, "how does a phase locked loop operate?" Just describing that you found a chip in your garage lab is not really a convincing way to select a PLL if one is trying to show his technical expertise. Now some credit of course should be given to just testing different things until they work,

because that shows significant determination, but then there should have been more of an attempt to develop a deeper understanding of the PLL once the right type had been identified.

Regarding the details of the paper, there are considerable waveform imperfections in Figure 1, and there is considerable ringing in Figure 2, which belies the claim of perfect symmetry. Where did these imperfections come from and how do they impact performance? Also, why was not the device tested on something more realistic than a hand held mirror?

Also, one of the possibilities that the author presents for the errors in the first and last measurement is temperature drift in the crystal oscillator. This is a quantity that is reported in commercial oscillators and can be explicitly calculated to judge the validity of this statement. I suspect that the author's second possibility, that the system suffers from manual positioning error during the measurement, is more likely, but even this does not explains why it would only exist for the first and last points, assuming that he repeated the experiments multiple times to check for accuracy.