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| |  | | --- | | Assignment: 11 | | Title: Write a program read the temperature sensor and send the values to the serial  monitor on the computer | | Objective: Understanding working principle of DHT11, LM35 temperature sensor,  Relationship between different temperature scales. | | Hardware: Arduino, LED, LM35, DHT11, etc | | Software: Arduino IDE | | **Apparatus:** Arduino Uno board, Micro-IoT sensor actuator board, Power adaptor. **Interface:**   |  |  | | --- | --- | | **Peripheral** | **Arduino Pin** | | DHT11 | A1 | | | **Procedure:**  **Step 1:** Connect the Arduino board to the Micro-IoT Sensor board using the FRC cable provided with the board.  **Step 2:** Connect the Power supply adaptor and power on the circuit. **Step 3:** Open Arduino IDE and create a new sketch (program) using the above pins. **Step 4:** In the Arduino IDE go to tools🡪Port and select the appropriate COM port.  **Step 5:** In the Arduino IDE click on the upload button ( ) to compile and download the code into the Arduino UNO. When successfully downloaded the code will start running.  **Step 6:** Open the Serial Monitor in Arduino IDE Tools🡪Serial Monitor and observe the values of the temperature sensor. | | Theory:  LM35 Temperature Sensor    LM35 Temperature Sensor Pinout  LM35 Sensor Pinout Configuration   |  |  |  | | --- | --- | --- | | Pin  Number | Pin Name | Description | | 1 | Vcc | Input voltage is +5v for typical application | | 2 | Analog  Out | There will be increase in 10mV for raise of every 1°C. Can range from -1V(-55°C) to 6V(150°C) | | 3 | Ground | Connected to ground of circuit |   LM35 Sensor Features  ● Minimum and Maximum Input Voltage is 35V and -2V respectively. Typically 5V.  ● Can measure temperature ranging from -55°C to 150°C  ● Output voltage is directly proportional (Linear) to temperature (i.e.) there will be a rise of  10mV (0.01V) for every 1°C rise in temperature.  ● ±0.5°C Accuracy  ● Drain current is less than 60uA  ● Low cost temperature sensor  ● Small and hence suitable for remote applications  ● Available in TO-92, TO-220, TO-CAN and SOIC package  LM35 Temperature Sensor Equivalent  LM34, DS18B20, DS1620, LM94022  How to use LM35 Temperature Sensor:  LM35 is a precession Integrated circuit Temperature sensor, whose output voltage varies, based on the  temperature around it. It is a small and cheap IC which can be used to measure temperature anywhere  between -55°C to 150°C. It can easily be interfaced with any Microcontroller that has ADC function or any  development platform like Arduino.  Power the IC by applying a regulated voltage like +5V (VS) to the input pin and connected the ground pin  to the ground of the circuit. Now, you can measure the temperature in form of voltage as shown below.    If the temperature is 0°C, then the output voltage will also be 0V. There will be rise of 0.01V (10mV) for  every degree Celsius rise in temperature. The voltage can converted into temperature using the below  formulae.    ● LM35 Temperature Sensor Applications  ● Measuring temperature of a particular environment  ● Providing thermal shutdown for a circuit/component  ● Monitoring Battery Temperature  ● Measuring Temperatures for HVAC applications.  ● How Does LM35 Sensor Work?  Main advantage of LM35 is that it is linear i.e. 10mv/°C which means for every degree rise in temperature  the output of LM35 will rise by 10mv. So if the output of LM35 is 220mv/0.22V the temperature will be  22°C. So if room temperature is 32°C then the output of LM35 will be 320mv i.e. 0.32V.  ● LM35 Interfacing Circuit    As such no extra components required to interface LM35 to ADC as the output of LM35 is linear with  10mv/degree scale. It can be directly interfaced to any 10 or 12 bit ADC. But if you are using an 8-bit ADC  like ADC0808 or ADC0804 an amplifier section will be needed if you require to measure 1°C change.  LM35 can also be directly connected to Arduino. The output of LM35 temperature can also be given to  comparator circuit and can be used for over temperature indication or by using a simple relay can be used  as a temperature controller.  ● DHT11 interfacing with arduino and weather station  DHT11 sensor is used to measure the temperature and humidity. It has a resistive humidity sensing  component and a negative temperature coefficient (NTC). An 8 bit MCU is also connected in it which is  responsible for its fast response. It is very inexpensive but it gives values of both temperature and  humidity at a time.  ● Specification of DHT11  ● It has humidity range from 20 to 90% RH  ● It has temperature range from 0 – 50 C  ● It has signal transmission range of 20 m  ● It is inexpensive  ● It has fast response and it is also durable  ● DHT11 Pin out    ● The first pin of the DHT11 is vcc pin.  ● The second pin of the DHT is Data pin.  ● The third pin is not used.  ● The fourth pin of the DHT sensor is ground.  ● DHT11 interfacing with arduino  First of all connect the ground and the VCC of the DHT11 temperature and humidity sensor to the ground  and 5v of the Arduino. Then connect the data pin of the DHT11 sensor to the pin 2 of the Arduino.    ● Installing the DHT11 Library  To run the following code in Arduino IDE you will first have to install the DHT library in you Arduino  directory.  Download the zip file from here and place it in your Arduino library folder. The path to Arduino library  folder for my computer is  Documents/ Arduino/ Libraries  Unzip the downloaded file and place it in this folder.  