Electro-Mechanical LED Oscilloscope

Description

You have just completed designing an LED display which displays a fixed pattern in space. In this project you will convert your display into an oscilloscope. You may use your Altera board to implement the digital logic circuits but all analog circuits must be implemented on a PCB.

Specification

Operation

You scope must:

- Display a 10V p-p signal (-5V to +5V)
- Display a sine, square or triangle wave generated by a signal generator
- Synchronize a repeating waveform so that a static pattern is displayed
- Display the highest possible frequency waveform
- Include a volts/div adjustment just like a commercial scope
- Include a sec/div adjustment just like a commercial scope

Note that in order to display a standing wave, you must implement the “trigger” function of the oscilloscope. You may implement a fixed or an adjustable (optional) trigger point that triggers on the rising slope of the input waveform.

You may use any of the features of the Altera board. For example, it is ok to use the switches, buttons and 7-segment displays to select and display scope settings.

Mechanism

You have already designed a mechanism that is actuated by a DC motor. Identify at least three aspects of your mechanism that could be improved and implement the improvements. You may use an additional 50g of material on 3-D printer. Any quota that you have left over from the first project may be rolled over into this project (150g total per team).

Electronics

Your design will be a combination of analog and digital electronics. Your analog electronics include:

- Driver circuit for the DC motor
- Driver circuit for the LEDs
- Sensor circuit for the optical sensor
- Comparators for converting an analog voltage into a digital value
All analog circuitry must be designed, simulated and layed out using Altium, and implemented on a PCB (not a prototyping board or breadboard).

All digital circuitry must be simulated and implemented using your Altera board. You may not load any 3rd party software on your Altera board. All VHDL code must be written by you. This includes any microcontroller simulator that may have been made available to you in another course.

**Project Deliverables**

**Demonstration**
- 10 minutes total
  - 4 minute demonstration
  - 6 minutes Q&A
- Schedule posted on website - you must be ready to start on time!
- Elect 2 group members to demo project (2 minutes each)
  - Brief description of design
  - Demonstration of working system
  - If system doesn’t work, demonstrate components using stubs & drivers

**Report**
- Report outline available on website
- Appendix must include:
  - Calculations (clearly hand-written is acceptable)
  - SolidWorks drawings of ALL parts
  - Altium schematics of ALL analog circuits
  - VHDL code for digital circuits
  - Simulation waveforms of ALL circuits using Altium for analog circuits and Quartus for digital circuits

**Mark Distribution**
- 100 * (number of students in group) total points
- Include, team name, student names, student numbers and points per student on form
- Hand in prior to demonstration