De2 Meteo Station

Team members

- Eva Momenceau
- François Soulié
- Paul Tissedre

Link to this file in your GitHub repository:

https://github.com/francois07/digital-electronics-project

Table of contents

Project objectives

Weather station with 2-axis solar tracking system. The following can be used: temperature, humidity, pressure, light intensity sensors, panel positioning motors, and others.

We decided to focus more on the meteo station side, using a sensor to get temperature and humidity to then display them on screen in a pretty way.

Hardware description

Sensor - DHT12

This sensor is used to get temperature and humidity values.

LCD Display - HD44780

This LCD display was used to display the temperature and humidity values we got from the sensor.

Servo Motor - SG90

This motor was used to simulate rotations of a solar panel.

Libraries description

Delay

Functions for busy-wait delay loops

IO

AVR device-specific IO definitions

Interrupt

Interrupts standard C library for AVR-GCC

timer

Timer library made in labs

stdlib

Standart C Library providing type such as `uint8_t`

UART

Peter Fleury's UART library

TWI

TWI library for AVR-GCC

LCD

LCD library for AVR-GCC

GPIO

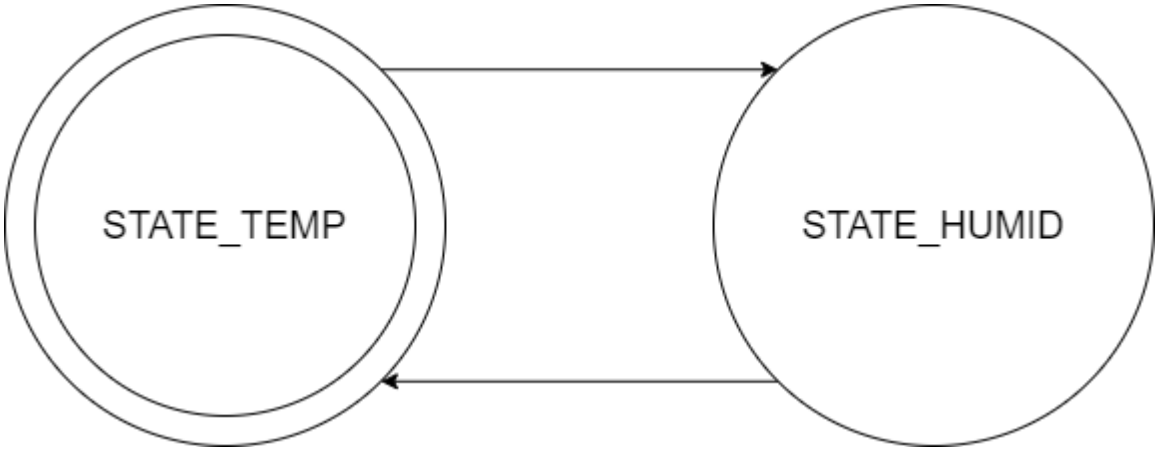
GPIO library made in labs

Main application

Description

As explained in project objectives, we decided to focus more on the meteo station side, since simulating the motors wasn't very relevant (only a few lines of code). To get temperature and humidity values, we used the `DHT12` sensor with I2C communication. To display them one after they other, we defined a simple state machine.

```
    // FSM
switch (state)
{
    // Get humidity
    case STATE_HUMID:
        // Display humidity value
        // ...

        state = STATE_TEMP;
        break;

    // Get temperature
    case STATE_TEMP:
        // Display temperature value
        // ...

        state = STATE_HUMID;
        break;

    default:
        state = STATE_TEMP;
        break;
}
```



