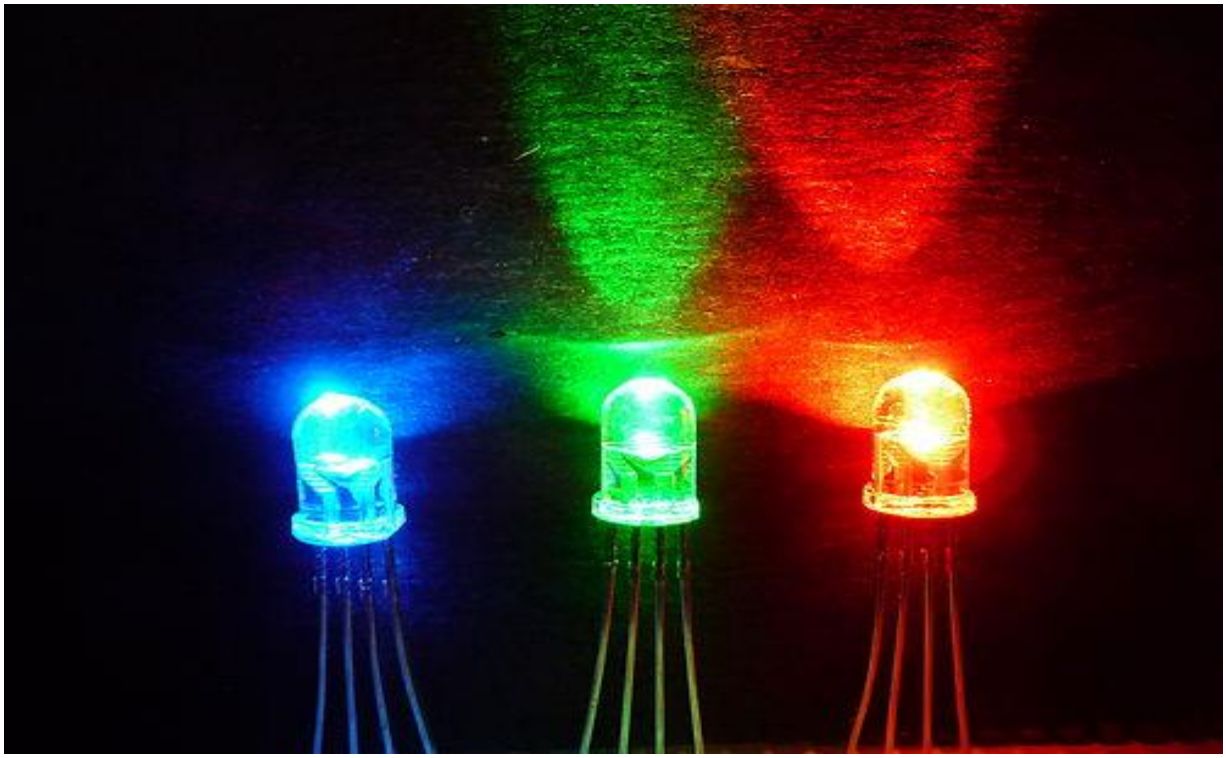
RGB LED Control V2.0 Design



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1-Description

1.1 Hardware components

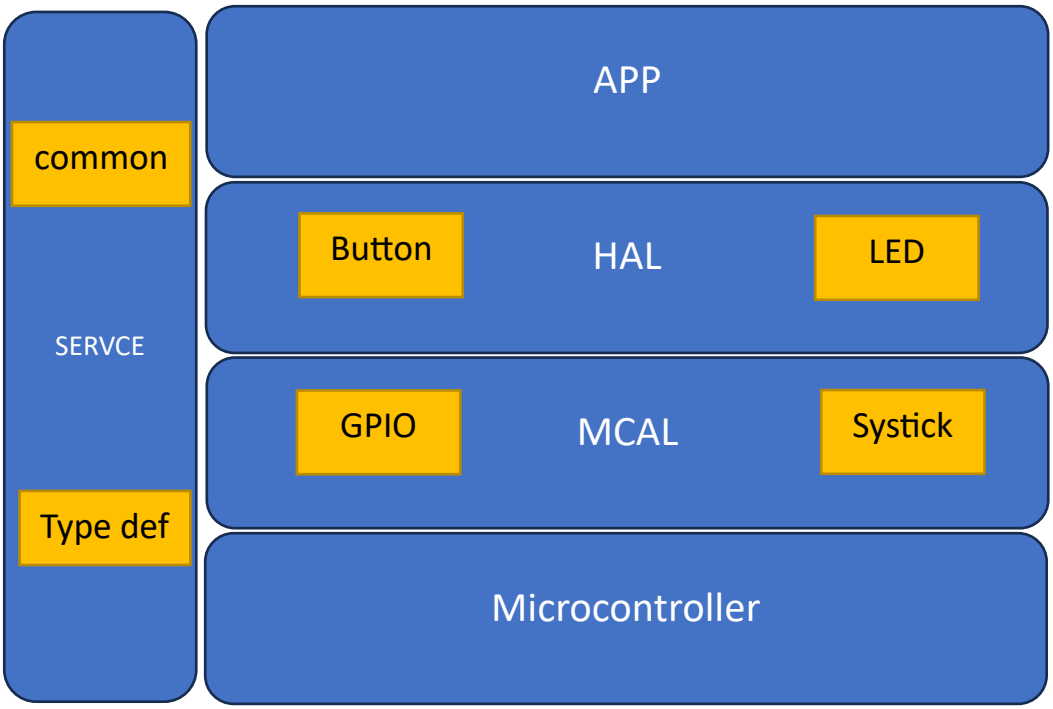
1. Use the TivaC board.
2. Use SW1 as an input button.
3. Use the RGB LED

1.2 Software Requirements

1. The RGB LED is OFF initially
2. Pressing SW1:
    1. After the first press, the Red led is on **for 1 second only**
    2. After the second press, the Green Led is on **for 1 second only**
    3. After the third press, the Blue led is on **for 1 second only**
    4. After the fourth press, all LEDs are on **for 1 second only**
    5. After the fifth press, should disable all LEDs
    6. After the sixth press, repeat steps from 1 to 6

2-High Level Design

2.1 Layered Architecture



2.2 Drivers Descriptions

2.2.1 GPIO Driver

Function: MCAL

Function: used to set pin direction (input or output), pin value (high or low) or read a value from a pin or toggle a pin

