



HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY
COMPUTER ENGINEERING

Microcontroller



Dr. Le Trong Nhan

Mục lục

Chapter 1. LED Animations	5
1 Exercise and Report	6
1.1 Exercise 1	6
1.2 Exercise 2	7
1.3 Exercise 3	8
1.4 Exercise 4	9
1.5 Exercise 5	10
1.6 Exercise 6	13
1.7 Exercise 7	14
1.8 Exercise 8	14
1.9 Exercise 9	14
1.10 Exercise 10	14

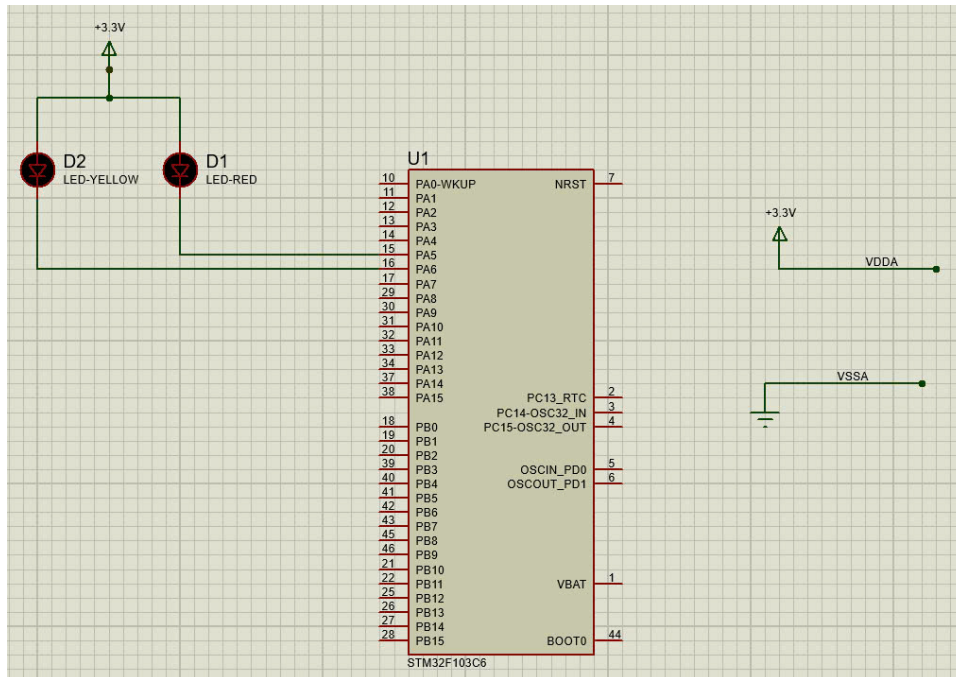
CHƯƠNG 1

LED Animations



1 Exercise and Report

1.1 Exercise 1

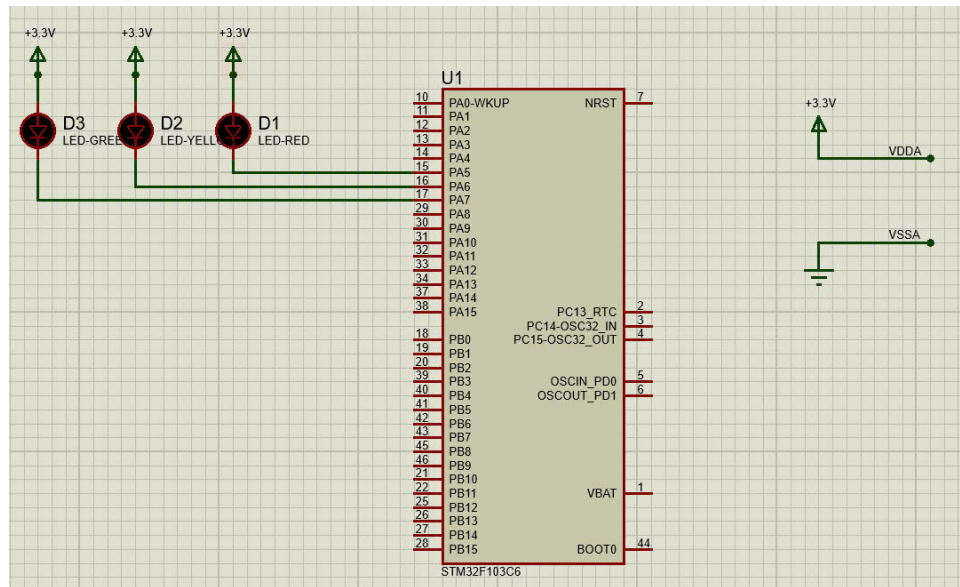


Hình 1.1: Schematic

```
1 while (1){
2 HAL_GPIO_WritePin(LED_RED_GPIO_Port, LED_RED_Pin, RESET);
3 HAL_GPIO_WritePin(LED_YELLOW_GPIO_Port, LED_YELLOW_Pin, SET);
4 HAL_Delay(2000);
5 HAL_GPIO_WritePin(LED_RED_GPIO_Port, LED_RED_Pin, SET);
6 HAL_GPIO_WritePin(LED_YELLOW_GPIO_Port, LED_YELLOW_Pin, RESET
7 );
8 HAL_Delay(2000);
9 }
```

