



HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY
COMPUTER ENGINEERING

Microcontroller



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Mục lục

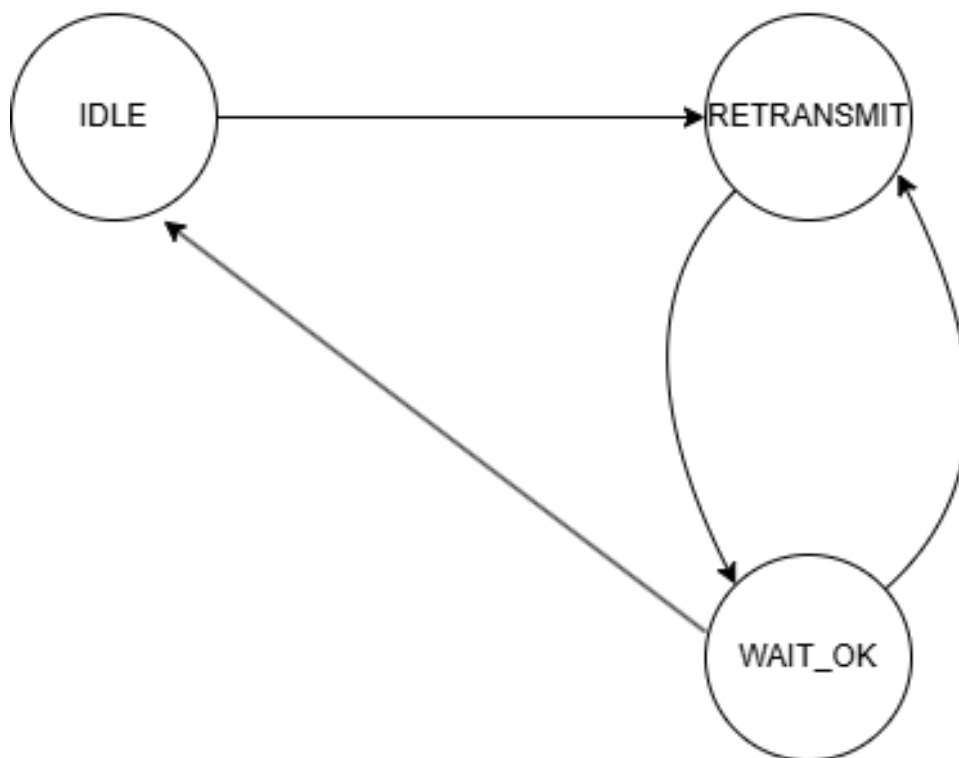
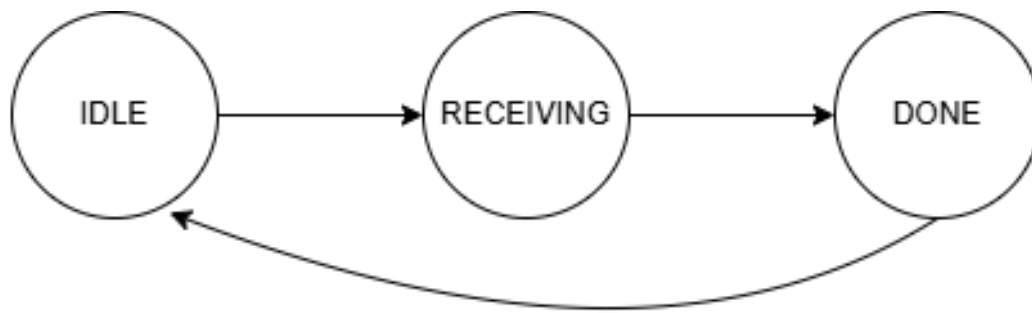
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CHƯƠNG 1