2.2.2 Button Driver

Location: HAL

Function: used to initialize the button, check the button status pressed or not

2.2.3 LED Driver

Location: HAL

Function: used to initialize the LEDs, describe the way of working the LEDs

2.2.4 Systick Driver

Location: MCAL

Function: used to make a time delay

2.2.5 Application Driver

Location: App

Function: Combine between the driver's API's to meet the requirement

2.3 Modules API's

2.3.1 GPIO Module

```
/**
 * @brief Initializes a set of pins with the specified configuration.
 * @param[in] ptr_st_GPIO_config    Address of the array of the specified pins.
 * @return en_GPIO_error_t
 */
en_GPIO_error_t GPIO_Init(const st_GPIO_config_t *ptr_st_GPIO_config);
/**
 * @brief Reads the state of a single pin.
 * @param[in] ptr_st_GPIO_config    Address of the specified pin configuration strcuture.
 * @param[in] ptr_pinValue          Address of the value where we stores the state of the pin.
 * @return en_GPIO_error_t
 */
en_GPIO_error_t GPIO_ReadPin(const st_GPIO_config_t *ptr_st_GPIO_config, uint8_t *ptr_pinValue);

/**
 * @brief Reads the state of a single pin.
 * @param[in] ptr_st_GPIO_config    Address of the specified pin configuration strcuture.
 * @param[in] pinValue              The value to be written on the specified pin.
 * @return en_GPIO_error_t
 */
en_GPIO_error_t GPIO_WritePin(const st_GPIO_config_t *ptr_st_GPIO_config, uint8 pinValue);
```

2.3.2 Button Module

```
/**
 * @brief Initializes the button pin.
 * @param[in] Button_config     Address of the configuration array.
 */
void BUTTON_Init(st_GPIO_config_t *Button_config);

/**
 * @brief Initializes the button pin.
 * @param[in] usr_buttonConfig Address of the configuration array.
 * @param[in] value        Address of the variables to store the state of push button.
 */
void BUTTON_IsPressed( st_GPIO_config_t *usr_buttonConfig, en_button_state_t *value);
```

2.3.3 LED Module

```
/**
 * @brief Initializes the LED pin using the configuration array.
 * @param[in] ptr_st_LED_config     Address of the configuration array.
 * @return en_GPIO_error_t
 */
void Led_Init(st_GPIO_config_t *ptr_st_LED_config);

/**
 * @brief Turns on the red LED and turns off all the other LEDs.
 * @param[in] ptr_st_LED_config     Address of the configuration array.
 * @return en_GPIO_error_t
 */
void LED_GreenOn(st_GPIO_config_t *ptr_st_LED_config);
```

```
/**
 * @brief Turns on the blue LED and turns off all the other LEDs.
 * @param[in] ptr_st_LED_config     Address of the configuration array.
 * @return en_GPIO_error_t
 */
void LED_BlueOn(st_GPIO_config_t *ptr_st_LED_config);

/**
 * @brief Turns on the green LED and turns off all the other LEDs.
 * @param[in] ptr_st_LED_config     Address of the configuration array.
 * @return en_GPIO_error_t
 */
void LED_RedOn(st_GPIO_config_t *ptr_st_LED_config);

/**
 * @brief Turns on all the LEDs.
 * @param[in] ptr_st_LED_config     Address of the configuration array.
 * @return en_GPIO_error_t
 */
void LED_AllOn(st_GPIO_config_t *ptr_st_LED_config);

/**
 * @brief Turns off all the LEDs.
 * @param[in] ptr_st_LED_config     Address of the configuration array.
 * @return en_GPIO_error_t
 */
void LED_AllOff(st_GPIO_config_t *ptr_st_LED_config);
```

2.3.4 Systick Module

```
/**
 * @brief Initializes the SysTick timer module.
 * @param[in] ptr_st_SYSTICK_config     Address of the configuration array.
 */
void SYSTICK_Init(st_SYSTICK_config_t *ptr_st_SYSTICK_config);

/**
 * @brief De-Initializes the SysTick timer module.
 */
void SYSTICK_DeInit(void);

/**
 * @brief Enables the SysTick timer module.
 */
void SYSTICK_StartTimer(void);

/**
 * @brief Disables the SysTick timer module.
 */
void SYSTICK_ResetTimer(void);

/**
 * @brief Stops the SysTick timer module.
 */
void SYSTICK_StopTimer(void);
```

```
/**
 * @brief Creates a blocking delay with the period specified.
 * @param[in] delay_ms  Specified period in milli-seconds.
 */
void SYSTICK_Delay_ms(uint32 delay_ms);
```

2.3.5 App Module

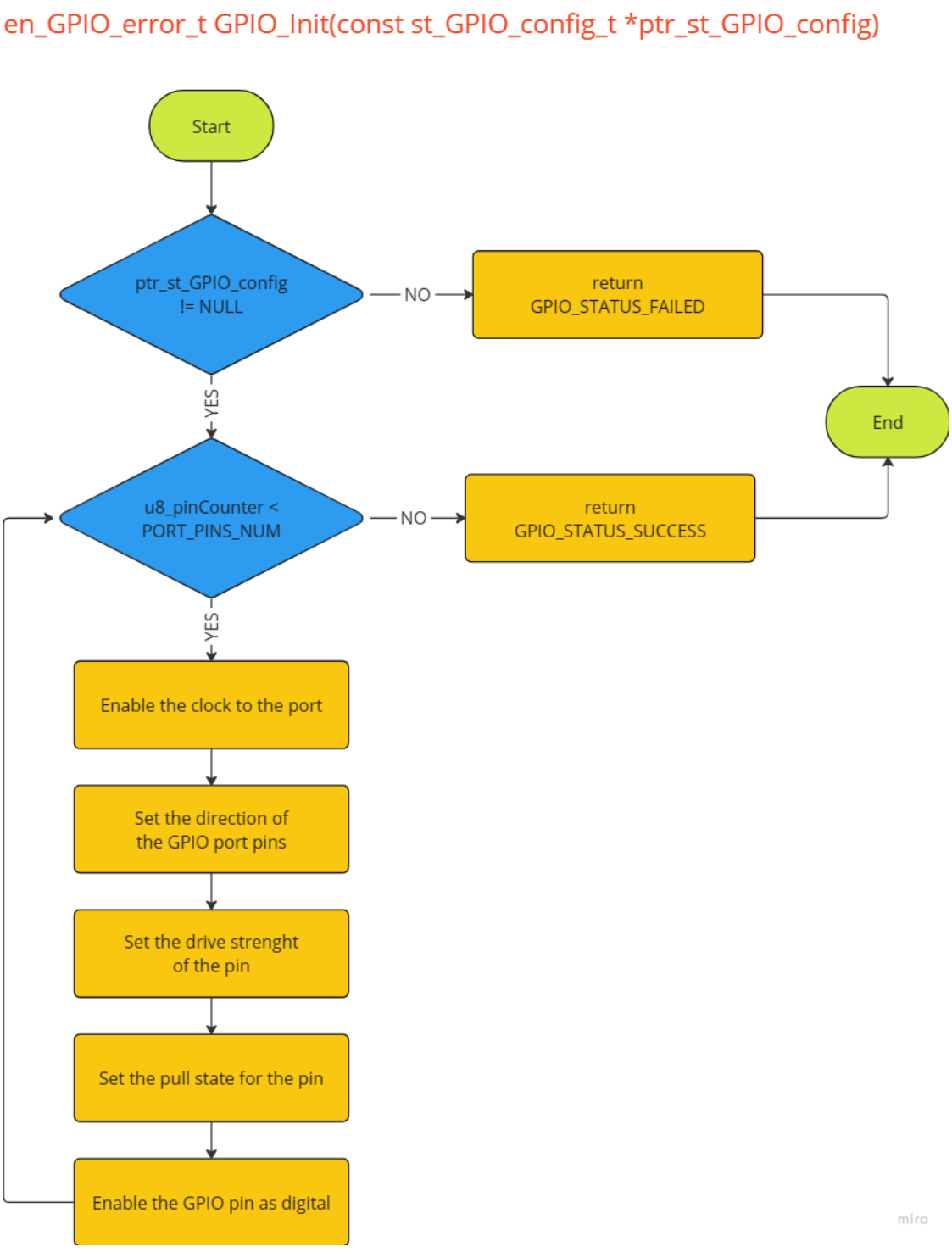
```
/**
 * @brief Initializes all the ECUAL.
 */
void APP_Init(void);

/**
 * @brief Starts the application logic.
 */
void APP_Start(void);
```

