Selection and Integration of Embedded Display Devices
Display System Revealed

LCD Screen Implementation

Touch Screen Support

VIA Display Advantages
Display System Revealed

- Evolution of Information Delivery
- Display System
- Resolution
Evolution of Information Delivery

Primitive Times
Evolution of Information Delivery

The Age of Electronics
Display Screen

Definition of Display System
- Electronic system providing visual information

Application Area of Display System
- Status monitoring and objective display
- Non-visible light or indirect visual image display
- HMI
Display System

System Structure

- Display Content
- Video Card
- Display Interface
- Display Device
Display System

Display Device

- Analog
  - TV
  - CRT

- Digital
  - LCD
  - DVI
  - HDMI
Display System

Display Interface

- HDMI
- LVDS
- MHL
- A/V
Resolution

Concept
- Display shows the number of pixels
- VESA and CEA Standards

Functionality
- Display content
- Display device

4K display device must be sharper than ordinary display devices?
**LCD Foundation**

**TTL**
1. TTL Signal
2. Parallel Transmission
3. High power consumption & high EMI
4. Low Resolution
5. Small Screen
6. Low Cost

**LVDS**
1. Low voltage differential signaling
2. Serial Transmission
3. Low power consumption & low EMI
4. High Resolution
5. Support 50 inch screen
6. High Cost
Screen Lighting

LCD Product Status
- Interface circuit complexity
- No standard hardware pin
- Data line easily damaged
- Vendor support limited

LCD Screen Instructions
- Interface type
- Driver implementation
Screen Lighting

LCD Screen Process

- Determine screen backlighting and normal voltage

5. Electrical Characteristics

<table>
<thead>
<tr>
<th>Signal</th>
<th>Item</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Clock</td>
<td>Frequency</td>
<td>$1/\text{T_{Clock}}$</td>
<td>46.6</td>
<td>72.1</td>
<td>82.5</td>
<td>MHz</td>
</tr>
<tr>
<td>Frame Rate</td>
<td>Frequency</td>
<td>$1/\text{T}_{V}$</td>
<td>50</td>
<td>60</td>
<td>75</td>
<td>Hz</td>
</tr>
<tr>
<td>Vertical</td>
<td>Period</td>
<td>$\text{T}_V$</td>
<td>1058</td>
<td>1066</td>
<td>2040</td>
<td></td>
</tr>
<tr>
<td>Section</td>
<td>Active</td>
<td>$\text{T}_{VD}$</td>
<td>1050</td>
<td>1050</td>
<td>1050</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blanking</td>
<td>$\text{T}_{VB}$</td>
<td>8</td>
<td>16</td>
<td>997</td>
<td></td>
</tr>
<tr>
<td>Horizontal</td>
<td>Period</td>
<td>$\text{T}_H$</td>
<td>880</td>
<td>1128</td>
<td>2040</td>
<td></td>
</tr>
<tr>
<td>Section</td>
<td>Active</td>
<td>$\text{T}_{HD}$</td>
<td>840</td>
<td>840</td>
<td>840</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blanking</td>
<td>$\text{T}_{HB}$</td>
<td>40</td>
<td>288</td>
<td>1200</td>
<td></td>
</tr>
</tbody>
</table>

- Determine the timing parameters and add drivers

VESDA standard: CVT, GTF

http://www.vesa.org/vesa-standards/standards-summaries/

Irregular screen
Screen Lighting

Define Interface parameters and configure the interface or modify drivers

- Channel
- Data Input Format

6.3 The Input Data Format

Note1: 8-bits signal input.
Note2: L:NS alike H:Thine alike
Device Debugging

Debug Object
- Timing
- Interface circuit configuration

Debug Mode
- Driver code debugging
- Debugging tools
Equipment Debugging

- Mismatch of clock pole or data format
- Abnormal Electric Power
- Skew Configuration Error
Display Screen Interface

LCD Screen implementation

Touch Screen Support

Hardware Architecture

Applications
Hardware Architecture

Touch Screen Module

Sensor

Touch Control Chip
Communication Interface

- **I2C**
  - Mainstream Interface, wide range of applications
  - Need to design connect circuits, porting is not convenient

- **USB**
  - Easy to connect, easy to port, supports large sized panels
  - Occupies one USB Interface

- **SPI/UART**
  - Rarely used, need to design connection circuit, porting is not convenient
ZCC2901 Touch Screen Example Case

Part I

Case Environment

- Application Environment
  - Platform
  - System

- Touch Screen
  - Controller
  - Bus Interface
ZCC2901 Touch Screen Example Case

Part II

Why VIA VAB-1000? -> Ultra compact with rich I/O
- 10cm x 7.2cm compact Pico-ITX
- HDMI and Dual LVDS
- MicroSD slot and GLAN
- 3 USB ports
- SPI and 8 GPIO
- 3 I2C and 2 COM
- S-video and miniPCIe
ZCC2901 Touch Screen Example Case

Part III

Hardware Connection
Driver Porting

- I2C and GPIO driver

```c
// STEP_2(REQUIRED): Customize your I/O ports & I/O operations
#define GTP_RST_PORT S5PV210_GPJ3(6)
#define GTP_INT_PORT S5PV210_GPH1(3)
#define GTP_INT_IRQ gpio_to_irq(GTP_INT_PORT)
#define GTP_INT_CFG S3C_GPIO_SF0(0xF)

#define GTP_GPIO_AS_INPUT(pin) do {\n    gpio_direction_input(pin);
    s3c_gpio_setpull(pin, S3C_GPIO_PULL_NONE);
} while(0)

#define GTP_GPIO_AS_INT(pin) do {\n    GTP_GPIO_AS_INPUT(pin);
    s3c_gpio_cfgpin(pin, GTP_INT_CFG);
} while(0)

#define GTP_GPIO_GET_VALUE(pin) gpio_get_value(pin)
#define GTP_GPIO_OUTPUT(pin_level) gpio_direction_output(pin, level)
#define GTP_GPIO_REQUEST(pin, label) gpio_request(pin, label)
#define GTP_GPIO_FREE(pin) gpio_free(pin)
```
ZCC2901 Touch Screen Example Case

Part V

- Screen calibration

- Touch key processing

```c
} else if ((y > 300) && (y < (300 + GTH_KEY_WIDTH_600))) { // BACK
    touch_key = KEY_BACK;
} else if ((y > 420) && (y < (420 + GTH_KEY_WIDTH_600))) { // V-UP
    touch_key = KEY_VOLUMEUP;

    input_event(ts- >input_dev, EV_KEY, touch_key, 1);
    input_sync(ts- >input_dev);
    input_event(ts- >input_dev, EV_KEY, touch_key, 0);
    input_sync(ts- >input_dev);
```
ZCC2901 Touch Screen Example Case

Part VI

Android Add Event

- Android customization key

Debugging and Testing
Display System Secrets

LCD Screen Implementation

Touch Screen Support

VIA Display Advantages
Android Application Development

- Phone
- Tablet
- Smart TV
  - Auto-electronic
- Smart Home
  - Smart City
  - HealthCare
Android Application Development

Interactive Holographic 3D Display?

Multi-size, Multi-screen, & Wireless Display Support

HDMI

LCD
VIA Display Solutions
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