LED Matrix

Core Concept Instructor Set

nPoints
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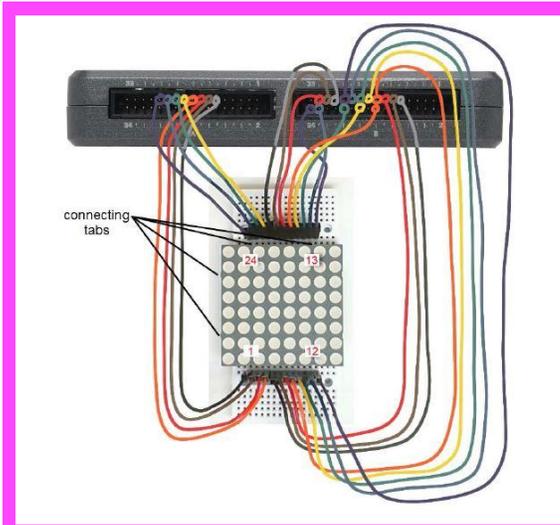
Example: Final LED Matrix Circuit

Materials:
myRIO
LED Matrix

"…used to in sports score displays and road signs."

Learn It!

An LED matrix is an 8x8 grid with a single green LED and red LED behind each circular dot. The LED matrix uses the same row/column wiring scheme as the keypad in chapter 25 with the two column lines and a shared row line. The shared row line is a shared ground for the LED's on a particular row. The column lines on the top and bottom provide anode lines for the red and green lights in each column.

By grounding a particular row and providing current to a particular column or set of columns on can make individual LED's light up.
LED Matrices are common display interfaces, used to in sports score displays and road signs.
In this exercise you will interface myRIO with an LED matrix, and learn some fundamentals of LED matrix display.

Build It!

The LED Matric interface requires two connections for each column, one for red and one for green, as well as a connection for each row providing a ground.

Creating a LED Matrix Circuit

Step 1: Connect the LED Matrix as indicated in the circuit diagrams. The LED Matrix requires twenty-four connections across both of myRIO's MXP A and MXP B ports.

Step 2: Open the LED Matrix demo folder and the LED Matrix project (LED Matrix demo.lvproj). Open the VI titled "Main.vi" (Figure 1). On the front panel are two control arrays, which should look like the LED matrix hardware component (Figure 1). The right matrix corresponds to the green LED's and the left corresponds to the red LED's. There is also a slider control to set the loop time, allowing the user to adjust how long the colors are pulsed onto the matrix.
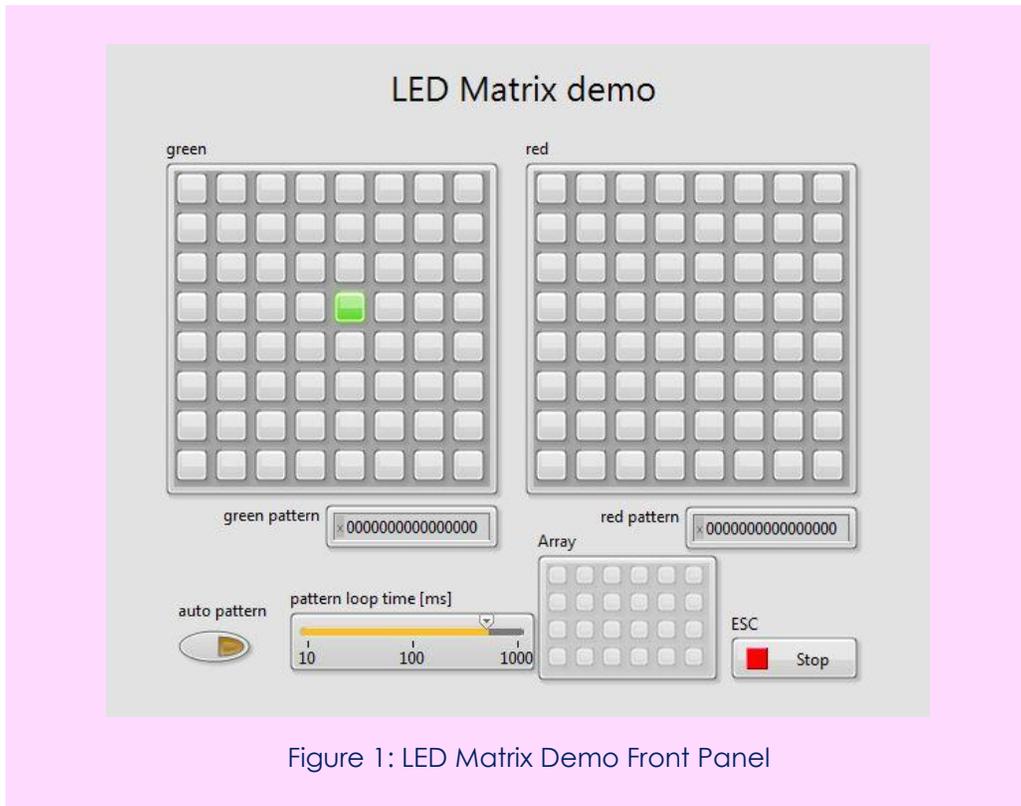
Figure 1: LED Matrix Demo Front Panel