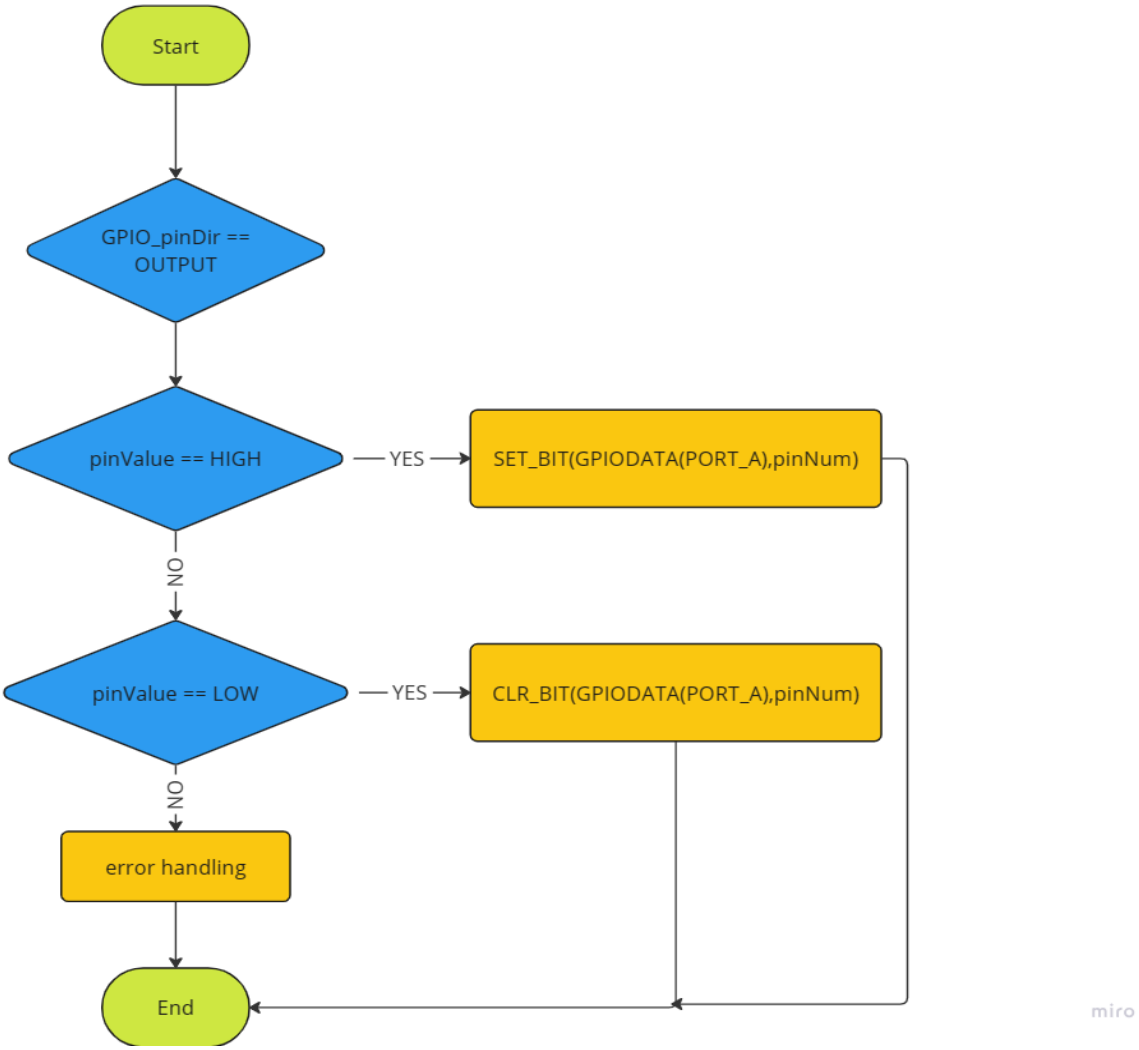
3-Low Level Design

3.1 APIs Flow Chart

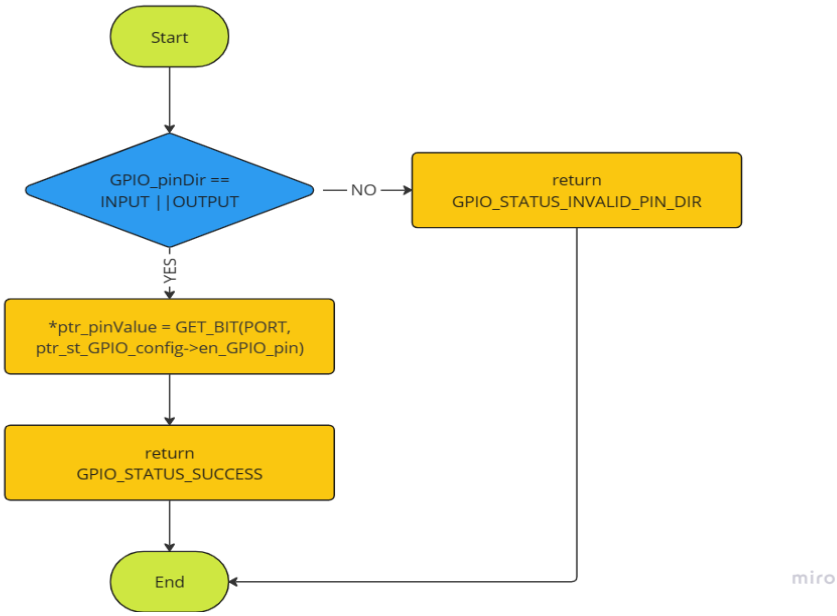
3.1.1 GPIO Module



en_GPIO_error_t GPIO_WritePin(const st_GPIO_config_t *ptr_st_GPIO_config, uint8 pinValue)

