透過SPI界面存取SD Card上的FAT

NuMicro® 32 位系列微控制器範例代碼介紹

文件資訊

代碼簡述	本範例代碼透過 SPI 界面存取 SD card 上的 FAT 檔案系統
BSP 版本	M451 Series BSP CMSIS V3.01.003
開發平台	NuTiny-EVB-M451-LQFP100 V1.3

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1 功能介紹

1.1 簡介

本範例代碼透過SPI界面存取SD card上的FAT檔案系統，並且提供簡單的檔案讀寫範例程式碼，示範如何操作FAT檔案。

1.2 原理

SD card支援兩種模式：SD卡模式及SPI模式。其中SPI模式只需透過四支引腳，即可讓支援SPI界面的MCU存取SD card上的資料。

Pin #	SD Mode			SPI Mode		
	Name	Type[1]	Description	Name	Type[1]	Description
1	CD/DAT3[2]	I/O/PP[3]	Card Detect/ Data Line [Bit 3]	CS	I[3]	Chip Select (neg true)
2	CMD	PP	Command/Response	DI	I	Data In
3	V_{SS1}	S	Supply voltage ground	VSS	S	Supply voltage ground
4	V_{DD}	S	Supply voltage	VDD	S	Supply voltage
5	CLK	I	Clock	SCLK	I	Clock
6	V_{SS2}	S	Supply voltage ground	VSS2	S	Supply voltage ground
7	DAT0	I/O/PP	Data Line [Bit 0]	DO	O/PP	Data Out
8	DAT1[4]	I/O/PP	Data Line [Bit 1]	RSV		
9	DAT2[5]	I/O/PP	Data Line [Bit 2]	RSV		

本範例代碼提供一組程式碼，可支援SPI模式的SD card命令流程。

本範例代碼同時引用一個簡單的FAT檔案系統程式庫：FatFs，可透過FatFs的API來讀寫SD card上面的檔案資料。使用者可參考檔案讀寫範例程式碼來操作FAT檔案。

1.3 執行結果

執行結果，以及打印資料。

```
PLL Clock = 144000000 Hz
Core Clock = 72000000 Hz

+-----------------------------------------------------+
|       M451 Series SPI + SD Card Sample Code         |
+-----------------------------------------------------+
SDCard Open success
SDCard Open success
rc=0 FR_OK
D-HS- 2019/08/01 15:09         0  SYSTEM~1
----A 1980/00/00 00:00        66  test.txt
D---- 2015/09/09 09:39         0  FF8
----A 2019/09/09 19:32      7388  main.c
   2 File(s),       7454 bytes total
   2 Dir(s),  3594223616 bytes free
Read data from file test.txt :
[hello hello hello hello hello hello hello hello hello hello hello hello ]
```

2 代碼介紹

設定 SPI 界面並執行 SD card 初始化流程：

```
    /* Initializes the physical disk drive */
    res = (FRESULT)disk_initialize(DRIVE_NUMBER);

    if (res != STA_OK)
    {
        put_rc(res);
        printf("\n\nInitialize SD card fail.\n");
    }
```

初始化 FatFs 檔案系統的工作區域：

```
    /* Registers a work area to the FatFs module */
    res = f_mount(DRIVE_NUMBER, &g_FatFs[0]);

    if (res != FR_OK)
    {
        put_rc(res);
        printf("\n\nMount file system fail.\n");
    }
```

透過 FatFs 檔案系統所提供的 API 來操作 SD card 上的檔案：

```
    /* Open file and set it to readable / writable mode */
    res = f_open(&file, "test.txt", FA_OPEN_ALWAYS | FA_READ | FA_WRITE);

    if (res == FR_OK)
    {
        /* Move file pointer to end of file (offset = file.fsize) */
        f_lseek(&file, file.fsize);
        /* Write something to file pointer */
        f_write(&file, "hello ", 6, &count);
        /* Move file pointer to begin of file (offset = 0) */
        f_lseek(&file, 0);
        /* Read something from file pointer */
        f_read(&file, g_buff, file.fsize, &count);
        printf("Read data from file test.txt : \n[%s]\n", g_buff);
```

```
        /* Close file */
        f_close(&file);
    }
    else
        printf("Open file fail. Return %d\n", res);
```

3 軟體與硬體環境

● 軟體環境

- ■ BSP 版本
  - ◆ M451 Series BSP CMSIS V3.01.003
- ■ IDE 版本
  - ◆ Keil uVersion 4.74

