ĐẠI HỌC QUỐC GIA THÀNH PHỐ HỒ CHÍ MINH

ĐẠI HỌC CÔNG NGHỆ THÔNG TIN

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THỰC TẬP DOANH NGHIỆP

1. YÊU CẦU

1.1. Gửi dữ liệu qua USART

1.2. Nhận dữ liệu qua USART

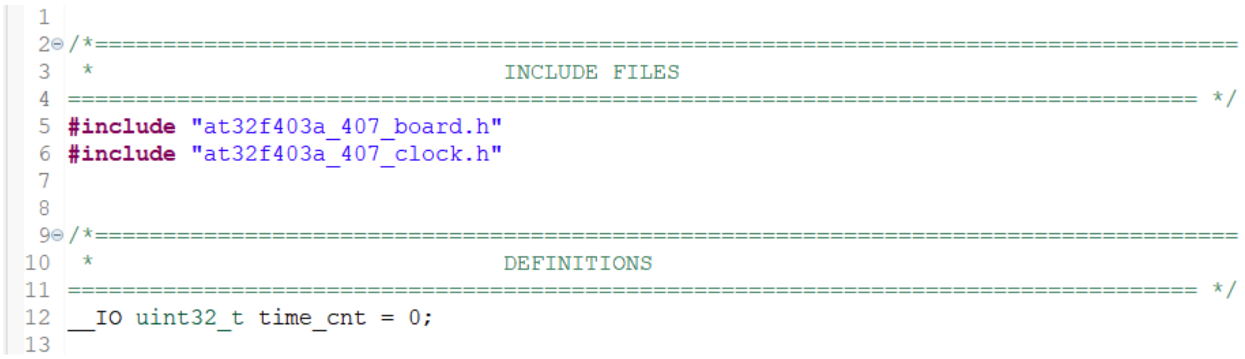
2. Gửi dữ liệu

2.1. README

- Send string through USART1, baudrate 115200
- Notice:
- AT32 IDE and Hercules terminal is recommended
- AT-START-F403A is currently in use

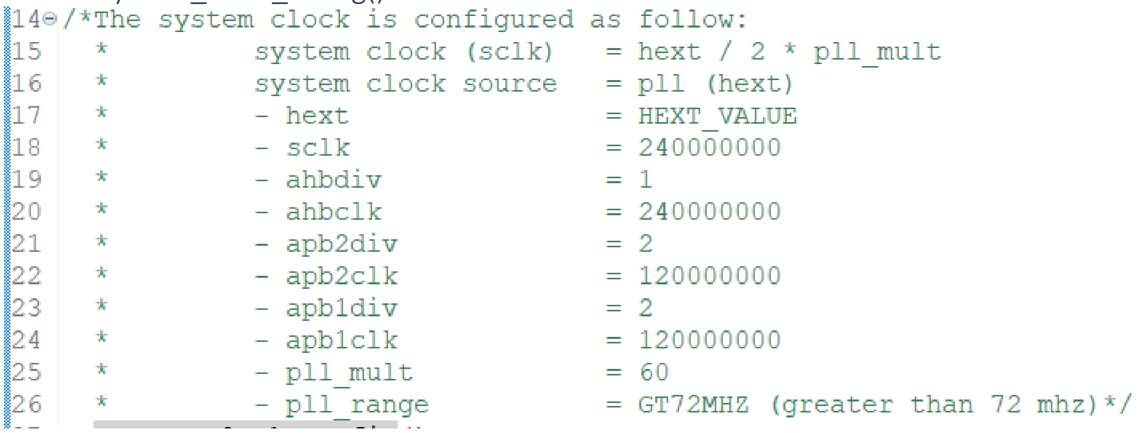
2.2. Source code

2.2.1. Include & definition



```c

/*==============================================================================
 *                              INCLUDE FILES
============================================================================= */
#include "at32f403a_407_board.h"
#include "at32f403a_407_clock.h"


/*==============================================================================
 *                              DEFINITIONS
============================================================================= */
__IO uint32_t time_cnt = 0;

```

2.2.2. system_clock_config():



