

Field Transmitter with Bluetooth Connectivity Powered From 4-20mA Current Loop

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Abstract: *The field transmitter with Bluetooth connectivity powered from 4-20mA current loop is the automated system in order to measure the humidity and temperature and to power the Bluetooth with the help of the current being produced from the sensor. And the sensed signal such as humidity and temperature is being shown with the help of PC or Mobile phones by Bluetooth. The sensor being used is DHT11 sensor (humidity integrated with temperature sensor). This is a digital sensor. This sensor senses the signal in which the digital signal is converted into analog (4-20mA) format with the help of D to A converter and the current is being stored in the battery and then it powers the Bluetooth then the sensed values are monitored with the help of PC or mobile phones. These are programmed with the help of arduino.*

Keywords: Arduino UNO, DHT 11 sensor, Bluetooth, Humidity and temperature, PC or mobile phones.

1. Introduction

Water vapour present in the air is called as Humidity. Humidity greatly affects or exerts influence on environmental and physiological factors. Improper humidity levels such as too high or too small can cause discomfort for both people and can damage many kinds of equipment's and materials. In business and industrial environment, the performance of equipment and materials is enhanced by applying proper humidity levels. Humidity is defined as 'The amount of water vapour in a unit of air'. But in this definition it is not considered that how dry or damp the air is. It can be only done by computing the ratio of the actual partial vapour pressure to the saturated partial vapour pressure at the same temperature. Improper humidity and temperature can cause problems in various industries like textile, paper, printing, leather processing, wood products and working at places like offices, libraries and museums. Hence it is necessary to maintain proper value of humidity and temperature. Temperature alone does not have a great effect on the fibres. However the temperature dictates the amount of moisture the air will hold in suspension and, therefore, temperature and humidity must be considered together. Thus to overcome the problem of industries such as textile, paper etc., the humidity and temperature has to be monitored.

2. Block Diagram and System Description

The below shown the block diagram in which the overall concept of the system is described. In this paper the overall concept is an automated form. The Humidity and temperature of a room is monitored and displayed in a Monitored PC or mobile phones. The sensor (DHT11) known as the humidity integrated with temperature sensor and the DAC is powered with the help of Arduino UNO. The humidity and temperature is sensed with the help of digital sensor. The digitally sensed value is converted into analog form where it provides current of about 4-20mA. This current is used to power the Bluetooth where the

digitally obtained signal is then sent with the help of Bluetooth to the monitored devices such as PC or mobile phones.

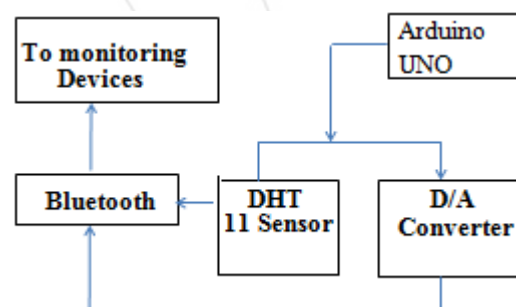


Figure 1: Block diagram

The above shown block diagram is explained clearly. As nowadays analog sensors are not used mostly because when analog sensors are used then the circuit has to be built in order to obtain in digital format or else a calibration has to be made to obtain the digital form which makes cost effective and also accuracy of the values cannot be obtained. This leads to improper measuring of signals. In order to overcome these problems digital sensor DHT 11 sensor is used to measure humidity as well as temperature. Arduino UNO is used to program the whole circuit to obtain the measured signal and to convert it into digital form and to send to the monitoring devices. This overall block diagram used to measure and to monitor the signals.

3. Hardware Description

The hardware used in this project is DHT 11 sensor, Arduino UNO, D to A converter.

A. DHT 11Sensor (Humidity integrated with temperature sensor):



Figure 2: DHT 11 sensor

This DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones.

Table 1: Specifications

| Item | Measurement Range | Humidity accuracy | Temp accuracy |
|--------|---------------------|-------------------|---------------|
| DHT 11 | 20-90% RH 0-50°C | +/-5% RH | +/-2°C |

When the connecting cable is shorter than 20 metres, a 5K pull-up resistor is recommended; when the connecting cable is longer than 20 metres, choose an appropriate pull-up resistor as needed. DHT11's power supply is 3-5.5V DC.

B. Arduino UNO:

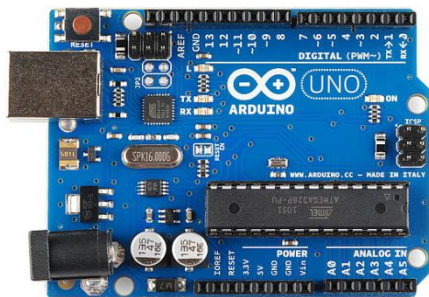


Figure 3: Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The power pins are as follows:

- VIN. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source).
- 5V. The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.
- 3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- GND. Ground pins.

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). The Arduino Uno is designed in a way that allows it to be reset by software running on a connected computer. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). The maximum length and width of the Uno PCB are 2.7 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Three screw holes allow the board to be attached to a surface or case.

C. D to A Converter:

The D to A Converter is used to convert the digital signal obtained from the sensor into analog signal as 4-20mA. The D to A converter used here is DAC 0808LCN from Texas instruments.

