Electro-Mechanical LED Display

Description

Traditional CRT technology uses magnetically charged plates to direct an electron beam onto individual pixels on a screen, lighting them up in a sequential manner. When done quickly, it appears as though all pixels are lit up simultaneously with a different colour and a continuous 2-dimensional picture is perceived by the viewer.

In this project you will design a mechanism that sweeps a row of LEDs back and forth along a straight line. By turning the individual LEDs on and off at the appropriate time, you will be able to display a 2-D image. Your mechanism will run at a constant speed in open-loop fashion and will use an optical sensor to detect when your mechanism is at its starting point so that you know when to begin displaying your image.

Specification

Mechanism

You will design a mechanical linkage that is actuated by a DC motor that moves its end-effector back and forth in a linear fashion. These types of linkages have been used for decades to drive locomotive wheels using a pneumatic piston.

Alternatively, there is a simplified planetary drive that converts rotary motion to linear motion. Visit the link on the “Handouts” page of the course website to see how it works.

You will design all of your mechanical parts using SolidWorks and build them by hand in the Thunder Lab or on the 3-D printer in the Lightning Lab. Information is available on the “Tools” tab on the course website. You can download and run SolidWorks on your personal computer. Load the software and verify your connection to the department license server ASAP to avoid delays when you need to use it.

A selection of small DC motors will be made available for you to choose from or you may provide your own from an old broken toy, tape deck or appliance. CAUTION: there are many
different types of motors that work in completely different ways. If you have a motor that you want to use, show it to the course instructor or a TA to verify that it is the correct type.

Display

Your display will comprise 8 or more LEDs mounted to the platform of your mechanism. Turning them on and off while they are swept from side to side will create the appearance of a 2-D image.

You will be provided with an optical sensor so you can determine when the linear stage is at its starting position. It is up to you whether your device displays while moving to the left, or the right or both.

Electronics

You will have to design the following electronics:

- Driver circuit for the DC motor
- Driver circuit for the LEDs
- Sensor circuit for the optical sensor
- Logic circuit for displaying a static pattern

The motor driver circuit should operate the motor so that it rotates at a constant velocity. Since the motors are DC motors, this needs to be a constant voltage source. Note that the required voltage to maintain a desired velocity will increase with the mechanical load (weight, friction, etc.) on the motor and you would normally compensate for this with a feedback system. If you are in Electrical Engineering, you will learn more about this in 3rd year (ECE 360 & 373) but you will just have to find the voltage that works best for now.

The LED driver circuit should switch the LEDs on and off and apply the rated current when they are on so that they are bright enough to see clearly.

The sensor circuit should monitor the optical sensor and send a trigger pulse to the logic circuit to begin displaying the desired pattern when it detects that the platform is at its start position.

The logic circuit should contain memory elements (flip-flops) so that a static pattern is displayed. A state-machine would work well for this purpose. You may not use your Altera board to implement the logic circuit. You must use ICs only and may display any static pattern you wish. You may optionally display a moving pattern (i.e. a stick man walking) by changing the pattern that is displayed each time the mechanism begins a new sweep.

You will design all of your electric circuits using Altium and solder them onto a prototyping board. Information is available on the “Tools” tab on the course website. You can download and run Altium on your personal computer. Load the software and verify your connection to the department license server ASAP to avoid delays when you need it.
**Project Deliverables**

**Demonstration**
- 10 minutes total
  - 4 minute demonstration
  - 6 minutes Q&A (1 minute per group member)
- 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 components
  - Demonstration of working system
  - If system doesn’t work, demonstrate components using stubs & drivers

**Report**
- Report outline available on website
- Appendix must include:
  - SolidWorks drawings of ALL parts
  - Altium schematics of ALL circuits
  - Simulation waveforms of ALL circuits

**Mark Distribution**
- 100 * (number of students in group) total points
- Form available on website
- Hand in during demonstration