MIAT_STM32 CMOS影像擷取

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Declared Version

Training Only	
Declare	
Document Number	
Document Version	**1.00**
Release Date	
Document Title	MIAT_STM32 CMOS影像擷取
Exercise Time	■
Platform	■ **MIAT_STM32.V2** ■ **MIAT IOB.V1**
Peripheral	■
Author	■ **WU-YANG Technology Co., Ltd.**

實驗目的(一)

☐ 使用MIAT_STM32實驗板透過MIAT_IOB實驗板整合2MPixels影像感測器進行影像擷取，並利用其取得之影像進行RGB色彩辨識實驗。
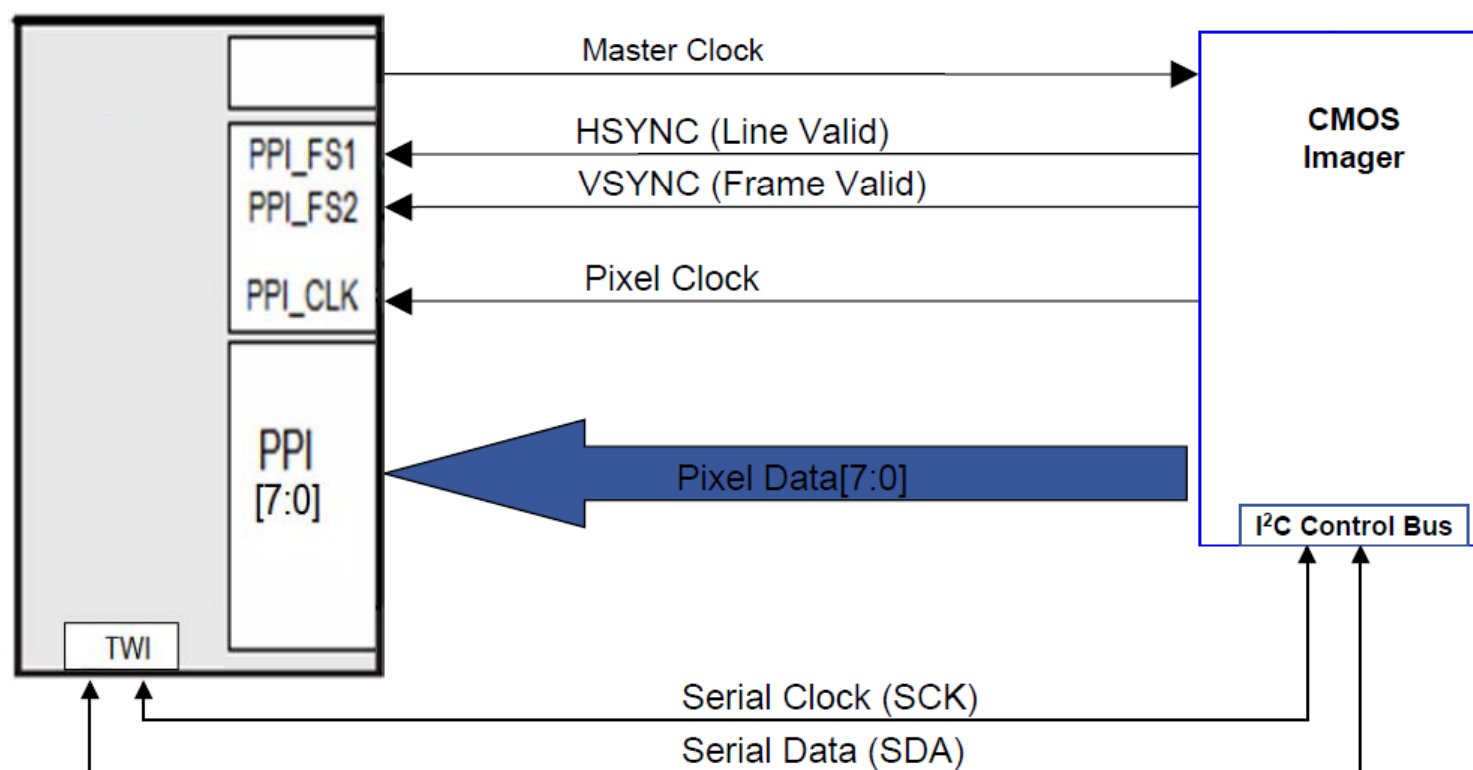
實驗原理

- System requirement
  - CMOS
  - LCD
  - KEY
- 通訊介面
  - Master Clock
    - Timer
  - I2C
  - PPI
    - Timer
    - GPIO
    - DMA
- CMOS Pixel Color Pattern

通訊介面

CMOS訊號

功能	訊號名稱	說明
Clock	Master Clock (MCLK)	提供CMOS時脈
I2C	SDA (SDATA)	I2C通訊資料
	SCK (SCLK)	I2C通訊時脈
PPI	Pixel Clock (PIXCLK)	CMOS pixel輸出時脈
	Pixel Data[7:0] (DOUT)	CMOS pixel資料輸出
	CMOS_HSYNC (LINE_VALID)	CMOS pixel資料輸出row同步訊號
	CMOS_VSYNC (LINE_VALID)	CMOS pixel資料輸出frame的時脈同步訊號

