ECC591 - PROJECT 1 (A)

IoT Room Conditions Monitoring Device

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Outline

- ❏ Overview
- ❏ Methodology
- ❏ Implementation
- ❏ Results
- ❏ Future Scope
- ❏ References

Overview

- IoT is a network of embedded systems with sensors which share, collect and visualize real time data.
- To monitor Temperature in Celsius, Pressure in hPa, and Humidity in % and visualize the data for further analysis.
- Collect data on ThingSpeak IoT Channel and download it in CSV or other format
- Achieved via embedding Microcontroller and sensors with a WiFi Module
- Helps with Wet Bulb calculations.

Literature Review

- Weather station study used DHT11, BMP180, Arduino Uno, and ThingSpeak for real-time weather monitoring.
- Environmental monitoring system study employed DHT11, BMP180, NodeMCU, and ThingSpeak to optimize classroom conditions.
- Air quality monitoring study utilized DHT11, BMP180, Arduino Uno, and ThingSpeak for real-time indoor air quality insights.
- Combined use of sensors, microcontrollers, and ThingSpeak offers cost-effective solutions for data collection and visualization.

Literature Review

- We learned from our research that we can make our project more cost-effective by using only one NodeMCU ESP8266, simplifying things with String usage.
- Additionally, we found that the DHT11 and BMP180 are both affordable and reliable, making them solid choices for our project.
- ThingSpeak emerged as the most suitable option, showcasing advantages over other applications in terms of user-friendliness, data visualization capabilities, and overall compatibility with our monitoring system.

Key Components

- **Sensors (DHT11, BMP180):** Affordable and easy in IoT; DHT11 measures humidity and temperature, BMP180 offers precise pressure and temperature.

- **Microcontrollers (Arduino Uno, NodeMCU):** Popular and versatile; Uno is user-friendly, NodeMCU provides Wi-Fi and low power.

- **ThingSpeak Platform:** Open-source, data collection; enables remote monitoring and trend analysis.

Key Components

Hardware

- Arduino UNO R3
- NodeMCU ESP8266
- DHT11 Sensor
- BMP180 Sensor

Software

- Arduino IDE
- ESP8266 HTTP Library
- Fritzing v1.1

Communication

- ThingSpeak
- SPI
- I2C

Methodology

- The sensors, DHT11 and BMP180 are used to collect data for Temperature, Humidity and Pressure.
- Arduino UNO Microcontroller fetches this data and sends a string to NodeMCU ESP8266.
- NodeMCU ESP8266 sends this string to ThingSpeak IoT cloud using API Key and HTTP Server Library.
- ThingSpeak Channel visualizes data and can be accessed publicly all over the world.

Methodology

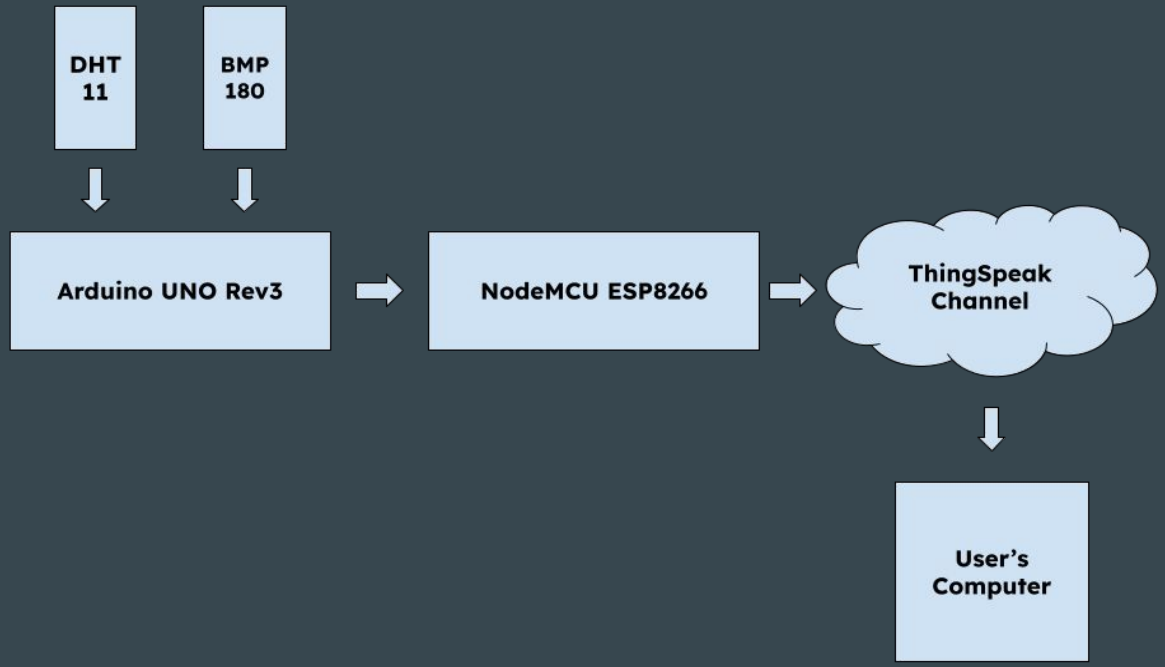

Fig. A flowchart of Methodology used.

