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/* USER CODE BEGIN Header */
/* WBB DAN003 and PLLTHI032 PRAC 3 for EEE3096S: Embedded Systems 2*/
/**
*****
* @file      : main.c
* @brief     : Main program body
*****
* @attention
*
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*
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* in the root directory of this software component.
* If no LICENSE file comes with this software, it is provided AS-IS.
*
*****
*/
/* USER CODE END Header */
/* Includes -----*/
#include "main.h"

/* Private includes -----*/
/* USER CODE BEGIN Includes */
#include <stdio.h>
#include "stm32f0xx.h"
#include <lcd_stm32f0.c>
#include <math.h>
// #include <iostream>
/* USER CODE END Includes */

/* Private typedef -----*/
/* USER CODE BEGIN PTD */

/* USER CODE END PTD */

/* Private define -----*/
/* USER CODE BEGIN PD */

/* USER CODE END PD */

/* Private macro -----*/
/* USER CODE BEGIN PM */

/* USER CODE END PM */

/* Private variables -----*/
ADC_HandleTypeDef hadc;
TIM_HandleTypeDef htim3;

/* USER CODE BEGIN PV */
uint32_t prev_millis = 0;
uint32_t curr_millis = 0;
uint32_t delay_t = 500; // Initialise delay to 500ms

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uint32_t frequency = 2;
uint32_t adc_val;
uint32_t ccr_val;
uint32_t currentTick = 0;
char lcdMessage;
/* USER CODE END PV */

/* Private function prototypes -----*/
void SystemClock_Config(void);
static void MX_GPIO_Init(void);
static void MX_ADC_Init(void);
static void MX_TIM3_Init(void);
void set_frequency(int freq);

/* USER CODE BEGIN PFP */
void EXTI0_1_IRQHandler(void);
void writeLCD(char *char_in);
uint32_t pollADC(void);
uint32_t ADCtoCCR(uint32_t adc_val);
/* USER CODE END PFP */

/* Private user code -----*/
/* USER CODE BEGIN 0 */
void set_frequency(int freq) {
    float period = 1/freq;
    // delay_t = round(period*1000);

    if (delay_t == 500) {
        delay_t = 1000;
    } else delay_t = 500;
}

/* USER CODE END 0 */

/**
 * @brief The application entry point.
 * @retval int
 */
int main(void)
{
    /* USER CODE BEGIN 1 */
    /* USER CODE END 1 */

    /* MCU Configuration-----*/

    /* Reset of all peripherals, Initializes the Flash interface and the Systick. */
    HAL_Init();

    /* USER CODE BEGIN Init */
    /* USER CODE END Init */

    /* Configure the system clock */
    SystemClock_Config();

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/* USER CODE BEGIN SysInit */
/* USER CODE END SysInit */

/* Initialize all configured peripherals */
MX_GPIO_Init();
MX_ADC_Init();
MX_TIM3_Init();

/* USER CODE BEGIN 2 */
init_LCD();

// PWM setup
uint32_t CCR = 0;
HAL_TIM_PWM_Start(&htim3, TIM_CHANNEL_3); // Start PWM on TIM3 Channel 3
/* USER CODE END 2 */

/* Infinite loop */
/* USER CODE BEGIN WHILE */
while (1)
{
    // Toggle LED0
    HAL_GPIO_TogglePin(GPIOB, LED7_Pin);

    // ADC to LCD; TODO: Read POT1 value and write to LCD
    HAL_ADC_Start(&hadc);
    pollADC();
    HAL_ADC_Stop(&hadc);

    ccr_val = ADctoCCR adc_val);
    __HAL_TIM_SET_COMPARE(&htim3, TIM_CHANNEL_3, ccr_val);

    // Converts adc_val to char and prints to LCD Screen
    char buf[BUFSIZ];
    sprintf(buf, "%lu", adc_val);
    writeLCD(buf);

    // Update PWM value; TODO: Get CRR

    // __HAL_TIM_SetCompare(&htim3, TIM_CHANNEL_3, CCR);

    // Wait for delay ms
    HAL_Delay (delay_t);
    /* USER CODE END WHILE */

    /* USER CODE BEGIN 3 */
}
/* USER CODE END 3 */
}

/**
 * @brief System Clock Configuration
 * @retval None
 */
void SystemClock_Config(void)

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{
    LL_FLASH_SetLatency(LL_FLASH_LATENCY_0);
    while(LL_FLASH_GetLatency() != LL_FLASH_LATENCY_0)
    {
    }
    LL_RCC_HSI_Enable();

    /* Wait till HSI is ready */
    while(LL_RCC_HSI_IsReady() != 1)
    {

    }
    LL_RCC_HSI_SetCalibTrimming(16);
    LL_RCC_HSI14_Enable();

    /* Wait till HSI14 is ready */
    while(LL_RCC_HSI14_IsReady() != 1)
    {

    }
    LL_RCC_HSI14_SetCalibTrimming(16);
    LL_RCC_SetAHBPrescaler(LL_RCC_SYSCLK_DIV_1);
    LL_RCC_SetAPB1Prescaler(LL_RCC_APB1_DIV_1);
    LL_RCC_SetSysClkSource(LL_RCC_SYS_CLKSOURCE_HSI);