Master Clock

- 功能說明
  - Sensor master clock
  - 6 MHz to 80 MHz

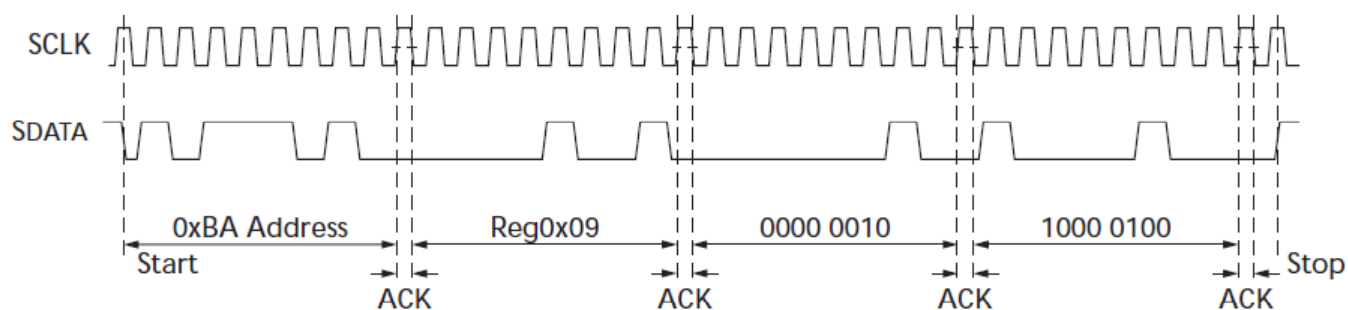- STM32方案
  - Timer2 Channel 2產生Clock

I2C介面

- 功能說明
  - Two-wire serial interface
  - CMOS Sensor控制

- STM32方案
  - I2C2 (Hardware Ready)

Write Timing Diagram
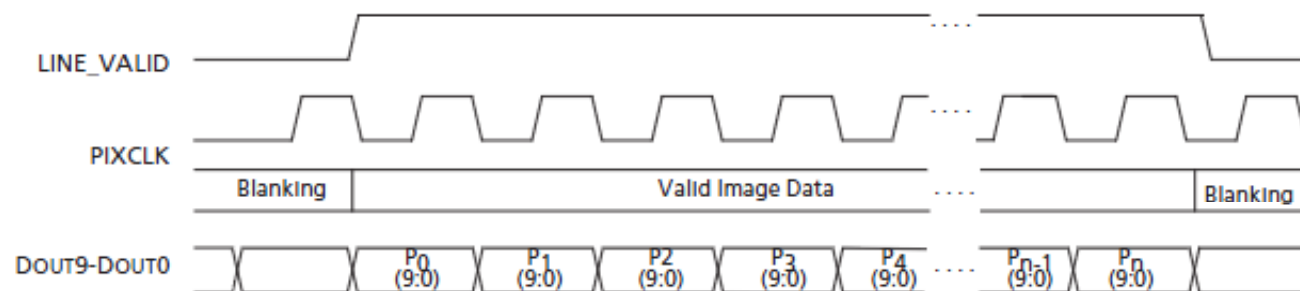
WRITE Timing to R0x09:0—Value 0x0284

SCLK

SDATA

| 0xBA Address | Reg0x09 | 0000 0010 | 1000 0100 |

Start

ACK   ACK   ACK   ACK   Stop

PPI介面

☐ 功能說明

  ■ 同步CMOS Frame

  ■ 接收CMOS Sensor資料

Pixel Data Timing Diagram

Timing Example of Pixel Data

Row Timing and FRAME_VALID/LINE_VALID Signals

FRAME_VALID

LINE_VALID

Number of master clocks   P   A   Q   A   Q   A   P
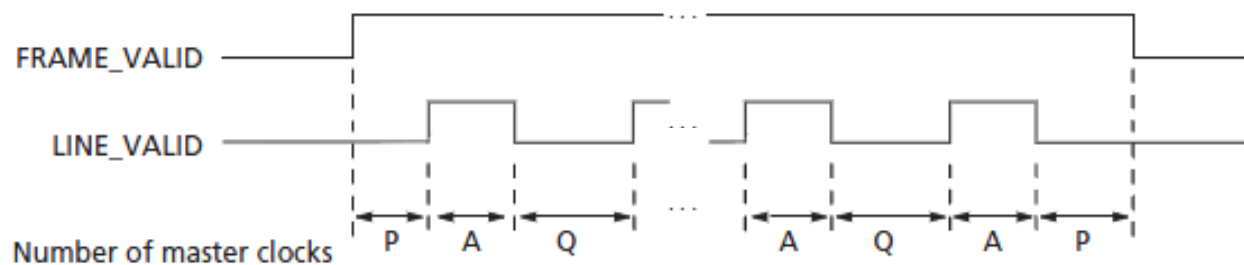
□ STM32方案

