**Reading the temperature and humidity data from the HW220 (HTU21D) sensor and displaying the readings over serial port**

**Objective:**

Read temperature and humidity data from the HW220 (HTU21D) sensor and display the readings over serial port.

**HTU21D sensor:**

The HTU21D is a high-precision digital sensor designed to measure humidity and temperature, featuring an I2C interface for easy integration with microcontrollers. Manufactured by TE Connectivity, this compact sensor offers excellent accuracy making it suitable for a wide range of applications such as weather stations, HVAC systems, environmental monitoring, and industrial automation. With low power consumption and pre-calibrated accuracy, the HTU21D is a reliable choice for projects requiring precise environmental data in a compact form factor, compatible with popular development platforms and supported by available libraries and documentation for seamless integration.

**Measurement Range:**

* Humidity: 0% to 100% RH (Relative Humidity).
* Temperature: -40°C to 125°C.

**Resolution:**

* Humidity: 0.04% RH.
* Temperature: 0.01°C.

**Accuracy:**

* Humidity: ±2% RH.
* Temperature: ±0.3°C.

**Operating voltage:**

3.3v

**HARDWARE** **SETUP:**

**Components** **Used:**

* STM32 Nucleo STM32F410 development board
* HTU21D digital humidity and temperature sensor
* Jumper wires

**Hardware** **Connections:**

The HTU21D sensor was connected to the STM32 Nucleo board as follows:

VCC: The VCC pin of the HTU21D sensor was connected to a 3.3V power supply on the board.

GND: The GND pin of the HTU21D sensor was connected to the ground (GND) on the board.

SDA: The SDA (data) pin of the HTU21D sensor was connected to the I2C data pin on the board.

SCL: The SCL (clock) pin of the HTU21D sensor was connected to the I2C clock pin on the board.

**Software Development:**

**STM32CubeIDE:**

STMicroelectronics' STM32CubeIDE is an integrated development environment (IDE) that serves as a comprehensive software platform for developing embedded applications for STM32 microcontrollers. It offers a user-friendly and feature-rich environment for code development, debugging, and system analysis. STM32CubeIDE combines the STM32CubeMX initialization code generator and a powerful Eclipse-based IDE, making it easier for developers to configure, optimize, and write code for STM32 microcontrollers. With its wide range of tools and features, STM32CubeIDE streamlines the development process, making it a valuable resource for engineers working on embedded systems and IoT applications.

**Code Implementation:**

The code was developed to read data from the HTU21D sensor using the I2C interface. Additionally, a UART was configured to communicate with Tera Term for displaying the data. The code is as follows,

**Code:**

/\* USER CODE BEGIN Header \*/

/\*\*

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\* @file : main.c

\* @brief : Main program body

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\* @attention

\*

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\*/

/\* USER CODE END Header \*/

/\* Includes ------------------------------------------------------------------\*/

**#include** "main.h"

/\* Private includes ----------------------------------------------------------\*/

/\* USER CODE BEGIN Includes \*/

**#include** <stdio.h>

**#include** <stdlib.h>

**#include** <string.h>

/\* USER CODE END Includes \*/

/\* Private typedef -----------------------------------------------------------\*/

/\* USER CODE BEGIN PTD \*/

/\* USER CODE END PTD \*/

/\* Private define ------------------------------------------------------------\*/

/\* USER CODE BEGIN PD \*/

/\* USER CODE END PD \*/

/\* Private macro -------------------------------------------------------------\*/

/\* USER CODE BEGIN PM \*/

/\* USER CODE END PM \*/

/\* Private variables ---------------------------------------------------------\*/

I2C\_HandleTypeDef hi2c1;

UART\_HandleTypeDef huart2;

/\* USER CODE BEGIN PV \*/

//volatile char str[20] = "";

/\* USER CODE END PV \*/

/\* Private function prototypes -----------------------------------------------\*/

**void** **SystemClock\_Config**(**void**);

**static** **void** **MX\_GPIO\_Init**(**void**);

**static** **void** **MX\_USART2\_UART\_Init**(**void**);

**static** **void** **MX\_I2C1\_Init**(**void**);

/\* USER CODE BEGIN PFP \*/

**void** **print**(**float** temp, **float** hum);

/\* USER CODE END PFP \*/

/\* Private user code ---------------------------------------------------------\*/

/\* USER CODE BEGIN 0 \*/

/\* USER CODE END 0 \*/

/\*\*

\* @brief The application entry point.