    /* Wait till System clock is ready */
    while(LL_RCC_GetSysClkSource() != LL_RCC_SYS_CLKSOURCE_STATUS_HSI)
    {

    }
    LL_SetSystemCoreClock(8000000);

    /* Update the time base */
    if (HAL_InitTick (TICK_INT_PRIORITY) != HAL_OK)
    {
        Error_Handler();
    }
    LL_RCC_HSI14_EnableADCControl();
}

/**
 * @brief ADC Initialization Function
 * @param None
 * @retval None
 */
static void MX_ADC_Init(void)
{
    /* USER CODE BEGIN ADC_Init 0 */
    /* USER CODE END ADC_Init 0 */

    ADC_ChannelConfTypeDef sConfig = {0};

    /* USER CODE BEGIN ADC_Init 1 */

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/* USER CODE END ADC_Init 1 */

/** Configure the global features of the ADC (Clock, Resolution, Data Alignment and
number of conversion)
*/
hadc.Instance = ADC1;
hadc.Init.ClockPrescaler = ADC_CLOCK_ASYNC_DIV1;
hadc.Init.Resolution = ADC_RESOLUTION_12B;
hadc.Init.DataAlign = ADC_DATAALIGN_RIGHT;
hadc.Init.ScanConvMode = ADC_SCAN_DIRECTION_FORWARD;
hadc.Init.EOCSelection = ADC_EOC_SINGLE_CONV;
hadc.Init.LowPowerAutoWait = DISABLE;
hadc.Init.LowPowerAutoPowerOff = DISABLE;
hadc.Init.ContinuousConvMode = DISABLE;
hadc.Init.DiscontinuousConvMode = DISABLE;
hadc.Init.ExternalTrigConv = ADC_SOFTWARE_START;
hadc.Init.ExternalTrigConvEdge = ADC_EXTERNALTRIGCONVEDGE_NONE;
hadc.Init.DMAContinuousRequests = DISABLE;
hadc.Init.Overrun = ADC_OVR_DATA_PRESERVED;
if (HAL_ADC_Init(&hadc) != HAL_OK)
{
    Error_Handler();
}

/** Configure for the selected ADC regular channel to be converted.
*/
sConfig.Channel = ADC_CHANNEL_6;
sConfig.Rank = ADC_RANK_CHANNEL_NUMBER;
sConfig.SamplingTime = ADC_SAMPLETIME_1CYCLE_5;
if (HAL_ADC_ConfigChannel(&hadc, &sConfig) != HAL_OK)
{
    Error_Handler();
}
/* USER CODE BEGIN ADC_Init 2 */
ADC1->CR |= ADC_CR_ADCAL;
while(ADC1->CR & ADC_CR_ADCAL);    // Calibrate the ADC
ADC1->CR |= (1 << 0);              // Enable ADC
while((ADC1->ISR & (1 << 0)) == 0); // Wait for ADC ready
/* USER CODE END ADC_Init 2 */
}

/**
 * @brief TIM3 Initialization Function
 * @param None
 * @retval None
 */
static void MX_TIM3_Init(void)
{
    /* USER CODE BEGIN TIM3_Init 0 */

    /* USER CODE END TIM3_Init 0 */

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TIM_ClockConfigTypeDef sClockSourceConfig = {0};
TIM_MasterConfigTypeDef sMasterConfig = {0};
TIM_OC_InitTypeDef sConfigOC = {0};

/* USER CODE BEGIN TIM3_Init 1 */

/* USER CODE END TIM3_Init 1 */
htim3.Instance = TIM3;
htim3.Init.Prescaler = 0;
htim3.Init.CounterMode = TIM_COUNTERMODE_UP;
htim3.Init.Period = 47999;
htim3.Init.ClockDivision = TIM_CLOCKDIVISION_DIV1;
htim3.Init.AutoReloadPreload = TIM_AUTORELOAD_PRELOAD_DISABLE;
if (HAL_TIM_Base_Init(&htim3) != HAL_OK)
{
    Error_Handler();
}
sClockSourceConfig.ClockSource = TIM_CLOCKSOURCE_INTERNAL;
if (HAL_TIM_ConfigClockSource(&htim3, &sClockSourceConfig) != HAL_OK)
{
    Error_Handler();
}
if (HAL_TIM_PWM_Init(&htim3) != HAL_OK)
{
    Error_Handler();
}
sMasterConfig.MasterOutputTrigger = TIM_TRGO_RESET;
sMasterConfig.MasterSlaveMode = TIM_MASTERSLAVEMODE_DISABLE;
if (HAL_TIMEx_MasterConfigSynchronization(&htim3, &sMasterConfig) != HAL_OK)
{
    Error_Handler();
}
sConfigOC.OCMode = TIM_OCMODE_PWM1;
sConfigOC.Pulse = 0;
sConfigOC.OCpolarity = TIM_OCPOLARITY_HIGH;
sConfigOC.OCFastMode = TIM_OCFAST_DISABLE;
if (HAL_TIM_PWM_ConfigChannel(&htim3, &sConfigOC, TIM_CHANNEL_3) != HAL_OK)
{
    Error_Handler();
}
/* USER CODE BEGIN TIM3_Init 2 */