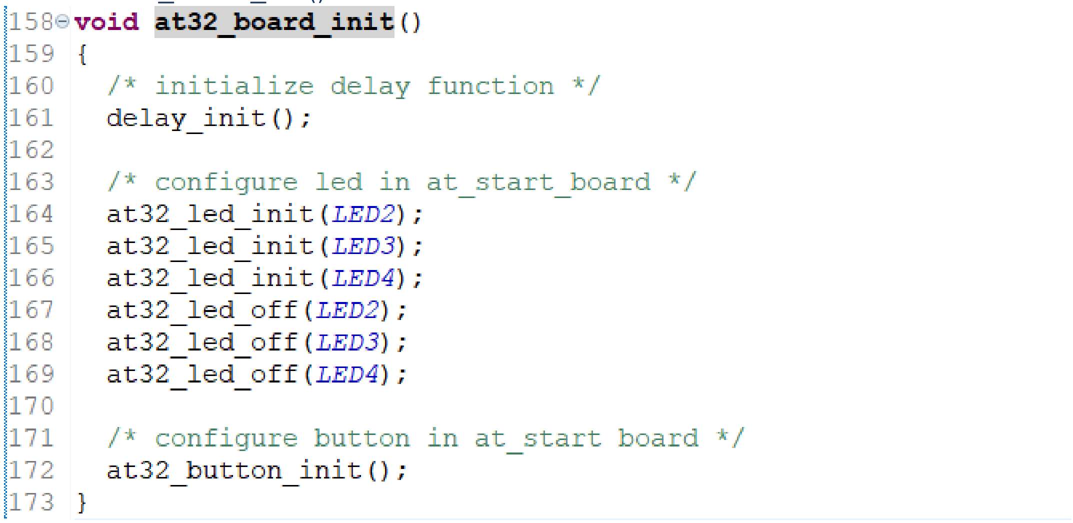
```c
/*The system clock is configured as follow:
 *          system clock (sclk)    = hext / 2 * pll_mult
 *          system clock source    = pll (hext)
 *          - hext                 = HEXT_VALUE
 *          - sclk                 = 240000000
 *          - ahbdiv               = 1
 *          - ahbclk               = 240000000
 *          - apb2div              = 2
 *          - apb2clk              = 120000000
 *          - apb1div              = 2
 *          - apb1clk              = 120000000
 *          - pll_mult             = 60
 *          - pll_range            = GT72MHZ (greater than 72 mhz)*/
```

- ○ system clock source (= 240 000 000) = pll (hext): clock ngoại thạch anh (HEXT_VALUE = 8 000 000) * pll_mult(=60)
- ○ => PLL_range greater than 72mhz
- ○ Apb1clk (= sclk / apb1div(=2)): 120 000 000 (maximum frequency of APB1/APB2)

```c
void system_core_clock_update(void)
```

