TRƯỜNG ĐẠI HỌC BÁCH KHOA – TP. HỒ CHÍ MINH

KHOA KHOA HỌC VÀ KỸ THUẬT MÁY TÍNH

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Lab 1 - LED Animation

Microcontroller - Microprocessor (Lab)

COURSE ID: CO3010 - HK251

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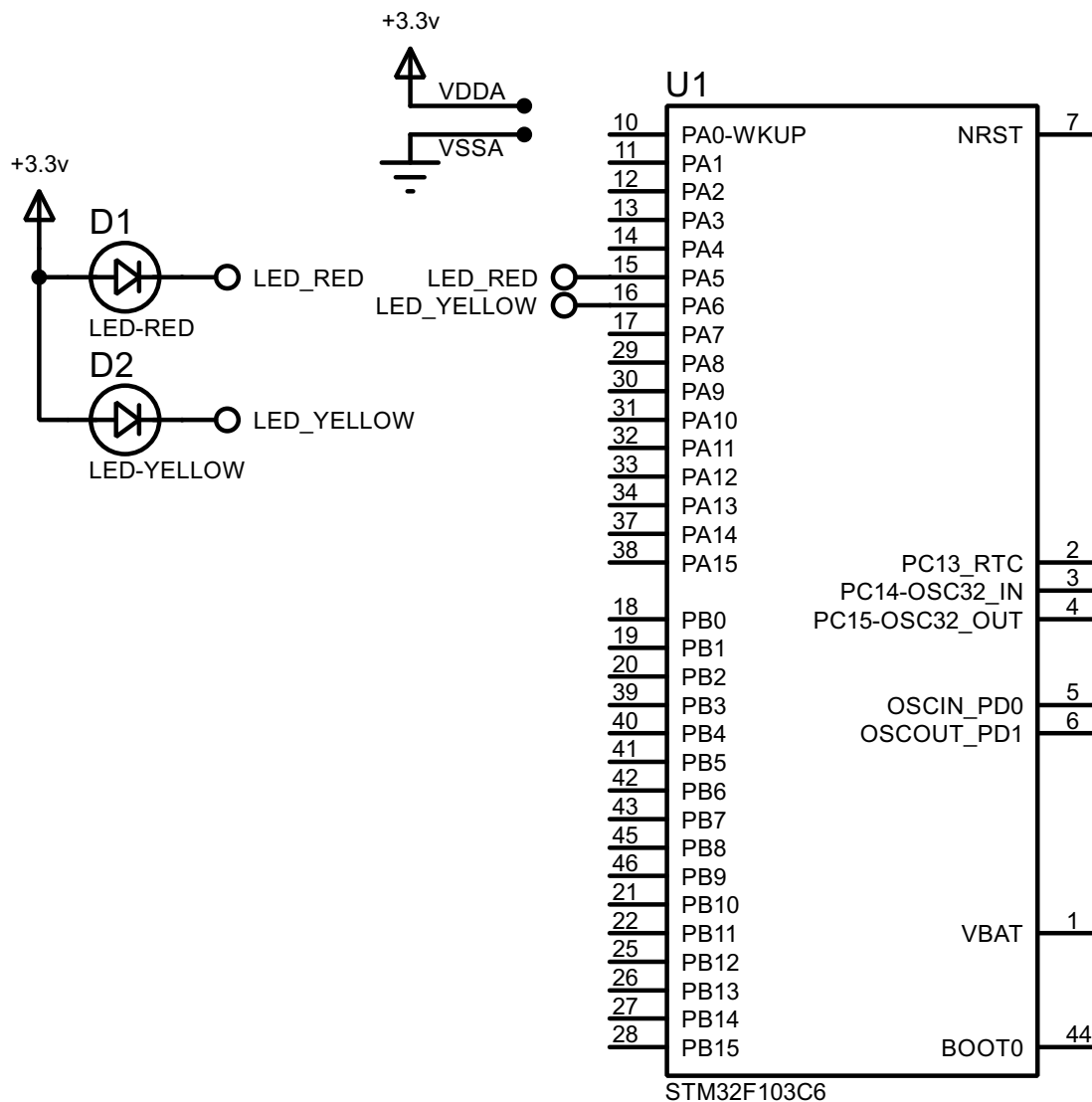
Supervising Lecturer: Dr. VÕ TUẤN BÌNH