To display values, we used a custom helper function we called `displaySensor`

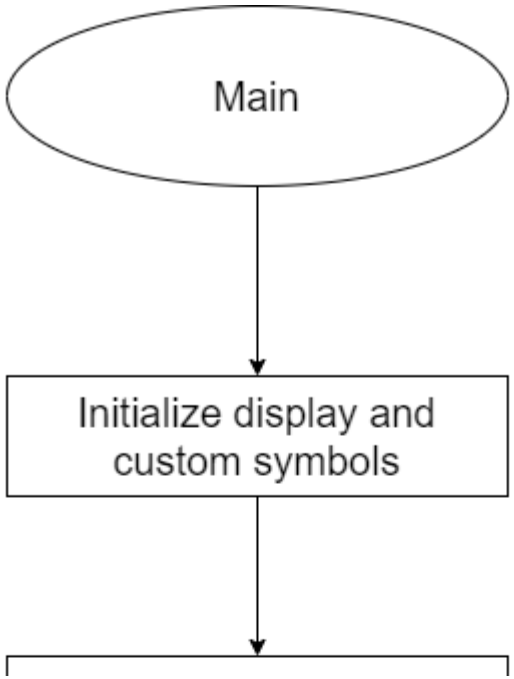
```
uint8_t displaySensor(char title[], uint8_t slave_adress, uint8_t reg_adress)
{
    uint8_t result = 1;
    char res_string[] = "000";

    lcd_gotoxy(1, 0);
    lcd_puts(title);

    twi_start((slave_adress<<1) + TWI_WRITE);
    twi_write(reg_adress);
    twi_stop();

    twi_start((slave_adress<<1) + TWI_READ);
    result = twi_read_ack();

    itoa(result, res_string, 10);

    lcd_gotoxy(0, 1);
    lcd_puts(res_string);

    return result;
}
```

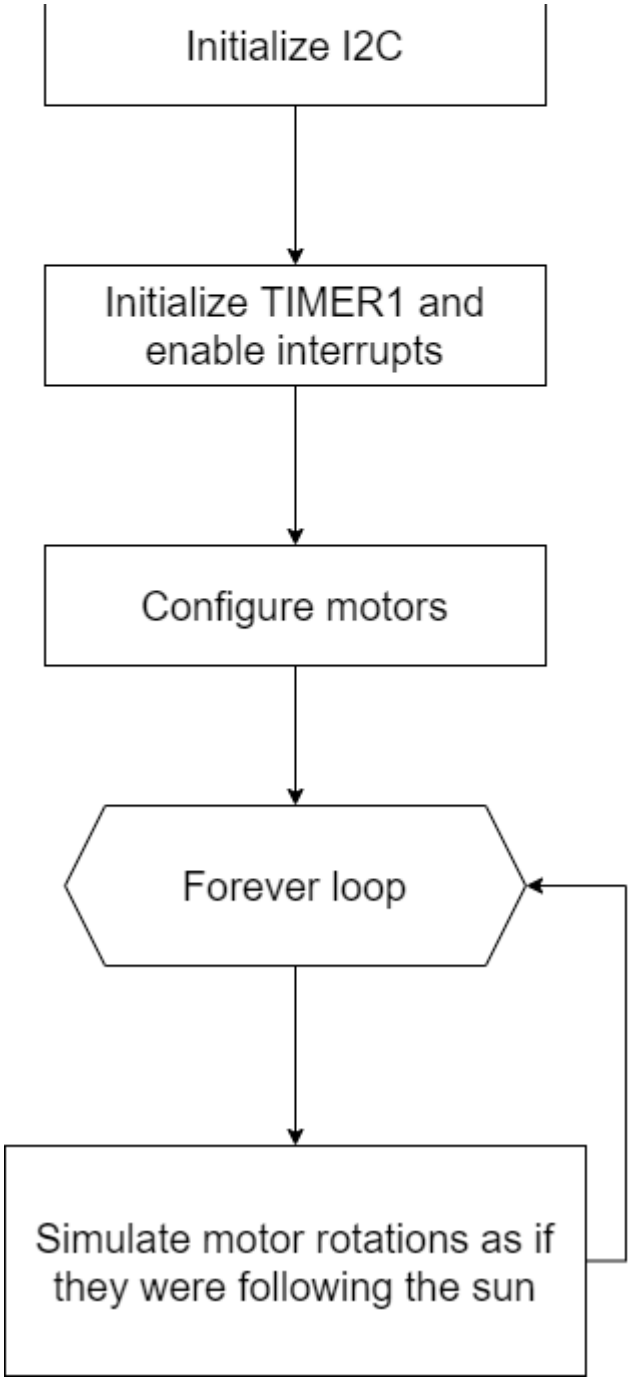
To simulate the solar panels' rotations, we rotate a motor on the side. If it was a real application, we would have to motors: 1 for `X` rotation and 1 for `Y` rotation. Also, there would be a scheduling of the rotation, unlike here where the motor juste goes back and forth between `-90deg` and `90deg`.
We also made a helper function for rotating the motors called `rotateMotor`

```
void rotateMotor(volatile uint8_t *reg_name, uint8_t pin_num, uint8_t period, uint64_t pulse)
{
    GPIO_write_low(reg_name, pin_num);
    for(uint8_t i=0; i < period; i++){
        _delay_ms(20);
        GPIO_toggle(reg_name, pin_num);
        _delay_us(pulse);
        GPIO_toggle(reg_name, pin_num);
    }
}
```

