**LED MATRIX DISPLAY**

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* **Introduction**

LED Matrix are used to display the patterns alphabet etc. In a matrix format, LEDs are arranged in rows and columns. All the columns are positives of the LEDs (all the anodes are connected in that column) and the rows are negatives (all the cathodes are connected bridging over the anode in the row).

**Application**

* Single color and bi-color tiles
* LED arrays (composed of LED lamps, chip LEDs, etc.)
* LED video screens
* Moving message panels

**Components**

* 200 LEDs
* 3 x 74HC595 shift registers
* 24 resistors
* 8 x 1k resistors
* 8 x 2N3904 transistors
* 1 x 4017 decade counter
* 1 x Arduino board or Atmega 328 chip.

**Role of shift register**

The use of shift registers minimizes the number of I/O pins required to drive the columns of the LED matrix. For driving 24 columns separately, we need 24 I/O pins of arduino , however, with the use of 74HC595 ICs, this number is reduced to 3. 74HC595 is an 8-stage serial-in, serial or parallel-out shift register, with a storage register. The shift register and storage register have separate clocks: SH\_CP (pin 11) and ST\_CP (pin 12). Data is fed serially into the register through DS pin (14) and is shifted on the positive-going transitions of the SH\_CP input.

**Role of counter**

Eight I/O pins are required to scan 8 rows in sequence. A port expander, such as CD4017 (counter), can be used for this purpose which uses only two I/O pins of arduino. The counter is cleared to zero count by a logical “1” on its reset line (15). The counter is advanced on the positive edge of the clock signal (pin 14), when the clock inhibit (pin 13) is grounded. The 8 decoded outputs are normally in the logical “0” state and go to the logical “1” state only at their respective time slot. Each decoded output remains high for 1 full clock cycle. The carry-out signal completes a full cycle for every 8 clock input cycles and is used as a ripple carry signal to any succeeding stages. The 8 rows of LED matrix are sequentially connected to the decoded outputs, Q0- Q7, of CD4017 through 8 transistors each of which provides a ground path to sink the combined current of all LEDs in a row. At the end of every 8th clock cycle, the arduino will reset the counter by issuing a logical “1” to its Reset pin (15).

**Working (Considering a 24x8 LED matrix)**

To display the alphabet A(any and every character will occupy 8x8 grid), first the row R1 is selected (which means R1 is pulled low in this case), and deselect other rows by blocking their ground paths (one way of doing that is by pulling R2 through R8 pins to logic high). Now, the first row is active, and the LEDs in the column C2 through C7 of this row are to be turned on, which can be done by applying forward bias voltages to these column. Next, select the row R2 (and deselect all other rows), and apply forward bias to C1 and C8, and so on. Therefore, by scanning across the row quickly **(> 100 times per second)**, and turning on the respective LEDs in each column of that row, the persistence of vision comes in to play, and we perceive the display image as still.

Arduino provides a 24 bit serial output, which is given as input to 3 serially connected shift registers, which then converts it into 24 bit parallel output. This output is then fed to the 24 columns of LED matrix display.

Arduino also provide input to CD4017 counter which is then supplied to the rows of LED matrix through transistors.