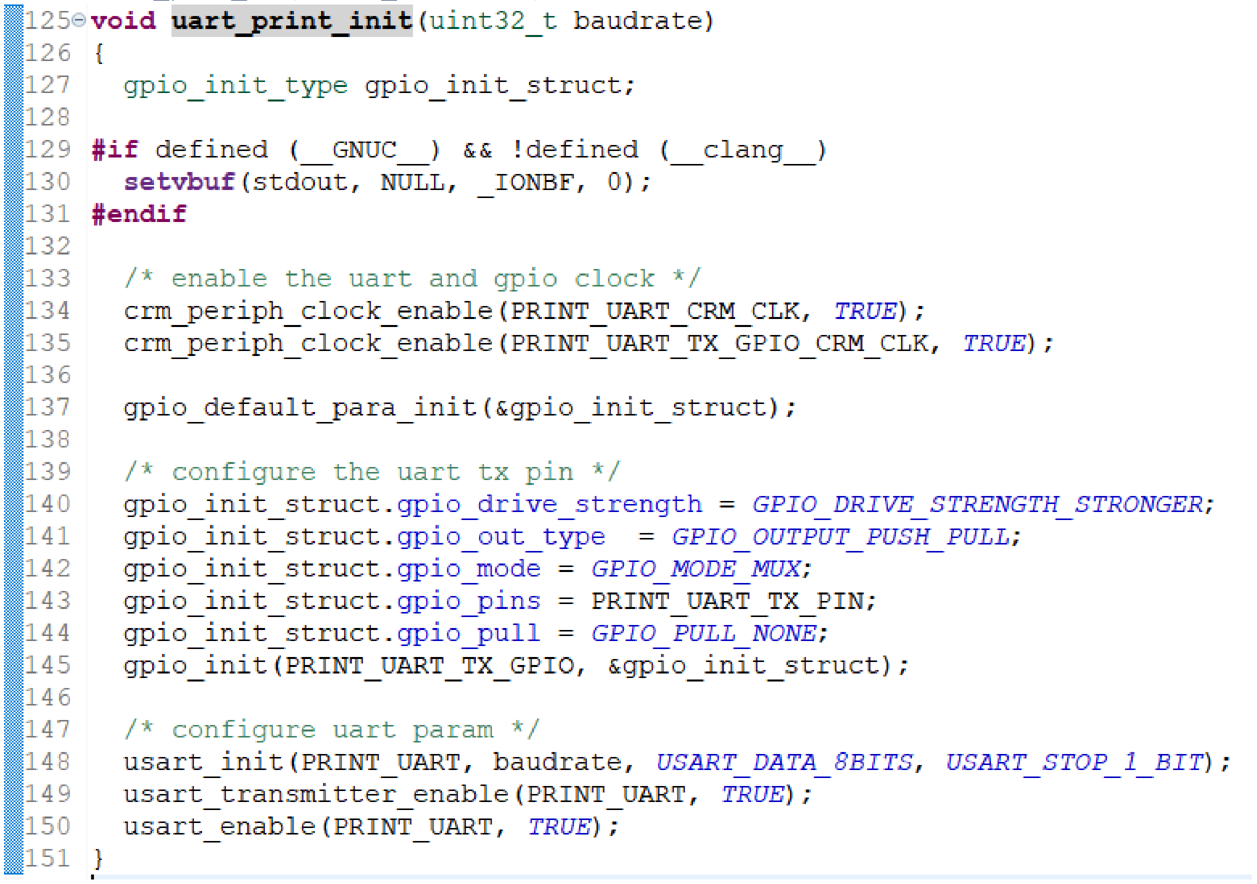
```
{
  uint32_t hext_prediv = 0, pll_mult = 0, pll_mult_h = 0, pll_clock_source =
0, temp = 0, div_value = 0;
  crm_sclk_type sclk_source;

  static const uint8_t sys_ahb_div_table[16] = {0, 0, 0, 0, 0, 0, 0, 0, 1, 2,
3, 4, 6, 7, 8, 9};

  /* get sclk source */
  sclk_source = crm_sysclk_switch_status_get();

  switch(sclk_source)
  {
    case CRM_SCLK_HICK:
      if(((CRM->misc3_bit.hick_to_sclk) != RESET) && ((CRM-
>misc1_bit.hickdiv) != RESET))
        system_core_clock = HICK_VALUE * 6;
      else
        system_core_clock = HICK_VALUE;
      break;
    case CRM_SCLK_HEXT:
      system_core_clock = HEXT_VALUE;
      break;
    case CRM_SCLK_PLL:
      pll_clock_source = CRM->cfg_bit.pllrcs;
      {
        /* get multiplication factor */
        pll_mult = CRM->cfg_bit.pllmult_l;
        pll_mult_h = CRM->cfg_bit.pllmult_h;
        /* process high bits */
        if((pll_mult_h != 0U) || (pll_mult == 15U)){
            pll_mult += ((16U * pll_mult_h) + 1U);
        }
        else
        {
            pll_mult += 2U;
        }

        if (pll_clock_source == 0x00)
        {
          /* hick divided by 2 selected as pll clock entry */
          system_core_clock = (HICK_VALUE >> 1) * pll_mult;
        }
        else
        {
          /* hext selected as pll clock entry */
          if (CRM->cfg_bit.pllhextdiv != RESET)
          {
            hext_prediv = CRM->misc3_bit.hextdiv;

            /* hext clock divided by 2 */
            system_core_clock = (HEXT_VALUE / (hext_prediv + 2)) * pll_mult;
          }
          else
          {
            system_core_clock = HEXT_VALUE * pll_mult;
          }
        }
      }
      break;
    default:
      system_core_clock = HICK_VALUE;
      break;
  }
```

2.2.3. at32_board_init():



