ENGINE

Teaching online electronics, microcontrollers and programming in Higher Education

Programing of embedded systems

9. Bargraph RGB

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Declaration

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Programing of embedded systems
9. Bargraph RGB

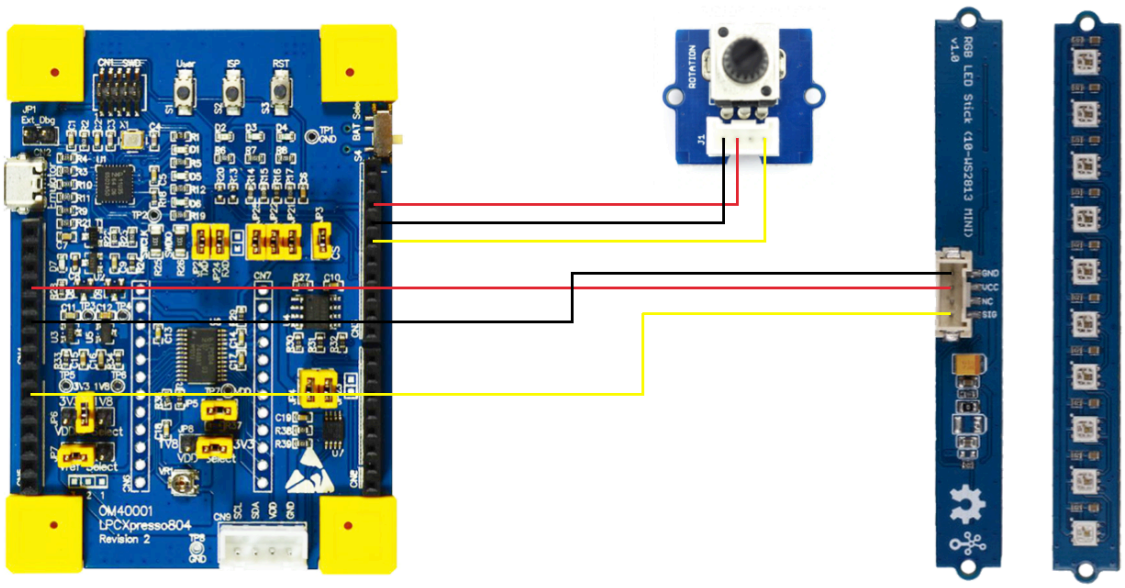
I. A/D Converter

1. Create a new project for the *LPCXpresso804* board and name it eg *Lab09*.
2. Configure the *SPI* interface to control *Neopixels* diodes - as in the *Lab06* manual.
3. Configure the *A/D* converter (one channel, 10 Hz sampling) - as in the *Lab07* manual.
4. Go to the main project file and modify the code as below:

```
#include <stdio.h>
#include "board.h"
#include "peripherals.h"
#include "pin_mux.h"
#include "clock_config.h"
#include "LPC804.h"
#include "fsl_debug_console.h"
#include "fsl_power.h"
#include "oled.h"

#define LEDS 10
#define GET_BIT(k, n)     (k &   (1 << (n)))
#define SET_BIT(k, n)     (k |=  (1 << (n)))
#define CLR_BIT(k, n)     (k &= ~(1 << (n)))

#define CODE_0                                  0b10000
#define CODE_1                                  0b11100

uint32_t colors[LEDS]={0};

static adc_result_info_t gAdcResultInfoStruct;
adc_result_info_t *volatile gAdcResultInfoPtr = &gAdcResultInfoStruct;
volatile uint16_t adcValue = 0;


/* ADC_SEQA_IRQn interrupt handler */
void ADC_ADC_SEQ_A_IRQHANDLER(void) {
          /* Get status flags */
          if (kADC_ConvSeqAInterruptFlag == (kADC_ConvSeqAInterruptFlag & ADC_GetStatusFlags(ADC_PERIPHERAL))) {
                    /* Place your interrupt code here */
                    ADC_GetChannelConversionResult(ADC_PERIPHERAL, 0, gAdcResultInfoPtr);
                    adcValue = gAdcResultInfoStruct.result;
                    /* Clear status flags */
                    ADC_ClearStatusFlags(ADC_PERIPHERAL, kADC_ConvSeqAInterruptFlag);
          }
}

void Neopixels_Send(SPI_Type *base, uint32_t n, uint32_t *value)
{
          uint16_t LED_data=0;

          for(int j=0;j<n;j++) {
                    for(int i=23;i>=0;i--) {
                              LED_data = GET_BIT(value[j], i) ? CODE_1 : CODE_0;

                              while(!(base->STAT & SPI_STAT_TXRDY_MASK));
                              base->TXDAT = LED_data ;
                    }
          }
          // Reset >= 280 us (WS2813)
          LED_data=0;
          for(int j=0;j<225;j++) { // 280 / 1.25