- GPIO同步Frame
- Timer3 Channel 1觸發接收
- DMA1 Channel 6 & GPIO接收資料

CMOS Pixel Color Pattern
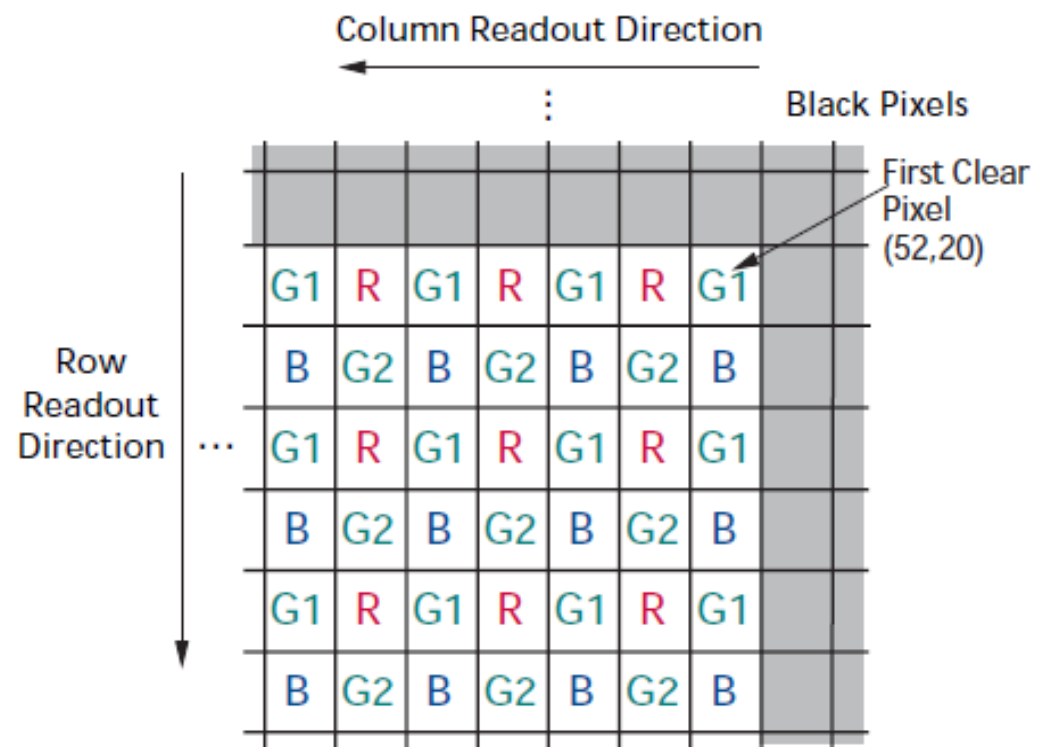
GUI硬體電路配置

Mapping Table

Num.	MIAT_STM32V2	MIAT_IOBV1	Num.	MIAT_STM32V2	MIAT_IOBV1
1	PC8 (3.26)	SW1	9	PE6 (1.5)	LCD_EN
2	PC9 (3.27)	SW2	10	PF6 (1.18)	LCD_R/W
3	PC10 (4.3)	SW3	11	PF7 (1.19)	LCD_RS
4	PC11 (4.4)	SW4	12	PF8(1.20)	LCD_D4
5	PB5 (4.27)	KEY1	13	PF9 (1.21)	LCD_D5
6	PB6 (4.28)	KEY2	14	PF10 (1.22)	LCD_D6
7	PB7 (4.29)	KEY3	15	PF11 (2.13)	LCD_D7
8	PB8 (4.31)	KEY4	16	VDD (2.36)	VCC3.3V

CMOS硬體電路配置

Mapping Table

Num.	MIAT_STM32V2	MIAT_IOBV1	Num.	MIAT_STM32V2	MIAT_IOBV1
1	PC0 (1.24)	CMOS_D0	10	PC1 (1.25)	CMOS_D1
2	PC2 (1.26)	CMOS_D2	11	PC3 (1.27)	CMOS_D3
3	PC4 (2.8)	CMOS_D4	12	PC5 (2.9)	CMOS_D5
4	PC6 (3.24)	CMOS_D6	13	PC7 (3.25)	CMOS_D7
5	PE4 (1.3)	CMOS_STBYN	14	PA1 (1.33)	CMOS_MCLK
6	VCC5V (1.36)	VCC5V	15	GND (1.35)	GND
7	PE3 (1.2)	CMOS_VSYNC	16	PA6 (2.6)	CMOS_PCLK
8	PE2 (1.1)	CMOS_HSYNC	17	PE5 (1.4)	CMOS_RST
9	PB10 (2.33)	CMOS_SCL	18	PB11 (2.34)	CMOS_SDA