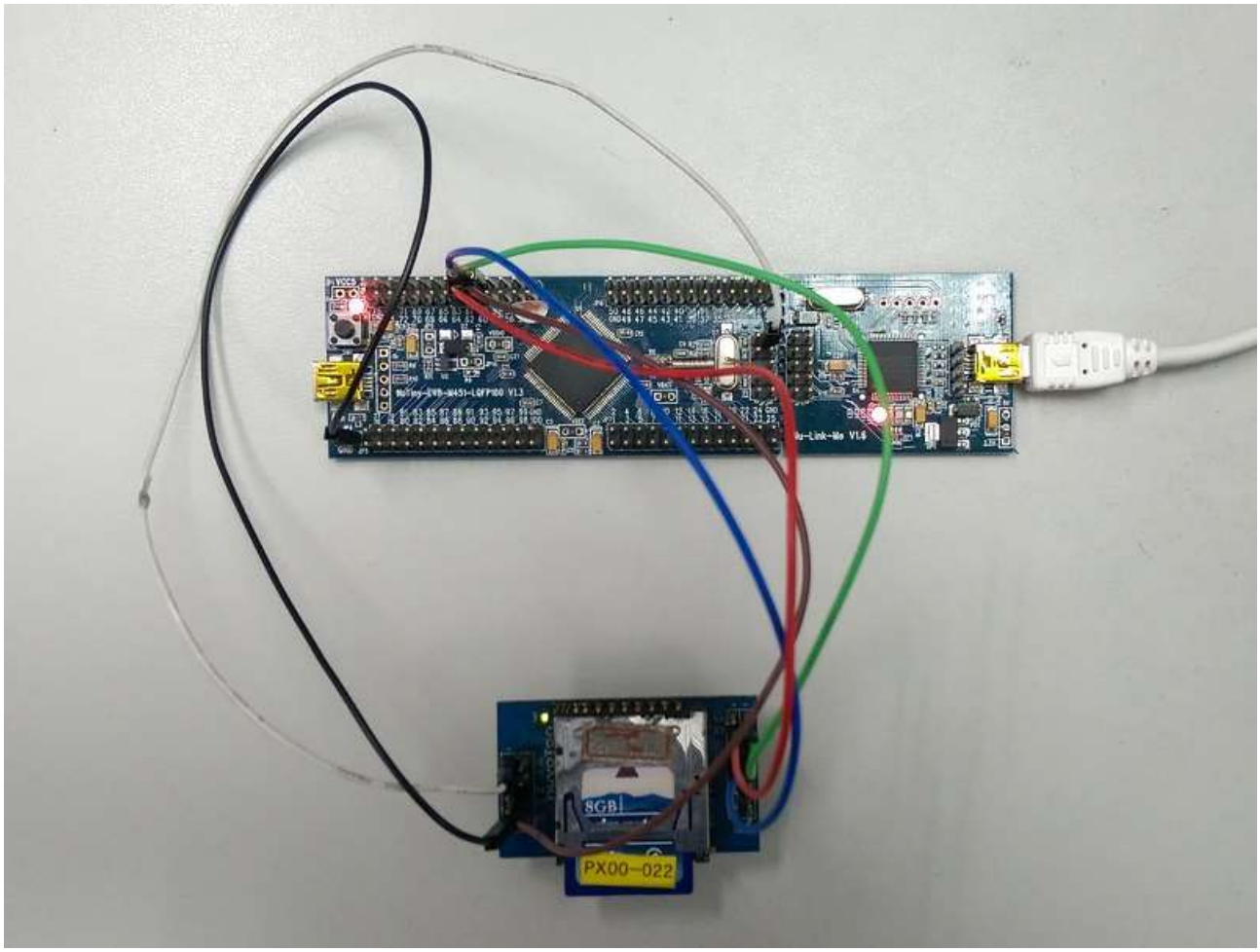
● 硬體環境

- ■ 電路元件
  - ◆ NuTiny-EVB-M451-LQFP100 V1.3
  - ◆ SD card socket board
- ■ 示意圖

M451 使用 SPI1 界面來存取 SD CARD。硬體外部線路連接如下。

(PA.4) SPI CS	→	CS
(PA.5) SPI MOSI	→	DI
(PA.7) SPI SCK	→	SCLK
(PA.6) SPI MISO	←	DO
M451		SD Card

- SPI CS 是 Chip Select，由 M451 擔任 SPI Master.
- SPI MOSI 是 M451 的 Data Out，連接 SD Card 的 Data In. 此接線必須外加上拉電阻, 避免訊號浮動.
- SPI SCK 是 Clock，由 M451 提供 Clock 給 SD Card 使用.
- SPI MISO 是 M451 的 Data In，連接 SD Card 的 Data Out. 此接線必須外加上拉電阻, 避免訊號浮動.


8GB
PX00-022

4 目錄資訊

EC_M451_FATFS_SPI_Mode_SDCard_V1.00	
Library	Sample code header and source files
CMSIS	Cortex® Microcontroller Software Interface Standard (CMSIS) by Arm® Corp.
Device	CMSIS compliant device header file
StdDriver	All peripheral driver header and source files
SampleCode	
ExampleCode	Source file of example code
M451_FATFS_SPI_Mode_SDCard	Source file of example code M451_FATFS_SPI_Mode_SDCard
FF8	A generic FAT file system module, FatFs, for small embedded systems. Its official website is: http://elm-chan.org/fsw/ff/00index_e.html.

5 如何執行範例程式

1. 根據目錄資訊章節進入 ExampleCode 路徑中的 KEIL 資料夾，雙擊 M451_FATFS_SPI_Mode_SDCard.uvproj。
2. 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
3. 進入除錯模式介面
   a. 執行代碼

6 修訂紀錄

Date	Revision	Description
Sep. 10, 2019	1.00	1. 初始發布.

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