Camera Interface Simulation by GPIO

Example Code Introduction for 32-bit NuMicro® Family

Information

Application	This code uses M480 GPIO to capture CMOS sensor image data.
BSP Version	M480 Series BSP CMSIS V3.03.000
Hardware	NuMaker-IoT-M487 v1.2

1 Function Description

1.1 Introduction

This example code uses GPIO to simulate camera interface (CCIR601, 8/4 bit) and capture image by a Himax CMOS sensor. The feature of CMOS sensor is as below table:

Part	Resolution	Color Depth	Frame Rate	Interface
HM01B0	320x240	8 bit	30	CCIR601

User can use SW2 button on EVB to save a BMP file into SD card.

1.2 Demo Result

```
CPU @ 192000000Hz(PLL@ 192000000Hz)
+-----------------------------------------------------------+
|         CMOS sensor Driver Sample Code                    |
|         Use PG.8~PG.15 to latch Data from D0~D7           |
|         MCLK:PD12 Vsync:PE0, Hsync:PE1, PCLK:PD5          |
+-----------------------------------------------------------+

I2C clock 100000 Hz
***** card insert !
HM01B0 Configured done.
```

2 Code Description

Check CMOS sensor ID and initialize sensor :

```
/* Read CMOS sensor ID */
CMOS_ID = HM01B0_ReadID();

/* Check CMOS sensor ID (default is Himax HM01B0) */
if (!(CMOS_ID == 0x1b0))
{
    printf("Device ID is not correct (0x%x), please reboot MCU.\n", CMOS_ID);
    while(1);
}
```

Uses GPIO to simulate camera interface (CCIR601, 8bit) :

```
    if (GPIO_GET_INT_FLAG(PE, BIT0))
    {
        /* Wait Vsync high */
        GPIO_CLR_INT_FLAG(PE, BIT0 | BIT1);
        for (i = 0; i < IMAGE_HEIGHT; i++)
        {
            // Wait Hsync high
            while (!GPIO_GET_INT_FLAG(PE, BIT1));

            GPIO_CLR_INT_FLAG(PE, BIT1);
            GPIO_CLR_INT_FLAG(PD, BIT8);

            for (j = 0; j < IMAGE_WIDTH * PIXEL_BYTES; j++)
            {
                // Latch data when PCLK is high
                while (!GPIO_GET_INT_FLAG(PD, BIT8));

                GPIO_CLR_INT_FLAG(PD, BIT8);
                /* Collect data in 8 bit mode */
                image[i * IMAGE_WIDTH + j] = (PG->PIN >> 8);
            }
        }
        …
        GPIO_CLR_INT_FLAG(PE, BIT0);
    }
```

3 Software and Hardware Environment

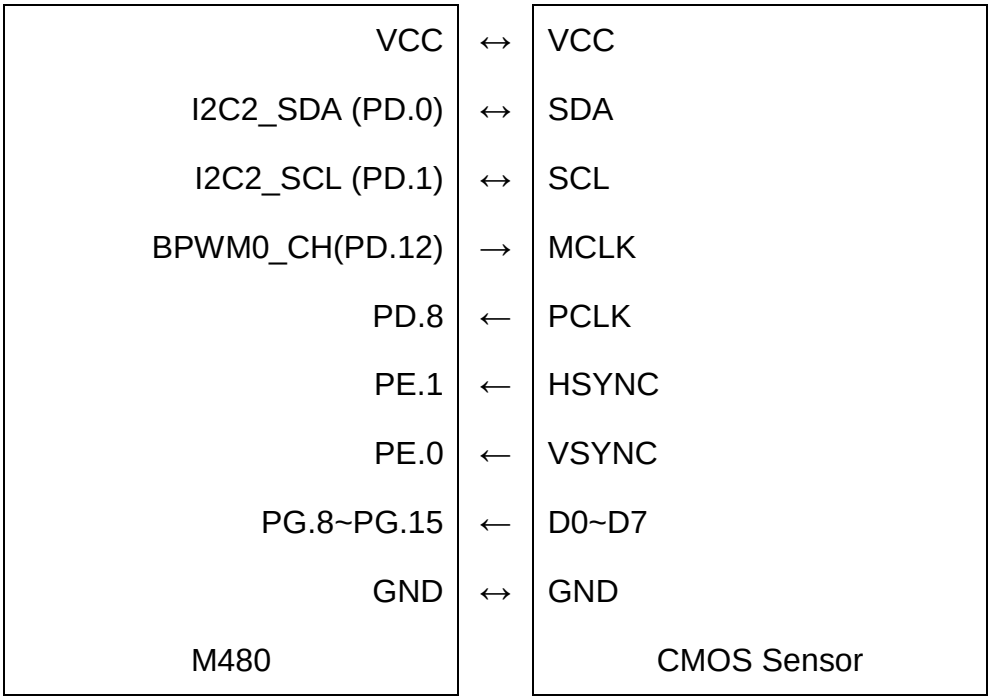
Software environment

- BSP version
  - M480 Series BSP CMSIS V3.03.000
- IDE version
  - Keil uVersion 5.26

Hardware environment

- Circuit components
  - NuMaker-IoT-M487
  - CMOS sensor (HM01B0)
- Diagram

M480 uses I^2C to transmit commands to CMOS sensor, and uses BPWM as CMOS MCLK. The CMOS sensor returns PCLK and HSYNC, VSYNC, and D0~D7 data according to the settings.



4 Directory Information

EC_M480_CMOS_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
ThirdParty	
FatFs	A generic FAT file system module for small embedded systems. Its official website is: http://elm-chan.org/fsw/ff/00index_e.html.

5 How to Execute Example Code

1. Browsing into sample code folder by Directory Information (section 4) and double click M480_CMOS.uvproj
2. Enter Keil compile mode
   a. Build
   b. Download
   c. Start/Stop debug session
3. Enter debug mode
   a. Run

6 Revision History

Date	Revision	Description
Jun. 21, 2019	1.00	1. Initially issued.

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