\* @retval int

\*/

**int** **main**(**void**) {

/\* USER CODE BEGIN 1 \*/

/\* USER CODE END 1 \*/

/\* MCU Configuration--------------------------------------------------------\*/

/\* Reset of all peripherals, Initializes the Flash interface and the Systick. \*/

HAL\_Init();

/\* USER CODE BEGIN Init \*/

/\* USER CODE END Init \*/

/\* Configure the system clock \*/

SystemClock\_Config();

/\* USER CODE BEGIN SysInit \*/

/\* USER CODE END SysInit \*/

/\* Initialize all configured peripherals \*/

MX\_GPIO\_Init();

MX\_USART2\_UART\_Init();

MX\_I2C1\_Init();

/\* USER CODE BEGIN 2 \*/

**unsigned** **char** command;

uint8\_t data[2] = { 0 }, flag = 1;

uint16\_t val;

**float** temp, hum;

/\* USER CODE END 2 \*/

/\* Infinite loop \*/

/\* USER CODE BEGIN WHILE \*/

**while** (1) {

/\* USER CODE END WHILE \*/

/\* USER CODE BEGIN 3 \*/

**if** (flag) {

command = 0xE3;

HAL\_I2C\_Master\_Transmit(&hi2c1, 64 << 1, &command, 1, 1000);

HAL\_I2C\_Master\_Receive(&hi2c1, 64 << 1, &data, 2, 1000);

val = ((data[0] << 8) | data[1]);

temp = -46.85 + 175.72 \* val / 65536;

flag = 0;

}

**if** (!flag) {

command = 0xE5;

HAL\_I2C\_Master\_Transmit(&hi2c1, 64 << 1, &command, 1, 1000);

HAL\_I2C\_Master\_Receive(&hi2c1, 64 << 1, &data, 2, 1000);

val = ((data[0] << 8) | data[1]);

hum = -6 + ((125 \* val) / 65536);

flag = 1;

}

print(temp, hum);

}

/\* USER CODE END 3 \*/

}

/\*\*

\* @brief System Clock Configuration

\* @retval None

\*/

**void** **SystemClock\_Config**(**void**) {

RCC\_OscInitTypeDef RCC\_OscInitStruct = { 0 };

RCC\_ClkInitTypeDef RCC\_ClkInitStruct = { 0 };

/\*\* Configure the main internal regulator output voltage

\*/

\_\_HAL\_RCC\_PWR\_CLK\_ENABLE();

\_\_HAL\_PWR\_VOLTAGESCALING\_CONFIG(PWR\_REGULATOR\_VOLTAGE\_SCALE2);

/\*\* Initializes the RCC Oscillators according to the specified parameters

\* in the RCC\_OscInitTypeDef structure.

\*/

RCC\_OscInitStruct.OscillatorType = RCC\_OSCILLATORTYPE\_HSI;

RCC\_OscInitStruct.HSIState = RCC\_HSI\_ON;

RCC\_OscInitStruct.HSICalibrationValue = RCC\_HSICALIBRATION\_DEFAULT;

RCC\_OscInitStruct.PLL.PLLState = RCC\_PLL\_ON;

RCC\_OscInitStruct.PLL.PLLSource = RCC\_PLLSOURCE\_HSI;

RCC\_OscInitStruct.PLL.PLLM = 16;

RCC\_OscInitStruct.PLL.PLLN = 336;