Guiding Questions:
- The matrix uses column and row illumination to light up individual LED's. Are there any limits to the characters that can be displayed?
- You can create Red and Green displays, can you think of a way to generate any other colors?

Step 3: Run the VI. The VI should begin in the "auto pattern" mode. The LED's will refresh and change every half second. Adjust the pattern loop time control and observe the difference this makes.

Click the "auto pattern button on the front panel to disable this feature. Try clicking one of the LED controls in either the red or green set. The corresponding LED should illuminate on the actual matrix. Try illuminating a particular LED in both colors. What happens?

Step 4: Examine the code in the block diagram of the Main VI. The VI contains three while a loops, one corresponding to the "auto pattern" case, another to a manual selection case and the last writes these signals to the matrix. In auto patterning, the VI uses array manipulation to generate the pattern seen on the matrix. In the manual case the pattern is chosen by the user using the controls on the front panel. Writing is accomplished by using the myRIO's digital outputs. For more information on the code, see the programming VI's in the "References and Guides" section.
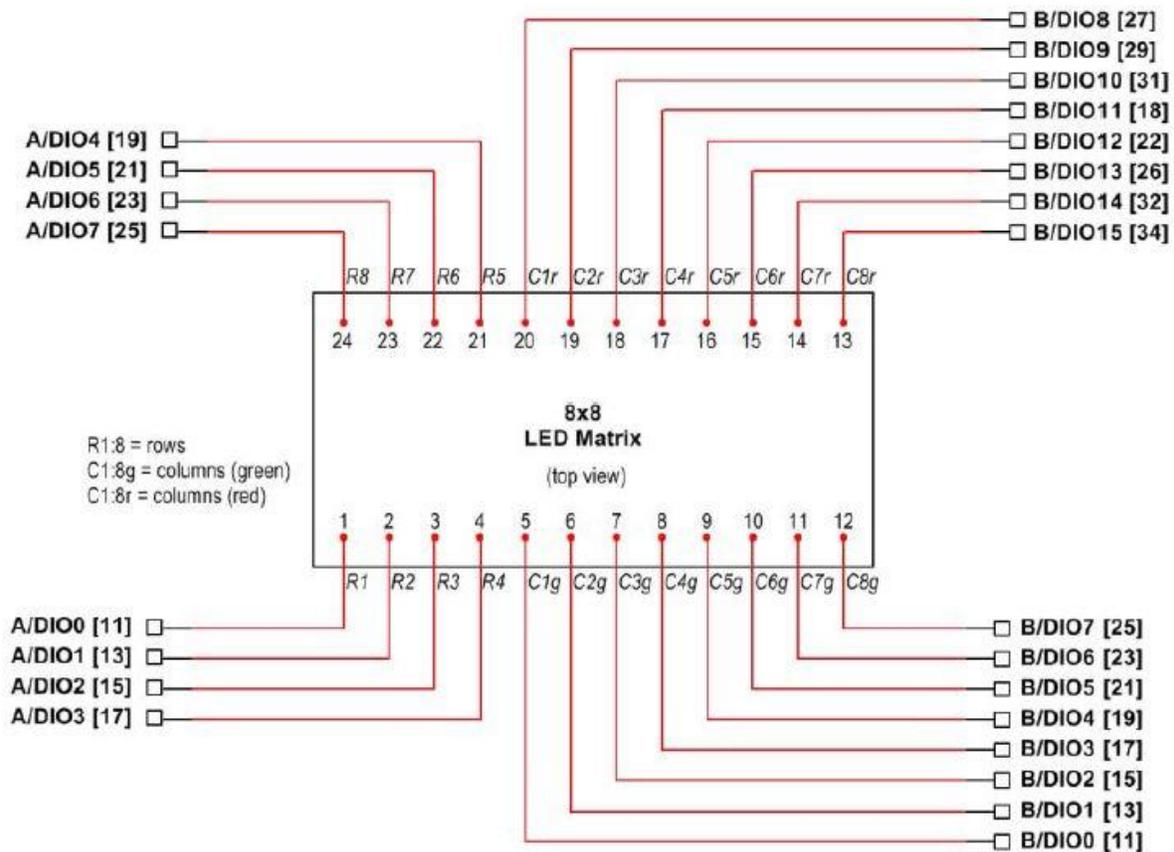
LED Matrix-Circuit Diagram

