PORTABLE WEATHER STATION WITH WEB BASED DATA VISUALIZATION AND ANALYTICS

PROJECT REPORT

Submitted for the course:

IoT FUNDAMENTALS

(ECE3501)

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October 2020

ABSTRACT

Portable Weather Station

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This being the decade of IoT, it is an upcoming trend to normalise digital transformation in almost every aspect of life. IoT is one of the biggest technology trends that organizations are not only investing in 2020 but even looking to understand in-depth as part of their R&D.

This project is an implementation of a popular requirement that has been implemented in every mobile device nowadays. The need for proper weather information and predictions has been absolutely necessary in today's world. The result of this project is a portable device that one can carry along, specialized only for this purpose, and provides extremely accurate predictions and information about the climate.

The circuitry was developed using a Wemos D1 Mini board. The device's case was 3D printed to match the dimensions of the circuit on the board. The device's size and weight were the most important factors that were taken into consideration during the whole process and the components were chosen respectively.

This project was carried out under the valuable feedback and guidance of Prof. Jaganatha Pandian who constantly monitored and corrected the flaws during the process. This report contains the specifics and the working of the project with a demo video demonstrating the device's capabilities.

LITERATURE SURVEY

An existing work related our project is a novel weather station which was designed using Micro Electro Mechanical Systems (MEMS), a technology that has been in significant use for the past two decades. Based on MEMS technology, multi-sensor chip integrated temperature, relative humidity and pressure is developed and manufactured. In the field of weather monitoring and forecast, it was observed that a micro system has an exceptional advantage compared to traditional weather monitoring stations. However, the integration processes of the sensors are a tad complicated and the performance strength of micro mechanical systems are relatively low.

A similarly made work is an update station which monitors additional parameters like monoxide density, windspeed, direction and pressure. This system is largely based on the Arduino for processing and sending data. For stability, this system uses a traditional ethernet wired connection at the cost of being less portable. The system comprises two main units' sensors: the outdoor units, to which the outdoor weather sensors are connected, and the indoor unit which is made up of two Arduino Uno boards mounted with an Ethernet shield. Its primary purpose is to write the weather data read by the outdoor unit to the SD card and send it to the online server for remote monitoring and data visualization.

Citation:

1) Fang, Z., Zhao, Z., Du, L., Zhang, J., Pang, C., & Geng, D. (2010, January). A new portable micro weather station. In *2010 IEEE 5th International Conference on Nano/Micro Engineered and Molecular Systems* (pp. 379-382). IEEE.
2) Lopez, J. C. B., & Villaruz, H. M. (2015, December). Low-cost weather monitoring system with online logging and data visualization. In *2015 International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM)* (pp. 1-6). IEEE.

PROBLEM STATEMENT

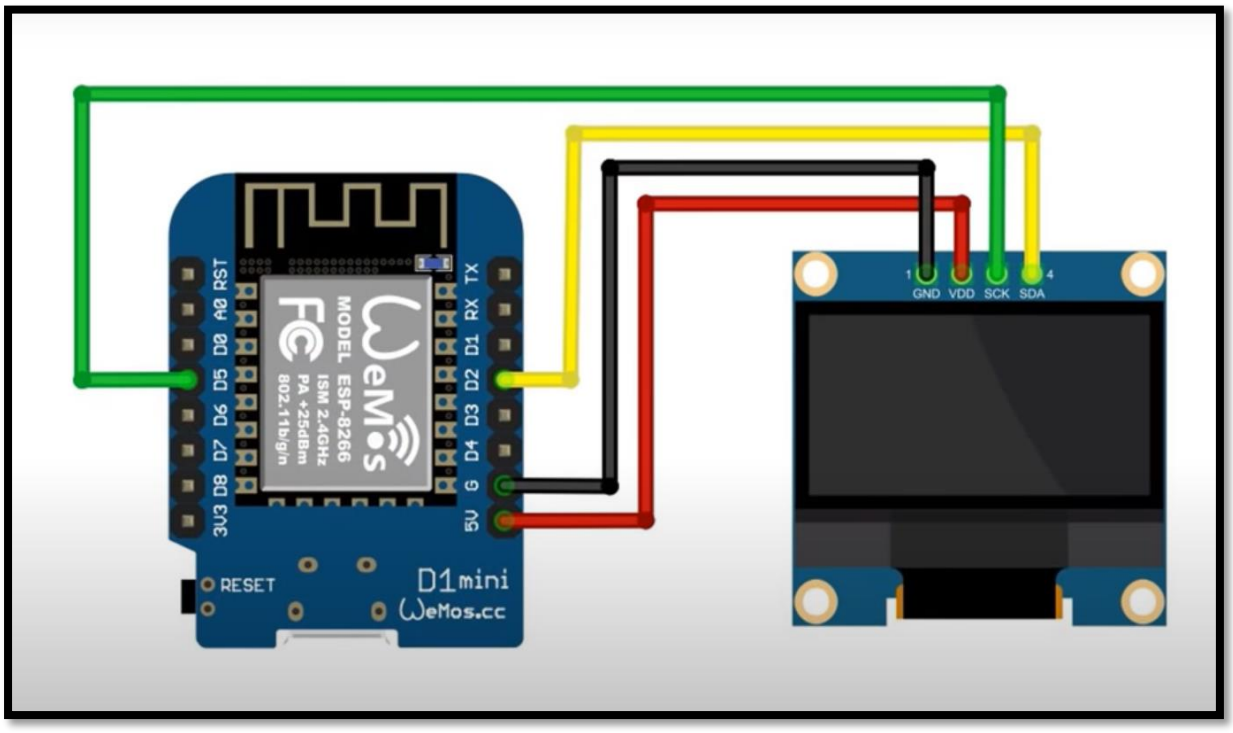
• Make a compact and reliable weather monitoring package for a user to know about his/her location's weather conditions or check the precise conditions at his/her home when the user is away.