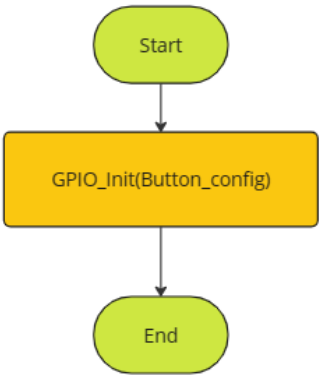


en_GPIO_error_t GPIO_ReadPin(const st_GPIO_config_t *ptr_st_GPIO_config, uint8_t *ptr_pinValue)

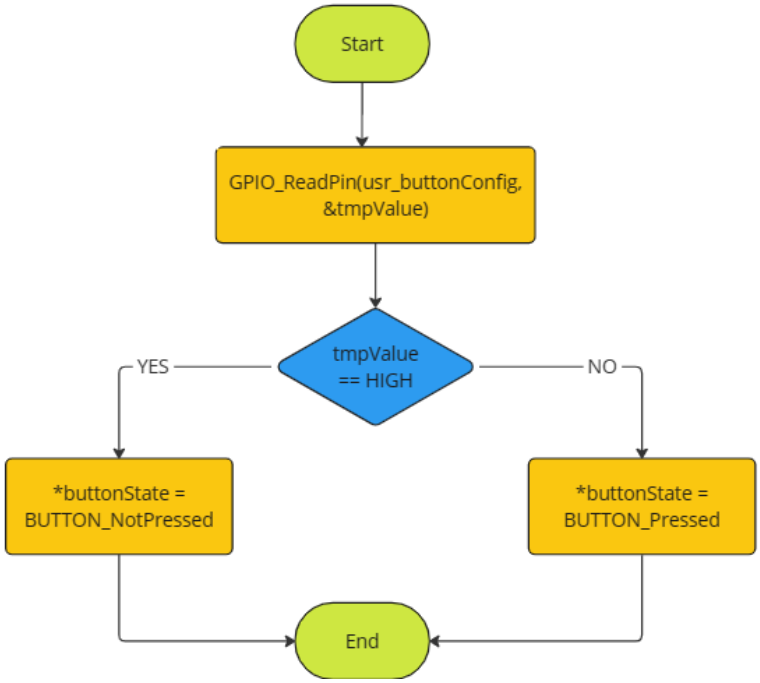


3.1.2 Button Module

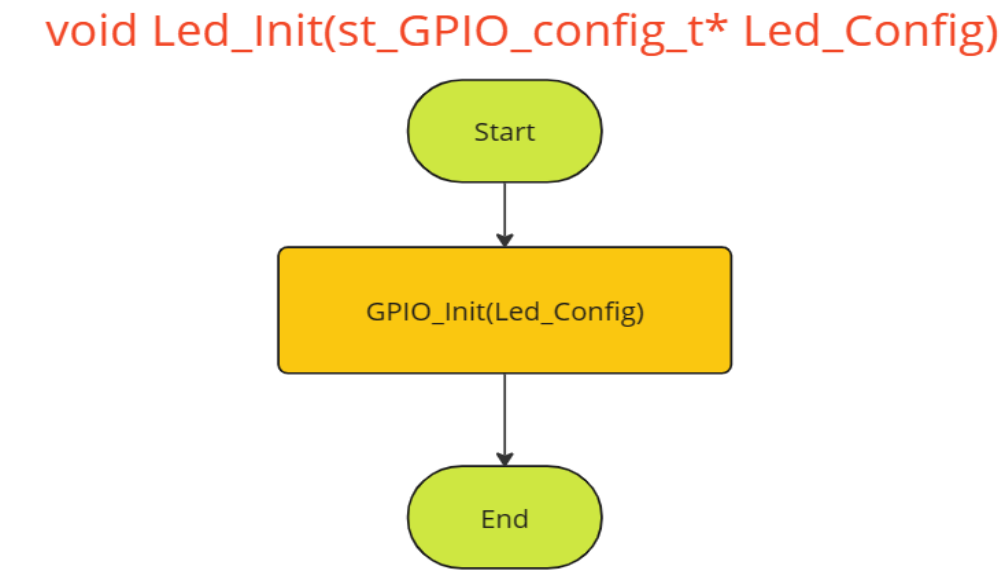
void button_init(st_GPIO_config_t* Button_config)

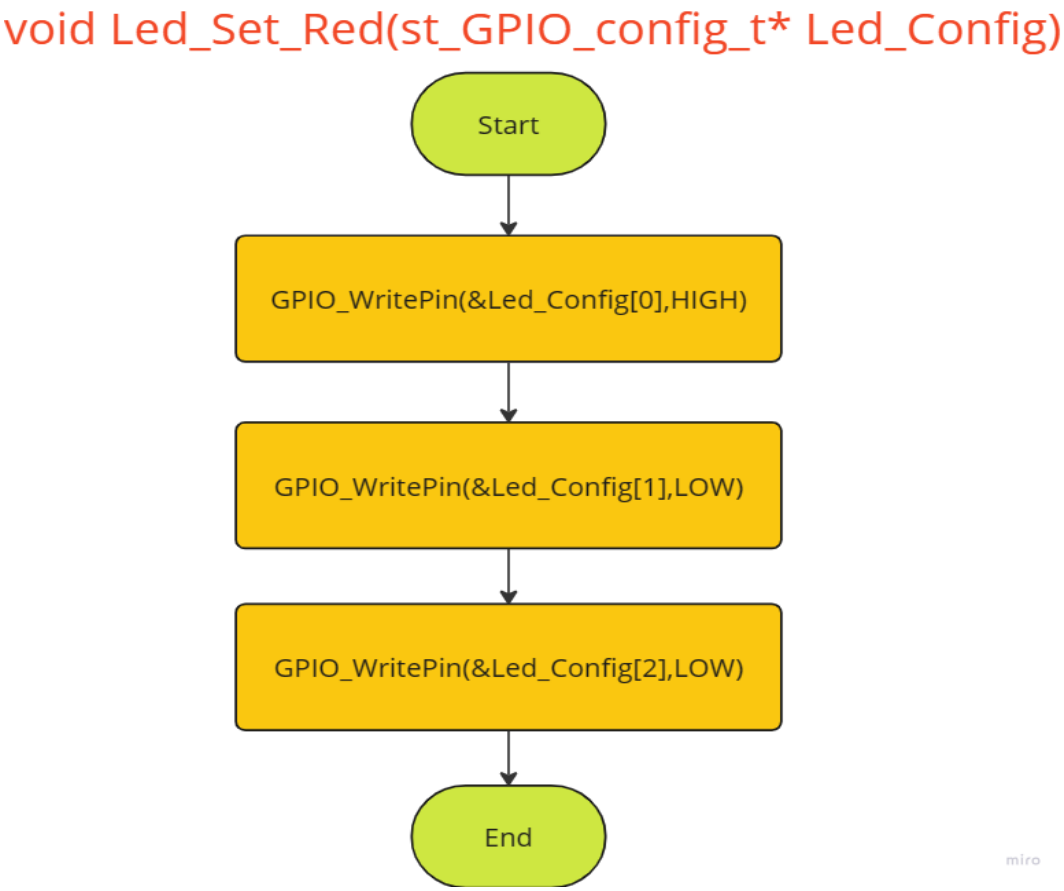


void BUTTON_IsPressed(st_GPIO_config_t *usr_buttonConfig, en_button_state_t *buttonState)

