Matrix Touch Screens

PROPOSE:
This applicationnote describes the construction, operation and use of a digital matrix touch screenused in conjunction with a graphics LCD flat panel.

GENERAL:
A touch screen is a thin transparent device that is placed in front of a display, an LCD in this case. It has an array of virtual buttons on its surface and is used to replace mechanical switches. It has several advantages over the mechanical switches it replaces.

First, its intuitive. It is natural for the operator to touch the words or pictures on the display to select the function depicted.

Second, its is versatile. The designer canverythenumberofdisplayedbuttons,iconsor words as needed. This eliminates the need for a keyboard or mechanical switches. It also allows the designer to change the shape or legend on the displayed buttons byasimple software change rather than a costlychange in the hardware.

Third, its less costly toplacemost or all of the human interface in a single programmable device.

THEORY OF OPERATION:
An LCD touch screen can be thought of as an array of transparent pushbutton switches placed in front of a graphical display.

There are a number of technologies inusetoaccomplish this. The two most commonly used with an LCD displayaretheresistive analog and the matrix digital type. This applicationnoteislimited to describing the matrix type. The matrix display is anarrayof mechanical contacts connected in an X/Y matrix. See Figure 1.

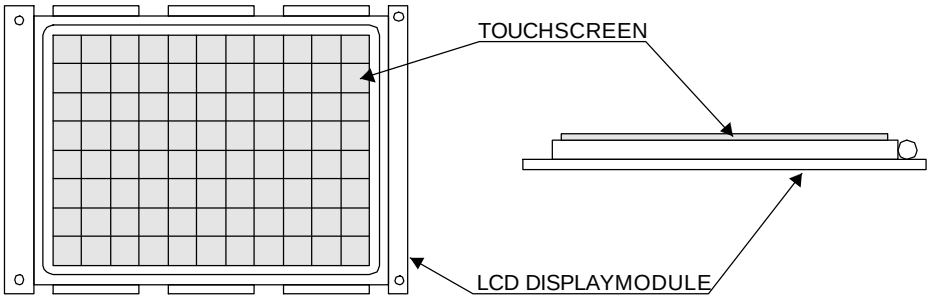

Figure #1

The touchpadisconstructed of a sheet of glass with transparent metal contacts platedonto it. A layer of flexible spacers is next applied to the glass in the area between the contacts. A layer of flexible Mylar with transparent metal contact is next bonded to the sandwich. One layer of contacts are connected together and become the columns and the other layer of contacts become the rows. All the connections are thenbrought out to a connector. See Figure 2.

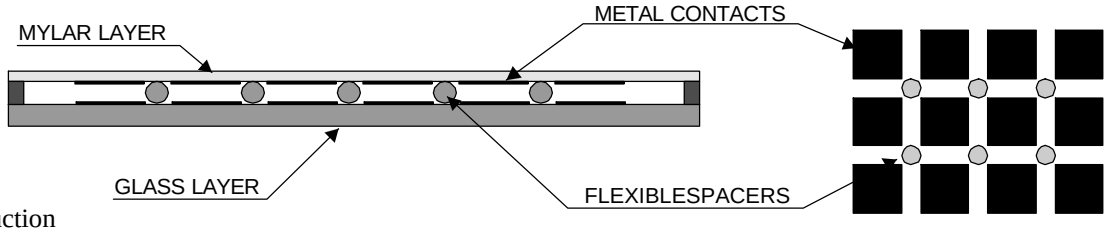

Figure #2
Touch Screen Construction

HARDWARE AND SOFTWARE:

The touch screen is normally interfaced to a micro controller via its parallel ports. As an example consider a 5 column by 3 row touch screen. See Figure #3. The 5 column lines and the 3 row lines are connected to an 8 bit port. The matrix is then scanned via software.

The I/O port is configured with the 5 column lines as inputs with the internal resistance of the port providing a pull-up to V_{DD}. The row lines are configured as outputs. A 0 is placed on R1 and 1's are placed on R2 and R3. The 5 column lines are then read. If no key is pushed the 5 column lines will be 1's. R1 is set to a 1 and R2 is now set to a 0 and the column lines are again read. Let's assume the switch at the intersection of R2 and C3 is depressed. When the column lines are read they will be 1's except for line C3 which is a 0. We now know that the pad at C3, R2 is depressed. This process continues until all three row lines have been scanned. This process can be repeated indefinitely.

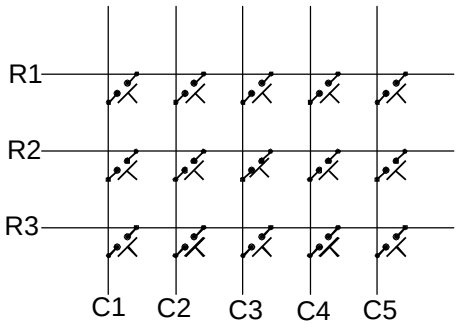

Figure #3

TYPICAL APPLICATION:

In this discussion we are going to place a simple menu with 4 buttons on a 320 x 240 LCD display with a 70 position touch panel (HDM3224TS-1). The first step is to design the menu with the button icons. See Figure #4. The button icons should be positioned directly under the touch pads. A button icon can be covered by more than one touch pad as shown in Figure #4.

Step two is to select the touch pad address or addresses for each button icon. In our example the buttons are assigned touch pad addresses as follows;

"SLOW" = C2,R7
"MEDIUM" = C2,R5
"FAST" = C2,R3,
"STOP" = C9,R2 or C10,R2 or ..... C9,R7 or C10,R7

The final step is to assign a program vector to each of the touch pad addresses listed above. Because of the dynamic nature of this interface the button color or shape can be altered when it is being depressed to give the operator a visual feedback that the action indeed took place.

The entire display can be changed as needed as well as the number of displayed buttons and their position and function. This is the most versatile and intuitive human interface possible.

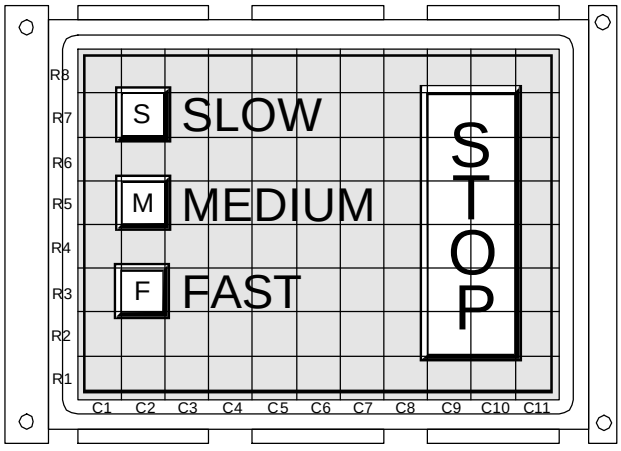

Figure #4
A typical application