CMOS硬體電路配置

MIAT_STM32.V2 Board	Mapping Num.	MIAT_IOB.V1 Board
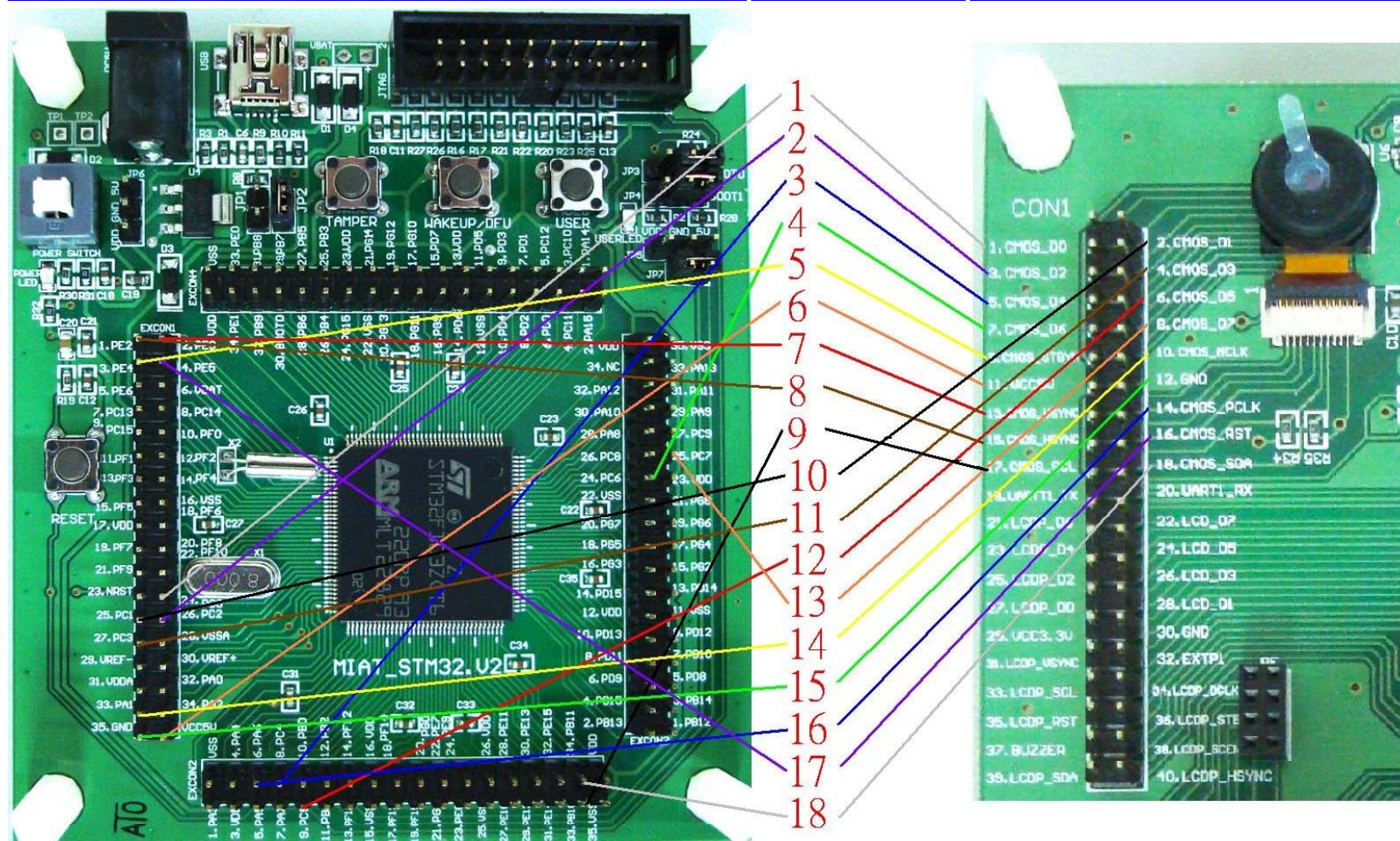
實驗步驟

- ☐ 範例目錄架構
- ☐ 函式庫說明
- ☐ 範例說明
- ☐ 參數說明
- ☐ 燒錄MIAT_STM32

範例目錄架構

- 範例目錄
  - 測試映像檔
  - 含括檔
  - 函式庫
  - 專案檔
  - 原始碼

```
□ 📁 CMOSCOLOR
     📁 image
     📁 include
     📁 library
  ⊞ 📁 project
     📁 source
```
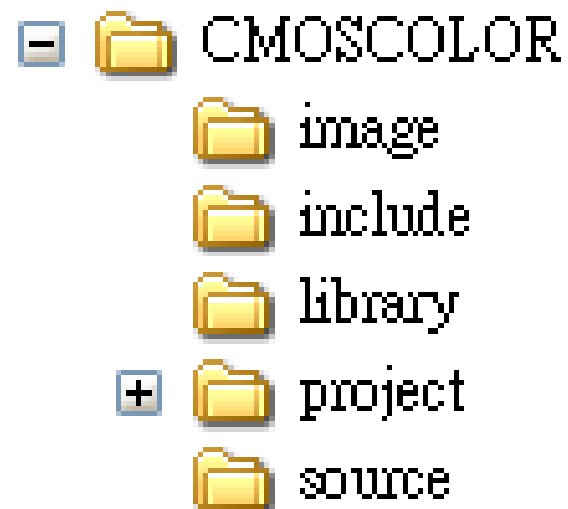
CMOS函式庫

☐ void CMOS_Init(void)

CMOS初始化函式

☐ void CMOS_Exposure(unsigned short Shutter_Width)

