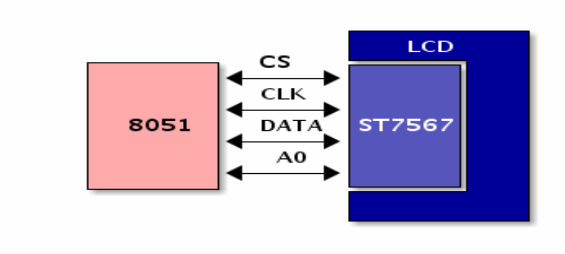
GRAPHICS LCD INTERFACING WITH 8051

It may require some graphics image to be displayed in 8051 based products through a monochrome bitmap LCD. This is considered to be a complex task because of its bus interfacing and several command sequence handling. This article explains how a graphics LCD from TIANMA can be connected to a 8051 micro-controller and pixels can be displayed on it with simple steps.

Theory

Consider interfacing the TIANMA TM12864J1CCWGWA LCD 128x64 pixels module based on the Sitronix ST7567 lcd controller with NXP's P89V664 8051 micro-controller. The LCD module provides **SPI** interface to host(micro-controller) communication. We can use **GPIO** pins of micro-controller to interface with LCD module instead of SPI pins of micro-controller for convenience. We may need to bitbang the data through gpio lines to get the SPI communication over gpio.



LCD Interfacing

Description

The LCD module has a internal memory and a control circuitary, to map the pixel information from the internal memory to LCD display. The internal memory and control circuitary can be accessed by the micro-controller through the SPI bus. The communication to LCD module from the micro-controller are classified as two type of transaction modes as described below.

Control Mode	This supports sending commands to intialize and configure the LCD parameters.
Data Mode	This supports sending the pixel information to be displayed in the LCD

Control Commands

The LCD module need to be configured and initialized with a set of commands by the micro-controller. These commands has to be sent to the LCD module one by one in sequence. The sequence can be found in the data sheet of LCD module.

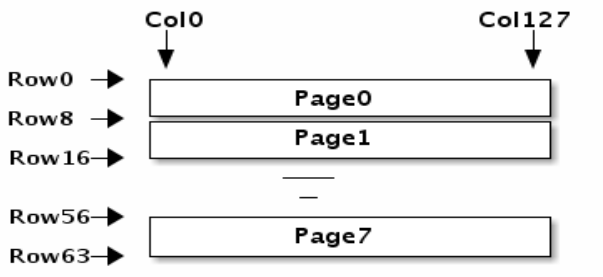
The mandatory control commands to initialize the LCD are listed below.

START_LINE	to set the start line of the display
INVERSE	to inverse 1’s to 0’s and 0’s to 1’s pixel buffer

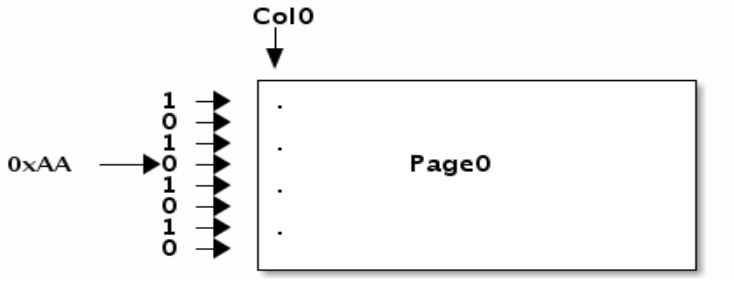
COM	to change the pixel orientation from left to right or right to left
SEG	to change the pixel orientation from top to bottom or bottom to top
PWR_CTRL	to enable internal power controllers
RR & EV	to set the display brightness
DISP_ON	to enable display

Pixel Data

The pixel data should be sent through the bus by choosing the data mode. Before sending a pixel data, we may need to select the exact page and the column where to display the data sent. LCD pixels are organized, such a way that 8 rows are combined as a page, thus forming 8 pages as the LCD supports 64 rows. A 8 bit pixel data sent to LCD module would be displayed in single vertical column, as one pixel in each row of the selected page. The page mapping and byte mapping information can be understood from the below diagrams.



Page Mapping



Byte to Pixel mapping

The commands to select the page and column are shown below

PAGE_SEL	to select one out of 8 pages
COL_SEL_L/H	to select one out of 128 columns

The steps to communicate with the LCD module are described below.

