The Simulation of the Temperature and the Humidity Measurement System

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Abstract

A number of simulation models in diverse domains have been developed using the Proteus simulation environment. The aim of this work is to achieve a functional system in terms of software system that enables measurement of temperature and humidity of an enclosure. The software of Proteus was used to do the simulation of the designed system. By simulation, drastically reduces debugging time that would occur if the practical implementation. For the simulation of system, I used an Arduino Uno development board, an temperature and humidity sensor used as the data collector, as well as an Real Time Clock (RTC), used for monitoring time.

Keywords: Proteus, Arduino, DHT22 sensor, Real Time Clock, MaxDetect 1-wire

1 Introduction

Temperature and humidity measurement is essential to taking control of your environment.

Proteus is a design software developed by Labcenter Electronics for electronic circuit simulation, schematic capture and PCB design. Proteus is a software package for computer-aided design, simulation and design of electronic circuits. It is an electronic design application tool which can simulate microcontroller and peripheral devices. Proteus can truly turn a complete design from concept into product. Proteus can program based on the virtual prototyped directly. Together with display and output devices, input and output can be seen after running of programs (http://onlinepresent.org/proceedings/vol77_2014/12.pdf). The unique nature of schematic based microcontroller simulation with Proteus facilitates rapid, flexible and parallel development of both the system hardware and the system firmware.

Proteus establishes a comprehensive electronic design and development environment. It consists of two main parts, the ISIS, the circuit design environment that even the simulator VSM includes, and the ARES, the PCB-Designer.

The ISIS (Intelligent Schematic Input System) is the environment for the design and simulation of electronic circuits. The ARES (Advanced Routing and Editing Software), is a software for PCB design.

2 The wiring diagram simulation

To simulate the Arduino Uno development board and the DHT22 sensor, it should be added their libraries to the simulation program. After adding the library and realization the wiring diagram, the written code is loaded in the development environment.

Figure 1 shows the simulation project. I added an oscilloscope to display the transmitted data through I2C.
2.1. Temperature and humidity sensor simulation

To communicate with the microcontroller, the DHT22 sensor, uses MaxDetect1-wirebus, specially designed by MaxDetect Technology Co., Ltd. Data transmitted to MaxDetect 1-wire are made from whole and decimal part. DATE formula is as follows:

\[ \text{DATA} = 8 \text{ integer data bit RH} + 8 \text{ decimal data bits RH} + 8 \text{ data bits integer T} + 8 \text{ decimal data bits T} + 8 \text{ check-sum bit}. \]

If the data is transmitted correctly, then check-sum should be:

\[ \text{Check-sum} = 8 \text{ integer data bit RH} + 8 \text{ decimal data bits RH} + 8 \text{ integer data bits T} + 8 \text{ decimal data bits T}. \]

[Figure 2. MaxDetect 1-wire bus illustration]

Black line in Figure 2 is the signal sent by the microcontroller and the gray line represents the signal transmitted by the DHT22 sensor. If microcontroller sends the start signal, the sensor changes its standby in running. The sensor will send a signal response of 40 bits of data symbolizing relative humidity and temperature.

If the microcontroller does not send the start signal, the sensor will not send the signal response.

Temperature and humidity calculation example:
If the sensor sends the following 40 bits string:
0000 0010 0000 1001 0000 0001 0010 1100 0011 1000
- Humidity calculating
  \[\text{binar RH} = 0000 0010 0000 1001 \implies \text{decimal RH} = 521\]
  \[\text{RH} = 521/10 = 52.1\%\]
- Temperature calculation:
  \[\text{binar T} = 0000 0001 0010 1100 \implies \text{decimal T} = 300\]
  \[T = 300/10 = 30^\circ\text{C}\]
- Check-sum calculation:
  \[\text{Check-sum} = 0000 0010 + 0000 1001 + 0000 0001 + 0010 1100 = 0011 1000\]

In the figure below you can see the signal transmitted on MaxDetect 1-wire bus. Once microcontroller initializes start of transmission, the DHT22 sensor sends the 40 bit response.

![Digital Oscilloscope](image)

**Figure 3. DHT22 sensor oscilloscope simulation**

### 2.2. Real Time Clock simulation

Arduino Uno board communicates with the DS1307 through I2C. I connected an oscilloscope on two specific I2C lines communication, to see the transmitted data.

In Figure 4, it can be seen RTC simulating. The LCD displays time and date.
In Figure 5, can be observed the transmitted data on I2C specific lines communication. Signal yellow line represents the clock (SCL) and blue signal representing the data line (SDA).
Conclusion

I am used the program Proteus software to simulate the project and to evaluate the design’s feasibility and stability. Temperature and humidity simulating system was designed by PROTEUS software. The MCU ATmega16U2 was used to control the whole system. The humidity and temperature sensor DHT22 was used as the data collector. The system compare the collecting temperature and humidity data with their normal value to decide whether modifying the temperature and humidity or not.

Design and development costs for such systems could be significantly reduced if only there were efficient techniques for evaluating design alternatives and predicting their impact on overall system performance metrics.

References


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