Program 1.1: main.c

1.2 Exercise 2

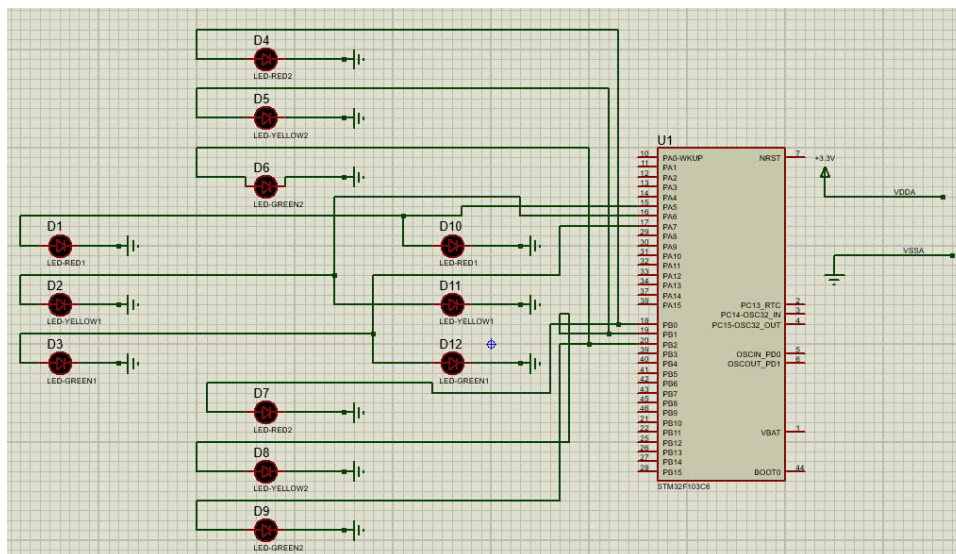


Hình 1.2: Schematic

```
1 while (1){
2     HAL_GPIO_WritePin(LED_RED_GPIO_Port , LED_RED_Pin ,
3     RESET);
4     HAL_GPIO_WritePin(LED_YELLOW_GPIO_Port ,
5     LED_YELLOW_Pin , SET);
6     HAL_GPIO_WritePin(LED_GREEN_GPIO_Port ,
7     LED_GREEN_Pin , SET);
8     HAL_Delay(5000);
9     HAL_GPIO_WritePin(LED_GREEN_GPIO_Port ,
10    LED_GREEN_Pin , RESET);
11    HAL_GPIO_WritePin(LED_RED_GPIO_Port , LED_RED_Pin ,
12    SET);
13    HAL_GPIO_WritePin(LED_YELLOW_GPIO_Port , LED_YELLOW_Pin ,
14    SET);
15    HAL_Delay(3000);
16    HAL_GPIO_WritePin(LED_YELLOW_GPIO_Port ,
17    LED_YELLOW_Pin , RESET);
18    HAL_GPIO_WritePin(LED_GREEN_GPIO_Port ,
19    LED_GREEN_Pin , SET);
20    HAL_GPIO_WritePin(LED_RED_GPIO_Port , LED_RED_Pin ,
21    SET);
22    HAL_Delay(2000);
23 }
```