調整CMOS曝光時間

☐ void CMOS_SetWindowOrigin(unsigned short Row_Start, unsigned short Column_Start)
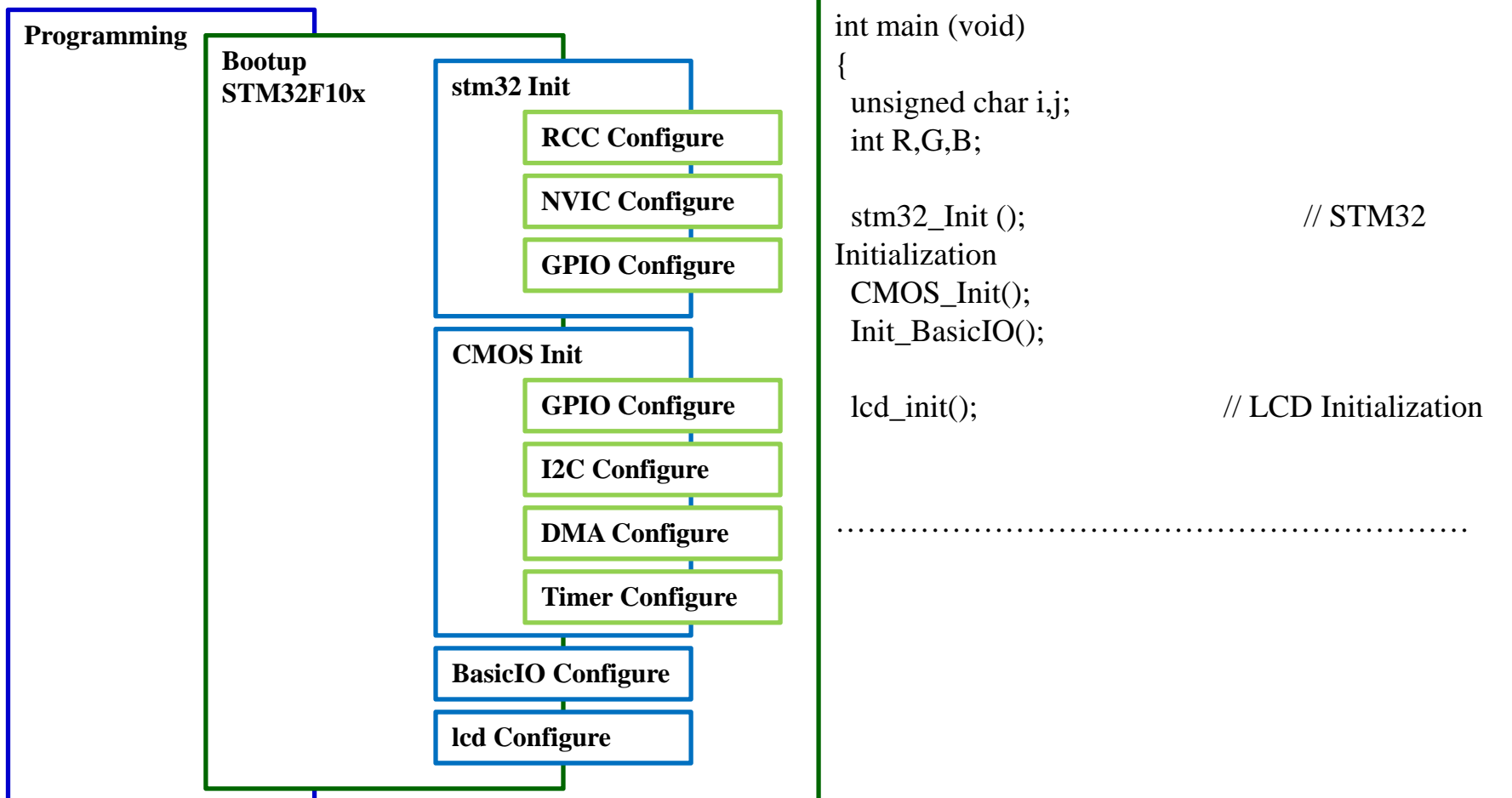
設定取像視窗起始位置

CMOS函式庫

☐ void CMOS_SetImageSize(unsigned short Row_Width, unsigned short Column_Width)

設定取像視窗大小

☐ void CMOS_Capture(unsigned char *CAM_Buffer)

取得CMOS影像存入CAM_Buffer記憶體區塊

範例說明

Programming

Bootup STM32F10x

stm32 Init

- RCC Configure
- NVIC Configure
- GPIO Configure

CMOS Init

- GPIO Configure
- I2C Configure
- DMA Configure
- Timer Configure

BasicIO Configure

lcd Configure

```
int main (void)
{
  unsigned char i,j;
  int R,G,B;

  stm32_Init ();                        // STM32
Initialization
  CMOS_Init();
  Init_BasicIO();

  lcd_init();                    // LCD Initialization

……………………………………………………
```

範例說明

CMOS operation

- **CMOS Exposure**
- **CMOS SetWindowOrigin**
- **CMOS SetImageSize**
- **Example**

CMOS operation

```
lcd_clear();
lcd_print ("MIAT_STM32 DEMO ");

CMOS_Exposure(0x0080);
CMOS_SetWindowOrigin(578,810);
CMOS_SetImageSize(128,128);

while(1)
{
  KEY_Buffer=Key_Scan();
  if(KEY_Buffer==1)
  {
    CAM_Buffer=(unsigned char *)0x60040000;

    CMOS_Capture(CAM_Buffer);
```

