Revised: August 17, 2018

EE 354 **Assigned: October 22, 2018**
Project 2 **Due: December 3, 2018**
Hour Glass, Pachinko, and Water Waves

Description
For this project you will simulate sand falling through an hour glass, a pachinko machine, and water waves using two 8 x 8 LED matrix displays (total of 128 LEDs) and an accelerometer configured as a level sensor.

Hour Glass
Figure 1 shows what the hour glass simulation might look like on your LED display. The red dots are the LEDs that are on and represent the falling sand. The black dots are the LEDs that are off and show the borders of the hourglass configuration.

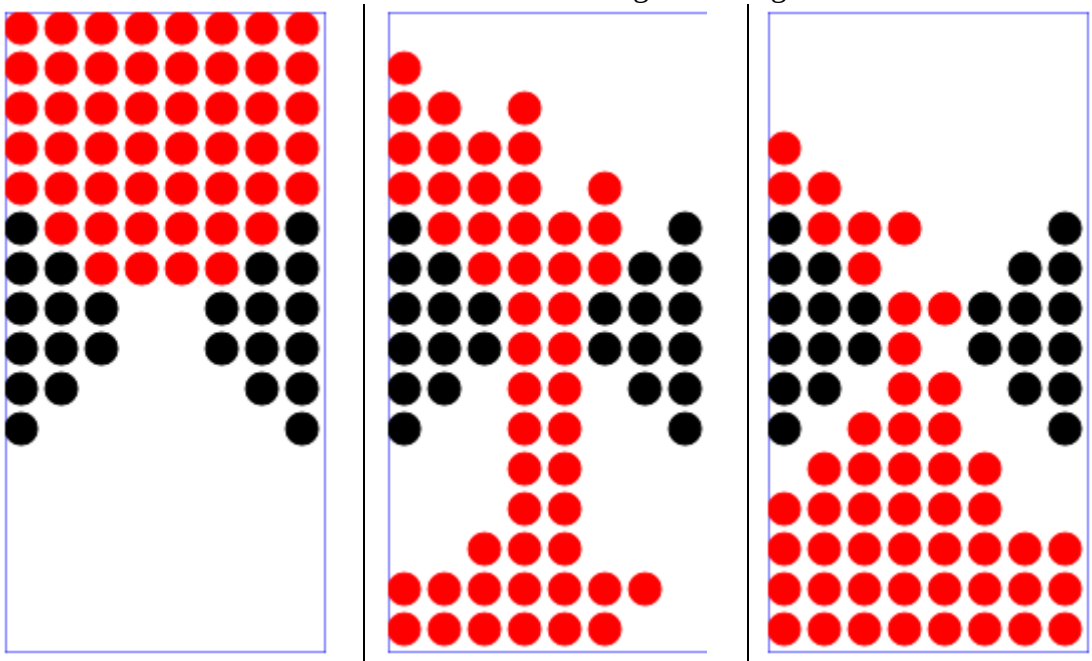

Figure 1
Sand falling through an hour glass. Sand is represented by red LEDs. The three figures show a sequence as the sand falls through the hour glass. You may want to add a clear piece of plastic with black on it to show the boundaries and the black dots.

Your hour glass must be sensitive to gravity so that if it is turned upside down the sand falls in the other direction. This should happen even if the sand has not all fallen through – that is you turn it over before it completes. Likewise, if you turn the hour glass on its side the sand should fall to that side.

Pachinko
Figure 2 shows a simulation of a Pachinko machine in which balls fall from the top into piles at the bottom taking a random path.