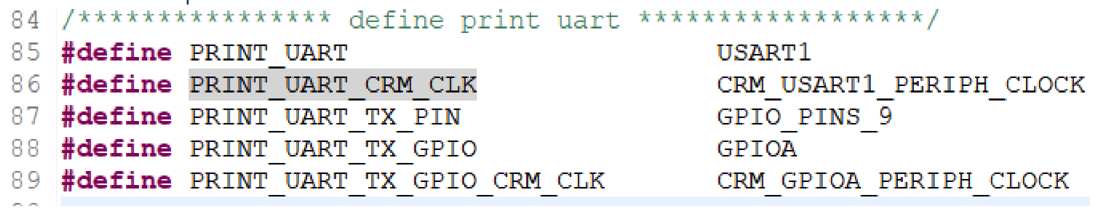
```
void at32_board_init()
{
  /* initialize delay function */
  delay_init();

  /* configure led in at_start_board */
  at32_led_init(LED2);
  at32_led_init(LED3);
  at32_led_init(LED4);
  at32_led_off(LED2);
  at32_led_off(LED3);
  at32_led_off(LED4);

  /* configure button in at_start board */
  at32_button_init();
}
```

2.2.4. uart_print_init(uint32_t baudrate)



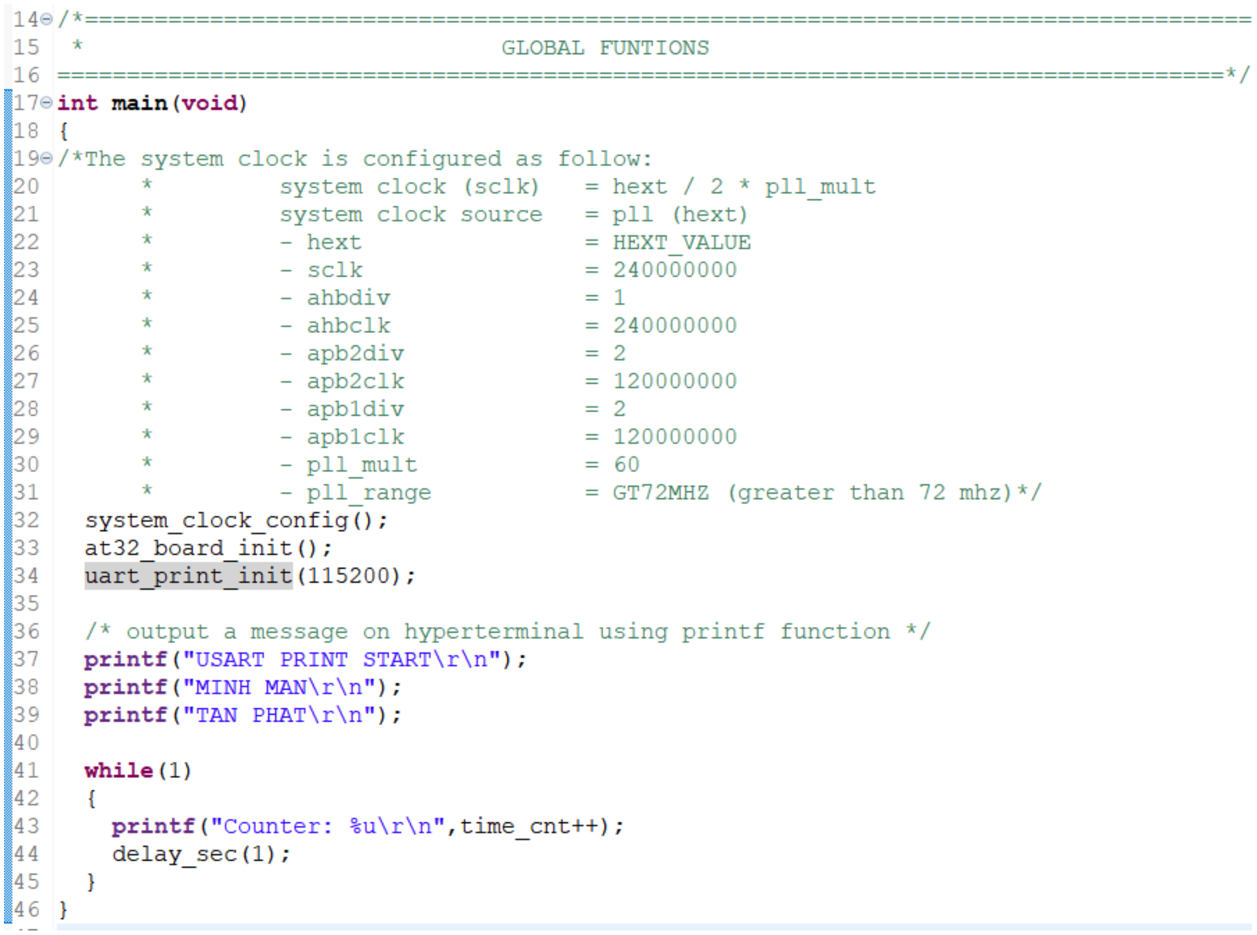
```
void uart_print_init(uint32_t baudrate)
{
  gpio_init_type gpio_init_struct;

#if defined (__GNUC__) && !defined (__clang__)
  setvbuf(stdout, NULL, _IONBF, 0);
#endif

  /* enable the uart and gpio clock */
  crm_periph_clock_enable(PRINT_UART_CRM_CLK, TRUE);
  crm_periph_clock_enable(PRINT_UART_TX_GPIO_CRM_CLK, TRUE);

  gpio_default_para_init(&gpio_init_struct);

  /* configure the uart tx pin */
  gpio_init_struct.gpio_drive_strength = GPIO_DRIVE_STRENGTH_STRONGER;
  gpio_init_struct.gpio_out_type  = GPIO_OUTPUT_PUSH_PULL;
  gpio_init_struct.gpio_mode = GPIO_MODE_MUX;
  gpio_init_struct.gpio_pins = PRINT_UART_TX_PIN;
  gpio_init_struct.gpio_pull = GPIO_PULL_NONE;
  gpio_init(PRINT_UART_TX_GPIO, &gpio_init_struct);

  /* configure uart param */
  usart_init(PRINT_UART, baudrate, USART_DATA_8BITS, USART_STOP_1_BIT);
  usart_transmitter_enable(PRINT_UART, TRUE);
  usart_enable(PRINT_UART, TRUE);
}
```