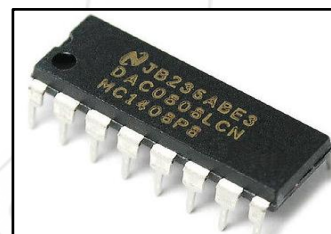


Figure 3: DAC 0808LCN

The DAC0808 is an 8-bit monolithic digital-to-analog converter (DAC) featuring a full scale output current settling time of 150 ns while dissipating only 33 mW with ±5V supplies. The power supply currents of the DAC0808 are independent of bit codes, and exhibits essentially constant device characteristics over the entire supply voltage range. The DAC0808 will interface directly with popular TTL, DTL or CMOS logic levels, and is a direct replacement for the MC1508/MC1408.

Features: Relative accuracy: ±0.19% error maximum, Full scale current match: ±1 LSB type, Fast settling time: 150 ns type, Noninverting digital inputs are TTL and CMOS compatible, High speed multiplying input slew rate: 8 mA/μs, Power supply voltage range: ±4.5V to ±18V, Low power consumption: 33 mW / ±5V.

4. Implementation

A. Connection of the circuit

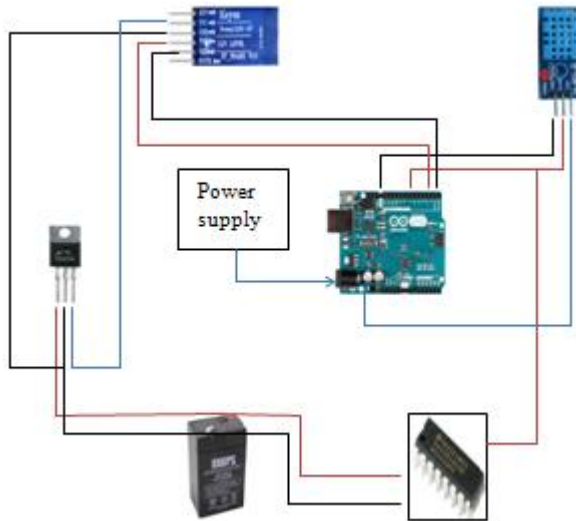


Figure 4: Overall Connection

The above shown is the overall connection of the circuit. The arduino UNO gnd pin is connected to the DHT 11 gnd. The 7th pin of the Arduino is used to obtain the data which is connected to the 2nd pin of the sensor. The sensor is powered with the help of 5V DC in Arduino board. The D to A converter is connected to the sensor and the battery in order to obtain the digital signals from the sensor and the signals are converted into 4-20 mA current which is stored in the battery converted into voltag and it is being connected to the bluetooth where it will power the bluetooth. And the digital signals are then being transmitted to the monitoring devices such as mobile phones or PC.

B. Software implementation



Figure 5: Screenshot of the program

The screenshot of the program is shown where the arduino program is similar to that of the C program. The program explains about that the measuring and transmitting of the signals to the bluetooth. The program also shows the connection between the arduino and the sensor. Thus C program to be the easily understandable language this language is used.

PROGRAM

```
#include "DHT.h"
// Pin for the DHT sensor
#define DHTPIN 7 //define DHTTYPE DHT22// #define
DHTTYPE DHT11
// Create instance for the DHT sensor
DHT dht(DHTPIN, DHTTYPE);
// Setup
void setup(void)
{
dht.begin();
Serial.begin(115200);
}
void loop(void)
{
// Get command
if (Serial.available()) {
// Read command
byte c = Serial.read ();
// If a measurement is requested, measure data and send it
back
if (c == 'm'){
int h = (int)dht.readHumidity();
int t = (int)dht.readTemperature();
#include "DHT.h"
// Pin for the DHT sensor
#define DHTPIN 7
#define DHTTYPE DHT22
// #define DHTTYPE DHT11
// Create instance for the DHT sensor
DHT dht(DHTPIN, DHTTYPE);
// Setup
void setup(void)
{
dht.begin(); Serial.begin(115200);
}
void loop(void)
{
// Get command
if (Serial.available()) {
// Read command
byte c = Serial.read ();
// If a measurement is requested, measure data and send it
back
if (c == 'm'){
int h = (int)dht.readHumidity();
int t = (int)dht.readTemperature();
// Send data (temperature,humidity)
Serial.println(String(t) + "," + String(h));
}
}
}
}
```

C. Result

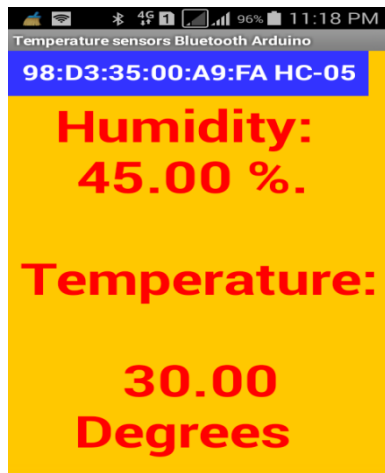


Figure 6: Overall output

The overall output for the above shown figure is obtained. By using the program we can measure the humidity and temperature signals of a room and send it to monitoring devices such as PC or mobile phones. For the current room temperature is acquired as 30⁰C and the humidity acquired as 45%. This humidity level is between 0-100 % which is considered as 4-20 mA. Where 4mA is considered as 0% and 20 mA is considered as full scale 100%. Thus, by saving the current in the battery it is used to power the Bluetooth by which the Bluetooth is activated and it is monitored.

5. Conclusion

This system is useful in small scale industries as it is cheap. Arduino can also be replaced with devices such as probe zigbee, IOT etc., and therefore it is easily importable. Thus this proposed system will be cheap, flexible and more secure. This system is applicable industries like textile, sugar, leather, food, pharmaceutical, paper and other various process industries.

References

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