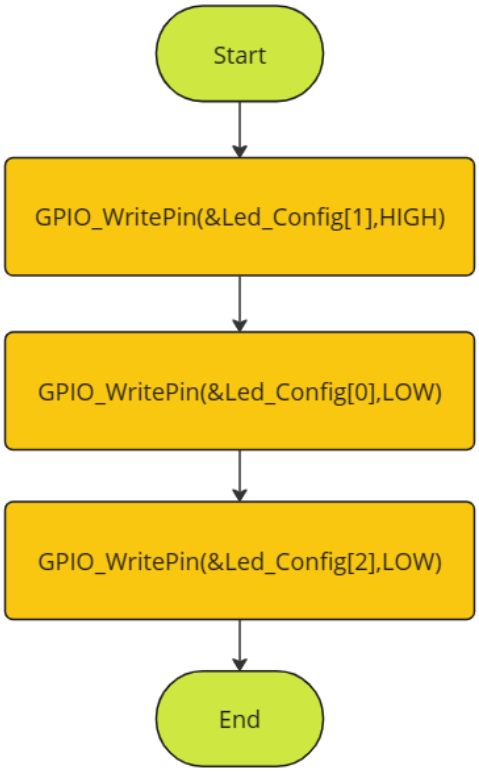


3.1.3 LED Module

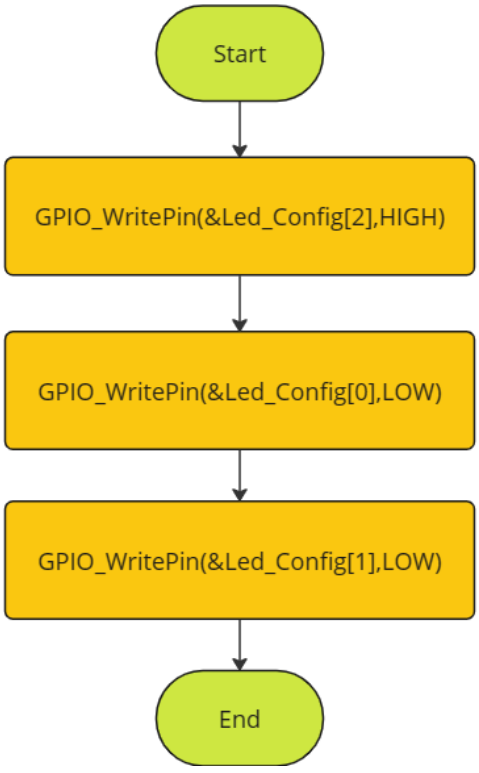




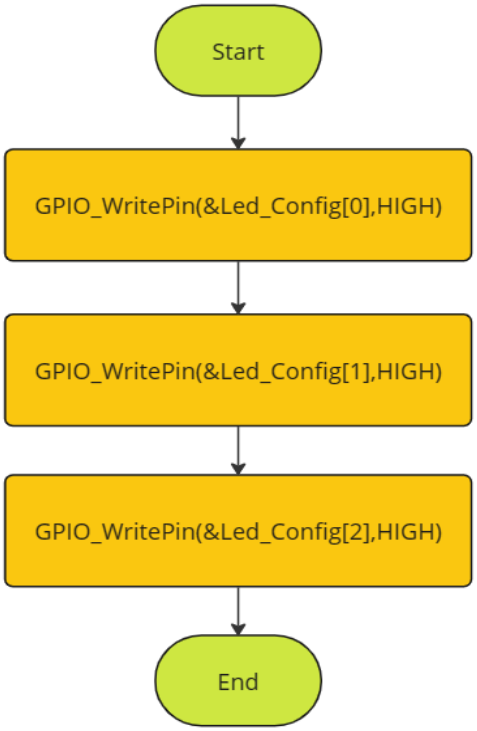
void Led_Set_Blue(st_GPIO_config_t* Led_Config)



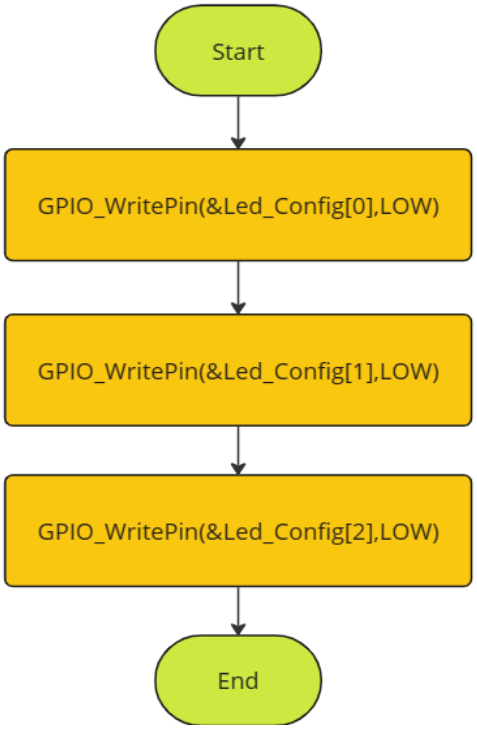
void Led_Set_Green(st_GPIO_config_t* Led_Config)



