Design laboratory

Project - Weather station

Communication with DHT11

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1. Introduction

DHT11 can measure two types of data, the measurement range for temperature is 0-50℃ with accuracy ±2℃ and 20%-90% with accuracy 5% for humidity. Devices communicate with the MCU using a one-wire serial transmission. We can divide transmission into five stages:

1. 8 bit - integral humidity data
2. 8 bit - decimal humidity data
3. 8 bit - integral temperature data
4. 8 bit - decimal humidity data
5. 8 bit - checksum

The checksum is a sum of all previous data segments.

The most important is the way how MCU communicate with DHT11 on serial one-wire.
At the begin we have initialization stag:

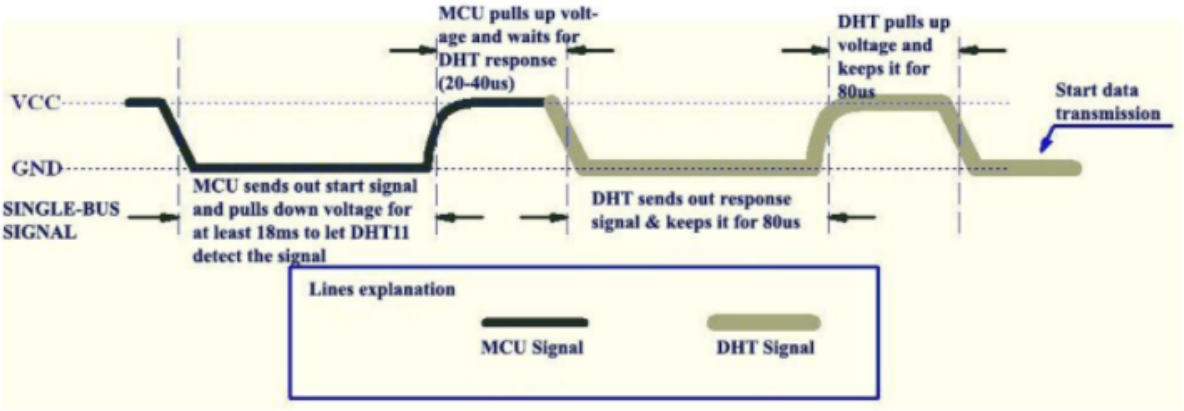

photo. nr. 1 - initialization stages of communication with DHT11 (source: https://drive.google.com/file/d/1f81pFnJUBGgLcCCYvYcs5uqO-6DGau5z/view?usp=sharing)

After the initialization we receive data, the logical state depends on the pulse length which it shows below.

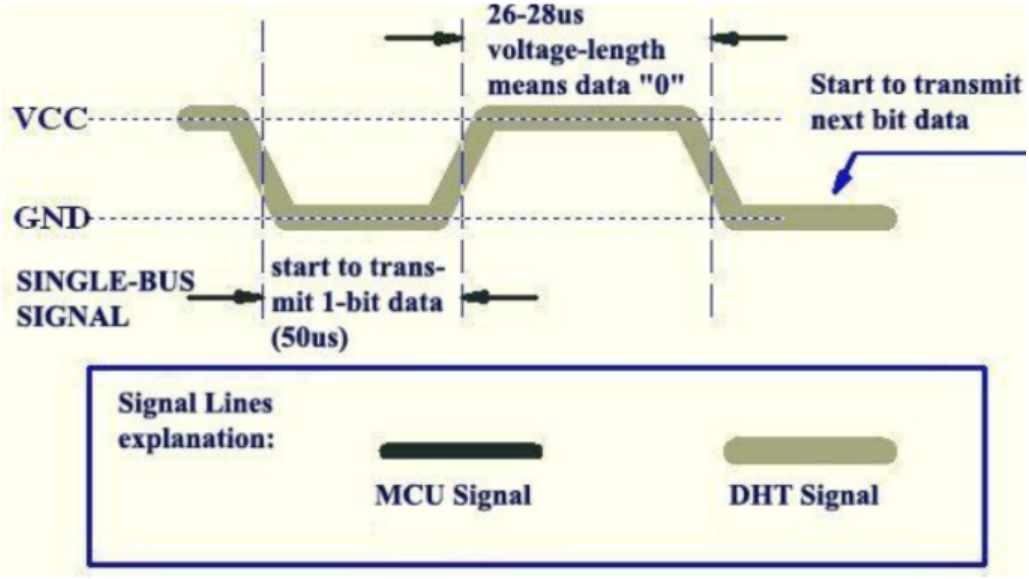

photo. nr. 2 - state signal logical “0”
(source: https://drive.google.com/file/d/1f81pFnJUBGgLcCCYvYcs5uqO-6DGau5z/view?usp=sharing)

