Microcontroller Display Interfacing Techniques

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Overview

Micro-controllers are useful to the extent that they communicate with other devices, such as sensors, motors, switches, keypads, displays, memory and even other micro-controllers.

Many interface methods have been developed over the years to solve the complex problem of balancing circuit design criteria such as features, cost, size, weight, power consumption, reliability, availability, manufacturability.

Many microcontroller designs typically mix multiple interfacing methods. In a very simplistic form, a micro-controller system can be viewed as a system that reads from (monitors) inputs, performs processing and writes to (controls) outputs.
Commonly Used Display Types

**LED (Light Emitting Diode) Displays:**
- Discrete LED’s
- LED Bar Graphs
- 7-Segment LED’s
- Alphanumeric LED’s
- Multi-color LED’s

**LCD (Liquid Crystal Display):**
- Low cost.
- Available in many formats.
- Low current consumption. High current with backlight.

Parallel
- Alphanumeric
  - 4-bit mode
  - 8-bit mode
- Graphical (includes computer monitors)

Serial (I2C, RS232, USB)
- Alphanumeric
- Graphical

**VFD (Vacuum Fluorescent Displays):**
- Good visibility in the dark. No need for backlight.
- Suitable for cost-insensitive applications such as automobiles, media PC’s.
- High current consumption.

**OLED (Organic LED) Displays:**
- Organic LED.
- High visibility under all light conditions.
- No need for backlight.
- Requires high voltage driver.
- Moderate current consumption.
Digital Output Example: LED control

LED Interface

8051 Microcontroller (AT89C51ED2)

VCC

Current Limiting Resistors

LED's

P0.3
P0.2
P0.1
P0.0

LED Bar Graph Interface

8051 Microcontroller (AT89C51ED2)

VCC
Parallel LCD interface

4-bit LCD Interface

8051 Microcontroller (AT89C51ED2)

Hello World

8-bit LCD Interface

8051 Microcontroller (AT89C51ED2)

Hello World
Matrix Orbital Serial Displays

I2C, RS232 or USB Options
Software programmable contrast, backlight and fonts. Easy to use
Supply Current: 10mA typical. Backlight Supply Current: 90mA typical

Character Display:

Graphical Display:

Interfaces:
Up to a 25-key keypad
RS232 or I2C
Two 100mA @ +5V General Purpose Outputs
RS232 mode: 9600 baud to 115,200 baud
I2C mode: Serial transfers of up to 100 Kbps

VFD Display:

Typical Supply current: 290mA ( up to 550mA inrush )
OLED Displays

Definition of OLED from Wikipedia:

An **organic** light-emitting diode (**OLED**) is a special type of **light-emitting diode** (LED) in which the **emissive** layer comprises a thin-film of certain **organic compounds**. The emissive **electroluminescent** layer can include a **polymeric** substance that allows the deposition of very suitable organic compounds, for example, in rows and columns on a flat carrier by using a simple "printing" method to create a matrix of pixels which can emit different colour light.

Matrix Orbital:

- They are less expensive than a VFD and incredibly bright
- Incredible viewing angle of 160 degrees
- Self-luminous, no backlight required
- Low power consumption
- Fast response time and pixel refresh rate
- Extended temperature available from -20° to +70° C
- Lifespan of 10,000+ hours
- Excellent for LCD or VFD replacement applications
OSRAM Pictiva:

Features:
- Graphics display matrix
- Single Color with 4-bit per pixel grayscale
- True emissive technology
- 160° viewing angle
- Passive matrix driven by an industry standard compatible IC
- Fast response, video frame rate-capable
- High contrast
- Wide operating temperature range
- Thin profile

Specifications:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Format</td>
<td>128 Columns x 64 Rows</td>
</tr>
<tr>
<td>Pixel Pitch</td>
<td>0.265 mm Square</td>
</tr>
<tr>
<td>Pixel Size</td>
<td>0.265 mm Square</td>
</tr>
<tr>
<td>Color</td>
<td>Yellow x=0.455, y=0.540</td>
</tr>
<tr>
<td>Grayscale</td>
<td>4-bit</td>
</tr>
<tr>
<td>Active Area</td>
<td>36.65 (W) x 16.22 mm (H)</td>
</tr>
<tr>
<td>Module Size</td>
<td>47.70(W) x 22.17 (H) x 3.00mm (T)</td>
</tr>
<tr>
<td>Luminance</td>
<td>100 cd/m² typical</td>
</tr>
<tr>
<td>Lifespan</td>
<td>10,000 Hours @ 25°C</td>
</tr>
<tr>
<td>Viewing Angle</td>
<td>160°</td>
</tr>
<tr>
<td>Contrast Ratio</td>
<td>100:1 minimum</td>
</tr>
<tr>
<td>Temp Range</td>
<td>-30° to +70°C</td>
</tr>
<tr>
<td>Logic Voltage</td>
<td>2.4 – 3.5V</td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>12 – 13V typical</td>
</tr>
<tr>
<td>Sleep Mode Power</td>
<td>0.05mA</td>
</tr>
<tr>
<td>Interface</td>
<td>Parallel/Serial</td>
</tr>
<tr>
<td>OLED Driver/Controller</td>
<td>0320</td>
</tr>
<tr>
<td>Packaging</td>
<td>COF (chip-on-flex)</td>
</tr>
<tr>
<td>Interconnect</td>
<td>2.5F (zero insertion force)</td>
</tr>
<tr>
<td>Weight</td>
<td>6.5 g net, excluding bezel</td>
</tr>
</tbody>
</table>