LCD Line1顯示
MIAT_STM32DEMO

設定CMOS參數

掃描KEY是否按下

如果KEY1按下，取得一張
128*128影像

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範例說明

CMOS operation

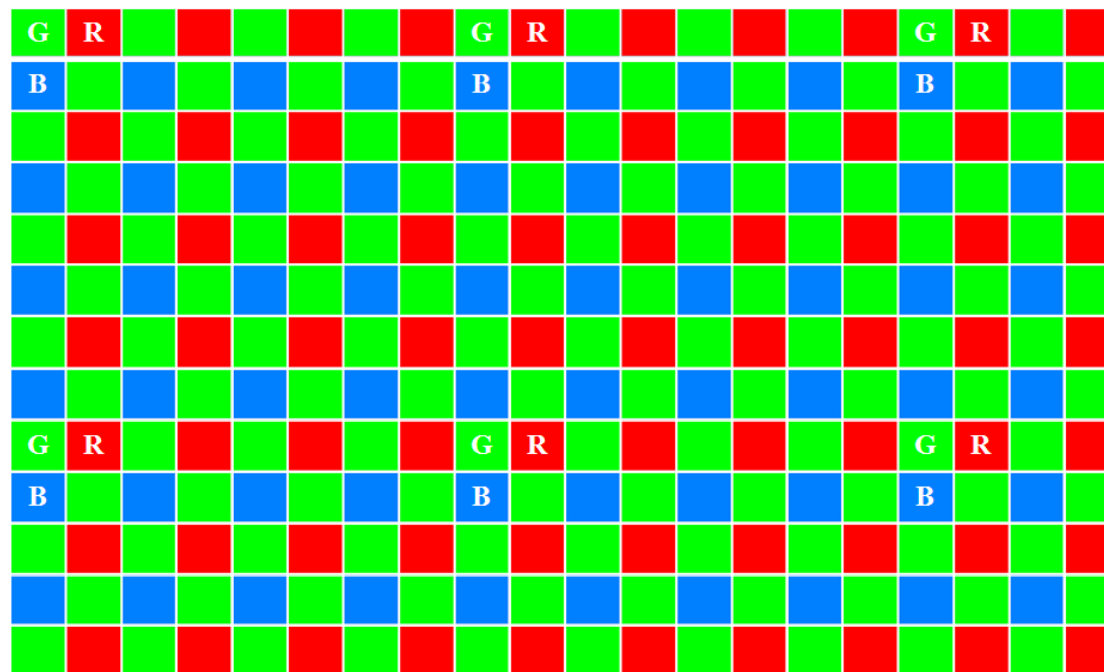> **Example**

```
CAM_Buffer=(unsigned char *)0x60040000;
   R=0;
   G=0;
   B=0;
   for(i=0;i<16;i++)
   {
    for(j=0;j<128;j+=8)
    {
      G+=CAM_Buffer[j];
    }
    for(j=1;j<128;j+=8)
    {
      R+=CAM_Buffer[j];
    }
    CAM_Buffer+=128;
    for(j=0;j<128;j+=8)
    {
      B+=CAM_Buffer[j];
    }
    CAM_Buffer+=896;
   }
```

由取得影像取樣，分別累積 RGB數值

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取樣方式

☐ 依照Pixel Color Pattern，RGB每8點取一點，由128*128 中影像中，取樣16*16*3點

範例說明

CMOS operation

Example

```
if(((G-R)>800) && ((G-B)>1000))
    {
     set_cursor (0, 1);
     lcd_print ("Color is Green  ");
    }
    else if(((R-G)>1000) && ((R-B)>1000))
    {
     set_cursor (0, 1);
     lcd_print ("Color is Red    ");
    }
    else if(((B-R)>1000) && ((B-G)>1000))
    {
     set_cursor (0, 1);
     lcd_print ("Color is Blue   ");
    }
    else
    {
     set_cursor (0, 1);
     lcd_print ("Color is Unknow ");
    }
  }
  else if(KEY_Buffer==2)
  {
     set_cursor (0, 1);
     lcd_print ("CLEAR           ");
  }
}
```

判定顏色，LCD Line2顯示 Color is ?

如果KEY2按下，清除LCD Line2顏色顯示，LCD Line2顯示Clear

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參數說明

- ☐ Row_Start
  - ■ Row_Start CMOS取像的Row起始位置
  - ■ Row_Start必須大於等於 28
- ☐ Column_Start
  - ■ Column_Start CMOS取像Column的起始位置
  - ■ Column_Start必須大於等於 60
- ☐ Row_Width
  - ■ CMOS取像Row的大小
  - ■ Row_Width + Row_Start必須小於等於1228
- ☐ Column_Width
  - ■ CMOS取像Column的大小
  - ■ Column_Width + Column_Start必須小於等於1660

燒錄MIAT_STM32

- [ ] Rebuilder all target files產生HEX
- [ ] DFU File Manager轉換HEX產生DFU
- [ ] DfuSe Demonstration燒錄DFU
- [ ] Leave DFU mode

CMOS影像擷取RGB色彩辨識實驗

實驗一

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實驗一練習

☐ 練習:

■ 修改CAM_Buffer與CMOS取像大小測試是否正常

■ 修改CMOS曝光時間、取像原點測試是否正常

■ 修改取樣點數測試是否正常

■ 修改判定顏色方式測試是否正常

實驗目的(二)

□ 使用MIAT_STM32實驗板透過MIAT_IOB實驗板整合2MPixels影像感測器進行影像擷取，並利用其取得之影像進行亮度檢測實驗。

實驗原理

- ☐ System requirement
  - ■ CMOS
  - ■ LCD
  - ■ LED
  - ■ KEY

GUI硬體電路配置

Num.	MIAT_STM32V2	MIAT_IOBV1	Num.	MIAT_STM32V2	MIAT_IOBV1
				Mapping Table	
1	PC8 (3.26)	SW1	13	PE6 (1.5)	LCD_EN
2	PC9 (3.27)	SW2	14	PF6 (1.18)	LCD_R/W
3	PC10 (4.3)	SW3	15	PF7 (1.19)	LCD_RS
4	PC11 (4.4)	SW4	16	PF8(1.20)	LCD_D4
5	PB5 (4.27)	KEY1	17	PF9 (1.21)	LCD_D5
6	PB6 (4.28)	KEY2	18	PF10 (1.22)	LCD_D6
7	PB7 (4.29)	KEY3	19	PF11 (2.13)	LCD_D7
8	PB8 (4.31)	KEY4	20	VDD (2.36)	VCC3.3V
9	PG8 (3.21)	LEDR1	21	PG12 (4.19)	LEDG1
10	PG9 (4.16)	LEDR2	22	PG13 (4.20)	LEDG2
11	PG10 (4.17)	LEDR3	23	PG14 (4.21)	LEDG3
12	PG11 (4.18)	LEDR4	24	PG15 (4.24)	LEDG4