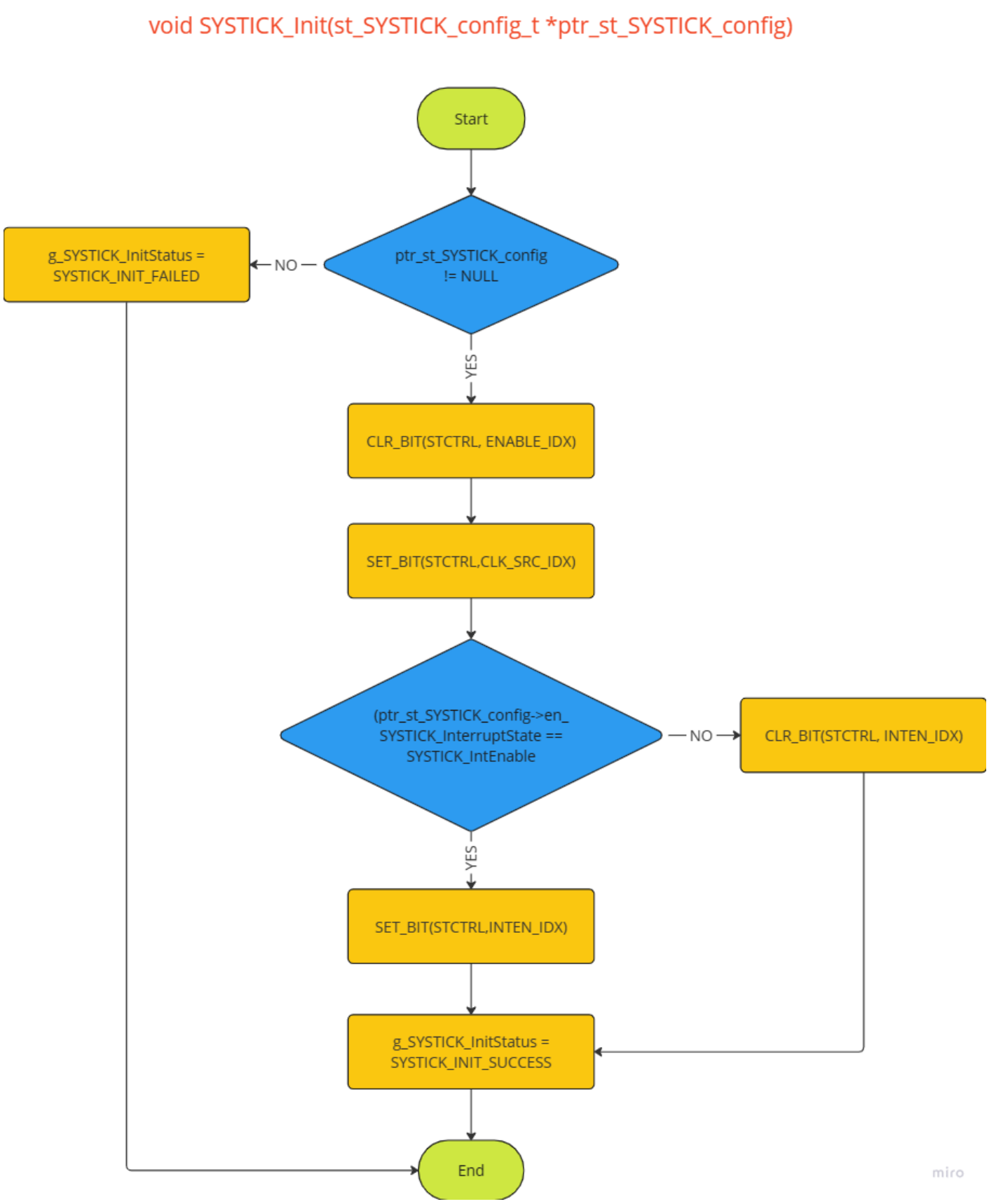
void Leds_on(st_GPIO_config_t* Led_Config)



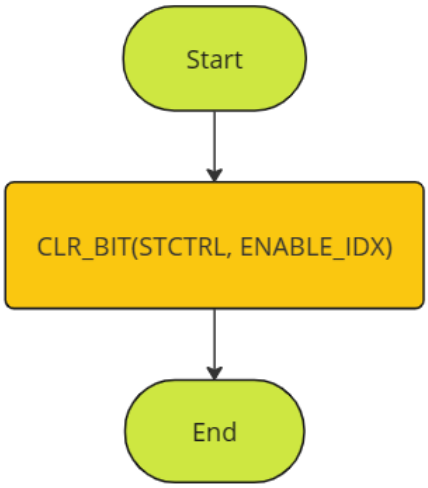
void Leds_off(st_GPIO_config_t* Led_Config)



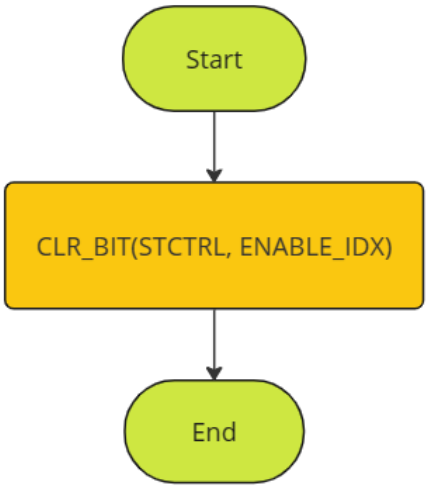
3.1.4 Systick Module



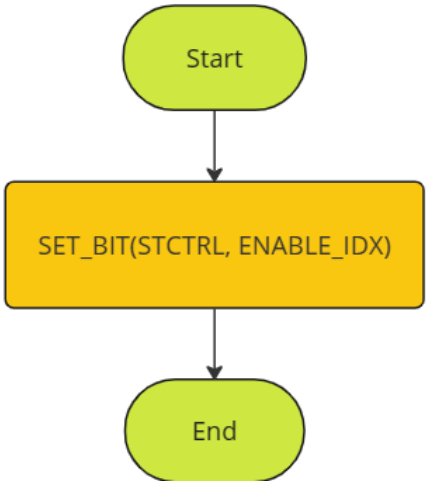
void SYSTICK_DeInit(void)



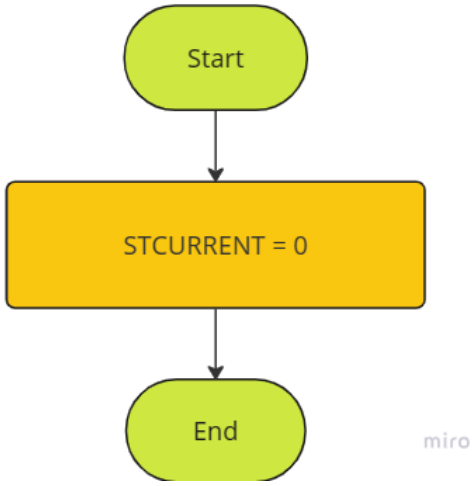
void SYSTICK_StopTimer(void)