2.2.5. Define print uart



```c
/***************** define print uart ******************/
#define PRINT_UART                       USART1
#define PRINT_UART_CRM_CLK               CRM_USART1_PERIPH_CLOCK
#define PRINT_UART_TX_PIN                GPIO_PINS_9
#define PRINT_UART_TX_GPIO               GPIOA
#define PRINT_UART_TX_GPIO_CRM_CLK       CRM_GPIOA_PERIPH_CLOCK
```

2.2.6. Main code



```c
/*==========================================================================================
 *                              GLOBAL FUNTIONS
 ==========================================================================================*/
int main(void)
{
/*The system clock is configured as follow:
      *          system clock (sclk)    = hext / 2 * pll_mult
      *          system clock source    = pll (hext)
      *          - hext                 = HEXT_VALUE
      *          - sclk                 = 240000000
      *          - ahbdiv               = 1
      *          - ahbclk               = 240000000
      *          - apb2div              = 2
      *          - apb2clk              = 120000000
      *          - apb1div              = 2
      *          - apb1clk              = 120000000
      *          - pll_mult             = 60
      *          - pll_range            = GT72MHZ (greater than 72 mhz)*/
  system_clock_config();
  at32_board_init();
  uart_print_init(115200);

  /* output a message on hyperterminal using printf function */
  printf("USART PRINT START\r\n");
  printf("MINH MAN\r\n");
  printf("TAN PHAT\r\n");

  while(1)
  {
    printf("Counter: %u\r\n",time_cnt++);
    delay_sec(1);
  }
}
```

- Gửi USART PRINT START\r\n"MINH MAN\r\n"TAN PHAT\r\n" khi reset
- Gửi giá trị Counter tăng dần sau mỗi 1 giây