Implementation

- DHT11 Sensor is connected with Arduino UNO with Digital Pins.
- BMP180 is connected to the Microcontroller with I2C Serial Communication.
- NodeMCU ESP8266 is to be connected with Arduino Microcontroller with SPI Serial Communication.
- Arduino IDE is used to upload to code to both NodeMCU ESP8266 and Arduino UNO Rev3. Codes can be found in our Lab Report.

Implementation

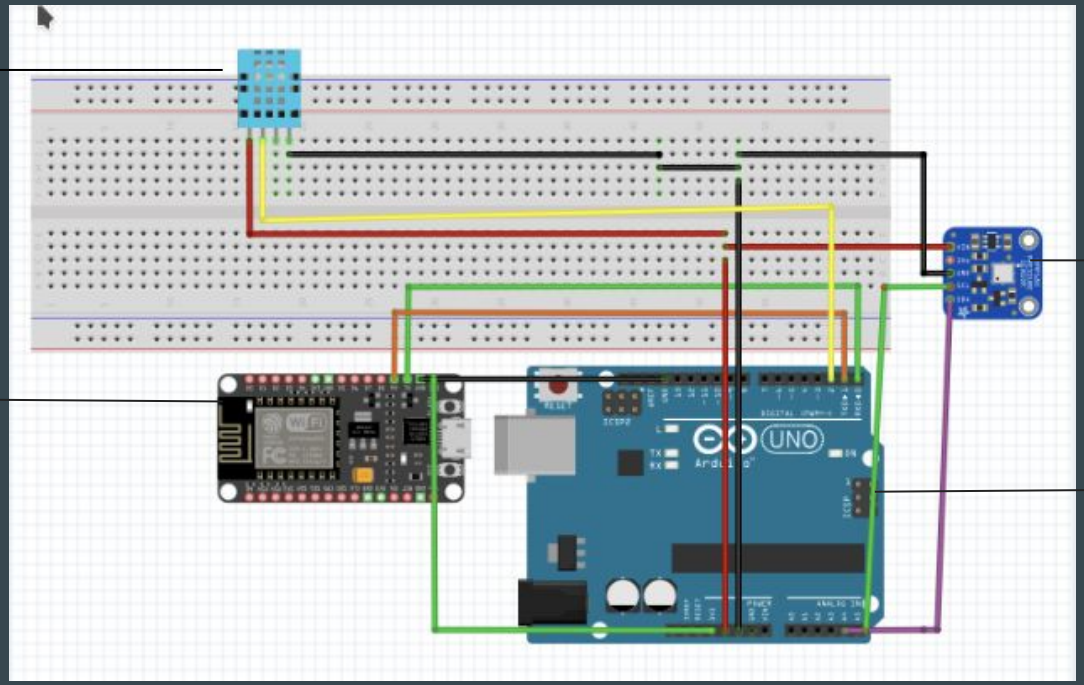

Fig. Circuit Implementation of Fritzing Platform.