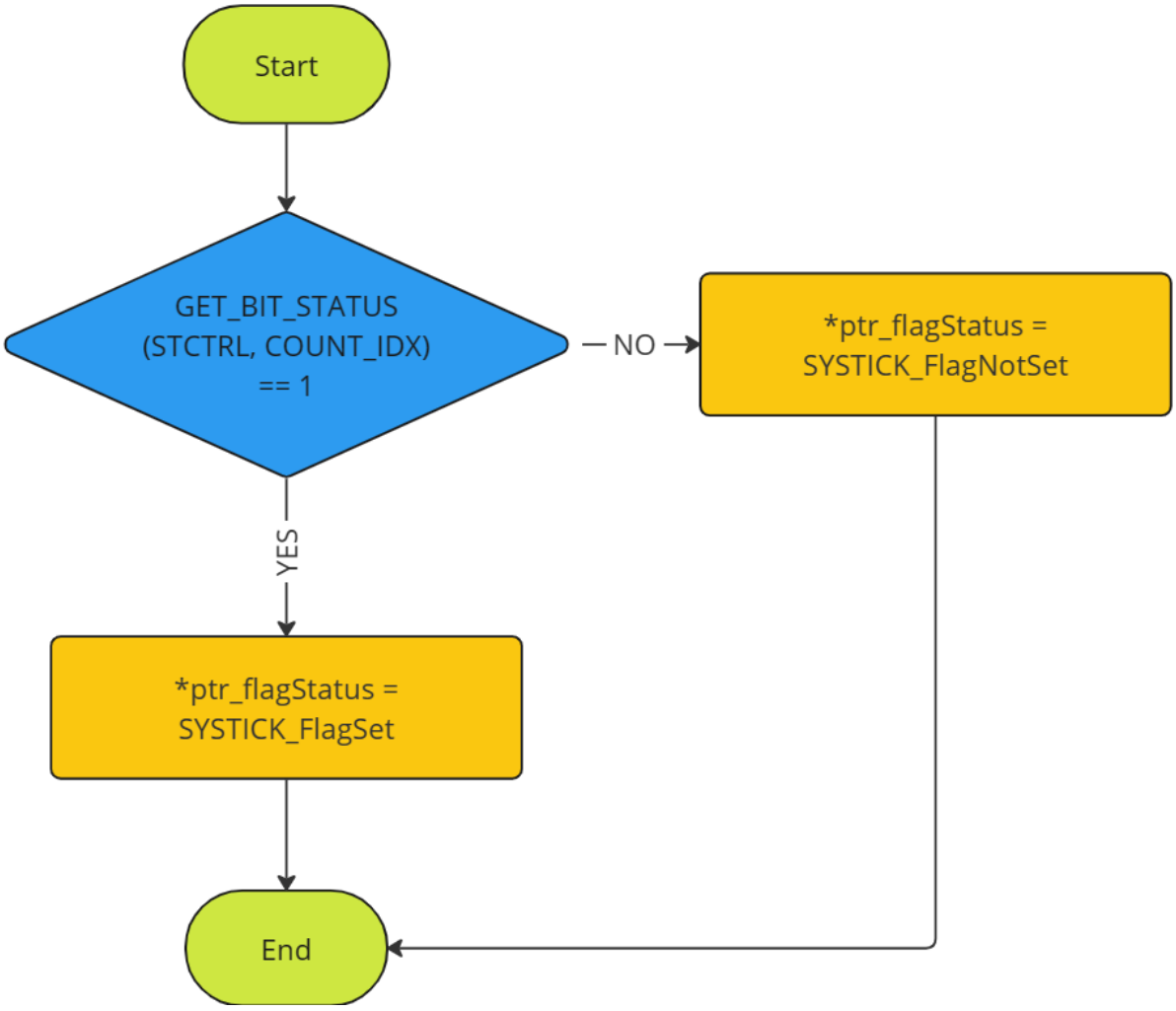
void SYSTICK_StartTimer(void)



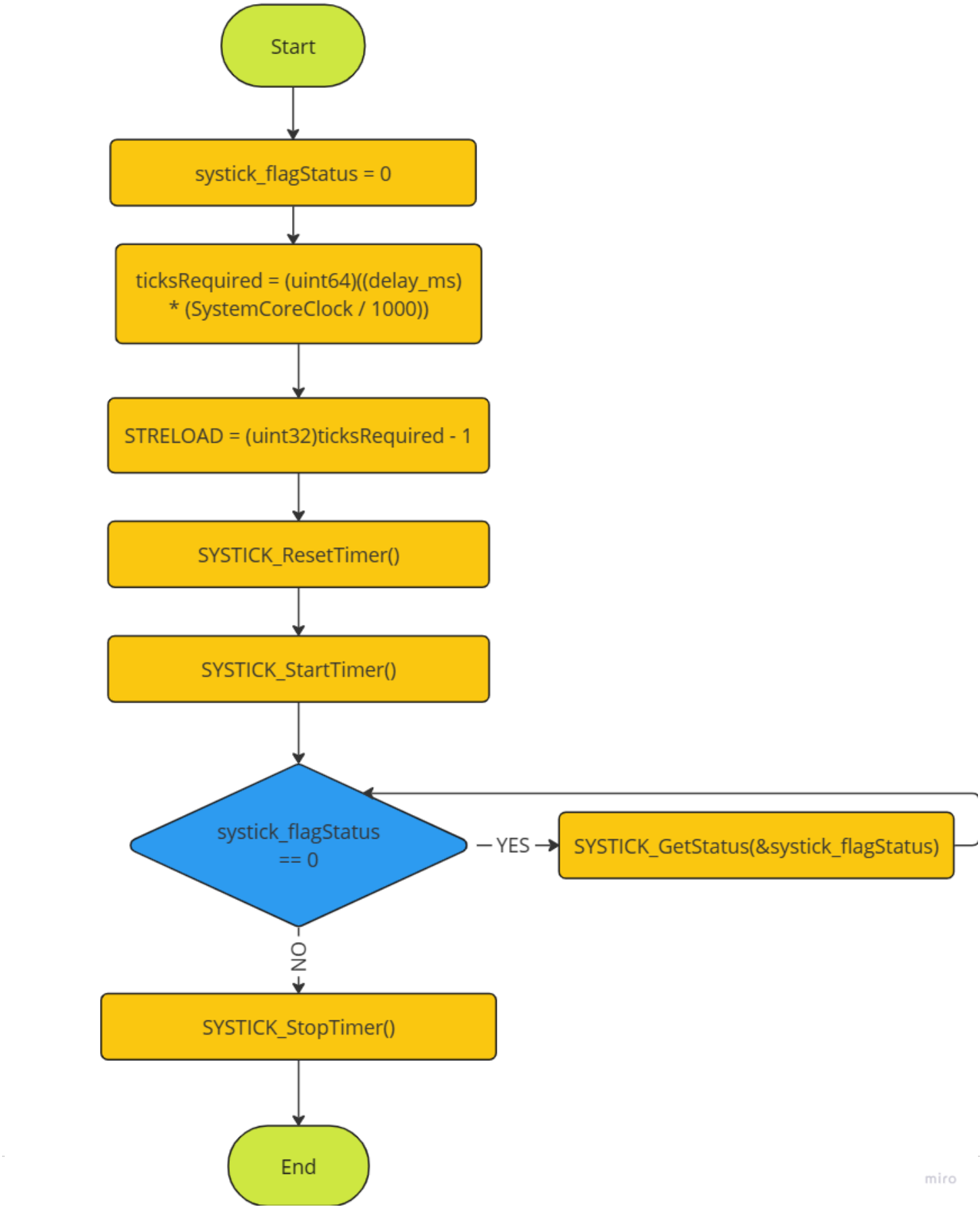
void SYSTICK_ResetTimer(void)



static void SYSTICK_GetStatus(en_SYSTICK_FlagStatus_t *ptr_flagStatus)



void SYSTICK_Delay_ms(uint32 delay_ms)