1 Exercise

The GitHub link for the lab files: https://github.com/hygameo/VXL-VDK_2352458

1.1 Exercise 1

### 1.1.1 Report 1: Depict the schematic from Proteus simulation in this report.

1.1.2 Report 2: Present the source code in the infinite loop while of your project.

```
HAL_GPIO_WritePin(GPIOA, LED_RED_Pin, GPIO_PIN_SET);
HAL_GPIO_WritePin(GPIOA, LED_YELLOW_Pin, GPIO_PIN_RESET);

while (1)
{
    HAL_GPIO_TogglePin(GPIOA, LED_RED_Pin | LED_YELLOW_Pin);
    HAL_Delay(2000);
}
```

1.2 Exercise 2

1.2.1 Report 1: Present the schematic.
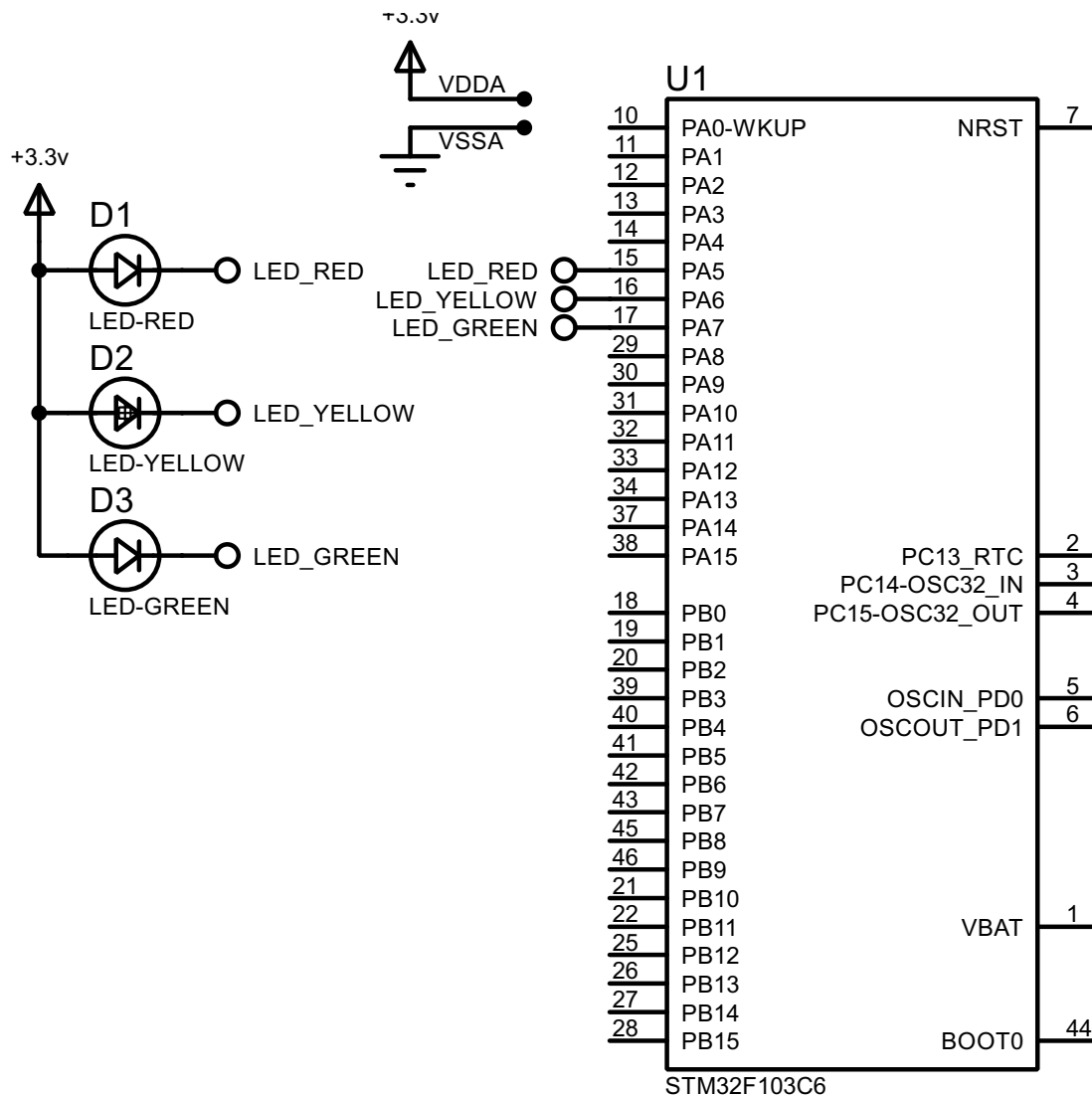
1.2.2 Report 2: Present the source code in while.
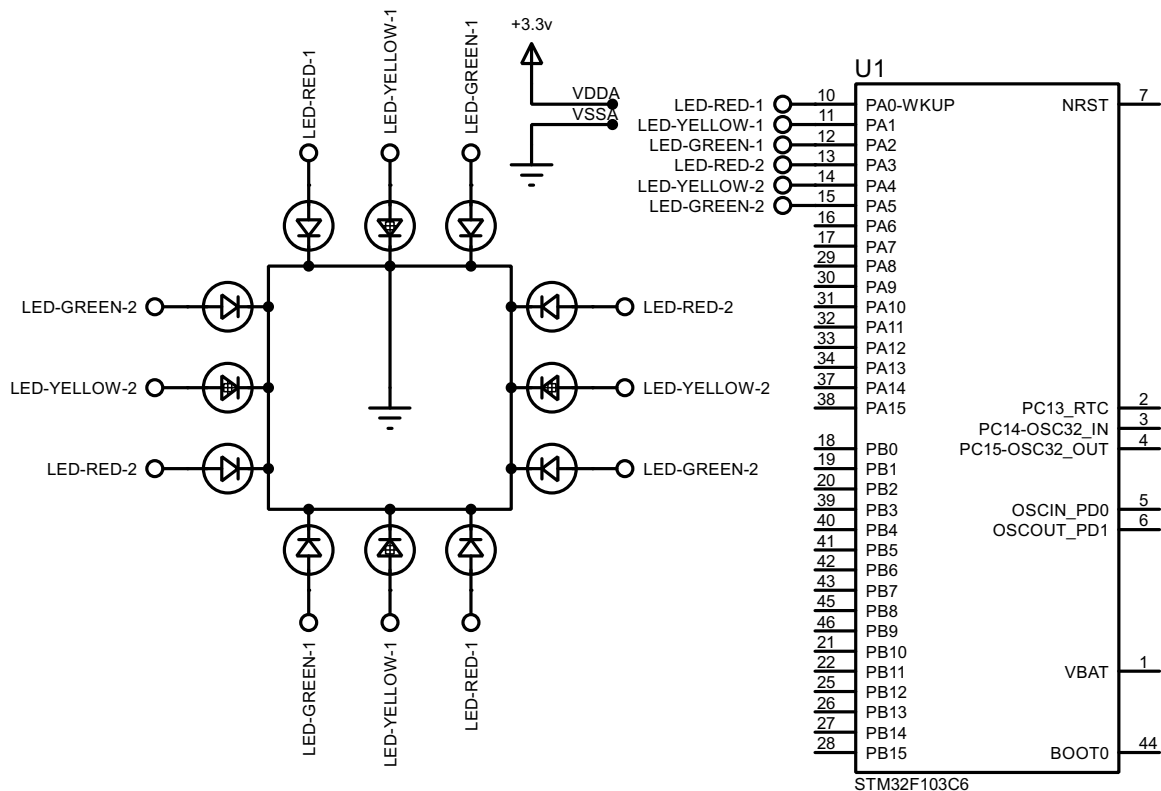
```
while (1)
{
    HAL_GPIO_WritePin(GPIOA, LED_RED_Pin, GPIO_PIN_RESET);
    HAL_GPIO_WritePin(GPIOA, LED_YELLOW_Pin, GPIO_PIN_SET);
    HAL_GPIO_WritePin(GPIOA, LED_GREEN_Pin, GPIO_PIN_SET);
    HAL_Delay(5000);

    HAL_GPIO_TogglePin(GPIOA, LED_RED_Pin | LED_YELLOW_Pin);
    HAL_Delay(2000);

    HAL_GPIO_TogglePin(GPIOA, LED_YELLOW_Pin | LED_GREEN_Pin);
    HAL_Delay(3000);
}
```

