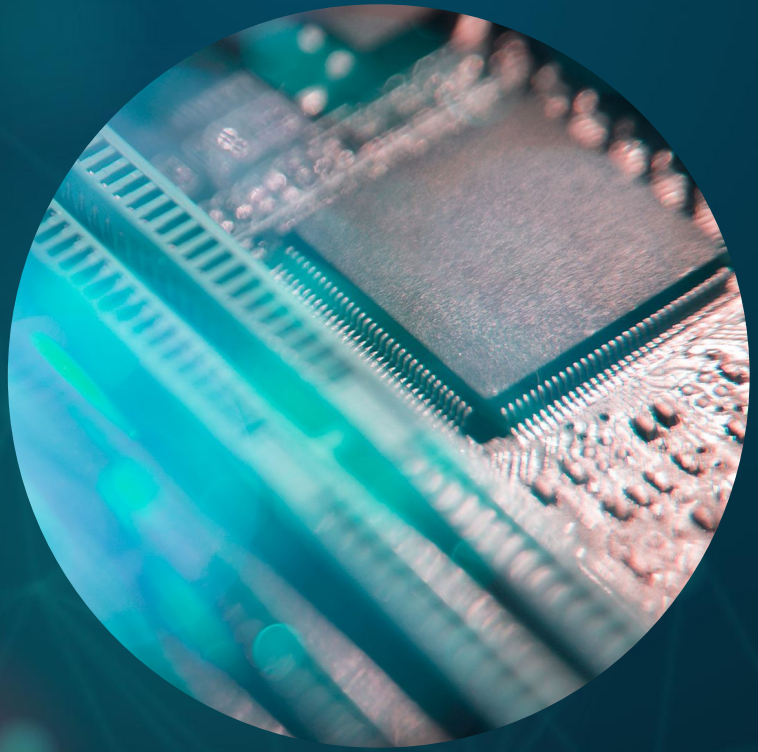
IMT SCHOOL

ARM Based Microcontroller

LED Matrix

Lecture 8



Advanced RISC Machines

IMT SCHOOL

Introduction 01

Light Emitting Diode Matrix

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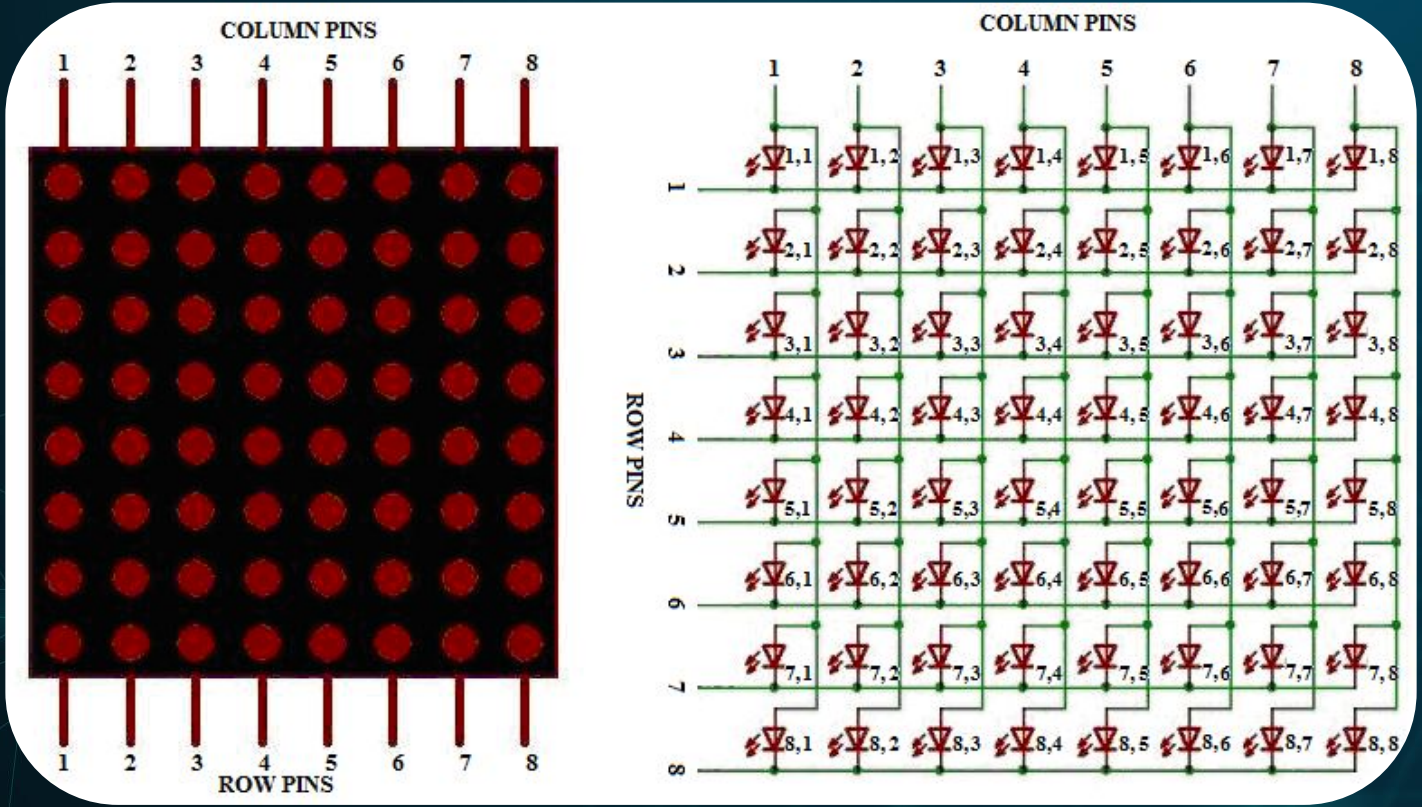
LED Matrix Display