2.3. Github & Video demo

2.3.1. Github:

Github_print

2.3.2. Video demo:

USART_print

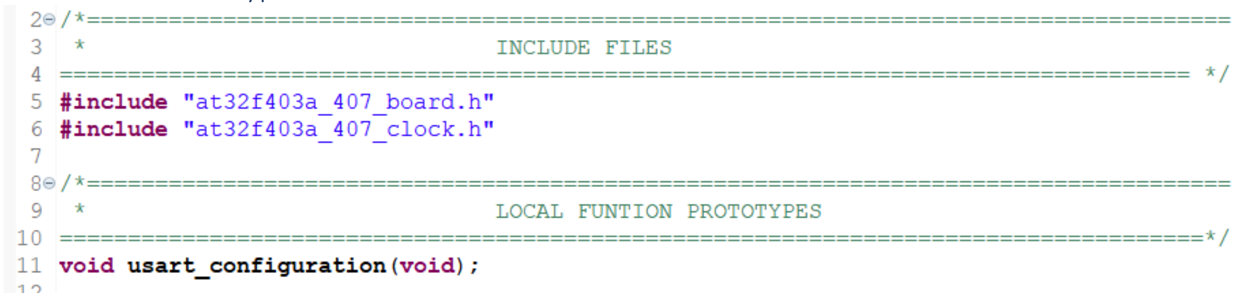
3. Nhận dữ liệu

3.1. README

- Control LED2,3,4 when get accurate data
- LED2: 0x02
- LED3: 0x03
- LED4: 0x04
- Notice:
- AT32 IDE and Hercules terminal is recommended
- AT-START-F403A is currently in use

3.2. Source code

3.2.1. Include & Typedef

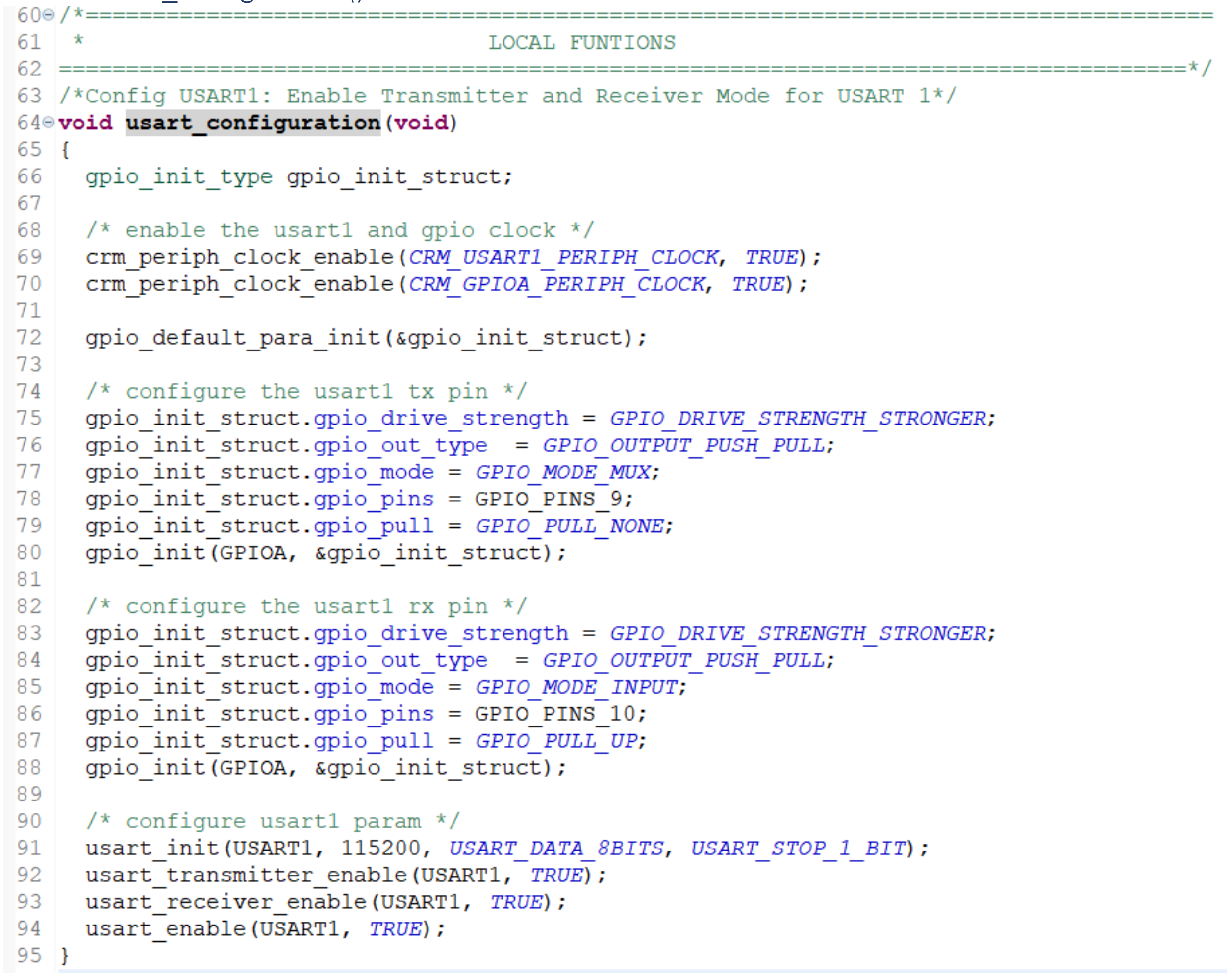


```
/*==========================================================================
 *                              INCLUDE FILES
========================================================================== */
#include "at32f403a_407_board.h"
#include "at32f403a_407_clock.h"

/*==========================================================================
 *                              LOCAL FUNTION PROTOTYPES
==========================================================================*/
void usart_configuration(void);
```