Program 1.2: main.c

1.3 Exercise 3



Hình 1.3: Schematic

```

1 void settraffilight1(GPIO_TypeDef* LED_GIPO_Port, uint16_t
   LED_Pin,GPIO_TypeDef* LED_1GIPO_Port, uint16_t LED_1Pin
   ,GPIO_TypeDef* LED_2GIPO_Port, uint16_t LED_2Pin)
2 {
3     HAL_GPIO_WritePin(LED_GIPO_Port, LED_Pin, SET);
4     HAL_GPIO_WritePin(LED_1GIPO_Port, LED_1Pin, RESET);
5     HAL_GPIO_WritePin(LED_2GIPO_Port, LED_2Pin, RESET);
6 }

```

Program 1.3: Ex3.c

```

1 while (1){
2     settraffilight1(LED_RED1_GPIO_Port,LED_RED1_Pin,
       LED_YELLOW1_GPIO_Port, LED_YELLOW1_Pin,
       LED_GREEN1_GPIO_Port, LED_GREEN1_Pin);
3     settraffilight1(LED_GREEN2_GPIO_Port, LED_GREEN2_Pin,
       LED_RED2_GPIO_Port, LED_RED2_Pin, LED_YELLOW2_GPIO_Port,
       LED_YELLOW2_Pin) ;
4     HAL_Delay(3000);
5     settraffilight1(LED_YELLOW2_GPIO_Port, LED_YELLOW2_Pin,
       LED_GREEN2_GPIO_Port, LED_GREEN2_Pin, LED_RED2_GPIO_Port
       , LED_RED2_Pin);
6     HAL_Delay(2000);
7     settraffilight1(LED_RED2_GPIO_Port, LED_RED2_Pin,
       LED_YELLOW2_GPIO_Port, LED_YELLOW2_Pin,
       LED_GREEN2_GPIO_Port, LED_GREEN2_Pin);
8     settraffilight1(LED_GREEN1_GPIO_Port, LED_GREEN1_Pin,
       LED_RED1_GPIO_Port, LED_RED1_Pin, LED_YELLOW1_GPIO_Port,
       LED_YELLOW1_Pin);
9     HAL_Delay(3000);

```



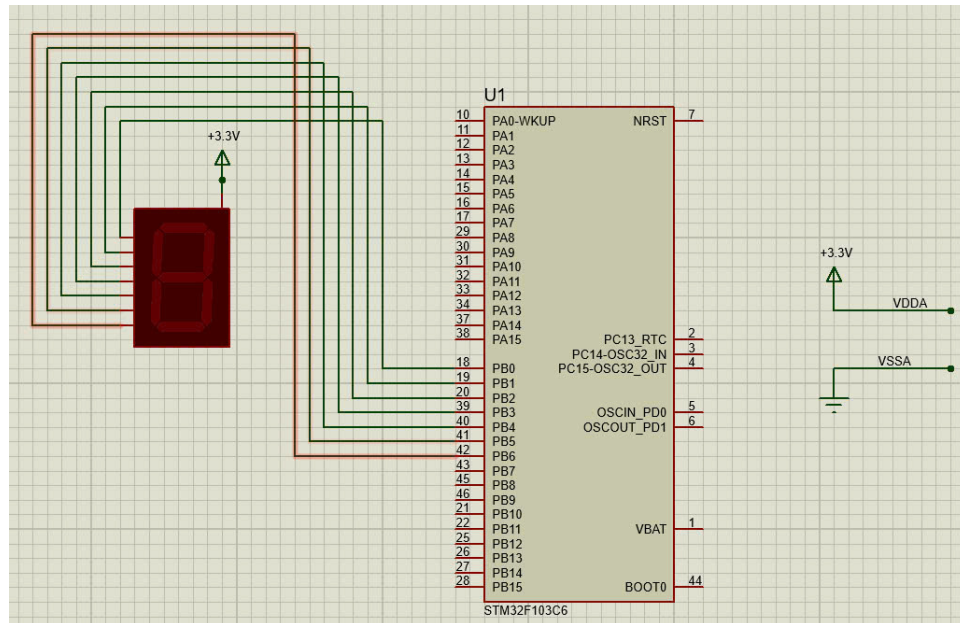
```

10 settrafficlight1(LED_YELLOW1_GPIO_Port, LED_YELLOW1_Pin,
    LED_GREEN1_GPIO_Port, LED_GREEN1_Pin, LED_RED1_GPIO_Port
    , LED_RED1_Pin);
11 HAL_Delay(2000);
12 }