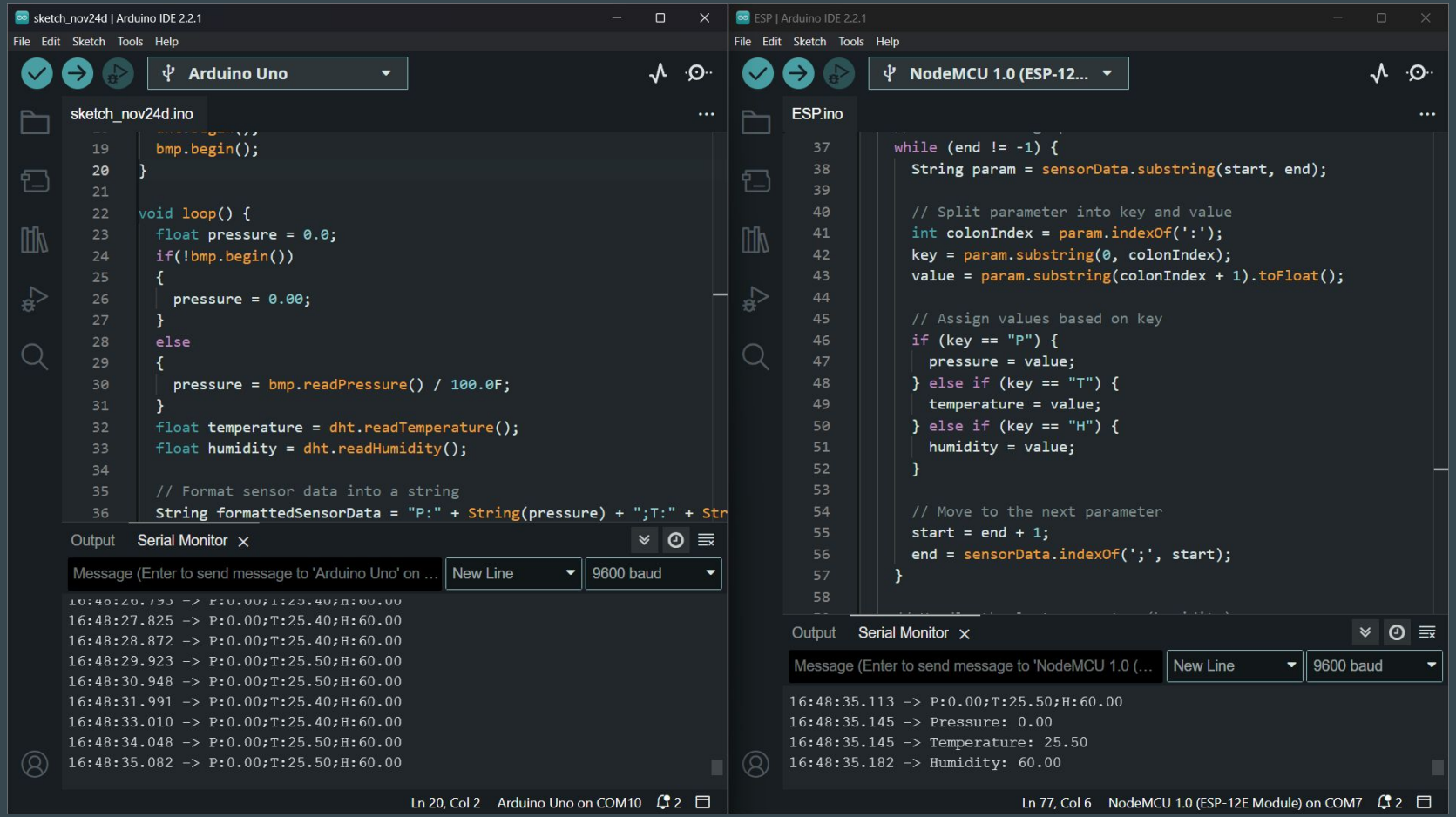

Fig. A snippet of Arduino IDE

Results

- ThingSpeak is a IoT Server by Mathworks which helps visualize data from sensors over internet.
- ThingSpeak Channel is used to visualized Temperature, Humidity and Pressure data on a graph with their respective value against Time.
- Data is organized into three formats: JSON, CSV and XML and can be downloaded easily.
- In a room at 25°C, our device accurately predicted Temperature, Pressure, and Humidity within the ranges of 0-50°C, 20-90%, and 300-1100 hPa, respectively at: https://thingspeak.com/channels/2358684.

