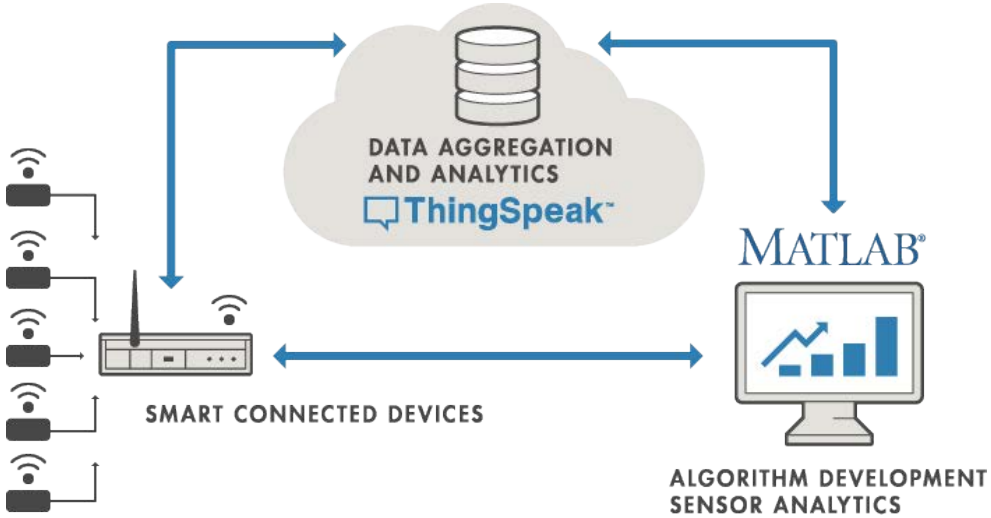
Experiment 04

Temperature Measurement

In this experiment, we will measure the temperature parameters of the environment. The microcontroller will transmit data to be visualized and manipulated in an IoT web service.

Background

ThingSpeak is an open-source Internet of Things (IoT) platform and web service provided by MathWorks, the company behind MATLAB. It allows you to collect, analyze, and visualize data from IoT devices and sensors. ThingSpeak provides a user-friendly interface for users to create and manage channels where data can be stored and analyzed.



ThinSpeak offers a comprehensive set of features, including data collection, channel creation, and custom field definitions. Users can leverage real-time data capabilities, historical data storage, and a user-friendly interface for data visualization. ThingSpeak's built-in MATLAB analytics enable basic data analysis, and its support for device integration makes it ideal for a variety of IoT projects. In addition to its technical capabilities, ThingSpeak promotes collaboration and knowledge sharing by enabling data sharing, alerts, and API access. It serves as a valuable tool for educational purposes, aiding in the teaching of IoT concepts and data analysis. Users can explore applications across domains, from weather and environmental monitoring to home and industrial automation. ThingSpeak's versatility and accessibility make it a popular choice for prototyping and experimenting with IoT solutions before real-world deployment, offering a dynamic platform for innovation and exploration.

Experiment Set-up: Configuration

The **BMP280** sensor is a digital barometric pressure and temperature sensor known for its precision and versatility. It accurately measures atmospheric pressure and temperature, making it suitable for diverse applications, including weather monitoring, altitude estimation, and indoor climate control. It communicates with microcontrollers through digital interfaces, such as I2C and SPI, ensuring seamless integration into various projects.

The sensor's compact size and low power consumption make it a practical choice for portable and battery-powered devices. It can estimate altitude changes based on pressure measurements, serving applications like GPS altitude correction and weather forecasting. Additionally, the BMP280 is commonly found in data logging systems, mobile devices, wearable technology, and HVAC solutions, offering valuable data for a wide array of industries and projects.

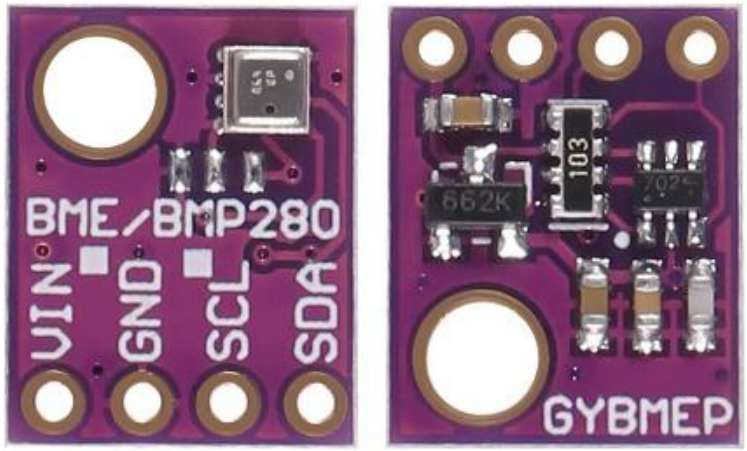


Fig1: The BMP280 sensor works by measuring the tiny changes in resistance of its piezoresistive pressure sensor and bandgap voltage of its temperature sensor. These measurements are then converted into digital values and compensated for temperature effects to provide accurate pressure and temperature readings.

Instructions

1. Log in to your account on ThingSpeak.com.
2. Create a new channel. Add a name to identify it with the project.
    a. Add two fields, one for writing temperature in celsius and the other one for fahrenheit.
3. Obtain your API Writing key and channel ID number
4. Open the "temperature.ino" file from the course materials
5. Install the libraries ThingSpeak (by MathWorks) and WiFi (Arduino Uno WiFi Dev Ed Library by Arduino). Go to Tools→Manage Libraries→ and use the search engine
6. Install the library for the weather sensor (Adafruit_BME280). Go to Tools→Manage Libraries→ and use the search engine
7. In the code, change your SSID and password, and add the API **writing** key and channel ID number noted in step 2
8. Flash the program and see what happens in the Serial Monitor and in your channel in the ThingSpeak website
9. In ThingSpeak, add a chart and a gauge widget for both measures (celcius and farenheit).
10. In the ThingSpeak website, play with the MATLAB Analysis and MATLAB Visualization options located in right top corner.
    a. In MATLAB Analysis use the example "Calculate high and low temperatures."
        i. Create the code and try to understand it. Make sure to change the temperature ID field to 1 in the case of monitoring celsius and 2 for monitoring fahrenheit. Also, add your channel ID and API **reading** key.
        ii. Save the code and run it
    b. In MATLAB Visualizations use a histogram to understand variation of temperature

☞ Deliverables

Demonstration:

1. Record a video demonstration explaining the outcome of the experiment. Refer to the title page for a brief description of the expected outcome. Make sure you talk over all observations and **the video is presentable.** Also, don't forget to show the data updating in real time on the serial monitor and in your ThingSpeak channel.
2. In the recording, show and explain the charts and gauge widgets. Also, show and explain what you did with the MATLAB Analysis and Visualizations options.
3. Address the following items in your recording or add it as text in the submission:
    a. Why do you think data visualization and analysis capabilities is important in IoT?
    b. How do you think this integration can leverage Artificial Intelligence and Machine learning applications in IoT?

References and Further Reading

[1] https://thingspeak.com/pages/learn_more
[2] https://adafruit.github.io/Adafruit_BME280_Library/html/index.html
[3] https://www.mathworks.com/help/thingspeak/examples.html