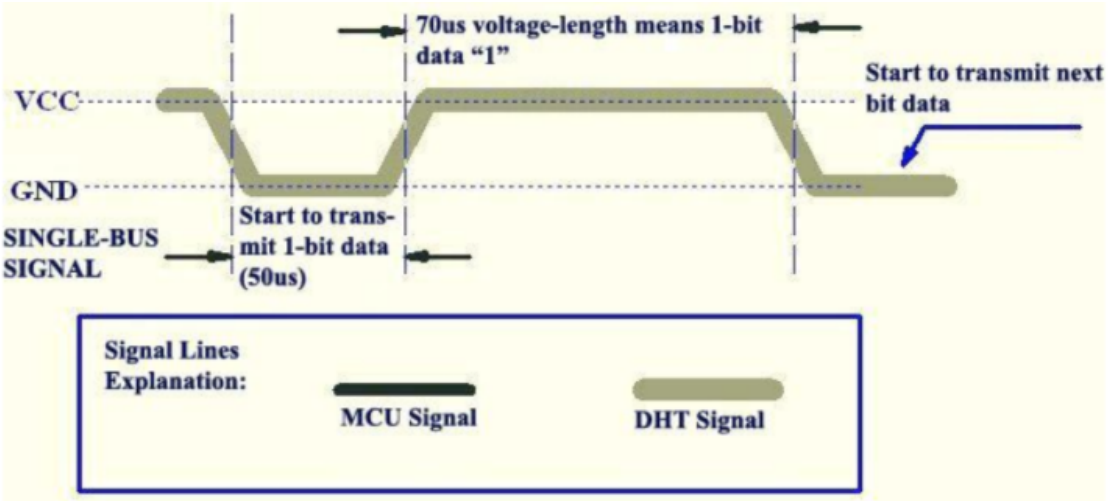

photo. nr. 3 - state signal logical “1”
(source: https://drive.google.com/file/d/1f81pFnJUBGgLcCCYvYcs5uqO-6DGau5z/view?usp=sharing)

2. Code overview

Below shows an implementation in the “c” language of the initialization state of communication with DHT11.

In our code macro **DHT11_PIN** refer to **PORTD6**

```
void DHT_Request()              /* Microcontroller send start pulse/request */
{
    DDRD |= (1<<DHT11_PIN);     //set PIN 6 on port D as a output
    PORTD &= ~(1<<DHT11_PIN);   /* set to low pin */
    _delay_ms(20);              /* wait for 20ms */
    PORTD |= (1<<DHT11_PIN);    /* set to high pin */
}
void DHT_Response()             /* receive response from DHT11 */
{
    DDRD &= ~(1<<DHT11_PIN);            //set PIN 6 on port D as an input
    while(PIND & (1<<DHT11_PIN));       // wait until DH11 change logical state to "0"
    while((PIND & (1<<DHT11_PIN))==0);  // DH11 will be in this state 80us
    while(PIND & (1<<DHT11_PIN));       // DH11 will be in this state 80us
}
```

photo nr. 4 - function to initialization a DHT11 sensor. (source: own code in file DHT11.c)

```
33  uint8_t DHT_Receive_data()          /* receive data, returns 8 bits */
34  {
35      uint8_t c = 0;
36      for (int q=0; q<8; q++)
37      {
38          while((PIND & (1<<DHT11_PIN)) == 0);  /* check received bit 0 or 1 */
39          _delay_us(30);
40          if(PIND & (1<<DHT11_PIN))/* if high pulse is greater than 30ms */
41          c = (c<<1)|(0x01);      /* then its logic HIGH */
42          else                    /* otherwise its logic LOW */
43          c = (c<<1);
44          while(PIND & (1<<DHT11_PIN));  //eventually wait for end logic HIGH
45      }
46      return c;
47  }
```

photo nr. 5 - function read data. (source: own code in file DHT11.c)

have these functions we can use them in the main program loop to accumulate all necessary data. According to the introduction, we have initialization (line 105, 106), then the program read all five data stages.

```
103         /*****************************************          DHT11          **********
104         _delay_ms(300);
105         DHT_Request();      /* send start pulse */
106         DHT_Response();     /* receive response */
107         I_HUM=DHT_Receive_data();   /* store first eight bit in I_HUM */
108         D_HUM=DHT_Receive_data();   /* store next eight bit in D_HUM */
109         I_Temp=DHT_Receive_data();  /* store next eight bit in I_Temp */
110         D_Temp=DHT_Receive_data();  /* store next eight bit in D_Temp */
111         CheckSum=DHT_Receive_data();/* store next eight bit in CheckSum */
112
```

photo nr. 6 - communication with the DHT11 (source: own code in file main.c)

3. Testing

photo no. 7 - Temperature and humidity displayed on the terminal (source: own photo)

The DHT11 sensor was placed in a roo, so we can see that the measurements are property. The thermometer in the room showed a temperature of 22.7 °C