                    while(!(base->STAT & SPI_STAT_TXRDY_MASK));
                    base->TXDAT = LED_data ;
          }
}

void Line(uint16_t v) {

          uint16_t level;
          for(int i=0;i<LEDS;i++) {
                    colors[i] = 0; // black
          }
          level = (LEDS-1)*v/4095;
          colors[level] = 0x00000F; // blue
          Neopixels_Send(SPI0_PERIPHERAL, LEDS, colors);
}
/*
 * @brief   Application entry point.
 */
int main(void) {

          /* Power on ADC. */
          POWER_DisablePD(kPDRUNCFG_PD_ADC0);
          /* Init board hardware. */
          BOARD_InitBootPins();
          BOARD_InitBootClocks();
          BOARD_InitBootPeripherals();
#ifndef BOARD_INIT_DEBUG_CONSOLE_PERIPHERAL
          /* Init FSL debug console. */
          BOARD_InitDebugConsole();
#endif
```

```
        SPI_WriteConfigFlags(SPI0_PERIPHERAL,  kSPI_ReceiveIgnore);

        while(1) {

                Line(adcValue);
        }
        return 0 ;
}
```

5. Connect the potentiometer and the *Neopixels* modules according to the diagram below:



6. Build a project, program the microcontroller and test the example.

   Do not exceed the value of 15 for individual RGB components! - in order not to overload the voltage stabilizer on the microcontroller board.

II. Exercises

1. Write a function that turns all the LEDs green to a set level:

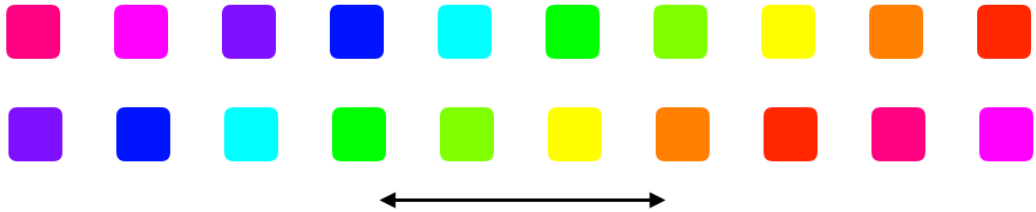
2. Write a function that works as above, but the last 4 LEDs should light up in yellow and red respectively:

3. Add a *hold-peak* function that displays the peak value in red. The peak value should "fall" much slower than the line of light itself:

4. Write a function that lights up all the LEDs to a set level, on a color from the *LUT* table:

```
uint32_t colorLUT[LEDS] = {
                    // GRB
                    0x000f00, //red
                    0x080f00, //orange
                    0x0f0f00, //yellow
                    0x0f0800, //chartreuse
                    0x0f0000, //green
                    0x0f000f, //cyan
                    0x00000f, //blue
                    0x00080f, //purple
                    0x000f0f, //violet
                    0x000f08  //magenta

};
```

5. Write a function that lights up all the LEDs as above, but rotates the colors by the level value:



6. Create your own effects depending on the value returned by the A / D converter. Remember not to exceed the value of 15 for each RGB component!