3.2 Precompiling & Linking Configurations

3.2.1GPIO

```
    * @enum en_GPIO_pinDir_t
    * Specifies the mode of operation of the pin.
    */
typedef enum {
        INPUT = 0, OUTPUT = 1
}en_GPIO_pinDir_t;

/**
    * @enum en_GPIO_driveCurrent_t
    * Specifies the drive current of the pin.
    */
typedef enum {
        DRIVE_2mA = 0, DRIVE_4mA = 1, DRIVE_8mA = 2
}en_GPIO_driveCurrent_t;

/**
    * @enum en_GPIO_pull_t
    * Specifies the pull state of the pin.
    */
typedef enum {
        PULL_UP = 0, PULL_DOWN = 1, OPEN_DRAIN = 2
}en_GPIO_pull_t;

typedef enum {
        GPIO_STATUS_SUCCESS                             =    100,
        GPIO_STATUS_CLOCK_FAILED                        =    101,
        GPIO_STATUS_SET_DIRECTION_FAILED                =    102,
        GPIO_STATUS_SET_DRIVE_CURRENT_FAILED            =    103,
        GPIO_STATUS_SET_PULL_FAILED                     =    104,
        GPIO_STATUS_INVALID_PIN_DIR,
        GPIO_STATUS_INVALID_PORT_NUM,
        GPIO_STATUS_INVALID_CONFIG_ARRAY                =    105
}en_GPIO_error_t;
```

```
typedef struct {
    en_GPIO_port_t          en_GPIO_port;
    en_GPIO_pin_t           en_GPIO_pin;
    en_GPIO_pinDir_t        en_GPIO_pinDir;
    en_GPIO_driveCurrent_t  en_GPIO_driveCurrent;
    en_GPIO_pull_t          en_GPIO_pull;
}st_GPIO_config_t;

/**
 * @brief Initializes a set of pins with the specified configuration.
 * @param[in] ptr_st_GPIO_config    Address of the array of the specified pins.
 * @return en_GPIO_error_t
 */
en_GPIO_error_t GPIO_Init(const st_GPIO_config_t *ptr_st_GPIO_config);


en_GPIO_error_t GPIO_DeInit(const st_GPIO_config_t *ptr_st_GPIO_config);

/**
 * @brief Reads the state of a single pin.
 * @param[in] ptr_st_GPIO_config    Address of the specified pin configuration strcuture.
 * @param[in] ptr_pinValue          Address of the value where we stores the state of the pin.
 * @return en_GPIO_error_t
 */
en_GPIO_error_t GPIO_ReadPin(const st_GPIO_config_t *ptr_st_GPIO_config, uint8_t *ptr_pinValue);

/**
 * @brief Reads the state of a single pin.
 * @param[in] ptr_st_GPIO_config    Address of the specified pin configuration strcuture.
 * @param[in] pinValue              The value to be written on the specified pin.
 * @return en_GPIO_error_t
 */
en_GPIO_error_t GPIO_WritePin(const st_GPIO_config_t *ptr_st_GPIO_config, uint8 pinValue);
void GPIO_TogglePin(const st_GPIO_config_t *ptr_st_GPIO_config);
```

3.2.2Button

```c
#define DEBOUNCE_THRESHOLD 9000

typedef enum {
    BUTTON_NotPressed = 0, BUTTON_Pressed = 1
}en_button_state_t;

/**
 * @brief Initializes the button pin.
 * @param[in] Button_config     Address of the configuration array.
 */
void BUTTON_Init(st_GPIO_config_t *Button_config);

/**
 * @brief Initializes the button pin.
 * @param[in] usr_buttonConfig Address of the configuration array.
 * @param[in] value         Address of the variables to store the state of push button.
 */
void BUTTON_IsPressed( st_GPIO_config_t *usr_buttonConfig, en_button_state_t *value);
```

```c
#include "button_config.h"

/* User configuration array. */
st_GPIO_config_t usr_button_config [PUSH_BUTTON_NUM] = {
    {PORT_F , PIN4 , INPUT , DRIVE_4mA , PULL_UP}
};
```

3.2.3LED

```
 * @brief Initializes the LED pin using the configuration array.
 * @param[in] ptr_st_LED_config     Address of the configuration array.
 * @return en_GPIO_error_t
 */
void Led_Init(st_GPIO_config_t *ptr_st_LED_config);

/**
 * @brief Turns on the red LED and turns off all the other LEDs.
 * @param[in] ptr_st_LED_config     Address of the configuration array.
 * @return en_GPIO_error_t
 */
void LED_GreenOn(st_GPIO_config_t *ptr_st_LED_config);

/**
 * @brief Turns on the blue LED and turns off all the other LEDs.
 * @param[in] ptr_st_LED_config     Address of the configuration array.
 * @return en_GPIO_error_t
 */
void LED_BlueOn(st_GPIO_config_t *ptr_st_LED_config);

/**
 * @brief Turns on the green LED and turns off all the other LEDs.
 * @param[in] ptr_st_LED_config     Address of the configuration array.
 * @return en_GPIO_error_t
 */
void LED_RedOn(st_GPIO_config_t *ptr_st_LED_config);

/**
 * @brief Turns on all the LEDs.
 * @param[in] ptr_st_LED_config     Address of the configuration array.
 * @return en_GPIO_error_t
 */
void LED_AllOn(st_GPIO_config_t *ptr_st_LED_config);
```

```
#include "led_config.h"

/* User configuration array. */
st_GPIO_config_t usr_led_config [PORT_PINS_NUM] = {
    {PORT_F, PIN1, OUTPUT,DRIVE_2mA, PULL_DOWN},   /* Red Led */
    {PORT_F, PIN2, OUTPUT,DRIVE_4mA, PULL_DOWN},   /* Blue Led */
    {PORT_F, PIN3, OUTPUT,DRIVE_8mA, PULL_DOWN}   /* Geen Led */
};
```

3.2.4 Systick

```
static uint8 g_SYSTICK_InitStatus = 0;

typedef enum {
    SYSTICK_IntDisable = 0, SYSTICK_IntEnable = 1
}en_SYSTICK_InterruptState_t;

typedef enum {
    SYSTICK_FlagNotSet = 0, SYSTICK_FlagSet= 1
}en_SYSTICK_FlagStatus_t;

typedef enum {
    SYSTICK_INIT_FAILED     =   200,
    SYSTICK_INIT_SUCCESS    =   201,
    SYSTICK_START_FAILED    =   202,
    SYSTICK_START_SUCCESS   =   203,
    SYSTICK_STOP_FAILED     =   204,
    SYSTICK_STOP_SUCCESS    =   205,
}en_SYSTICK_Status;

typedef struct {
    uint32 delay_ms;
    en_SYSTICK_InterruptState_t en_SYSTICK_InterruptState;

}st_SYSTICK_config_t;

void SYSTICK_Init(st_SYSTICK_config_t *ptr_st_SYSTICK_config);
void SYSTICK_DeInit(void);
void SYSTICK_StartTimer(void);
void SYSTICK_ResetTimer(void);
void SYSTICK_StopTimer(void);
void SYSTICK_Delay_ms(uint32 delay_ms);
```

```
#include "systick_config.h"

st_SYSTICK_config_t usr_systick_config = {
    1, SYSTICK_IntDisable
};
```