After copying the files, the Arduino library folder should have a new folder named DHT containing the  dht.h and dht.cpp. After that copy the following code in the Arduino IDE and upload the code.  ● Code of DHT11 interfacing with arduino  // Code for DHT11 Temperature and humidity sensor.  #include " DHT.h " // including the library of DHT11 temperature and  humidity sensor  #define DHTPIN 2 // Selecting the pin at which we have connected  DHT11  #define DHTTYPE DHT11 // Selecting the type of DHT sensors  DHT dht ( DHTPIN, DHTTYPE ) ;  void setup ( ) {  Serial.begin ( 9600 ) ;  dht.begin ( ) ; // The sensor will start working  }  void loop ( ) {  // Reading temperature or humidity may take about 2 seconds because it  is a very slow sensor.  float humidity = dht.readHumidity ( ) ; // Declaring h a variable and  storing the humidity in it.  float temp = dht.readTemperature ( ) ; // Declaring t a variable and  storing the temperature in it.  // Checking if the output is correct. If these are NaN, then there is  something in it.  if ( isnan ( t ) || isnan ( h ) ) {  Serial.println ( " Sensor not working " ) ;  }  else  {  Serial.print ( " Temp is " ) ;  Serial.print ( temp ) ; // Printing the temperature on  display.  Serial.println ( " \*C " ) ; // Printing “ \*C ” on display.  Serial.print ( " Humidity in % is : " ) ;  Serial.print ( humidity ) ; // Printing the humidity on display  Serial.print ( " % \t " ) ; // Printing “%” on display  }  }  ● Weather Station using DHT11 and arduino  In this example we will make a weather station that will sense the humidity and temperature and will  show it on the lcd attached to the Arduino. Make the circuit as shown in the diagram. The resistor in the  circuit will make the black light darker. We have used the 220 ohm resistor but you can use any resistor  having value near to that. The potentiometer we used in the circuit is used to set the screen contrast. We  have used the 10 K ohm value but you can choose any value relative to that one.    ● Components Required  ● Arduino Uno (you can use any)  ● 16 x 2 LCD  ● DHT11 Temperature and humidity sensor  ● 10 K ohm potentiometer  ● 220 ohm resistor  ● Code of weather station using arduino and DHT11  // This code is for the weather station using the DHT11 humidity and temperature  sensor.  // Install the library of the DHT before uploading the code in the Arduino IDE  #include < dht.h > // including the DHT library  #include < LiquidCrystal.h > // including the LCD library  LiquidCrystal lcd ( 12, 11, 5, 4, 3, 2 ) ; // initializing the lcd pins  dht DHT ; // declaring dht a variable  #define DHT11\_PIN 8 // initializing pin 8 for dht  void setup ( ) {  lcd.begin ( 16, 2 ) ; // starting the 16 x 2 lcd  }  void loop ( )  {  int chk = DHT.read11(DHT11\_PIN ) ; // Checking that either the dht is  working or not  lcd.setCursor ( 0, 0 ) ; // starting the cursor from top left  lcd.print ( " Temperature is : " ) ; // printing the “ Temperature is : ” on  the lcd  lcd.print ( DHT.temperature ) ; // printing the temperature on the lcd  lcd.print ( ( char ) 223 ) ;  lcd.print ( " C " ) ; // Printing “ C “ on the display  lcd.setCursor ( 0 , 1 );  lcd.print ( " Humidity is : " ) ; // printing “ humidity is : ” on the  display  lcd.print ( DHT.humidity ) ; // printing humidity on the display  lcd.print ( " % " ) ; // printing “ % ” on display  delay ( 1000 ) ; // Giving delay of 1 second.  }  Temperature Scales  Thermometers measure temperature according to well-defined scales of measurement. The three most  common temperature scales are the Fahrenheit, Celsius, and Kelvin scales.  ● Celsius Scale & Fahrenheit Scale  The Celsius scale has a freezing point of water as 0ºC and the boiling point of water as 100ºC. On the  Fahrenheit scale, the freezing point of water is at 32ºF and the boiling point is at 212ºF. The temperature  difference of one degree Celsius is greater than a temperature difference of one degree Fahrenheit. One  degree on the Celsius scale is 1.8 times larger than one degree on the Fahrenheit scale 180/100=9/5.  ● Kelvin Scale  Kelvin scale is the most commonly used temperature scale in science. It is an absolute temperature scale  defined to have 0 K at the lowest possible temperature, called absolute zero. The freezing and boiling  points of water on this scale are 273.15 K and 373.15 K, respectively. Unlike other temperature scales, the  Kelvin scale is an absolute scale. It is extensively used in scientific work. The Kelvin temperature scale  possesses a true zero with no negative temperatures. It is the lowest temperature theoretically achievable  and is the temperature at which the particles in a perfect crystal would become motionless.  ● Relationship Between Different Temperature Scales  The relationship between three temperature scales is given in the table below:  Relationship between different Temperature Scales | | **Observation:**  The DHT11 sensor is a digital sensor which measures the temperature and humidity. We can read the temperature and humidity using arduino and show the temperature in Celsius or Fahrenheit.  **You can run the program and observe the output values in Fahrenheit on the Serial Monitor.** | | **Code:**  #include <dht.h>  dht DHT;  #define DHT11\_PIN A1  float min\_t,max\_t;  void setup()  {  Serial.begin(9600);  Serial.println("Humidity (%),\tTemperature (F)"); min\_t = 0xffff;  max\_t=0x00;  }  void loop()  {  // READ DATA  int chk = DHT.read11(DHT11\_PIN);  // DISPLAY DATA  Serial.print(DHT.humidity, 1);  Serial.print("\t");  Serial.println((DHT.temperature\*1.8)+32, 1);    delay(1000);  } | | Title: Executed a program read the temperature sensor and send the values to the serial  monitor on the computer | |