實驗步驟

- ☐ 範例目錄架構
- ☐ 範例說明

範例目錄架構

□ 範例目錄

- 測試映像檔
- 含括檔
- 函式庫
- 專案檔
- 原始碼
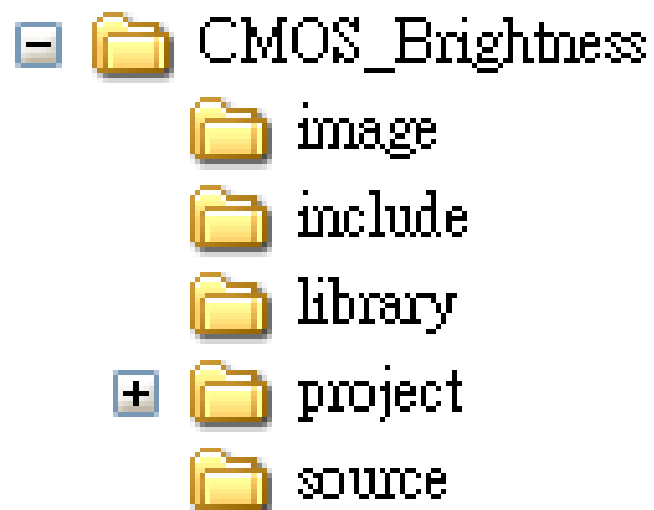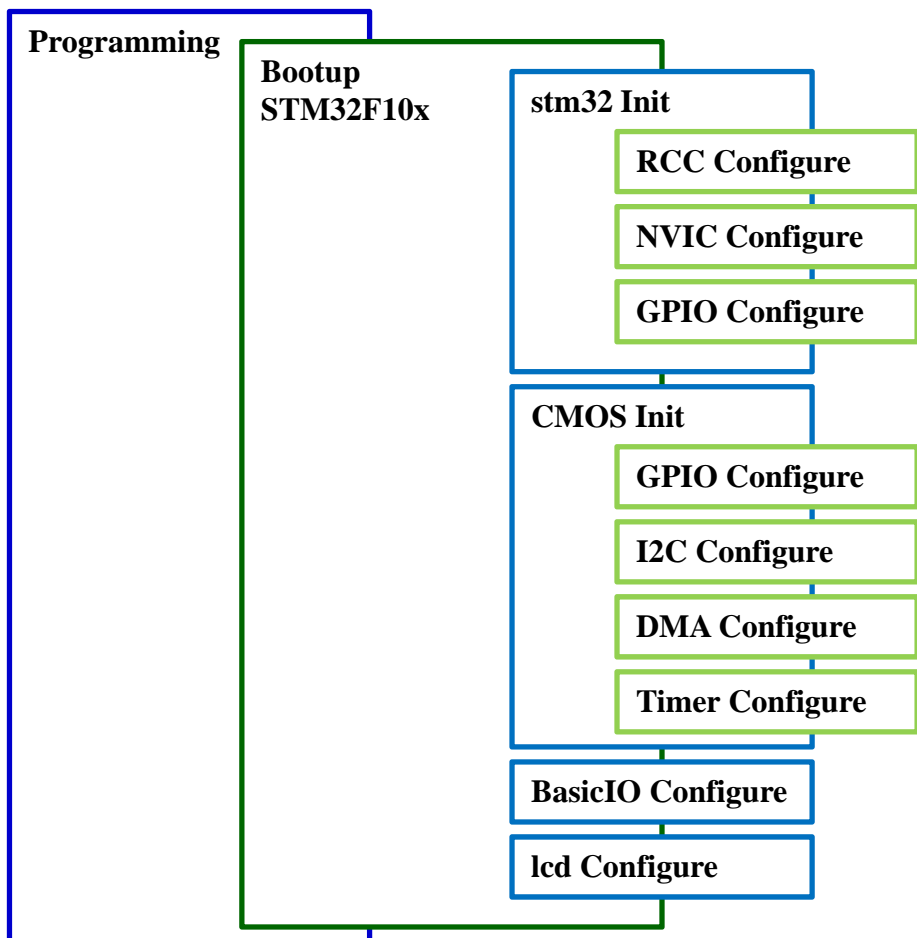
```
CMOS_Brightness
    image
    include
    library
    project
    source
```

範例說明

Programming

Bootup STM32F10x

stm32 Init

- RCC Configure
- NVIC Configure
- GPIO Configure

CMOS Init

- GPIO Configure
- I2C Configure
- DMA Configure
- Timer Configure

BasicIO Configure

lcd Configure

```
int main (void)
{
  unsigned char i,j;
  int R,G,B;

  stm32_Init ();              // STM32 Initialization
  CMOS_Init();
  Init_BasicIO();

  lcd_init();                 // LCD Initialization


  ..................................................................
```