/* USER CODE END TIM3_Init 2 */
HAL_TIM_MspPostInit(&htim3);
}

/**
 * @brief GPIO Initialization Function
 * @param None
 * @retval None
 */
static void MX_GPIO_Init(void)

```

```

{
    LL_EXTI_InitTypeDef EXTI_InitStruct = {0};
    LL_GPIO_InitTypeDef GPIO_InitStruct = {0};
    /* USER CODE BEGIN MX_GPIO_Init_1 */
    /* USER CODE END MX_GPIO_Init_1 */

    /* GPIO Ports Clock Enable */
    LL_AHB1_GRP1_EnableClock(LL_AHB1_GRP1_PERIPH_GPIOF);
    LL_AHB1_GRP1_EnableClock(LL_AHB1_GRP1_PERIPH_GPIOA);
    LL_AHB1_GRP1_EnableClock(LL_AHB1_GRP1_PERIPH_GPIOB);

    /**/
    LL_GPIO_ResetOutputPin(LED7_GPIO_Port, LED7_Pin);

    /**/
    LL_SYSCFG_SetEXTISource(LL_SYSCFG_EXTI_PORTA, LL_SYSCFG_EXTI_LINE0);

    /**/
    LL_GPIO_SetPinPull(Button0_GPIO_Port, Button0_Pin, LL_GPIO_PULL_UP);

    /**/
    LL_GPIO_SetPinMode(Button0_GPIO_Port, Button0_Pin, LL_GPIO_MODE_INPUT);

    /**/
    EXTI_InitStruct.Line_0_31 = LL_EXTI_LINE_0;
    EXTI_InitStruct.LineCommand = ENABLE;
    EXTI_InitStruct.Mode = LL_EXTI_MODE_IT;
    EXTI_InitStruct.Trigger = LL_EXTI_TRIGGER_RISING;
    LL_EXTI_Init(&EXTI_InitStruct);

    /**/
    GPIO_InitStruct.Pin = LED7_Pin;
    GPIO_InitStruct.Mode = LL_GPIO_MODE_OUTPUT;
    GPIO_InitStruct.Speed = LL_GPIO_SPEED_FREQ_LOW;
    GPIO_InitStruct.OutputType = LL_GPIO_OUTPUT_PUSHPULL;
    GPIO_InitStruct.Pull = LL_GPIO_PULL_NO;
    LL_GPIO_Init(LED7_GPIO_Port, &GPIO_InitStruct);

    /* USER CODE BEGIN MX_GPIO_Init_2 */
    HAL_NVIC_SetPriority(EXTI0_1_IRQn, 0, 0);
    HAL_NVIC_EnableIRQ(EXTI0_1_IRQn);
    /* USER CODE END MX_GPIO_Init_2 */
}

/* USER CODE BEGIN 4 */
void EXTI0_1_IRQHandler(void)
{
    // TODO: Add code to switch LED7 delay frequency
    if ((HAL_GetTick() - currentTick) > 6) {
        if (frequency == 1) {
            frequency = 2;
        } else frequency = 1;

        set_frequency(frequency);
    }
}

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    HAL_GPIO_EXTI_IRQHandler(Button0_Pin); // Clear interrupt flags
    currentTick = HAL_GetTick();
}
}

// TODO: Complete the writeLCD function
void writeLCD(char *char_in){
    delay(3000);
    lcd_command(CLEAR);
    lcd_putstr(char_in);
}

// Get ADC value
uint32_t pollADC(void){
    // TODO: Complete function body to get ADC val
    adc_val = HAL_ADC_GetValue(&hadc);
    return adc_val;
}

// Calculate PWM CCR value
uint32_t ADCtoCCR(uint32_t adc_val){
    // TODO: Calculate CCR val using an appropriate equation
    uint32_t ccr_val = adc_val*11.71875;
    return ccr_val;
}

void ADC1_COMP_IRQHandler(void)
{
    adc_val = HAL_ADC_GetValue(&hadc); // read adc value
    HAL_ADC_IRQHandler(&hadc); //Clear flags
}

/* USER CODE END 4 */

/**
 * @brief This function is executed in case of error occurrence.
 * @retval None
 */
void Error_Handler(void)
{
    /* USER CODE BEGIN Error_Handler_Debug */
    /* User can add his own implementation to report the HAL error return state */
    __disable_irq();
    while (1)
    {
    }
    /* USER CODE END Error_Handler_Debug */
}

#ifdef USE_FULL_ASSERT
/**
 * @brief Reports the name of the source file and the source line number
 * where the assert_param error has occurred.

```



```
* @param file: pointer to the source file name
* @param line: assert_param error line source number
* @retval None
*/
void assert_failed(uint8_t *file, uint32_t line)
{
    /* USER CODE BEGIN 6 */
    /* User can add his own implementation to report the file name and line number,
       ex: printf("Wrong parameters value: file %s on line %d\r\n", file, line) */
    /* USER CODE END 6 */
}
#endif /* USE_FULL_ASSERT */
```