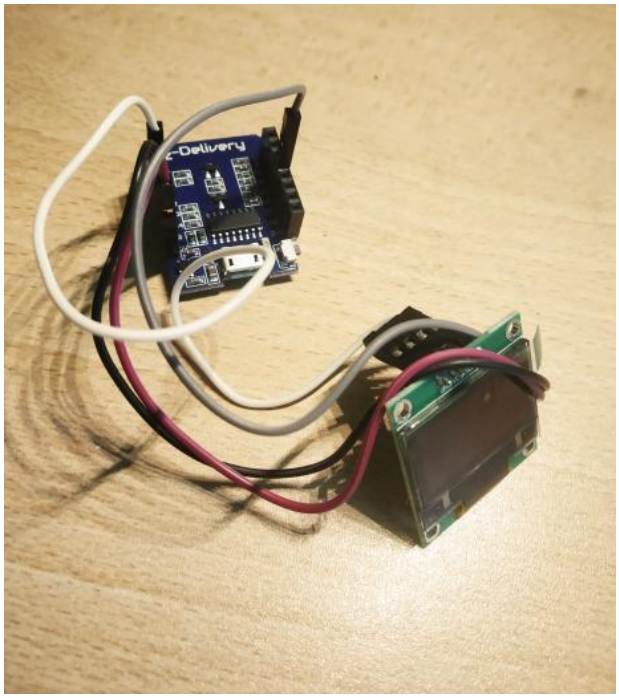
• Provide personalized periodic notifications to the user's primary device about the conditions of a particular day and suggest short notes for the user to handle the day.

• Provide the user with a dashboard which contains a comprehensive view of the weather and climate of the day, so the user can plan his errands accordingly.

DESIGN DETAILS

Circuit Diagram:



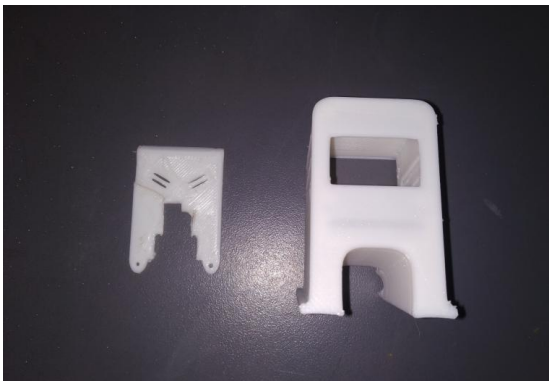


HARDWARE COMPONENTS

- 1.3 Inch I2C/IIC Display Module
- Wemos D1 Mini
- 3D Printed case

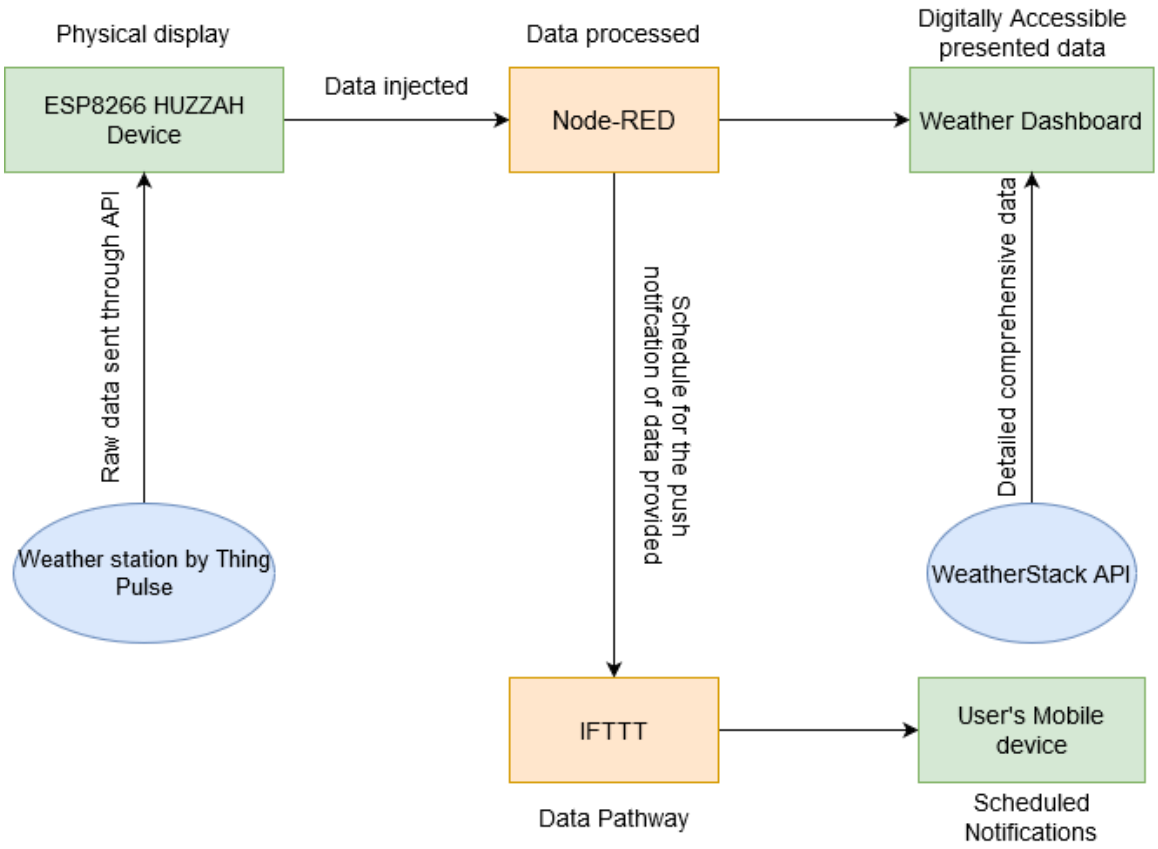
SOFTWARE COMPONENTS

- Arduino IDE
- Node RED
- IFTTT
- Initial State
- OpenWeather One Call API
- Fusion 360
- ThingPulse

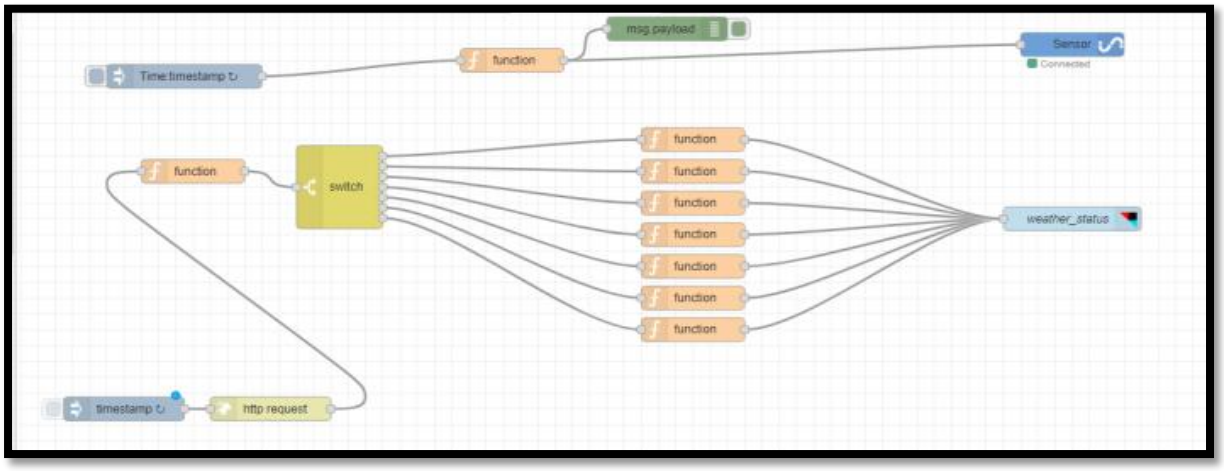


3D printed Cases

WORKING MECHANISM:



Raw weather data that consists of important climate parameters are obtained by the Huzzah board through the API linkage provided by the Weather Station library by ThingPulse (Arduino IDE). The Weather Dashboard created though the InitialState platform then obtains the same information from a related API which (WeatherStack API). Certain parameters are then injected into Node-RED which in turn pushes values as information to IFTTT that interfaces the mobile devices to Node-RED for pushing notifications to the user's phone.