```

Program 1.4: main.c

1.4 Exercise 4



Hình 1.4: Schematic

```

1 void display7SEG(int num) {
2     const uint8_t segmentMap[10] = {
3         0b11111100,
4         0b01100000,
5         0b11011010,
6         0b11110010,
7         0b01100110,
8         0b10110110,
9         0b10111110,
10        0b11100000,
11        0b11111110,
12        0b11110110
13    };
14    HAL_GPIO_WritePin(a_GPIO_Port, a_Pin, (segmentMap[num] &
15        0b10000000) ? GPIO_PIN_RESET : GPIO_PIN_SET);
16    HAL_GPIO_WritePin(b_GPIO_Port, b_Pin, (segmentMap[num] &
17        0b01000000) ? GPIO_PIN_RESET : GPIO_PIN_SET);
18    HAL_GPIO_WritePin(c_GPIO_Port, c_Pin, (segmentMap[num] &
19        0b00100000) ? GPIO_PIN_RESET : GPIO_PIN_SET);
20 }

```

```

17 HAL_GPIO_WritePin(d_GPIO_Port, d_Pin, (segmentMap[num] &
    0b00010000) ? GPIO_PIN_RESET : GPIO_PIN_SET);
18 HAL_GPIO_WritePin(e_GPIO_Port, e_Pin, (segmentMap[num] &
    0b00001000) ? GPIO_PIN_RESET : GPIO_PIN_SET);
19 HAL_GPIO_WritePin(f_GPIO_Port, f_Pin, (segmentMap[num] &
    0b00000100) ? GPIO_PIN_RESET : GPIO_PIN_SET);
20 HAL_GPIO_WritePin(g_GPIO_Port, g_Pin, (segmentMap[num] &
    0b00000010) ? GPIO_PIN_RESET : GPIO_PIN_SET);
21 }

```

Program 1.5: Ex4.c

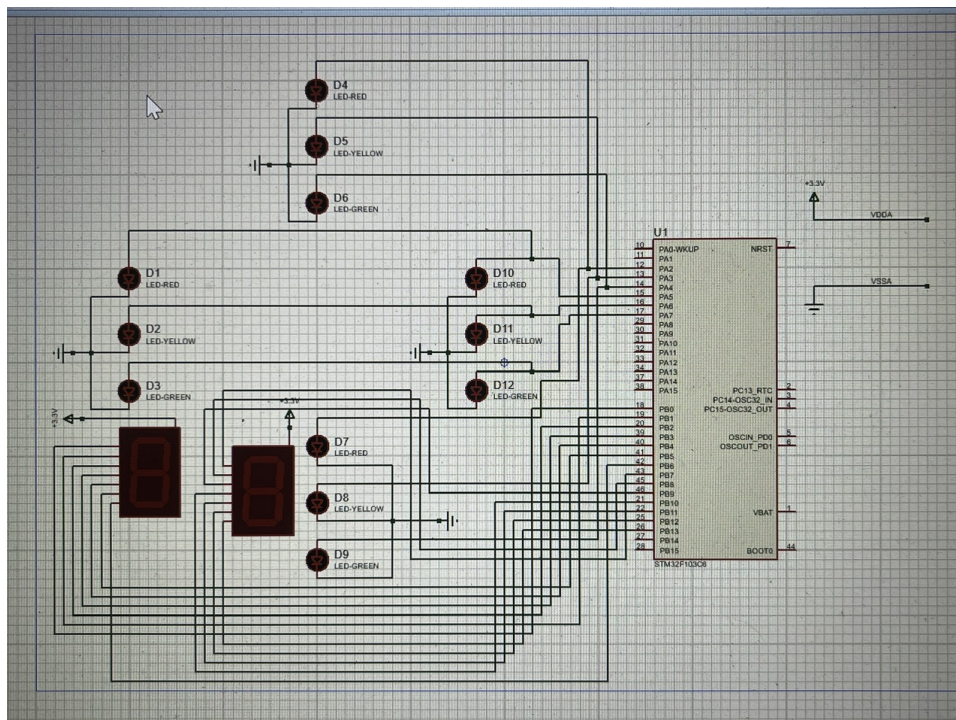
```

1 int counter = 0;
2 while (1){
3     if(counter >= 10) counter = 0;
4     display7SEG(counter++);
5     HAL_Delay(1000);
6
7 }