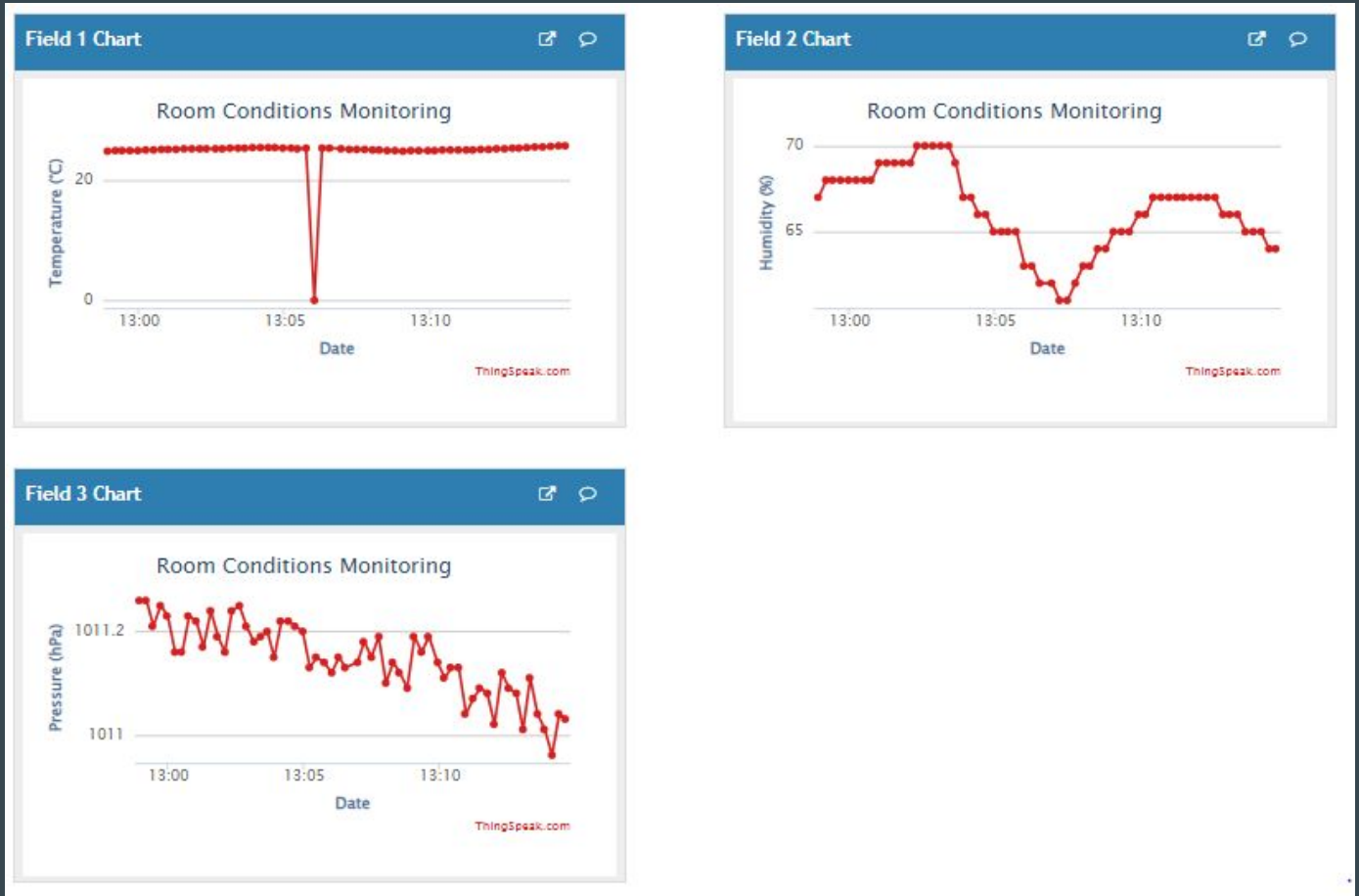

Fig. A snippet of the ThingSpeak Channel

Results

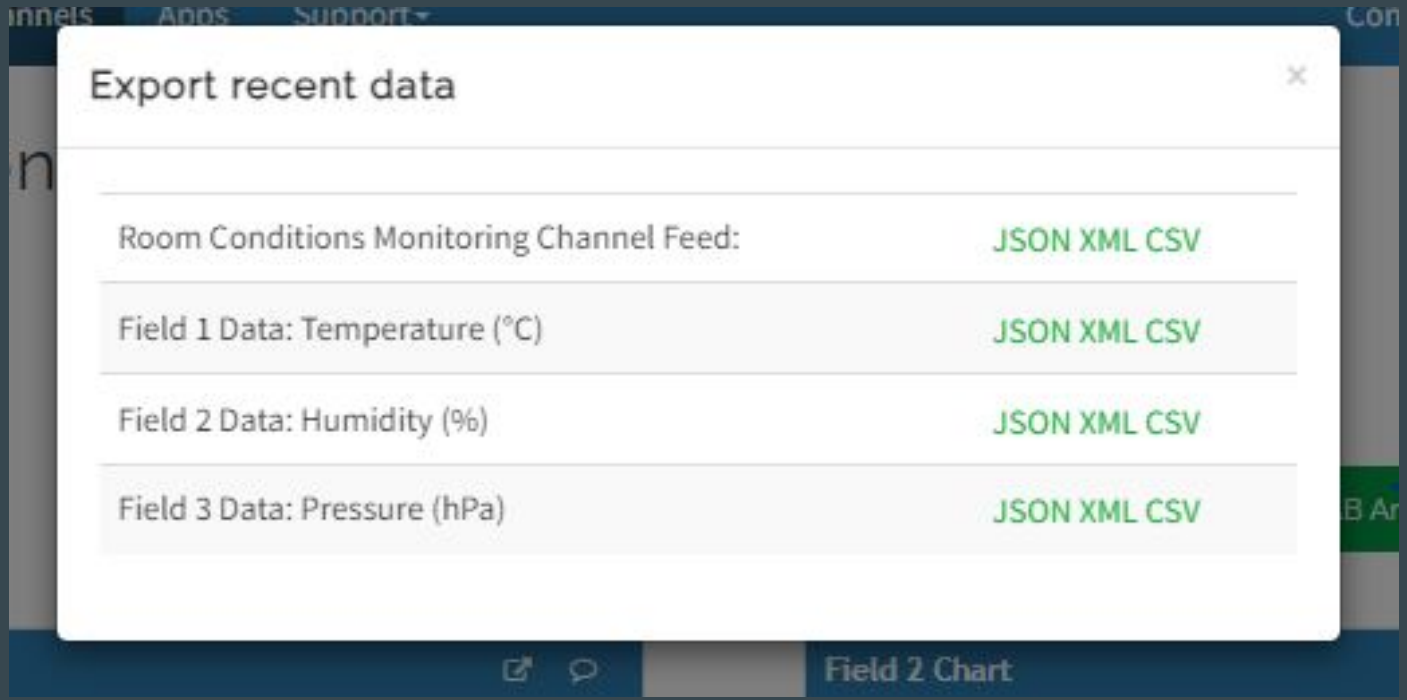

Fig. Showcase of ThingSpeak Channel

Results

	A	B	C	D	E
1	created_at	entry_id	temperature	Humidity	Pressure
2	2023-11-28 07:17:39 UTC	38	25.1	67	1011.53
3	2023-11-28 07:17:55 UTC	39	25.1	68	1011.48
4	2023-11-28 07:18:11 UTC	40	25.1	68	1011.52
5	2023-11-28 07:18:26 UTC	41	25.2	68	1011.51
6	2023-11-28 07:18:42 UTC	42	25.2	68	1011.46
7	2023-11-28 07:18:58 UTC	43	25.3	68	1011.51
8	2023-11-28 07:19:13 UTC	44	25.3	68	1011.45
9	2023-11-28 07:19:29 UTC	45	25.4	68	1011.52
10	2023-11-28 07:19:45 UTC	46	25.4	68	1011.48
11	2023-11-28 07:20:00 UTC	47	25.4	68	1011.48
12	2023-11-28 07:20:16 UTC	48	25.5	68	1011.54
13	2023-11-28 07:20:44 UTC	49	25.4	69	1011.48
14	2023-11-28 07:21:00 UTC	50	25.6	68	1011.48

Fig. A preview of CSV file containing data of all sensors, found at ThingSpeak Channel

Future Scope

- Implement machine learning algorithms for predictive analysis and personalized recommendations.
- Develop a user-friendly mobile app for remote monitoring and control.
- Connect with other IoT devices and platforms for broader applications.
  - Farming with IoT, connecting sensors for optimized crop management.
  - IoT for precise environmental control, ensuring optimal conditions for experiments and research.

References