Sequence to intialize a graphics LCD

- Reset the LCD controller
- Intialize the power control registers
- Choose the page, column and orientations
- Switch the display on

Sequence to write command to a LCD

- Assert chip select
- Deassert the A0 line to choose command mode
- Write command through gpio line

- Deassert the chip select

Sequence to write data to a LCD

- Assert chip select
- Assert the A0 line to choose data mode
- Write data through the gpio line
- Deassert the chip select

Sequence to write pixel data to LCD

- Assert chip select
- Select page with page selection command
- Select the columm with column selection command
- Write the data through the bus
- Deassert the chip select

To have complete display manipulation a buffer has to be maintained in software, if the micro-controller can support a memory of 1 Kile Byte for LCD code, then this can be achieved.

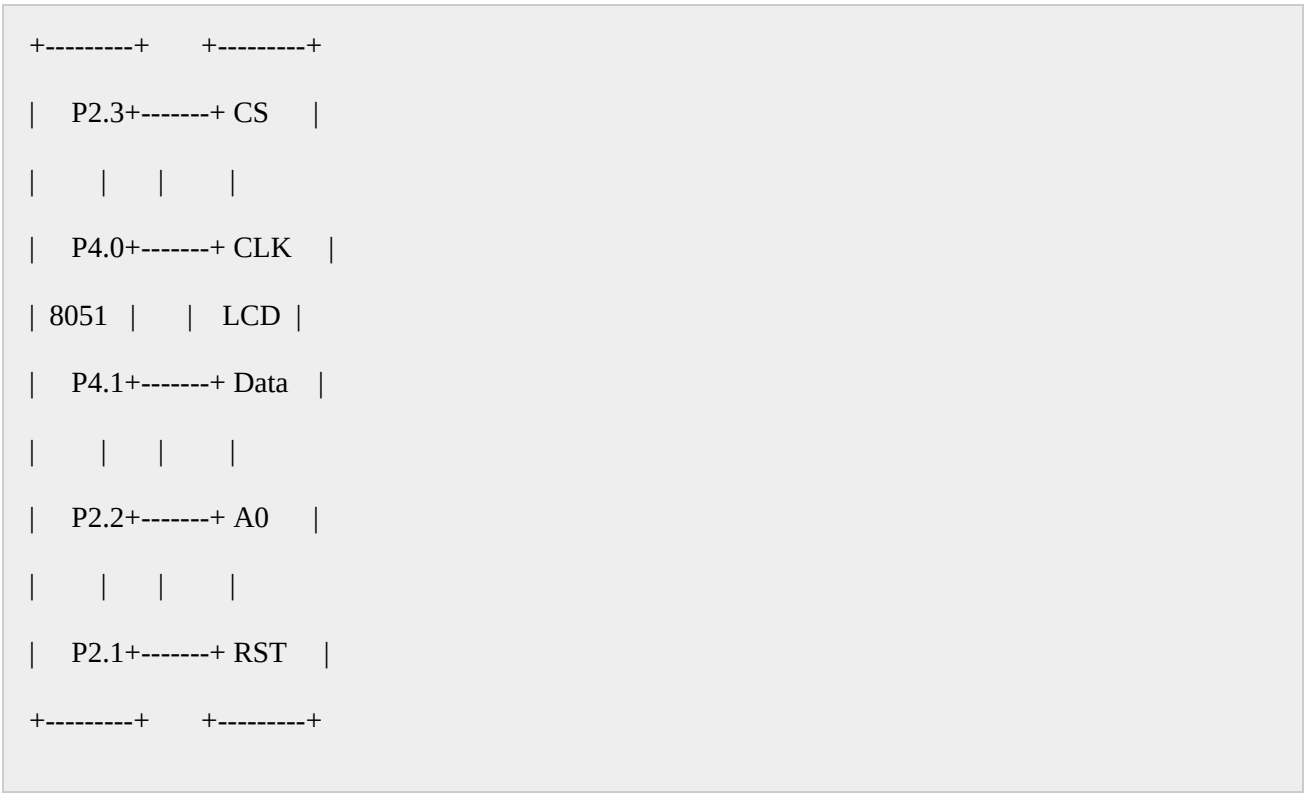
Hardware

It requires five gpio pins to be connected to the LCD module from the micro-controller.

CS	Chip select/Enable to the LCD module
CLK	clock line to the LCD module
DATA	data line to the LCD module
A0	control line to choose between command and data mode
RST	To reset the micro-controller

We have shown a connection interface in the below diagram.

LCD Hardware Circuit



Source: http://www.zilogic.com/blog/gfx-lcd-8051.html