```

Program 1.6: main.c

1.5 Exercise 5



Hình 1.5: Schematic

```

1 int counterred=6;
2 int counteryellow=2;
3 int countergreen=3;

```

```

4 GPIO_TypeDef* segmentPorts[2][NUM_SEGMENTS] = {
5     {a1_GPIO_Port, b1_GPIO_Port, c1_GPIO_Port,
      d1_GPIO_Port, e1_GPIO_Port, f1_GPIO_Port, g1_GPIO_Port},
6     {a2_GPIO_Port, b2_GPIO_Port, c2_GPIO_Port,
      d2_GPIO_Port, e2_GPIO_Port, f2_GPIO_Port, g2_GPIO_Port}
7 };
8 uint16_t segmentPins[2][NUM_SEGMENTS] = {
9     {a1_Pin, b1_Pin, c1_Pin, d1_Pin, e1_Pin, f1_Pin,
      g1_Pin},
10    {a2_Pin, b2_Pin, c2_Pin, d2_Pin, e2_Pin, f2_Pin,
      g2_Pin}
11 };
12 const uint8_t segmentMap[10] = {
13     0b11111100,
14     0b01100000,
15     0b11011010,
16     0b11110010,
17     0b01100110,
18     0b10110110,
19     0b10111110,
20     0b11100000,
21     0b11111110,
22     0b11110110
23 };
24 void settrafficlight1(GPIO_TypeDef* LED_GPIO_Port,
      uint16_t LED_Pin, GPIO_TypeDef* LED_1GPIO_Port, uint16_t
      LED_1Pin, GPIO_TypeDef* LED_2GPIO_Port, uint16_t LED_2Pin
25 ){
26     HAL_GPIO_WritePin(LED_GPIO_Port, LED_Pin, SET);
27     HAL_GPIO_WritePin(LED_1GPIO_Port, LED_1Pin, RESET);
28     HAL_GPIO_WritePin(LED_2GPIO_Port, LED_2Pin, RESET);
29 }
30 void display7SEG(int ledNum, int num) {
31     for (int i = 0; i < NUM_SEGMENTS; i++) {
32         HAL_GPIO_WritePin(segmentPorts[ledNum][i],
33             segmentPins[ledNum][i],
34             (segmentMap[num] & (0
35             b10000000 >> i)) ? RESET : SET);
36     }
37 }
38 void process(){
39     settrafficlight1(LED_RED1_GPIO_Port, LED_RED1_Pin,
      LED_YELLOW1_GPIO_Port, LED_YELLOW1_Pin,
      LED_GREEN1_GPIO_Port, LED_GREEN1_Pin);
40     settrafficlight1(LED_GREEN2_GPIO_Port, LED_GREEN2_Pin,
      LED_RED2_GPIO_Port, LED_RED2_Pin,
      LED_YELLOW2_GPIO_Port, LED_YELLOW2_Pin);
41     for(int i=5;i>=2;i--){
42         display7SEG(0, counterred--);
43     }
44 }

```

```

40     display7SEG(1, countergreen--);
41     HAL_Delay(1000);
42 }
43     settraffilight1(LED_YELLOW2_GPIO_Port,
LED_YELLOW2_Pin, LED_GREEN2_GPIO_Port, LED_GREEN2_Pin,
LED_RED2_GPIO_Port, LED_RED2_Pin);
44     for(int i=2;i>=0;i--){
45         display7SEG(0, counterred--);
46         display7SEG(1, counteryellow--);
47         HAL_Delay(1000);
48         if(i<=0){
49             counterred=6;
50             counteryellow=2;
51             countergreen=3;
52         }
53     }
54     settraffilight1(LED_RED2_GPIO_Port, LED_RED2_Pin,
LED_YELLOW2_GPIO_Port, LED_YELLOW2_Pin,
LED_GREEN2_GPIO_Port, LED_GREEN2_Pin);
55     settraffilight1(LED_GREEN1_GPIO_Port, LED_GREEN1_Pin
, LED_RED1_GPIO_Port, LED_RED1_Pin,
LED_YELLOW1_GPIO_Port, LED_YELLOW1_Pin);
56     for(int i=5;i>=2;i--){
57         display7SEG(1, counterred--);
58         display7SEG(0, countergreen--);
59         HAL_Delay(1000);
60     }
61     settraffilight1(LED_YELLOW1_GPIO_Port,
LED_YELLOW1_Pin, LED_GREEN1_GPIO_Port, LED_GREEN1_Pin,
LED_RED1_GPIO_Port, LED_RED1_Pin);
62     for(int i=2;i>=0;i--){
63         display7SEG(1, counterred--);
64         display7SEG(0, counteryellow--);
65         HAL_Delay(1000);
66         if(i<=0){
67             counterred=6;
68             counteryellow=2;
69             countergreen=3;
70         }
71     }
72 }