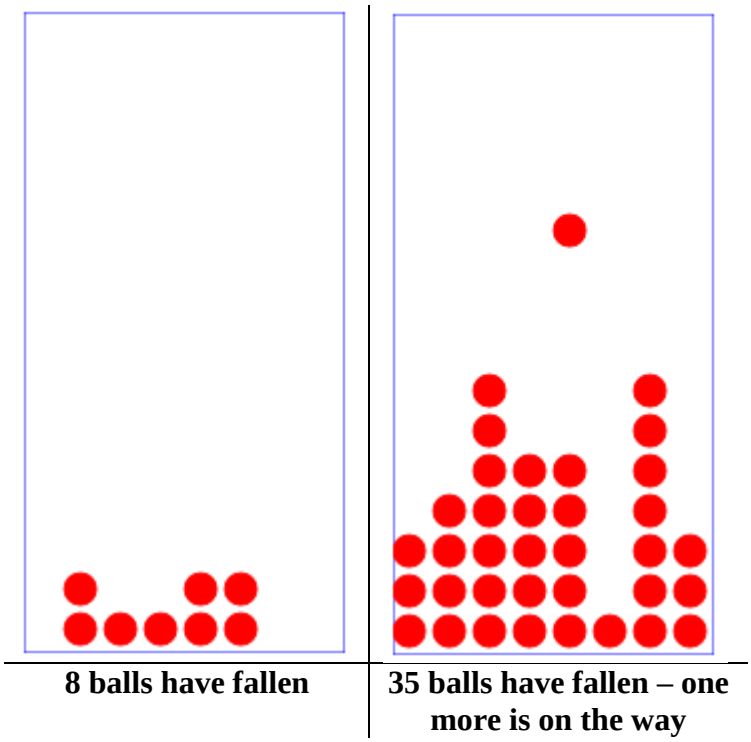

Figure 2
Pachinko machine. Balls fall from the top. As each ball falls it moves down going randomly left, right or straight down.

The pachinko balls must be sensitive to gravity and fall in whichever way the game is tilted – left, right, up, or down.

Water Falling
Figure 3 shows one arrangement for a falling water display. The black dots represent LEDs that are off and the blue dots represent LEDs that are on (yours will be red). In Figure 3 there are two "shelves" and the water flows over them from top to bottom. Many other arrangements are possible and this is left up to you. Your water flow must be sensitive to gravity so that the water flows which ever direction is down.

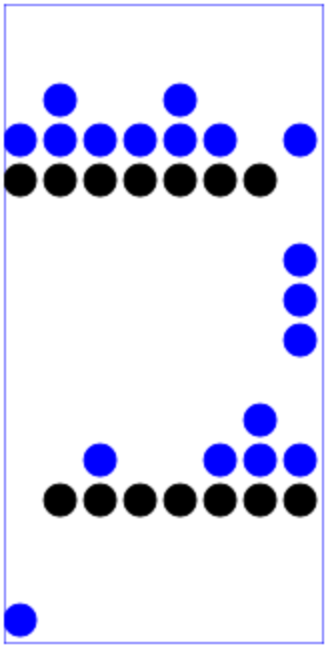

Figure 3
Flowing water. The blue balls are water and the black represent a shelf. You may want to put a clear piece of plastic over your display with black dots on it for the shelves.

LED Arrays
LEDs
We will use two arrays of LEDs where each array has 8 x 8 diodes arranged in a square. A typical 8 x8 array is available here:
https://www.datasheets360.com/pdf/4368546661359715048

The CLM-1588B array is 1.5 inches square and we will use this in class. There are other arrays available in different sizes and colors. See Jeff Cron if you would like to get something different for your project.

The physical arrangement of the LEDs and a circuit diagram for a single 8 x 8 array is shown in Figure 2.