RCC\_OscInitStruct.PLL.PLLP = RCC\_PLLP\_DIV4;

RCC\_OscInitStruct.PLL.PLLQ = 7;

**if** (HAL\_RCC\_OscConfig(&RCC\_OscInitStruct) != *HAL\_OK*) {

Error\_Handler();

}

/\*\* Initializes the CPU, AHB and APB buses clocks

\*/

RCC\_ClkInitStruct.ClockType = RCC\_CLOCKTYPE\_HCLK | RCC\_CLOCKTYPE\_SYSCLK

| RCC\_CLOCKTYPE\_PCLK1 | RCC\_CLOCKTYPE\_PCLK2;

RCC\_ClkInitStruct.SYSCLKSource = RCC\_SYSCLKSOURCE\_PLLCLK;

RCC\_ClkInitStruct.AHBCLKDivider = RCC\_SYSCLK\_DIV1;

RCC\_ClkInitStruct.APB1CLKDivider = RCC\_HCLK\_DIV2;

RCC\_ClkInitStruct.APB2CLKDivider = RCC\_HCLK\_DIV1;

**if** (HAL\_RCC\_ClockConfig(&RCC\_ClkInitStruct, FLASH\_LATENCY\_2) != *HAL\_OK*) {

Error\_Handler();

}

}

/\*\*

\* @brief I2C1 Initialization Function

\* @param None

\* @retval None

\*/

**static** **void** **MX\_I2C1\_Init**(**void**) {

/\* USER CODE BEGIN I2C1\_Init 0 \*/

/\* USER CODE END I2C1\_Init 0 \*/

/\* USER CODE BEGIN I2C1\_Init 1 \*/

/\* USER CODE END I2C1\_Init 1 \*/

hi2c1.Instance = I2C1;

hi2c1.Init.ClockSpeed = 100000;

hi2c1.Init.DutyCycle = I2C\_DUTYCYCLE\_2;

hi2c1.Init.OwnAddress1 = 0;

hi2c1.Init.AddressingMode = I2C\_ADDRESSINGMODE\_7BIT;

hi2c1.Init.DualAddressMode = I2C\_DUALADDRESS\_DISABLE;

hi2c1.Init.OwnAddress2 = 0;

hi2c1.Init.GeneralCallMode = I2C\_GENERALCALL\_DISABLE;

hi2c1.Init.NoStretchMode = I2C\_NOSTRETCH\_DISABLE;

**if** (HAL\_I2C\_Init(&hi2c1) != *HAL\_OK*) {

Error\_Handler();

}

/\* USER CODE BEGIN I2C1\_Init 2 \*/

/\* USER CODE END I2C1\_Init 2 \*/

}

/\*\*

\* @brief USART2 Initialization Function

\* @param None

\* @retval None

\*/

**static** **void** **MX\_USART2\_UART\_Init**(**void**) {

/\* USER CODE BEGIN USART2\_Init 0 \*/

/\* USER CODE END USART2\_Init 0 \*/

/\* USER CODE BEGIN USART2\_Init 1 \*/

/\* USER CODE END USART2\_Init 1 \*/

huart2.Instance = USART2;

huart2.Init.BaudRate = 115200;

huart2.Init.WordLength = UART\_WORDLENGTH\_8B;

huart2.Init.StopBits = UART\_STOPBITS\_1;

huart2.Init.Parity = UART\_PARITY\_NONE;

huart2.Init.Mode = UART\_MODE\_TX\_RX;

huart2.Init.HwFlowCtl = UART\_HWCONTROL\_NONE;

huart2.Init.OverSampling = UART\_OVERSAMPLING\_16;

**if** (HAL\_UART\_Init(&huart2) != *HAL\_OK*) {

Error\_Handler();

}

/\* USER CODE BEGIN USART2\_Init 2 \*/

/\* USER CODE END USART2\_Init 2 \*/

}

/\*\*

\* @brief GPIO Initialization Function

\* @param None

\* @retval None

\*/

**static** **void** **MX\_GPIO\_Init**(**void**) {

GPIO\_InitTypeDef GPIO\_InitStruct = { 0 };