Flow and Error Control in Communication

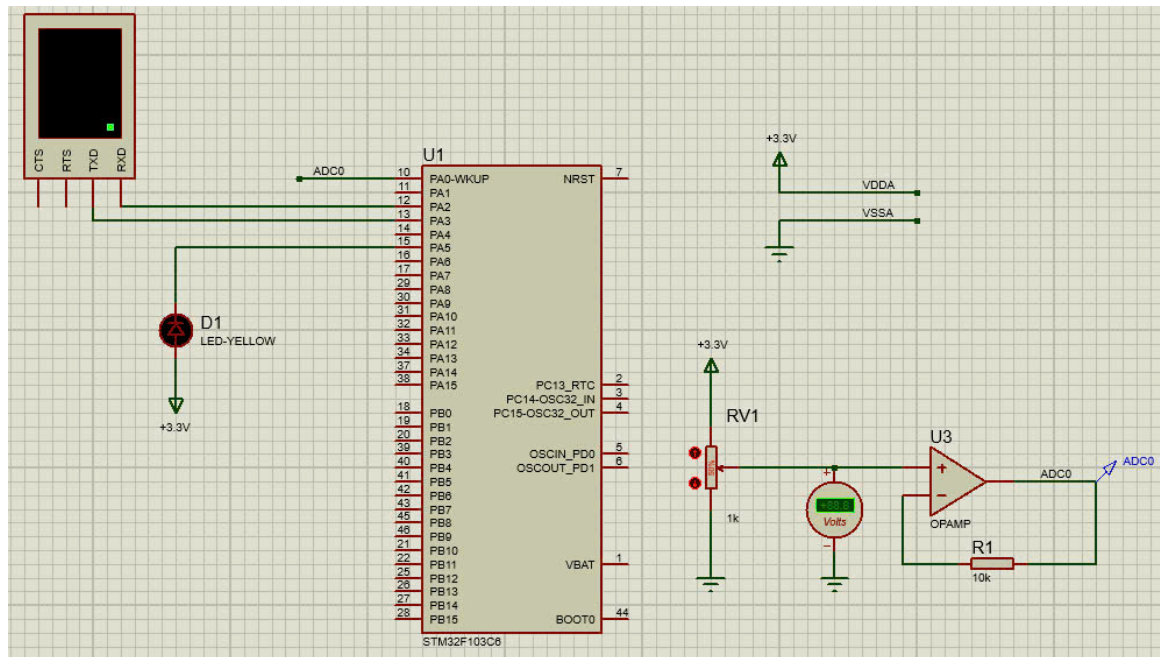


1 FSM



Hình 1.1: Các máy trạng thái khi giao tiếp UART

2 Proteus



Hình 1.2: Schematic in Proteus

3 Code

```
1 #include "main.h"
2
3 /* Private includes
   -----
   */
4 /* USER CODE BEGIN Includes */
5 #include "string.h"
6 #include <stdio.h>
7 #include "software_timer.h"
8 /* USER CODE END Includes */
9
10 /* Private typedef
   -----
   */
11 /* USER CODE BEGIN PTD */
12
13 /* USER CODE END PTD */
14
15 /* Private define
   -----
   */
16 /* USER CODE BEGIN PD */
```

```

17 #define MAX_BUFFER_SIZE 200
18 #define RTS 1
19 #define OK 2
20 #define THREE_SECOND 3
21 /* USER CODE END PD */
22
23 /* Private macro
   -----
   */
24 /* USER CODE BEGIN PM */
25
26 /* USER CODE END PM */
27
28 /* Private variables
   -----
   */
29 ADC_HandleTypeDef hadc1;
30
31 TIM_HandleTypeDef htim2;
32
33 UART_HandleTypeDef huart2;
34
35 /* USER CODE BEGIN PV */
36
37 /* USER CODE END PV */
38
39 /* Private function prototypes
   -----*/
40 void SystemClock_Config(void);
41 static void MX_GPIO_Init(void);
42 static void MX_ADC1_Init(void);
43 static void MX_USART2_UART_Init(void);
44 static void MX_TIM2_Init(void);
45 /* USER CODE BEGIN PFP */
46
47 /* USER CODE END PFP */
48
49 /* Private user code
   -----
   */
50 /* USER CODE BEGIN 0 */
51 uint8_t temp = 0; // B i ỉ n l u d l i u n h n
   t UART
52 uint8_t buffer[MAX_BUFFER_SIZE]; // B m l u
   d l i u n h n t UART
53 uint8_t index_buffer = 0; // C h s h i n t i c a
   b m
54 uint8_t buffer_flag = 0; // C í í ? n h d u d
   l i u c n h n h o n t t