1.3 Exercise 3

1.3.1 Report 1: Present the schematic.

1.3.2 Report 2: Present the source code in while.

```
typedef enum {
    RED = 0, YELLOW = 1, GREEN = 2
} LED;
void setLED(LED Road1LED, LED Road2LED, int sec) {
    HAL_GPIO_WritePin(GPIOA,
    LED_RED_1_Pin    | LED_YELLOW_1_Pin |
    LED_GREEN_1_Pin  | LED_RED_2_Pin    |
    LED_YELLOW_2_Pin | LED_GREEN_2_Pin  , GPIO_PIN_RESET);
    HAL_GPIO_TogglePin(GPIOA,
    (Road1LED == RED ? LED_RED_1_Pin : (Road1LED == YELLOW ?
        LED_YELLOW_1_Pin : LED_GREEN_1_Pin)) |
    (Road2LED == RED ? LED_RED_2_Pin : (Road2LED == YELLOW ?
        LED_YELLOW_2_Pin : LED_GREEN_2_Pin))
    );
    HAL_Delay(sec * 1000);
}
int main(void){
    while (1){
        setLED(RED, GREEN, 3);
        setLED(RED, YELLOW, 2);
        setLED(GREEN, RED, 3);
        setLED(YELLOW, RED, 2);
    }
}
```

1.4 Exercise 4

1.4.1 Report 1: Present the schematic.
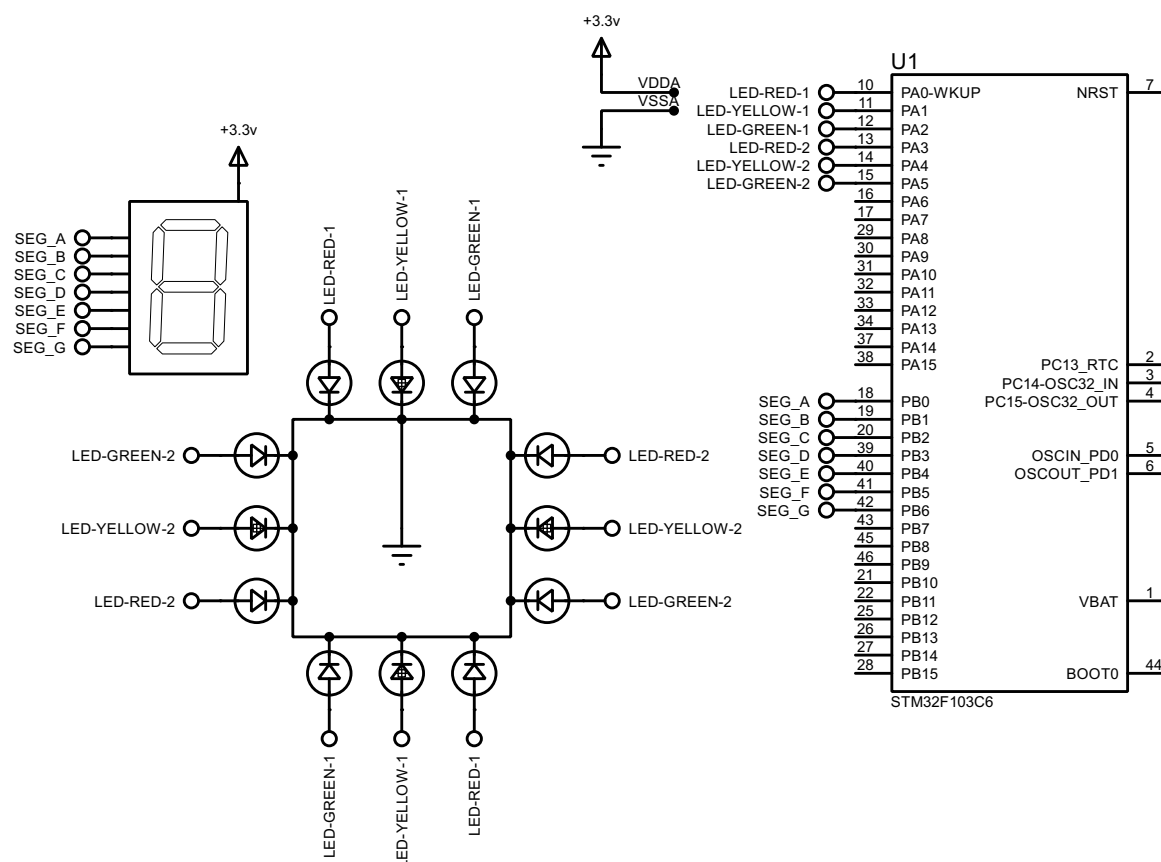
1.4.2 Report 2: Present the source code for display7SEG function.

```
uint8_t segmentMap[10] = {
    0b1111110, 0b0110000,
    0b1101101, 0b1111001,
    0b0110011, 0b1011011,
    0b1011111, 0b1110000,
    0b1111111, 0b1111011
};

uint8_t SegPin[7] = {
    SEG_A_Pin, SEG_B_Pin,
    SEG_C_Pin, SEG_D_Pin,
    SEG_E_Pin, SEG_F_Pin,
    SEG_G_Pin
};

void display7SEG(int num) {
    uint8_t bitmask = segmentMap[num];

    for(int i = 0; i < 7; i++) HAL_GPIO_WritePin(GPIOB, SegPin[i], (
        bitmask & (1 << (6 - i))) ? RESET : SET);
}
```