```

Program 1.7: Ex5.c

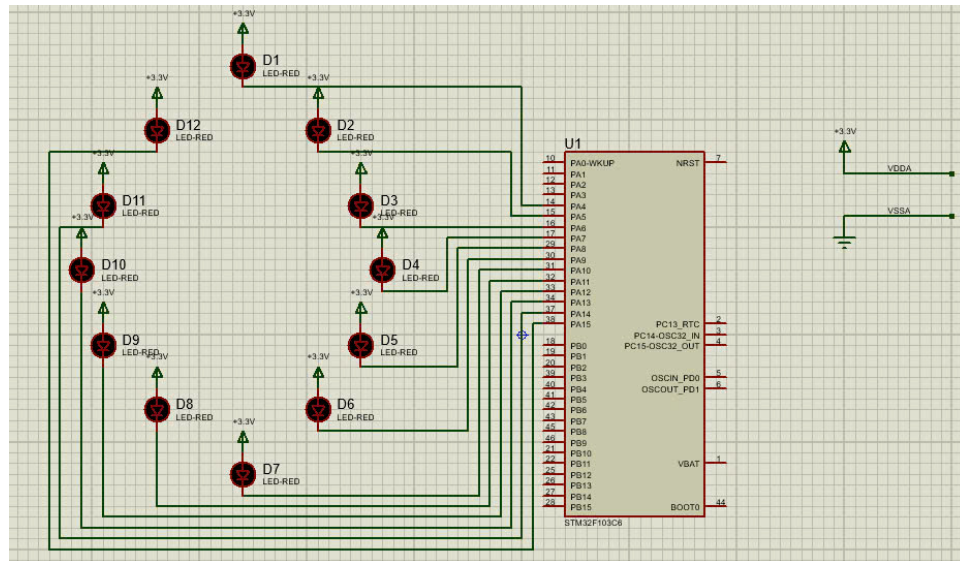
```

1 while (1){
2     process();
3 }

```

Program 1.8: main.c

1.6 Exercise 6



Hình 1.6: Schematic

```

1 int counter=0;
2 GPIO_TypeDef* segmentPorts[12] = {
3     LED0_GPIO_Port, LED1_GPIO_Port, LED2_GPIO_Port,
4     LED3_GPIO_Port, LED4_GPIO_Port, LED5_GPIO_Port,
5     LED6_GPIO_Port, LED7_GPIO_Port, LED8_GPIO_Port,
6     LED9_GPIO_Port, LED10_GPIO_Port, LED11_GPIO_Port};
7 uint16_t segmentPins[12]={
8     LED0_Pin, LED1_Pin, LED2_Pin, LED3_Pin, LED4_Pin, LED5_Pin,
9     LED6_Pin, LED7_Pin, LED8_Pin, LED9_Pin,
10    LED10_Pin, LED11_Pin};
11 void TurnOnEveryClock(int num) {
12     for (int i = 0; i < 12; i++) {
13         if(i==num) HAL_GPIO_WritePin(segmentPorts[num],
14             segmentPins[num], RESET);
15         else HAL_GPIO_WritePin(segmentPorts[i],
16             segmentPins[i], SET);
17     }
18 }

```

Program 1.9: Ex6.c

```

1 while (1){
2     if(counter>=12) counter=0;
3     TurnOnEveryClock(counter++);
4     HAL_Delay(1000);
5 }