- P. F. Gabriel and Z. Wang, "Design and Implementation of Home Automation system using Arduino Uno and NodeMCU ESP8266 IoT Platform," 2022 International Conference on Advanced Mechatronic Systems (ICAMechS), Toyama, Japan, 2022, pp. 161-166, doi: 10.1109/ICAMechS57222.2022.10003361.
- Razali, M.A.A., Kassim, M., Sulaiman, N.A. and Saaidin, S., 2020, June. A ThingSpeak IoT on real time room condition monitoring system. In 2020 IEEE International Conference on Automatic Control and Intelligent Systems (I2CACIS) (pp. 206-211). IEEE.
- G. M. Debele and X. Qian, "Automatic Room Temperature Control System Using Arduino UNO R3 and DHT11 Sensor," 2020 17th International Computer Conference on Wavelet Active Media Technology and Information Processing (ICCWAMTIP), Chengdu, China, 2020, pp. 428-432, doi: 10.1109/ICCWAMTIP51612.2020.9317307.
- P. Agrawal and G. Chitranshi, "Internet of Things for monitoring the environmental parameters," 2016 International Conference on Information Technology (InCITe) - The Next Generation IT Summit on the Theme - Internet of Things: Connect your Worlds, Noida, India, 2016, pp. 48-52, doi: 10.1109/INCITE.2016.7857588.

Thank you!

Here's the Google Drive link to a video we created showing the project:

https://drive.google.com/file/d/1OvWo7OZg7Hawrt-jUyQe4R69BgrY9K4L/view?usp=drivesdk

Link to our ThingSpeak Public Channel:

https://thingspeak.com/channels/2358684