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LED Matrix Display

Using LED matrices, a simple display can be created. A display of 7 rows and 25 columns was made using the following: 5 7x5 LED matrices, 32 npn transistors, 32 4.7kohm resistors, 6 protoboards, a PIC16f870 microcontroller, 5 volt DC power supply and a copious supply of wire. The microcontroller is programmed to light up the individual LED's sequentially to created the desired message. Transistors are used to insure sufficient current is supplied to the LED selected by the microcontroller.

LED matrices are arranged on a protoboard in a row, creating a 7 row, 25 column LED grid. The 7 rows are controlled by the following pins, starting from the pin 1 side row: 9, 14, 8, 12 or 5, 1, 7, and 12. Notice the fifth row can be controlled by either pin 12 or 5. This is one of two redundancies in the LED matrix. The other occurs with pins 11 and 4, which control the middle column. The 7 row pins are the cathode connections. The 5 rows constitute the anode connections of each LED, which are, starting from the top of the LED matrix, pins: 13, 3, 11 or 4, 10, and 6. The pin-out varies from one LED matrix to another. Before wiring the display, the proper pin-to-LED relationship should be determined, as it may vary from the pin-out listed above. Connecting a row and column pin will light the LED corresponding to an intersection of that row and column. Of course, if current is sent to more than one row and/or column, multiple LED's can chosen.

The LED matrix is operated one column at a time. With each column, specific rows are also chosen depending on the character that will be spelled out. Then the next

column is chosen, and the cycle continues. This cycle may be repeated as long as that specific character should be displayed. The fast clock speed of the microcontroller, which is faster than the human eye can discern, causes the cycling columns to appear as if they are one solid image. In fact, to make an object move across the display, delays must be added to slow the movement between columns.

The columns and rows are controlled by PORTC and PORTB of the microcontroller, respectively. A row may be selected by setting the corresponding bit of PORTB. Rows, in this report, are numbered from bottom to top, corresponding to bits 0 to 7, respectively. Columns, on the other hand, must be multiplexed. There are twenty-five columns, which will required two four-to-sixteen multiplexers. In this report, columns are numbered, from left to right, zero through twenty-four. Columns 0-15 are directly connected to one multiplexer. The remaining nine columns are connected to the other multiplexer. The columns are operated by the five lowest significant bits in PORTC. Each multiplexer controls no more than 16 columns. Since the first column is considered to be 0, each multiplexer will not have to count higher than 15, thus requiring only four bits. The fifth bit used PORTC is used to select which multiplexer should be used. This is accomplished by bit 5 to the inhibit pin of the multiplexer, with a not gate between the PORTC and second multiplexer. Therefore, if PORTC equals 10000. The zeroth column of the second multiplexer is selected, or the sixteenth column in the whole matrix. This arrangement allows all columns to be scrolled through successively by simply incrementing PORTC. An example of lighting a column completely is sending 1010101 to PORTB and 10 to PORTC which would light up every other LED in the second column, keeping in mind the numbering system here beginnings with zero.

As has been illustrated, multiple LED may be illuminated simultaneously. Therefore it is important that the LED's are supplied with enough current so that they may be seen. To accomplish this, transistors are used between the microcontroller and both cathode and anode connections of the LED's. The circuits are shown in Figure 2. In this particular circuit, 4.7kohm resistors were used. However, lower resistance is suggested, as this particular setup was, at times, a bit dim.

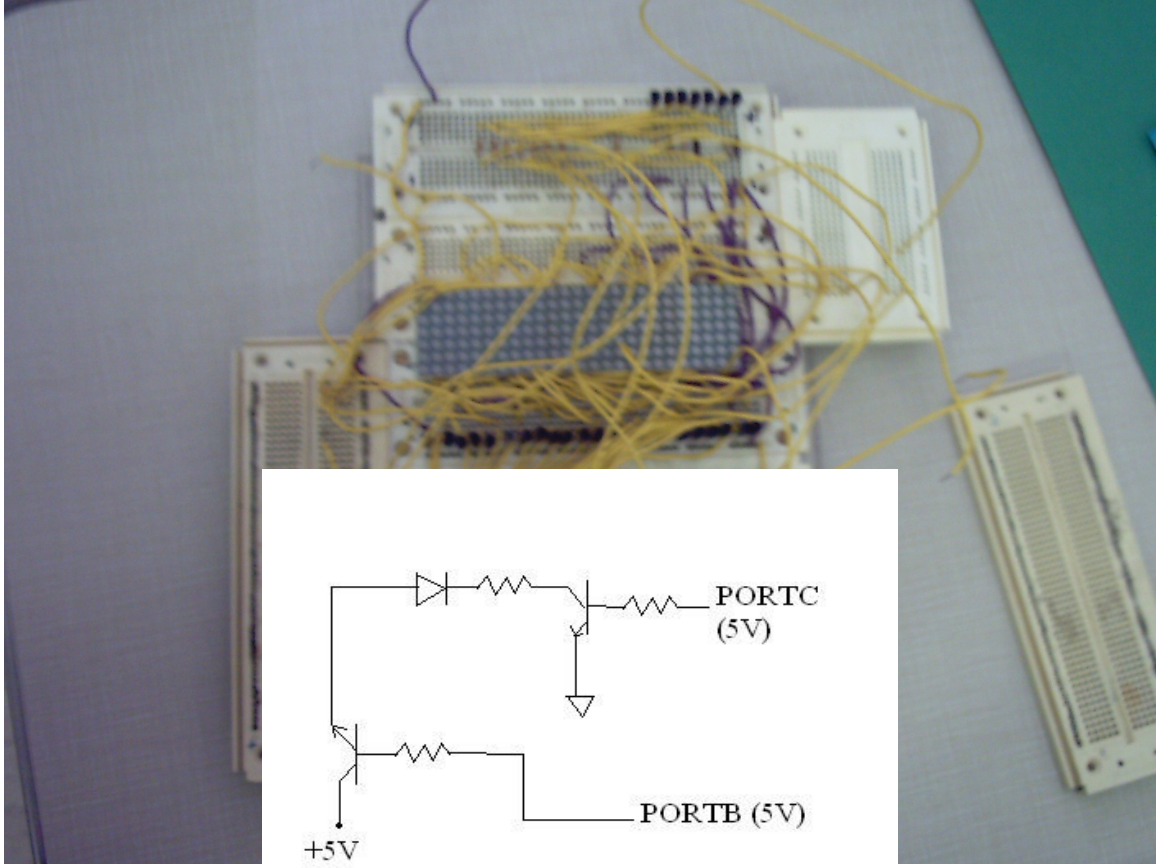

Figure 1

Figure 2