```

```

55 int command_state = THREE_SECOND;
56 uint8_t cmd_data[MAX_BUFFER_SIZE];
57 static uint32_t last_adc_value = 0;
58 static uint32_t adc_value = 1234;
59 char adc_response[20];
60 int transmit_counter=0;
61 static enum {
62     PARSER_IDLE,
63     PARSER_RECEIVING,
64     PARSER_DONE
65 } parser_state = PARSER_IDLE;
66 static enum {
67     UART_IDLE,
68     UART_SEND_ADC,
69     UART_WAIT_OK,
70     UART_RETRANSMIT
71 } uart_state = UART_IDLE;
72
73 void HAL_UART_RxCpltCallback(UART_HandleTypeDef *huart)
74 {
75     if (huart->Instance == USART2) // Kim tra n i u l
76     {
77         // HAL_UART_Transmit(&huart2, &temp, 1, 50);
78         buffer[index_buffer++] = temp; // L u d l i u
79         // N i u b m y , reset c h s v i i ?
80         if (index_buffer == MAX_BUFFER_SIZE)
81             index_buffer = 0;
82     }
83
84     // í ? t c í í ? buffer_flag th nh 1 nh
85     buffer_flag = 1;
86
87     // T i í p t c n h n d l i u t UART ( b t
88     HAL_UART_Receive_IT(&huart2, &temp, 1);
89 }
90
91 void command_parser_fsm() {
92     static uint8_t cmd_idx = 0;
93     char characters = buffer[index_buffer - 1]; // L y
94     switch (parser_state) {
95         case PARSER_IDLE:
96             if (characters == '!') { // B t u
97                 // h u i l nh

```

```

97         cmd_idx = 0;
98         cmd_data[cmd_idx++] = characters;
99         parser_state = PARSER_RECEIVING;
100     }
101     break;
102
103     case PARSER_RECEIVING:
104         cmd_data[cmd_idx++] = characters; // L u k í
105         t
106         if (characters == '#') { // K í t t h c
107         c h u i l n h
108             parser_state = PARSER_DONE;
109             cmd_data[cmd_idx] = '\0'; // K í t t h c
110         c h u i
111         }
112         break;
113
114     case PARSER_DONE:
115         // K i m t r a c h u i l n h
116         if (strcmp((char *)cmd_data, "!RTS#") == 0) {
117             command_state = RTS; // L n h y u c u
118             g i g i t r A D C
119         } else if (strcmp((char *)cmd_data, "!OK#") ==
120         0) {
121             command_state = OK; // í ? n h d u
122             k í t t h c g i a o t i í p
123         }
124         parser_state = PARSER_IDLE; // Quay l i
125         t r n g t h i b a n u
126         break;
127
128     default:
129         parser_state = PARSER_IDLE;
130         break;
131     }
132
133     // Reset index_buffer khi t g i i h n
134     if (index_buffer >= MAX_BUFFER_SIZE) {
135         index_buffer = 0;
136     }
137 }
138
139 void uart_communication_fsm() {
140
141     switch (uart_state) {
142     case UART_IDLE:
143         // transmit_counter=0;
144         if (command_state == RTS) {