1.5 Exercise 5

1.5.1 Report 1: Present the source code.

```c
typedef enum {
    RED = 0, YELLOW = 1, GREEN = 2
} LED;
uint8_t segmentMap[10] = {
    0b1111110, 0b0110000,
    0b1101101, 0b1111001,
    0b0110011, 0b1011011,
    0b1011111, 0b1110000,
    0b1111111, 0b1111011
};
uint8_t SegPin[7] = {
    SEG_A_Pin, SEG_B_Pin,
    SEG_C_Pin, SEG_D_Pin,
    SEG_E_Pin, SEG_F_Pin,
    SEG_G_Pin
};
void display7SEG(int num) {
    uint8_t bitmask = segmentMap[num];

    for(int i = 0; i < 7; i++) HAL_GPIO_WritePin(GPIOB, SegPin[i], (
        bitmask & (1 << (6 - i))) ? RESET : SET);
}
void setLED(LED Road1LED, LED Road2LED, int sec){
    HAL_GPIO_WritePin(GPIOA,
    LED_RED_1_Pin    | LED_YELLOW_1_Pin |
    LED_GREEN_1_Pin  | LED_RED_2_Pin    |
    LED_YELLOW_2_Pin | LED_GREEN_2_Pin  , GPIO_PIN_RESET);

    HAL_GPIO_TogglePin(GPIOA,
    (Road1LED == RED ? LED_RED_1_Pin : (Road1LED == YELLOW ?
        LED_YELLOW_1_Pin : LED_GREEN_1_Pin)) |
    (Road2LED == RED ? LED_RED_2_Pin : (Road2LED == YELLOW ?
        LED_YELLOW_2_Pin : LED_GREEN_2_Pin))
    );

    for(int i = sec; i > 0; i--){
        display7SEG(i);
        HAL_Delay(1000);
    }
}
int main(void)
{
    while (1)
    {
        setLED(RED, GREEN, 3);
        setLED(RED, YELLOW, 2);
        setLED(GREEN, RED, 3);
        setLED(YELLOW, RED, 2);
    }
}
```