範例說明

CMOS operation

- CMOS Exposure
- CMOS SetWindowOrigin
- CMOS SetImageSize
- Example

CMOS operation

```
lcd_clear();
lcd_print ("MIAT_STM32 DEMO ");

CMOS_Exposure(0x0080);
CMOS_SetWindowOrigin(578,810); //548,476
CMOS_SetImageSize(128,128);

bright=65535;
Dark=0;

while(1)
{

  CAM_Buffer=(unsigned char *)0x60040000;

  CMOS_Capture(CAM_Buffer);

  CAM_Buffer=(unsigned char *)0x60040000;
  G=0;
  for(i=0;i<16;i++)
  {
   for(j=0;j<128;j+=8)
   {
     G+=CAM_Buffer[j];
   }
   CAM_Buffer+=1024;
  }
```

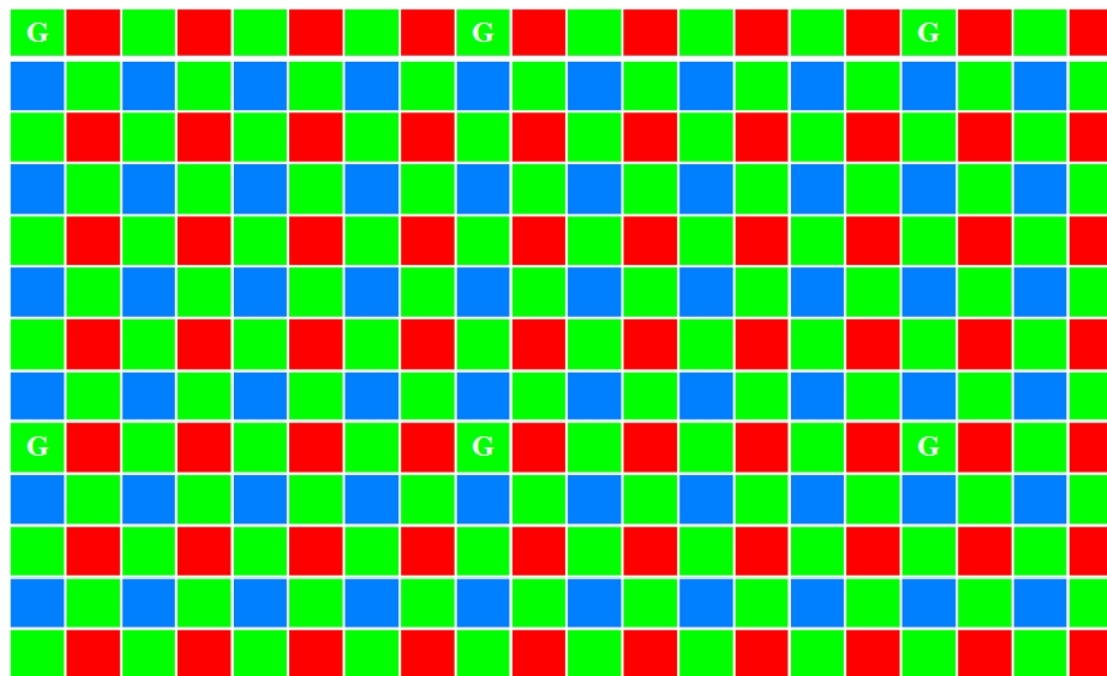LCD Line1顯示
MIAT_STM32DEMO

設定CMOS參數

由取得影像取樣，累積G數值

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取樣方式

☐ 依照Pixel Color Pattern，每8點G取一點，由128*128中影像中，取樣16*16點

範例說明

CMOS operation

Example

```
KEY_Buffer=Key_Scan();
  if(KEY_Buffer==1)
  {
    Dark=G;
    set_cursor (0, 1);
    lcd_print ("Set Dark value  ");
  }
  else if(KEY_Buffer==2)
  {
    bright=G;
    set_cursor (0, 1);
    lcd_print ("Set bright value");
  }
  else if((bright-Dark)>0)
  {
    Interval=(bright-Dark)>>8;

    i=1;
    LED_Buffer=0;
    G-=Dark;
```

掃描KEY是否按下

如果KEY1按下，紀錄G累積值為全黑，LCD Line2顯示Set Dark Value

如果KEY2按下，紀錄G累積值為全黑，LCD Line2顯示Set bright Value

範例說明

CMOS operation

Example

```
while(G>0)
  {
    for(j=0;j<i;j++)
    {
                G-=Interval;
    }
    if(G>0)
    {
      LED_Buffer+=i;
                if(i>255)break;
    }
    else
    {
      G=0;
    }
                i<<=1;
  }
  LED_DATA_OUT(LED_Buffer);
  set_cursor (0, 1);
  lcd_print ("Display value   ");
  }
  else
  {
   set_cursor (0, 1);
   lcd_print ("Range Error    ");
  }

  }
```

判定亮度，由LED以光棒方式顯示

當範圍設定錯誤時，LCD Line2顯示Range Error

CMOS影像擷取亮度檢測實驗

實驗二

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實驗二練習

☐ 練習:

■ 修改CAM_Buffer與CMOS取像大小測試是否正常

■ 修改CMOS曝光時間、取像原點測試是否正常

■ 修改取樣點數測試是否正常

Q & A

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