```

```

139         HAL_GPIO_WritePin(LED_YELLOW_GPIO_Port ,
LED_YELLOW_Pin, RESET);
140         // adc_value = HAL_ADC_GetValue(&hadc1); //
        í ? í ? c gi tr ADC
141         snprintf(adc_response, sizeof(adc_response)
, "!ADC=%lu#\r\n", (uint32_t)adc_value); // í ? nh
        d ng c h u i l nh
142         // HAL_UART_Transmit(&huart2, (uint8_t *)
adc_response, strlen(adc_response), 100); // G i qua
UART
143         last_adc_value = adc_value; // L u gi
        t r ADC
144         uart_state = UART_RETRANSMIT; // Ch u y n
sang t r ng th i ch í ? p h n h i
145         // setTimer(0, 3000); // B t u
        m th í ? i gian 3 gi y
146     }
147     break;
148
149     case UART_WAIT_OK:
150         if (isTimerExpired(0)) { // H í t th í ? i gian
        ch í ?
151             uart_state = UART_RETRANSMIT; // Ch u y n
sang t r ng th i g i l i
152         }
153         if(transmit_counter==5&&(command_state != OK)){
154             uart_state = UART_RETRANSMIT;
155         }
156         if (command_state == OK) { // N h n p h n
        h i !OK#
157             HAL_GPIO_WritePin(LED_YELLOW_GPIO_Port ,
LED_YELLOW_Pin, SET);
158             transmit_counter=0;
159             command_state=THREE_SECOND;
160             uart_state = UART_IDLE;
161         }
162         break;
163
164     case UART_RETRANSMIT:
165         if(transmit_counter<5){
166             snprintf(adc_response, sizeof(adc_response), "!ADC
=%lu#\r\n", (uint32_t)last_adc_value); // í ? nh
        d ng c h u i ADC
167             HAL_UART_Transmit(&huart2, (uint8_t *)adc_response ,
strlen(adc_response), 100); // G i l i qua UART
168             if(transmit_counter<4) setTimer(0, 3000);
169             // Reset l i th í ? i gian ch í ?
170 //             if(transmit_counter==4) clear_timer_flag(0);

```

```

171         transmit_counter++;
172         uart_state = UART_WAIT_OK; // Chuyn vii?
173         t r n g   t h   i   chii?   p h n   h i
174     }
175     else {
176         // uart_state = UART_IDLE;
177         // command_state=THREE_SECOND;
178         // transmit_counter=0;
179         uart_state = UART_WAIT_OK;
180     }
181     break;
182
183     default:
184         uart_state = UART_IDLE;
185         break;
186 }
187
188 /* USER CODE END 0 */
189
190 /**
191  * @brief The application entry point.
192  * @retval int
193  */
194 int main(void)
195 {
196     /* USER CODE BEGIN 1 */
197
198     /* USER CODE END 1 */
199
200     /* MCU Configuration
201      -----
202      */
203
204     /* Reset of all peripherals, Initializes the Flash
205        interface and the SysTick. */
206     HAL_Init();
207
208     /* USER CODE BEGIN Init */
209
210     /* USER CODE END Init */
211
212     /* Configure the system clock */
213     SystemClock_Config();
214
215     /* USER CODE BEGIN SysInit */
216
217     /* USER CODE END SysInit */

```

```

216  /* Initialize all configured peripherals */
217  MX_GPIO_Init();
218  MX_ADC1_Init();
219  MX_USART2_UART_Init();
220  MX_TIM2_Init();
221  /* USER CODE BEGIN 2 */
222  HAL_UART_Receive_IT(&huart2, &temp, 1);
223  HAL_TIM_Base_Start_IT(&htim2);
224  // HAL_UART_RxCpltCallback(&huart2);
225  // HAL_ADC_Start(&hadc1);
226  //HAL_ADC_GetValue(&hadc1);
227  command_state = THREE_SECOND;
228  /* USER CODE END 2 */
229
230  /* Infinite loop */
231  /* USER CODE BEGIN WHILE */
232  while (1)
233  {
234
235      if (buffer_flag == 1) {
236          command_parser_fsm(); // Ph n t ch
237          l nh
238          buffer_flag = 0; // Reset c í í ?
239          n h n buffer
240          }
241          uart_communication_fsm();
242          /* USER CODE END WHILE */
243
244          /* USER CODE BEGIN 3 */
245      }
246      /* USER CODE END 3 */
247  }

```

Program 1.1: main.c

4 Link Github

<https://github.com/quangtrungcode/STM32LAB5.git>