1.6 Exercise 6

1.6.1 Report 1: Present the schematic.
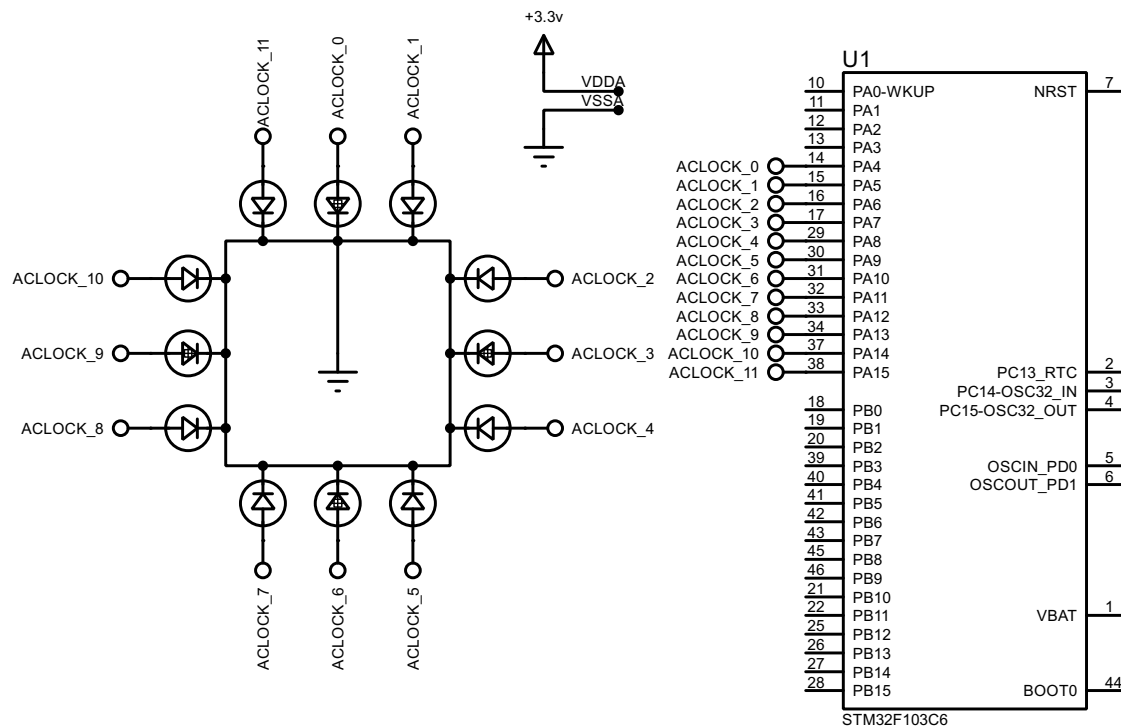
1.6.2 Report 2: Implement a simple program to test the connection of every single LED.

```c
uint16_t ACLOCK_Pins[12] = {
    ACLOCK_0_Pin , ACLOCK_1_Pin , ACLOCK_2_Pin ,
    ACLOCK_3_Pin , ACLOCK_4_Pin , ACLOCK_5_Pin ,
    ACLOCK_6_Pin , ACLOCK_7_Pin , ACLOCK_8_Pin ,
    ACLOCK_9_Pin , ACLOCK_10_Pin, ACLOCK_11_Pin
};

int main(void)
{
    while (1)
    {
        for(int i = 0; i < 12; i++){
            HAL_GPIO_WritePin(GPIOA, ACLOCK_Pins[i], GPIO_PIN_SET);
            HAL_Delay(250);
        }
        for(int i = 11; i > 0; i--){
            HAL_GPIO_WritePin(GPIOA, ACLOCK_Pins[i], GPIO_PIN_RESET);
            HAL_Delay(250);
        }
    }
}
```

1.7 Exercise 7

1.7.1 Report 1: Present the source code of this function.

```
void clearAllClock(void) {
    for (int i = 0; i < 12; i++) HAL_GPIO_WritePin(GPIOA, ACLOCK_Pins[
        i], GPIO_PIN_RESET);
}
```

1.8 Exercise 8

1.8.1 Report 1: Present the source code of this function.

```
void setNumberOnClock(int num) {
    HAL_GPIO_WritePin(GPIOA, ACLOCK_Pins[num], GPIO_PIN_SET);
}
```

1.9 Exercise 9

1.9.1 Report 1: Present the source code of this function.

```
void clearNumberOnClock(int num) {
    HAL_GPIO_WritePin(GPIOA, ACLOCK_Pins[num], GPIO_PIN_RESET);
}
```

1.10 Exercise 10

1.10.1 Report 1: Integrate the whole system and use 12 LEDs to display a clock.

```
int hour = 0;
int minute = 0;
int second = 0;

while (1)
{
    clearAllClock();
    setNumberOnClock(hour % 12);
    setNumberOnClock((minute / 5) % 12);
    setNumberOnClock((second / 5) % 12);

    second++;

    if(second == 60){ second = 0; minute++; }
    if(minute == 60){ minute = 0; hour++; }

    if(hour == 12) hour = 0;

    HAL_Delay(10);
}
```