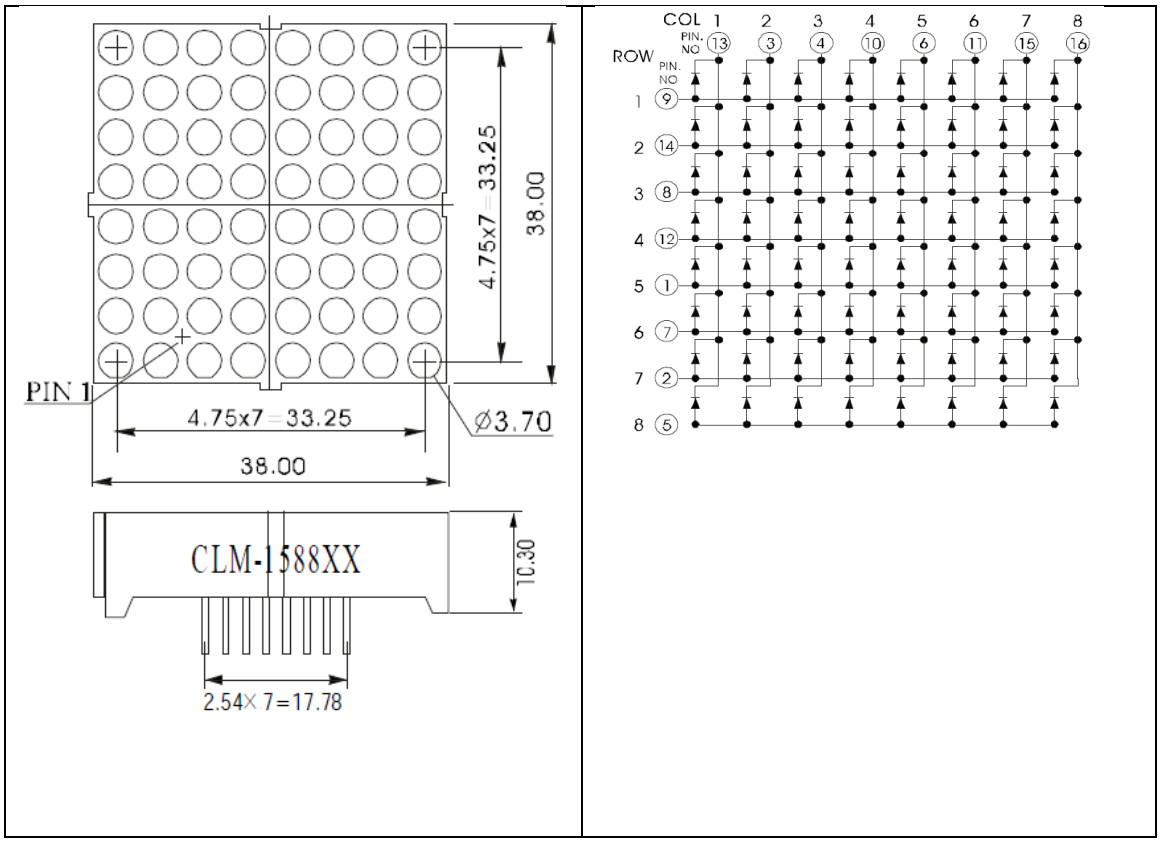

Figure 2
An array of 8 x 8 LEDs. Note that there are 64 diodes but only 16 pins where each pin is a common cathode or common anode for 8 LEDs. By making a cathode line low and an anode line high you can turn on any one LED. This is the pinout for the CLM-1588B array. Other arrays that look similar may have a very different pinout.

Specifications

1. The game container which you build must fit within a container that is no larger than 6" x 8" x 2". Nothing may extend beyond this boundary – this include switch handles, knobs, LEDs, etc.
2. The game must be completely self-contained and battery operated.
3. The game must be sturdy enough to survive a ***six*** foot drop onto a concrete floor.
4. You must use the ARM stm32F446 Nucleo board to drive your hour glass.
5. You must have a method for the user to turn the game on or off, reset the game to start over, and select which game is being displayed such that the user does not have to open you container.
6. Your container must be relatively water resistant. For testing purposes 8 ounces of water will be poured over each game while it is running. This water must not impede the game in any way.
7. Your container must be secure and should not rattle when shaken.
8. You must provide a mechanism for changing the batteries that does not require disassembly. Removing one or two screws is acceptable.
9. Your software must contain at least one subprogram in C and at least one subprogram in 8051 assembler.

10. Your project must consider the following factors in the design: safety, manufacturability, economic, environmental, and reliability.

Variations on the original hour glass are encouraged.

Grading:

This project will be done individually and a single grade will be given for each project. A total of 100 points is available for the project and will be awarded on the following basis:

Points	Item
25 points	Does your project work and meet specifications
15 points	Creativity and novel added features
15 points	Finished product quality
15 points	Documentation of software
15 points	Documentation of hardware
15 points	Other documentation

The project report should consist of:

- A cover sheet with your name, the project number and title, and the date turned in.
- A list of novel features. Creativity may consist of novel hardware or software implemented features or a novel packaging technique.
- A list of those items you were able to demonstrate as working to the instructor.
- A discussion of how you considered safety, reliability, economic, manufacturability, and environmental factors.
- An estimate based on theoretical and empirical data as to the power requirements.
- Hardware documentation.
- Software documentation.

At a minimum your hardware documentation must consist of a system diagram, a complete circuit diagram (with pin numbers), and a mechanical sketch or photo of your project done to a level of detail such that another person in the class could build your project from your diagram. At a minimum your software documentation should consist of fully commented source code for all of the modules in your program and a pseudocode design with enough detail that another person in the class could duplicate the function of your software.

The grade for this project will be based on what is complete and handed in as of ***11:00am on December 3, 2018. No late grades will be given.***