A dot-matrix display is an electronic digital display that uses many LEDs arranged in a matrix to display numbers, alphabetic characters and shapes unlike 7-segment displays that can be used for displaying numbers only.

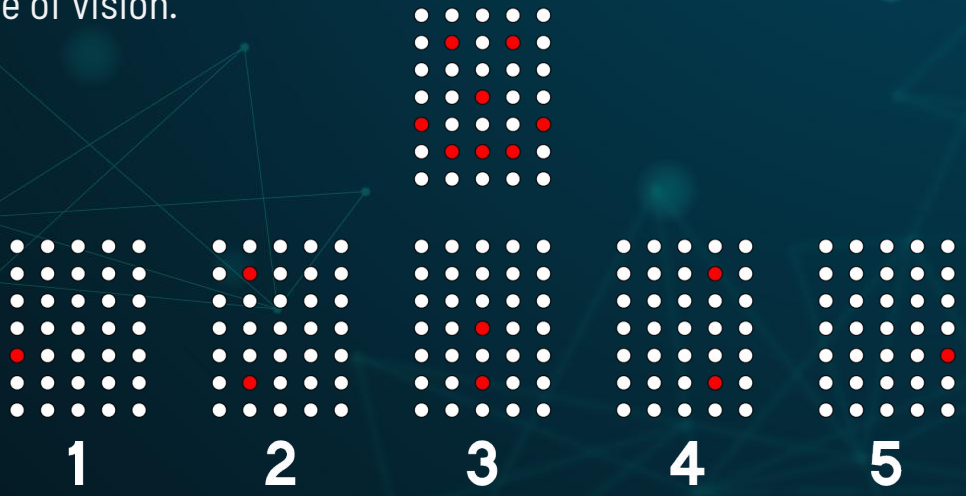
In a LED dot matrix display, the LEDs are located at the column and row intersections of the matrix. LEDs in the same row are connected together as are LEDs in the same column.

LED Matrix Display



Concept of Operation

The Dot Matrix Display is mainly characterized by its type, size and color. As mentioned before, its type may be CCAR or ACCR. The size of is defined by the number of columns x number of rows. 5x7 Led Matrix is a display that has 5 columns and 7 rows. The color of the display is depending on the type of the used LEDs. It may be monochrome, which uses only monochrome LEDs, or RGB display, which uses RGB LEDs. The basic operation concept depends on multiplexing the LEDs. It means turning on one led for a short period and doing this repeatedly for each LED. If you do this fast enough then your eye will not notice any flicker. This concept is called persistence of vision.



Concept of Operation

The previous figure shows the operation principle. This is an example of 5x7 Matrix display.
The final desired image is the smiling emotion. To display this image we will control each column individually. The process starts by activating column by column, and turn on the LEDs for each column according to the desired final image.

Detailed steps are listed below:

1. Activate Column 1, Turn on Row 5
2. Activate Column 2, Turn on Row 2 and Row 7
3. Activate Column 3, Turn on Row 4 and Row 7
4. Activate Column 4, Turn on Row 2 and Row 7
5. Activate Column 5, Turn on Row 5

Doing these steps in a fast way will show the final image clearly.

Timing Calculations

From the previous example, we can observe that each column will be turned on for one time, and turned off four times. However, in the final image we need to see each column is always turned on. How can we do that ?

The persistence of image theory means the effect that vision seems to persist continuously when the light that enters the eyes is interrupted with short and regular intervals. By many experiments, 50-60 Hz is the optimum safely frequency used for human eyes. It means that if any column were turned on 50 times in a second, human eye would see it continuously on.

For 5x7 display, there are five columns each one needs to be turned on 50 times (Assuming working on 50Hz). The total number of scenes needed is 5 muliplied by 50 which results 250 Scene. So the scene time is equals to 4 ms.

Timing Calculations

To generalize the rule, the wait time could be calculated according to the following equation:

$$\text{Scene Waiting Time in Seconds} = \frac{1}{\text{Number of Scenes}}$$

While the number of scenes could be calculated according to the following equation:

$$\text{Number of Scenes} = \text{Number of Columns} \times \text{Frequency}$$

OR

$$\text{Number of Scenes} = \text{Number of Rows} \times \text{Frequency}$$

Note that the LED Matrix display can be Column controlled by activating column by column and turn on LEDs for each one or Row controlled by activating row by row and turn on LEDs for each row.

STM32 Is AWESOME

Session LAb

Create **LED-Matrix** Driver

Time To Code

THANKS!

Do you have any questions?

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