```

Program 1.10: main.c

1.7 Exercise 7

```
1 void clearAllClock(){
2     HAL_GPIO_WritePin(GPIOA, LED_PINS, SET);
3 }
```

Program 1.11: main.c

1.8 Exercise 8

```
1 GPIO_TypeDef* segmentPorts[12] = {LED0_GPIO_Port,
    LED1_GPIO_Port, LED2_GPIO_Port, LED3_GPIO_Port,
    LED4_GPIO_Port,
2 LED5_GPIO_Port, LED6_GPIO_Port, LED7_GPIO_Port, LED8_GPIO_Port
    , LED9_GPIO_Port, LED10_GPIO_Port, LED11_GPIO_Port};
3 uint16_t segmentPins[12]={LED0_Pin, LED1_Pin, LED2_Pin,
    LED3_Pin, LED4_Pin, LED5_Pin, LED6_Pin, LED7_Pin
4     , LED8_Pin, LED9_Pin, LED10_Pin, LED11_Pin};
5 void clearNumberOnClock(int num) {
6     HAL_GPIO_WritePin(segmentPorts[num], segmentPins[num],
    RESET);
7 }
```

Program 1.12: Ex8.c

1.9 Exercise 9

```
1 GPIO_TypeDef* segmentPorts[12] = {LED0_GPIO_Port,
    LED1_GPIO_Port, LED2_GPIO_Port, LED3_GPIO_Port,
    LED4_GPIO_Port,
2 LED5_GPIO_Port, LED6_GPIO_Port, LED7_GPIO_Port, LED8_GPIO_Port
    , LED9_GPIO_Port, LED10_GPIO_Port, LED11_GPIO_Port};
3 uint16_t segmentPins[12]={LED0_Pin, LED1_Pin, LED2_Pin,
    LED3_Pin, LED4_Pin, LED5_Pin, LED6_Pin, LED7_Pin
4     , LED8_Pin, LED9_Pin, LED10_Pin, LED11_Pin};
5 void clearNumberOnClock(int num) {
6     HAL_GPIO_WritePin(segmentPorts[num], segmentPins[num],
    SET);
7 }
```

Program 1.13: Ex9.c

1.10 Exercise 10

```
1 int second=0;
2 int minute=0;
```



```

3 int hour=0;
4 GPIO_TypeDef* segmentPorts[12] = {LED0_GPIO_Port ,
    LED1_GPIO_Port ,LED2_GPIO_Port ,LED3_GPIO_Port ,
    LED4_GPIO_Port ,
5 LED5_GPIO_Port ,LED6_GPIO_Port ,LED7_GPIO_Port ,LED8_GPIO_Port
    ,LED9_GPIO_Port ,LED10_GPIO_Port ,LED11_GPIO_Port}; //
    LED 1
6 uint16_t segmentPins[12]={LED0_Pin,LED1_Pin,LED2_Pin ,
    LED3_Pin
7 ,LED4_Pin,LED5_Pin,LED6_Pin,LED7_Pin,LED8_Pin,LED9_Pin ,
    LED10_Pin,LED11_Pin};
8 void setClock(int num){
9     HAL_GPIO_WritePin(segmentPorts[num], segmentPins[
    num], RESET);
10 }
11 void clearClock(int num){
12     HAL_GPIO_WritePin(segmentPorts[num], segmentPins[
    num], SET);
13 }
14 void setClockBegin(int hour,int minute,int second){
15     HAL_GPIO_WritePin(segmentPorts[hour], segmentPins
    [hour], RESET);
16     if(minute%5==0) HAL_GPIO_WritePin(segmentPorts[
    minute/5], segmentPins[minute/5], RESET);
17     if(second%5==0) HAL_GPIO_WritePin(segmentPorts[
    second/5], segmentPins[second/5], RESET);
18     HAL_Delay(2000);
19 }

```

Program 1.14: Ex10.c

```

1 setClockBegin(hour,minute,second);
2 while (1)
3 {
4     second++;
5     if (second >= 60) {
6         second = 0;
7         minute++;
8         setClock((minute / 5+12)%12);
9         if(((minute / 5+11)%12)!=hour) clearClock(((minute
    / 5+11)%12));
10         if (minute >= 60) {
11             minute = 0;
12             hour++;
13             setClock((hour+12)%12);
14             if((hour+11)%12!=0) clearClock((hour
    +11)%12);
15             if (hour >= 12) {
16                 hour = 0;
17             }

```

```
18         }
19     }
20     setClock((second / 5+12)%12);
21     if(((second / 5+11)%12)!=hour&&((second / 5+11)%12)!=
minute/5+12)%12) clearClock(((second / 5+11)%12));
22     HAL_Delay(100);
23 }
```

Program 1.15: main.c