3.2.2. system_clock_config(); at32_board_init();

- Tương tự config Gửi dữ liệu

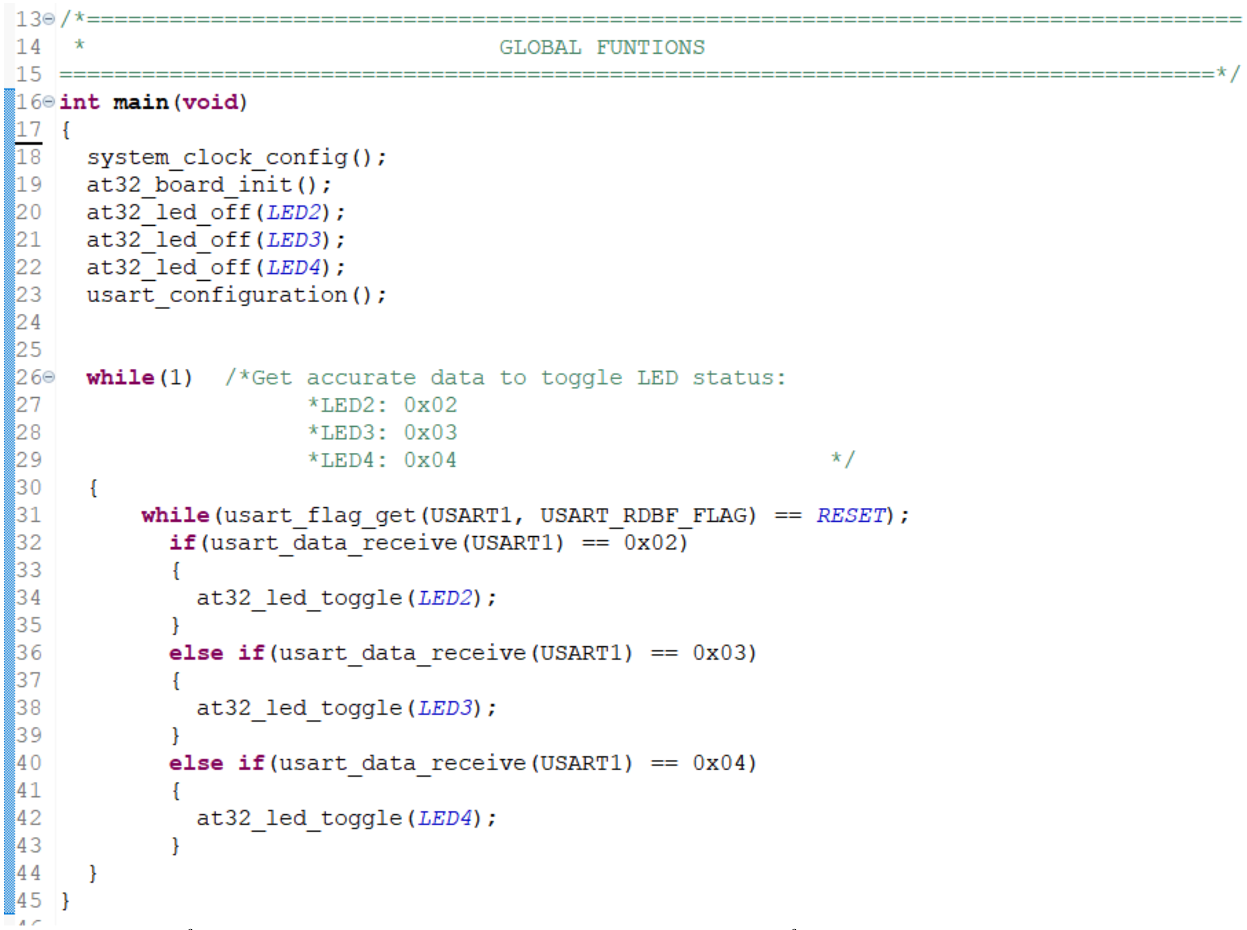
3.2.3. usart_configuration()



```c
/*=================================================================================
 *                               LOCAL FUNTIONS
=================================================================================*/
/*Config USART1: Enable Transmitter and Receiver Mode for USART 1*/
void usart_configuration(void)
{
  gpio_init_type gpio_init_struct;

  /* enable the usart1 and gpio clock */
  crm_periph_clock_enable(CRM_USART1_PERIPH_CLOCK, TRUE);
  crm_periph_clock_enable(CRM_GPIOA_PERIPH_CLOCK, TRUE);

  gpio_default_para_init(&gpio_init_struct);

  /* configure the usart1 tx pin */
  gpio_init_struct.gpio_drive_strength = GPIO_DRIVE_STRENGTH_STRONGER;
  gpio_init_struct.gpio_out_type  = GPIO_OUTPUT_PUSH_PULL;
  gpio_init_struct.gpio_mode = GPIO_MODE_MUX;
  gpio_init_struct.gpio_pins = GPIO_PINS_9;
  gpio_init_struct.gpio_pull = GPIO_PULL_NONE;
  gpio_init(GPIOA, &gpio_init_struct);

  /* configure the usart1 rx pin */
  gpio_init_struct.gpio_drive_strength = GPIO_DRIVE_STRENGTH_STRONGER;
  gpio_init_struct.gpio_out_type  = GPIO_OUTPUT_PUSH_PULL;
  gpio_init_struct.gpio_mode = GPIO_MODE_INPUT;
  gpio_init_struct.gpio_pins = GPIO_PINS_10;
  gpio_init_struct.gpio_pull = GPIO_PULL_UP;
  gpio_init(GPIOA, &gpio_init_struct);

  /* configure usart1 param */