/\* USER CODE BEGIN MX\_GPIO\_Init\_1 \*/

/\* USER CODE END MX\_GPIO\_Init\_1 \*/

/\* GPIO Ports Clock Enable \*/

\_\_HAL\_RCC\_GPIOC\_CLK\_ENABLE();

\_\_HAL\_RCC\_GPIOH\_CLK\_ENABLE();

\_\_HAL\_RCC\_GPIOA\_CLK\_ENABLE();

\_\_HAL\_RCC\_GPIOB\_CLK\_ENABLE();

/\*Configure GPIO pin Output Level \*/

HAL\_GPIO\_WritePin(LD2\_GPIO\_Port, LD2\_Pin, *GPIO\_PIN\_RESET*);

/\*Configure GPIO pin : B1\_Pin \*/

GPIO\_InitStruct.Pin = B1\_Pin;

GPIO\_InitStruct.Mode = GPIO\_MODE\_IT\_FALLING;

GPIO\_InitStruct.Pull = GPIO\_NOPULL;

HAL\_GPIO\_Init(B1\_GPIO\_Port, &GPIO\_InitStruct);

/\*Configure GPIO pin : LD2\_Pin \*/

GPIO\_InitStruct.Pin = LD2\_Pin;

GPIO\_InitStruct.Mode = GPIO\_MODE\_OUTPUT\_PP;

GPIO\_InitStruct.Pull = GPIO\_NOPULL;

GPIO\_InitStruct.Speed = GPIO\_SPEED\_FREQ\_LOW;

HAL\_GPIO\_Init(LD2\_GPIO\_Port, &GPIO\_InitStruct);

/\* USER CODE BEGIN MX\_GPIO\_Init\_2 \*/

/\* USER CODE END MX\_GPIO\_Init\_2 \*/

}

/\* USER CODE BEGIN 4 \*/

**void** **print**(**float** temp, **float** hum) {

**char** str[60] = "";

**memset**(str, 0, **strlen**(str));

**sprintf**(str, "temperature is %.2f and humidity is %.2f\n", temp, hum);

HAL\_UART\_Transmit(&huart2,str, **strlen**(str), 1000);

}

/\* USER CODE END 4 \*/

/\*\*

\* @brief This function is executed in case of error occurrence.

\* @retval None

\*/

**void** **Error\_Handler**(**void**) {

/\* USER CODE BEGIN Error\_Handler\_Debug \*/

/\* User can add his own implementation to report the HAL error return state \*/

\_\_disable\_irq();

**while** (1) {

}

/\* USER CODE END Error\_Handler\_Debug \*/

}

**#ifdef** USE\_FULL\_ASSERT

/\*\*

\* @brief Reports the name of the source file and the source line number

\* where the assert\_param error has occurred.

\* @param file: pointer to the source file name

\* @param line: assert\_param error line source number

\* @retval None

\*/

**void** assert\_failed(uint8\_t \*file, uint32\_t line)

{

/\* USER CODE BEGIN 6 \*/

/\* User can add his own implementation to report the file name and line number,

ex: printf("Wrong parameters value: file %s on line %d\r\n", file, line) \*/

/\* USER CODE END 6 \*/

}

**#endif** /\* USE\_FULL\_ASSERT \*/

**TERA TERM CONFIGURATION:**

Tera Term was opened on computer. A connection was established to the COM port to which the STM32 Nucleo board was connected. Baud rate, receive type and flow control settings were configured to match the UART settings.

**OBSERVATION:**

After transferring the code to the STM32 Nucleo board, the real-time temperature and humidity data were read by the HTU21D sensor and displayed in Tera Term over the UART connection.

**CONCLUSION:**

The data displayed on the Tera Term was almost accurate to the readings of the temperature and humidity monitoring device as the interfacing of the sensor and STM32 board was successful.