Expand it!

- Finish the "Auto pattern generator" loop and update the main loop to add a pattern codes array for the red LEDs.
- Create a set of 64-bit pattern codes to make your own animation, and then update the 1-D array constant in the "Auto pattern generator" loop. You may find it more convenient to change the constant to a front-panel control. You may also want to use "Array Size" from the Programming | Array sub-palette instead of the constant "4" to make your code accommodate an arbitrary number of 64-bit patterns.
- Think of a way to map one or more measurements such as the onboard accelerometer output or analog input voltages onto the display. For example, you could make eight bar graphs to show eight analog input voltages, or you could map the X and Y outputs from the accelerometer onto a Cartesian grid. Your mapping destination is the 2-D Boolean array global variables.
- Add a pointer slide to vary the loop time of the timed loop: pull down on the "Right Data Node" on the upper-right interior of the timed loop to expose the "Next Loop Iteration Timing" terminal (appears at dt), and then create a front-panel control to interactively adjust the loop time. Set the lower limit to 1 ms to avoid selecting 0ms (this hangs the application).

- Observe the effects of jitter on the display: change the timed loop to a standard while loop (right-click on the loop frame and select "Replace with While Loop") and then add a 1 ms time delay. You should notice that the display intensity has a slight random flicker because the real-time processor now has more freedom to process background tasks. The timed loop, on the other hand, guarantees a precise loop time.

Research it!

Study the video LEDMatrix Interfacing Theory (youtu.be/vsBjZBLdeNc, 9:51) to learn more about the LED matrix wiring diagram and pin connections, electrical interfacing (especially the substantial voltage/current mismatch between the red and green LEDs), and the raster display technique that permits an arbitrary pattern of dots to be selected.

Study the video Bluetooth Demo Walk Through (https://www.youtube.com/watch?v=vsBjZBLdeNc&feature=youtu.be, 15:08) to learn the design principles of LED Matrix demo

Study the video Digital Output Low-Level VIs (youtu.be/WvnInG3ffqY, 4:53) learn how to use the low-level VIs to connect Boolean arrays directly to the digital outputs, i.e., as a bus.

8x8 LED Matrix Datasheet by SparkFun ~ Datasheet for the 8_8 LEDmatrix:
http://www.sparkfun.com/datasheets/Components/SanYoung-Medium-RG.pdf

MAX7219 LED Display Driver with SPI Interface by Maxim Integrated s Includes power transistors and raster display controller to completely offload the detailed control of each LED. Simply send the patterns via the SPI serials bus:
http://www.maximintegrated.com/MAX7219s