基於ML51實現電子紙模組控制

NuMicro® 8 位系列微控制器範例代碼介紹

文件資訊

代碼簡述	本範例代碼基於ML51的SPI及GPIO功能，實現控制微雪電子的電子紙模組 2.9inch e-Paper Module (B)
BSP 版本	ML51_BSP_Keil_C51_V1.0.0
開發平台	NT-ML51PC V1.1

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1 功能介紹

1.1 簡介

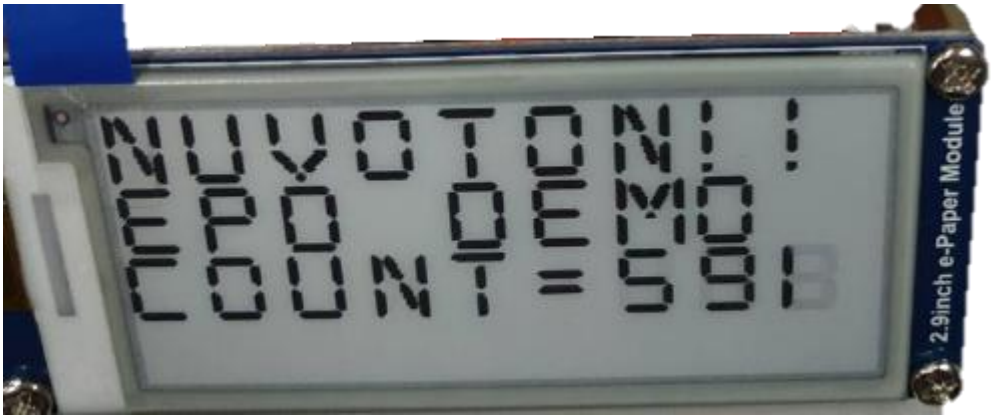
電子紙是一種基於電泳顯示技術(Electro-Phoretic Display，EPD)的反射式顯示屏。顯示的原理為帶電離子在外加電場的透明或彩色液體中移動，經過翻轉或流動來使像素變亮或變暗，並可以被製作在玻璃、金屬或塑料基板上。

電泳技術優點包括耗能低、具有亮暗雙穩態、反射型顯示器具有良好的日光可讀性、黑暗環境中具有高可讀性、改變影像的瞬間才會耗電等。目前電泳式技術最大瓶頸在於彩色化困難，現今廠商多加裝彩色濾光片處理，但會造成亮度、對比下降等問題。

模組相關資訊請參考此網站：http://www.waveshare.net/wiki/2.9inch_e-Paper_Module_(B)

1.2 執行結果

本範例代碼基於ML51的SPI及GPIO功能，實現控制微雪電子的電子紙模組 2.9inch e-Paper Module (B)。



2 代碼介紹

(1) 先初始化與EPD模組相連接的GPIO，切換至PUSHPULL模式，再初始化SPI功能

(2) 透過SPI下指令給EPD模組進行初始化，然後傳送顯示內容

```
void main(void)
{
    //EPD GPIO INIT
    P25_INPUT_MODE;
    P24 = 1;
    P23 = 1;
    P22 = 1;
    P24_PUSHPULL_MODE;
    P23_PUSHPULL_MODE;
    P22_PUSHPULL_MODE;
    //SPI GPIO initial
    MFP_P00_SPI0_MOSI;
    P00_QUASI_MODE;
    MFP_P02_SPI0_CLK;
    P02_QUASI_MODE;
    //Initial SPI0 for EPD
    SPI_Open(SPI0, SPI_MASTER, 10, SPI_MODE_3, MSB_FIRST);
    EPD_Init(&epd, lut_full_update);

    EPD_SetFrameMemory(&epd, 0, 0); //clear ram
    EPD_DisplayFrame();

    EPD_SetFrameMemory(&epd, 0, 0); //clear ram
    EPD_DisplayFrame();

    //inital EPD function
    EPD_Init(&epd, lut_partial_update);

    while(1)
    {
        print_lcd(0, "Nuvoton!!!");
        print_lcd(32, " EPD Demo");
        sprintf(value, "count=%d", count_t);
        print_lcd(64, value);
        EPD_DisplayFrame();
        EPD_DelayMs(2000);
        count_t++;
    }
```

透過Send command来实现显示的子程式

```
/**
*  @brief: update the display
*          there are 2 memory areas embedded in the e-paper display
*          but once this function is called,
*          the the next action of SetFrameMemory or ClearFrame will
*          set the other memory area.
*/
void EPD_DisplayFrame(void)
{
    EPD_SendCommand(DISPLAY_UPDATE_CONTROL_2);
    EPD_SendData(0xC4);
    EPD_SendCommand(MASTER_ACTIVATION);
    EPD_SendCommand(TERMINATE_FRAME_READ_WRITE);
    EPD_WaitUntilIdle();
}
```

3 軟體與硬體環境

- **軟體環境**
  - BSP 版本
    - ML51_BSP_Keil_C51_V1.0.0
  - 案例名稱
    - WS_EPD_Module.uvproj
- **硬體環境**
  - 硬體需求
    - NT-ML51PC V1.1 tiny board
    - 2.9inch e-Paper Module (B)。
  - 接線圖

將N76E003與2.9inch e-Paper Module (B)透過下列方式連接。

NT-ML51PC V1.1		2.9inch e-Paper Module (B)
VCC	↔	VCC
(GPIO INPUT)P25	↔	EPD_BUSY
(GPIO OUTPUT)P24	↔	EPD_RESET
(GPIO OUTPUT)P23	↔	EPD_DC
(GPIO OUTPUT)P22	↔	EPD_CS
(SPI CLK)P02	↔	EPD_CLK
(SPI MOSI)P00	↔	EPD_MOSI
GND	↔	GND

4 目錄資訊

- EC_ML51_WS_EPD_Module_V1.0
  - Library: Sample code header and source files.
    - Device: ML51 device header files.
    - Startup: Keil51 startup files
    - StdDriver: All peripheral driver header and source files.
  - Sample_Code
    - ExampleCode: Source file of example code.
      - WS_EPD_Module Source file of EPD display module.

5 如何執行範例程式

1. 本專案支援Keil uVersion 4.6及以上版本
2. 根據目錄資訊進入Sample_Code\ExampleCode資料夾，雙擊Wiegand_Master與Wiegand_Slave資料夾中的Wiegand_Master.uvproj與Wiegand_Slave.uvproj
3. 進入編譯模式介面
   a. 編譯
   b. 下載代碼至記憶體
   c. 進入 / 離開除錯模式
4. 進入除錯模式介面
   a. 可別進入除錯模式進行調試
   b. 執行代碼

6 修訂紀錄

日期	版本	描述
Sep. 24, 2019	1.00	1. 初始發布.

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