  usart_init(USART1, 115200, USART_DATA_8BITS, USART_STOP_1_BIT);
  usart_transmitter_enable(USART1, TRUE);
  usart_receiver_enable(USART1, TRUE);
  usart_enable(USART1, TRUE);
}
```

- Cấu hình GPIO, mode cho USART1 tx, rx
- Enable transmitter và receiver để gửi/ nhận dữ liệu

3.2.4. Main code



```c
/*===================================================================================
 *                                    GLOBAL FUNTIONS
===================================================================================*/
int main(void)
{
  system_clock_config();
  at32_board_init();
  at32_led_off(LED2);
  at32_led_off(LED3);
  at32_led_off(LED4);
  usart_configuration();


  while(1)  /*Get accurate data to toggle LED status:
                  *LED2: 0x02
                  *LED3: 0x03
                  *LED4: 0x04                           */
  {
      while(usart_flag_get(USART1, USART_RDBF_FLAG) == RESET);
        if(usart_data_receive(USART1) == 0x02)
        {
          at32_led_toggle(LED2);
        }
        else if(usart_data_receive(USART1) == 0x03)
        {
          at32_led_toggle(LED3);
        }
        else if(usart_data_receive(USART1) == 0x04)
        {
          at32_led_toggle(LED4);
        }
  }
}
```

- Thay đổi trạng thái LED khi nhận chính xác dữ liệu. Cụ thể:
    - 0x02: LED2
    - 0x03: LED3
    - 0x04: LED4

3.3. Github & Video demo:

3.3.1. Github:

Github_receive

3.3.2. Video demo:

USART_receive