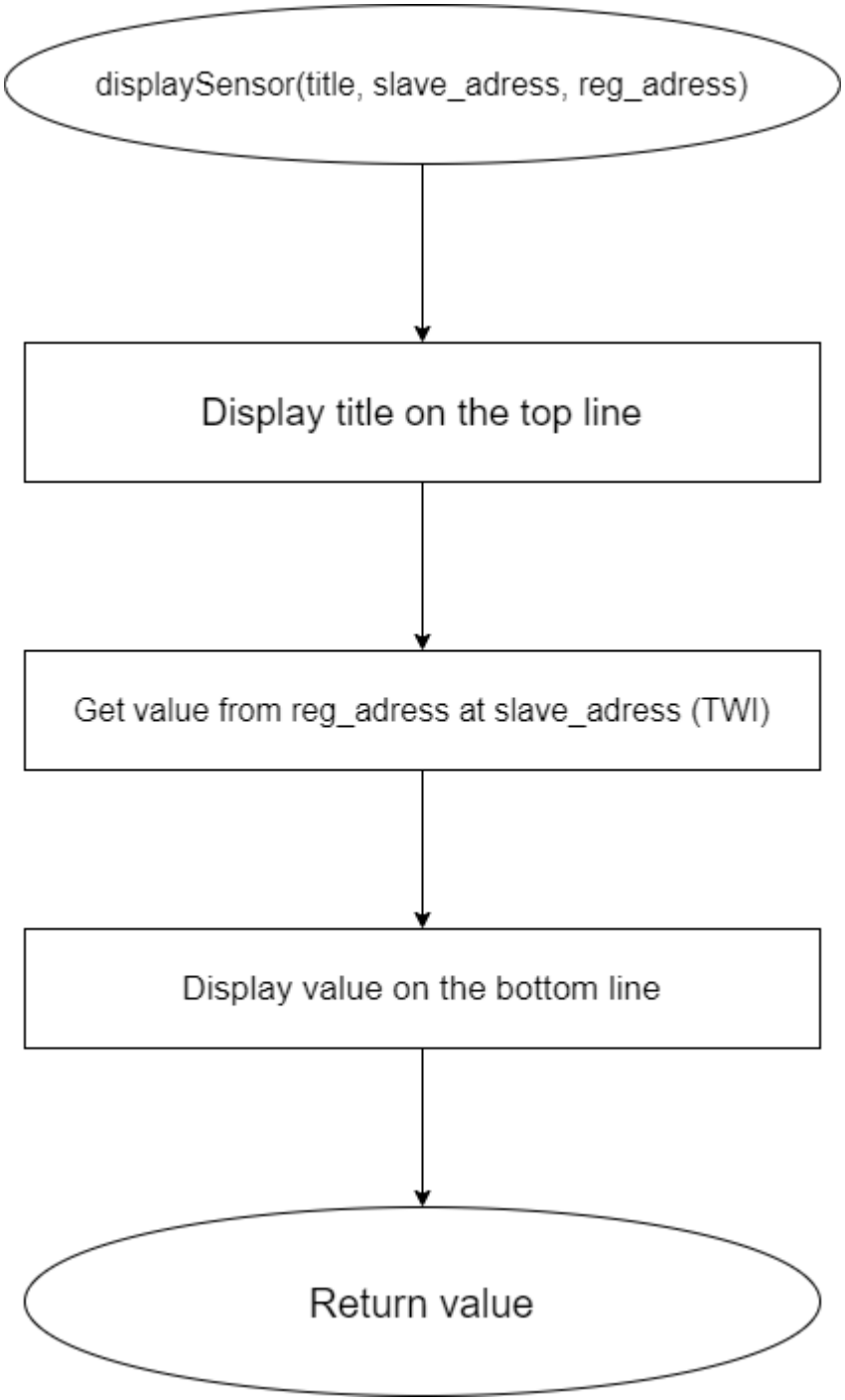
Flowcharts

Main function

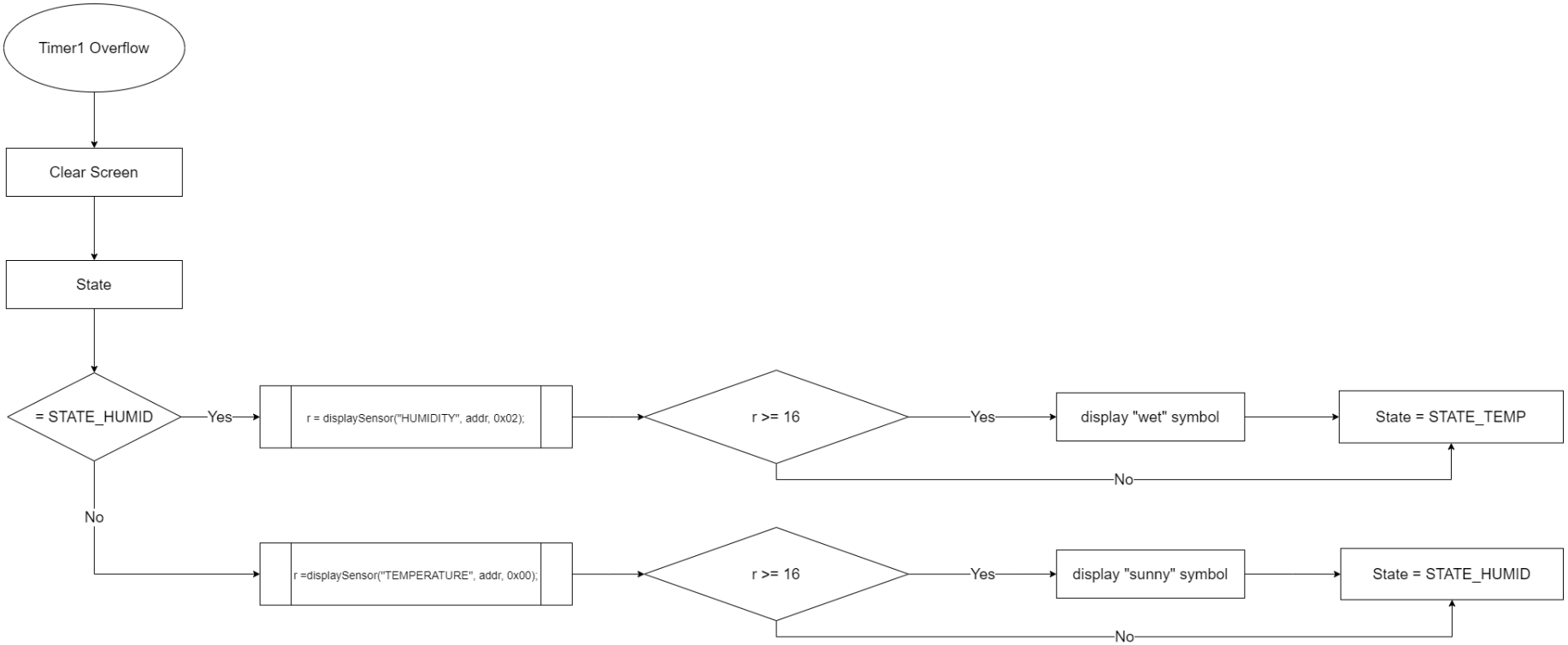




displaySensor function


displaySensor(title, slave_adress, reg_adress)
Display title on the top line
Get value from reg_adress at slave_adress (TWI)
Display value on the bottom line
Return value

ISR function



Video

You can find our project video here (https://www.youtube.com/watch?v=LFCsTHv8JU4)

References

1. SG90 Servo Motor datasheet
2. DHT12 Sensor datasheet
3. Arduino Shield