FEATURES COVERED FROM IoT POINT OF VIEW

The entire project depends on cloud features like data pipeline through cloud. Data procurement is done through the respective weather data APIs. This ensures the swift transfer of data through to the respective nodes in the entire system. Moreover, it also reduces the storage necessities of the handheld devices, thus enabling ergonomic optimization. This entire cloud architecture eliminated the presence of physical data storage facilities.

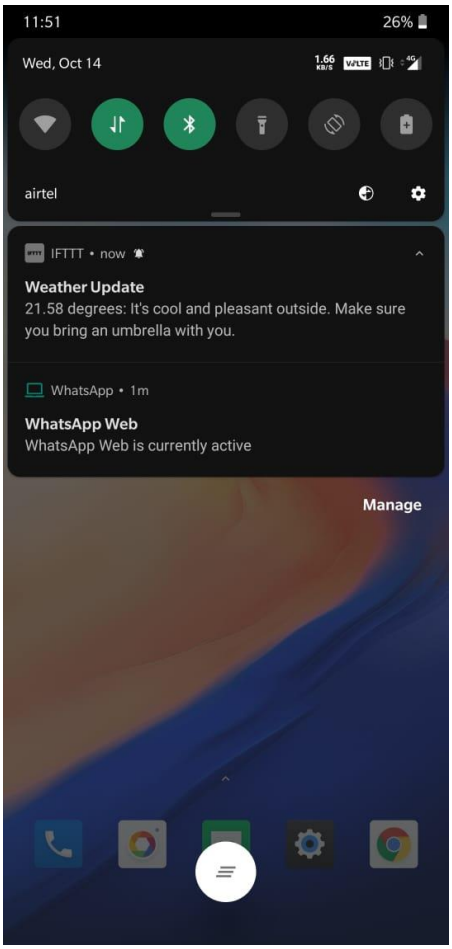
The InitialState platform allows and easy to use interface for data visualization solutions. It has customizable tiles that require minimal coding. The platform also has a very dynamic data procurement backend service that reduces latency and delay in the entire process. This is really necessary for real-time visualizations and thus makes the weather dashboard more reliable and precise.

The transfer of weather data from the cloud structures to the mobile devices are securely protected in two ways. One the IFTTT applet is two protected through passwords in both the mobile device and the transmitting account. The applet is also protected through an unique ID. The Node-RED is also interfaced with InitialState through two IDs(one being the bucket key and access key). The node-red interfacing to IFTTT is also authorized through a key. All these keys are randomly generated and this level of authorization is extremely crucial to protect the data that is being transferred through these pipelines. It ensures that only the subscribers and publishers have access to the data and also that they don’t have access to the data they are not entitled to.

Results Obtained:

The device was developed, it shows current climatic information.

The weather dashboard was developed.



The rich phone notifications were pushed through the IFTTT applet.

Demo Video Link:

https://drive.google.com/file/d/1VGj47N6h8-7tR1XZVHFDKnWU-09wBIXK/view?usp=sharing

FUTURE SCOPE

This device has great scope of implementation in coming times. This type of devices can be used in different sectors like military and industries to eliminate the presence of huge (bulky and expensive) weather monitoring systems. But this can only be done with drastically improving the accuracy and precision of these devices. This is where cloud comes into the scene and provides clear cut solutions to latency and precision problems. With the current rate at the cloud technology is improving, this technology is not far away from implementation and integration into this sectors.

REFERENCES

1) Z. Fang, Z. Zhao, L. Du, J. Zhang, C. Pang, and D. Geng, “A new portable micro weather station,” 2010 IEEE 5th International Conference on Nano/Micro Engineered and Molecular Systems, 2010.
2) 2) J. C. B. Lopez and H. M. Villaruz, “Low-cost weather monitoring system with online logging and data visualization,” 2015 International Conference on Humanoid, Nanotechnology, Information Technology,Communication and Control, Environment and Management (HNICEM), 2015.
3) N. B. A. Sulaiman and M. D. D. B. Sadli, “An IoT-based Smart Garden with Weather Station System,” 2019 IEEE 9th Symposium on Computer Applications & Industrial Electronics (ISCAIE), 2019.
4) I. Sarkar, B. Pal, A. Datta, and S. Roy, “Wi-Fi-Based Portable Weather Station for Monitoring Temperature, Relative Humidity, Pressure, Precipitation, Wind Speed, and Direction,” Information and Communication Technology for Sustainable Development Advances in Intelligent Systems and Computing, pp. 399–404, 2019.