IoT Final Project Report
Workspace Environment Monitor

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1) Abstract:

In this project we have built a workspace environment monitor to describe how fit a workspace is for its workers. Our system tracks many aspects of the workspace such as noise levels, air humidity, and temperature. The system would also give a score for the environment to determine how much better we can make the space.

2) Motivation:

People spend nearly a third of their day at their workspaces. Workplaces must ensure that the environment in which people work must be safe and healthy. A healthy workplace improves overall working efficiency of the employees. 69% of businesses reported improvements in employee satisfaction and engagement after implementing healthy workspace features. Using this project, we plan to generate data which will aid in careful planning and monitoring of workspaces.

3) Features:

I. We aim to build a system that continuously monitors various workspace environment factors

II. The implemented system would rate the fitness factor of the environment based on the data collected

III. This monitoring station will monitor the Ultra-Violet, sound level, temperature, humidity, air quality (CO_2). All above parameters are the common factors on safety working environment

IV. If the rating falls below a certain threshold, the system will notify the responsible personnel

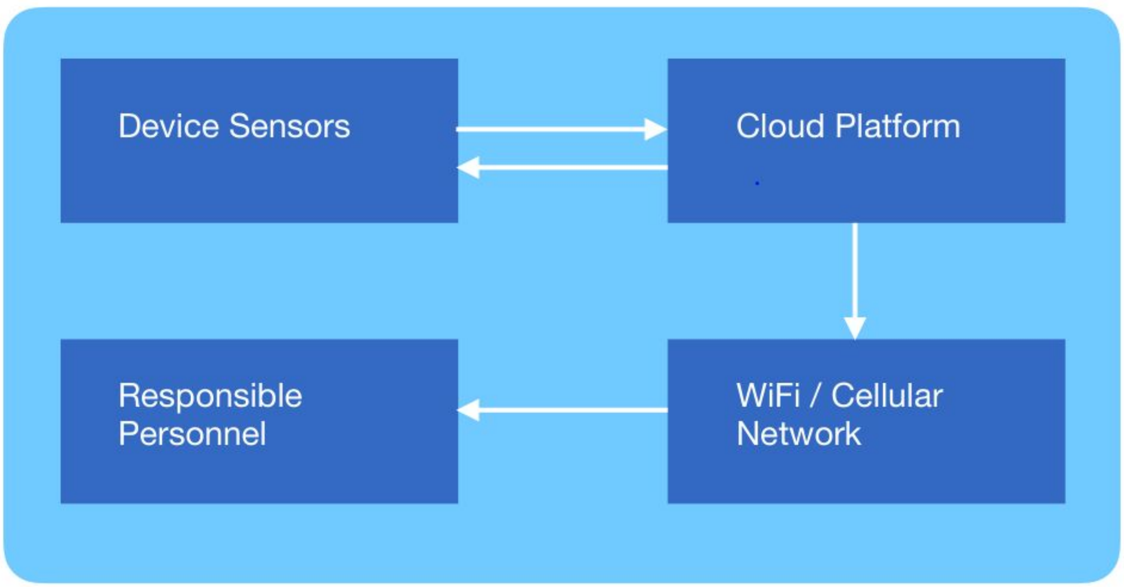
4) System Design

I. Wireless protocol:

We plan to use WiFi as our wireless protocol. The detailed architecture is shown in the next section.

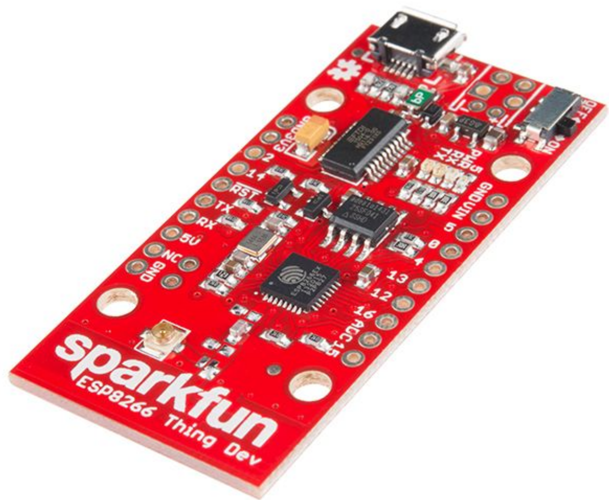
II. Architecture:

Fig 1: High-level architecture diagram

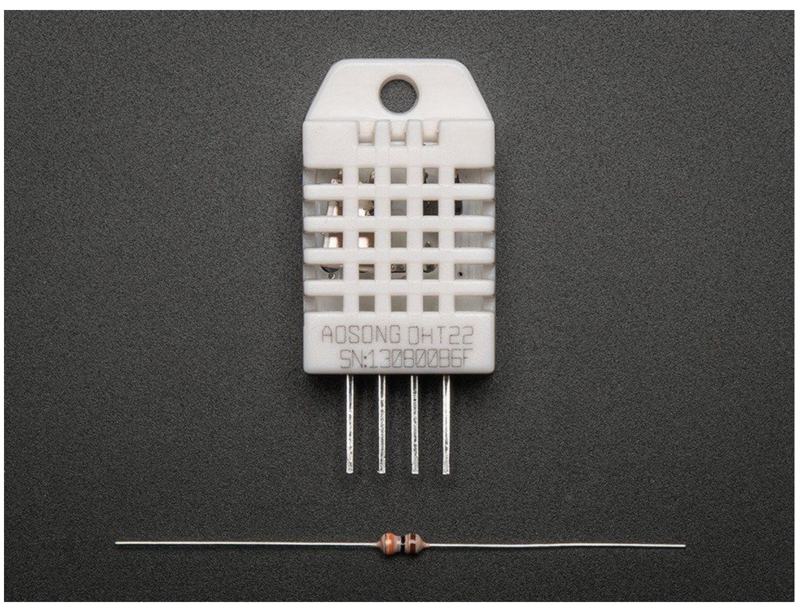


5) Components Required:

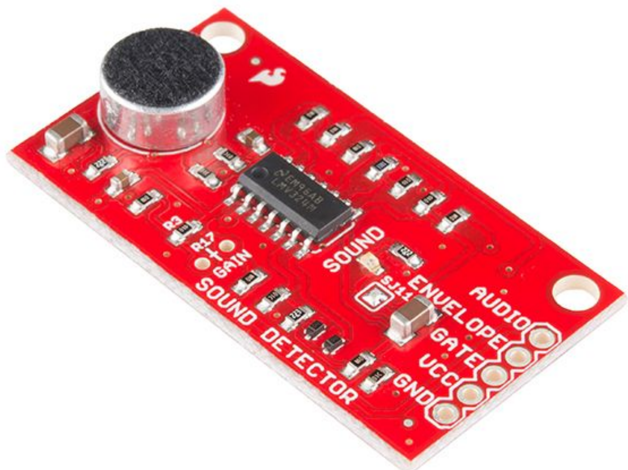
1) Sparkfun Thing Dev ESP8266



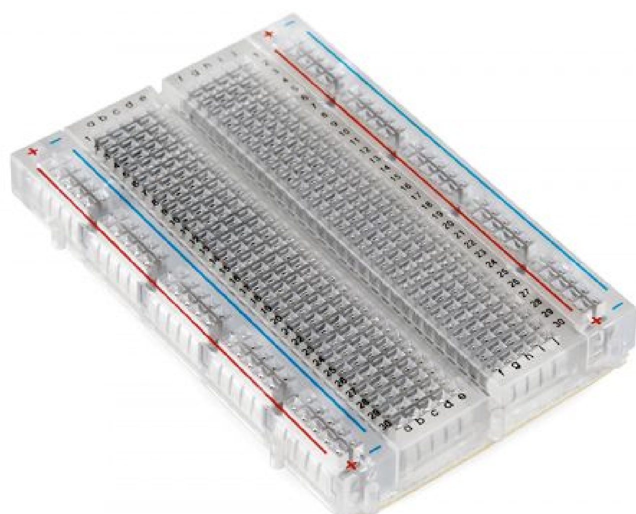
2) Temperature and Humidity Sensor AOSONG DHT22



3) Sound Detector



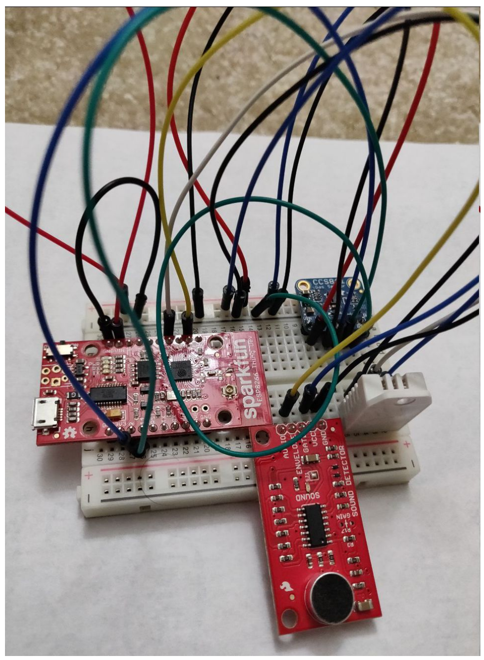
4) Breadboard



6) Basic Workflow

User Side:

On the user side, we have the setup for reading and sending the telemetry information. The sensors mentioned above send the information regarding Temperature, Humidity and Sound levels of the immediate environment in which our setup is placed. We have used a Breadboard to make the connections from the various sensors to the Sparkfun Thing Dev board as shown in the image below. We connect to a WiFi access point as mentioned in our code and send data in form of JSON objects. The private keys for the Azure account we are sending the data to are mentioned in the same code.



Cloud Side:

We are sending the data from the user's workplace to the cloud server where we have hosted our web application. Our device is registered on the server and using IoT Hub's connection key and device registration connection key, we establish communication between our system and our web application. On the cloud we are collecting the data which was sent in the form of JSON objects and we are visualizing this data using graphs. We have two telemetry graphs and three score graphs. The score graphs depict fitness factors of Temperature, Humidity and Sound Measurements. If a workspace has optimal working conditions i.e. optimal temperature, sound and humidity, Fitness factors will be 100. Hence, Fitness Factors represent how fit the workspace is for the employees to work in.

The Temperature Fitness Factor is calculated by the formula:
TemperatureFactor:
max(float(0), Benchmark - TempFactor * myabs(optimalTemp - temperature));

Here, Benchmark is the most optimal value of a fitness factor and thus is set to 100. optimalTemp is the optimal temperature and is set to 24. TempFactor is set to 20 which is set after calibration of the data set.

The Sound Fitness Factor is calculated by the formula:
SoundFactor: optimalSound>value?Benchmark: max(float(0), Benchmark - SoundFactor*(value - optimalSound))

Here, optimalSound is set to 400 after referencing relevant material on the internet. SoundFactor is set to 0.05 after calibration of the data set.

The Humidity Fitness Factor is calculated by the formula:
HumidityFactor:
max(float(0), Benchmark - HumidityFactor * myabs(optimalHumidity - humidity));

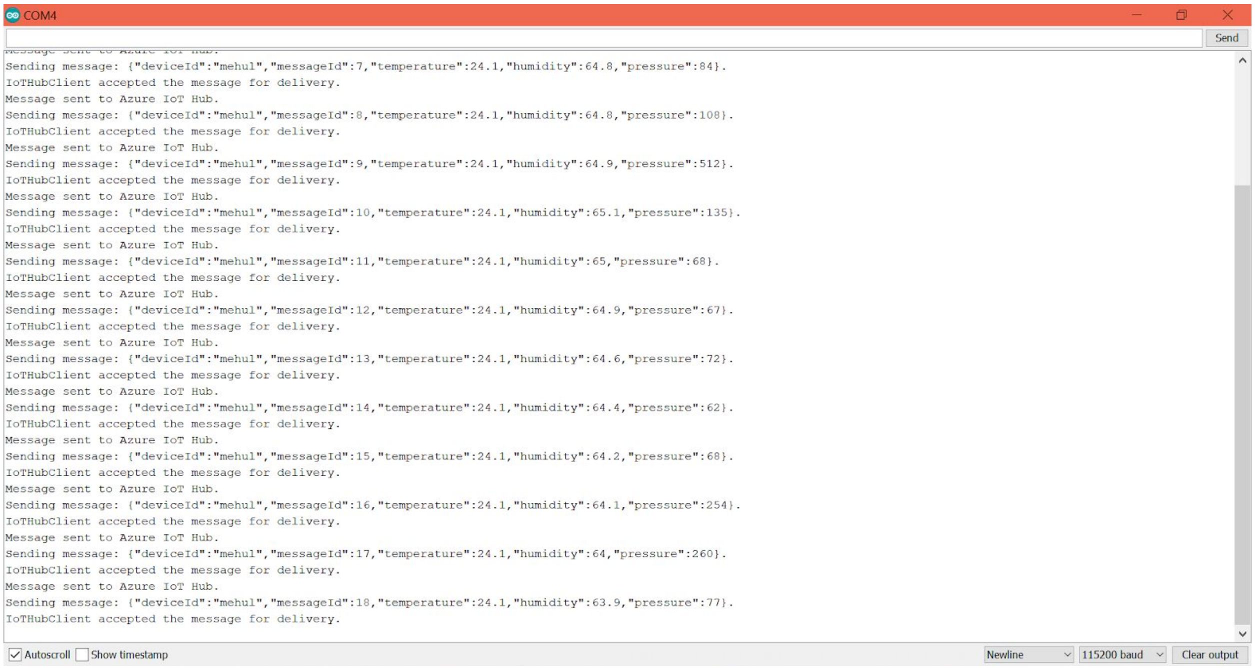
The first graph shows the telemetry information from the Temperature and Humidity Sensor. The second one shows the telemetry information from the Sound Detector. The other three graphs show the fitness information regarding the values of these three sensors. The cloud side is as shown in the picture below:

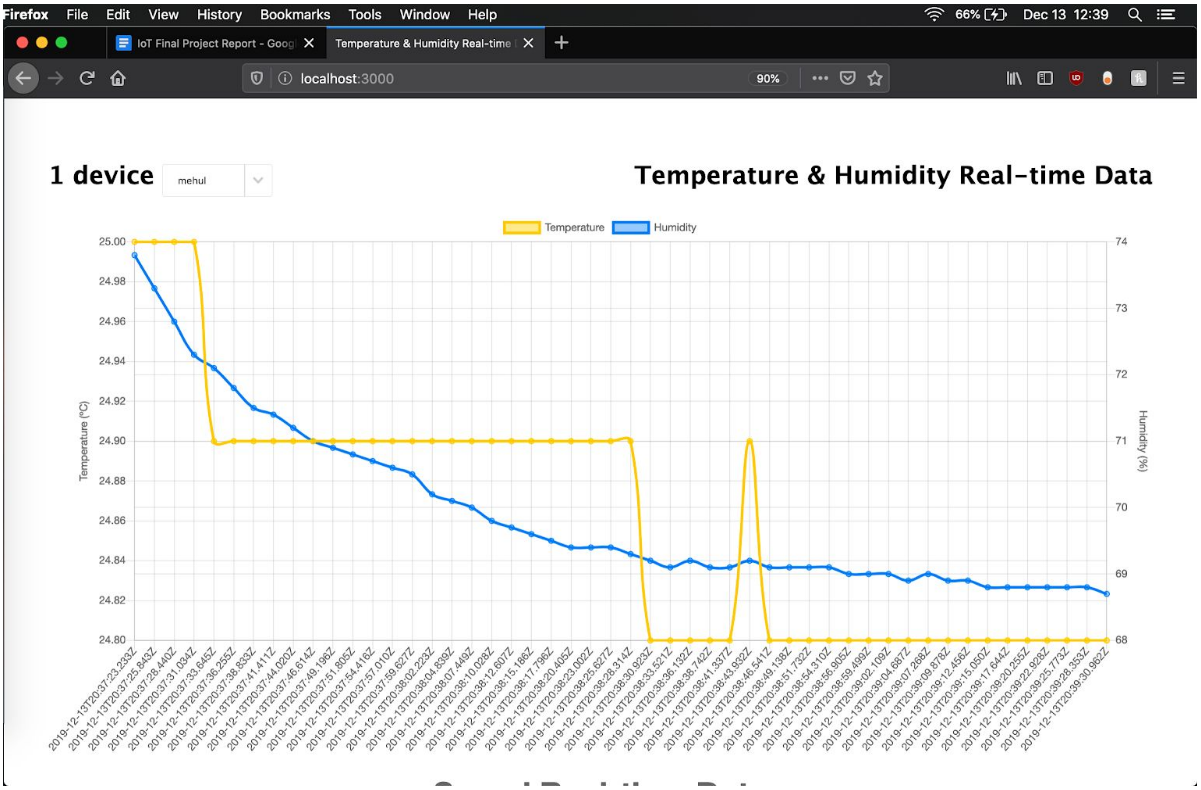
7) Demo Video:

https://photos.app.goo.gl/RRPM7Q2sZYCJgQXe9

8) Screenshots:

Transmission of information from Sparkfun Thing Dev Board:

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66% Dec 13 12:39
IoT Final Project Report - Goog
Temperature & Humidity Real-time
localhost:3000
90%
1 device
mehul
Temperature & Humidity Real-time Data
Temperature
Humidity
Temperature (°C)
Humidity (%)
25.00
24.98
24.96
24.94
24.92
24.90
24.88
24.86
24.84
24.82
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74
73
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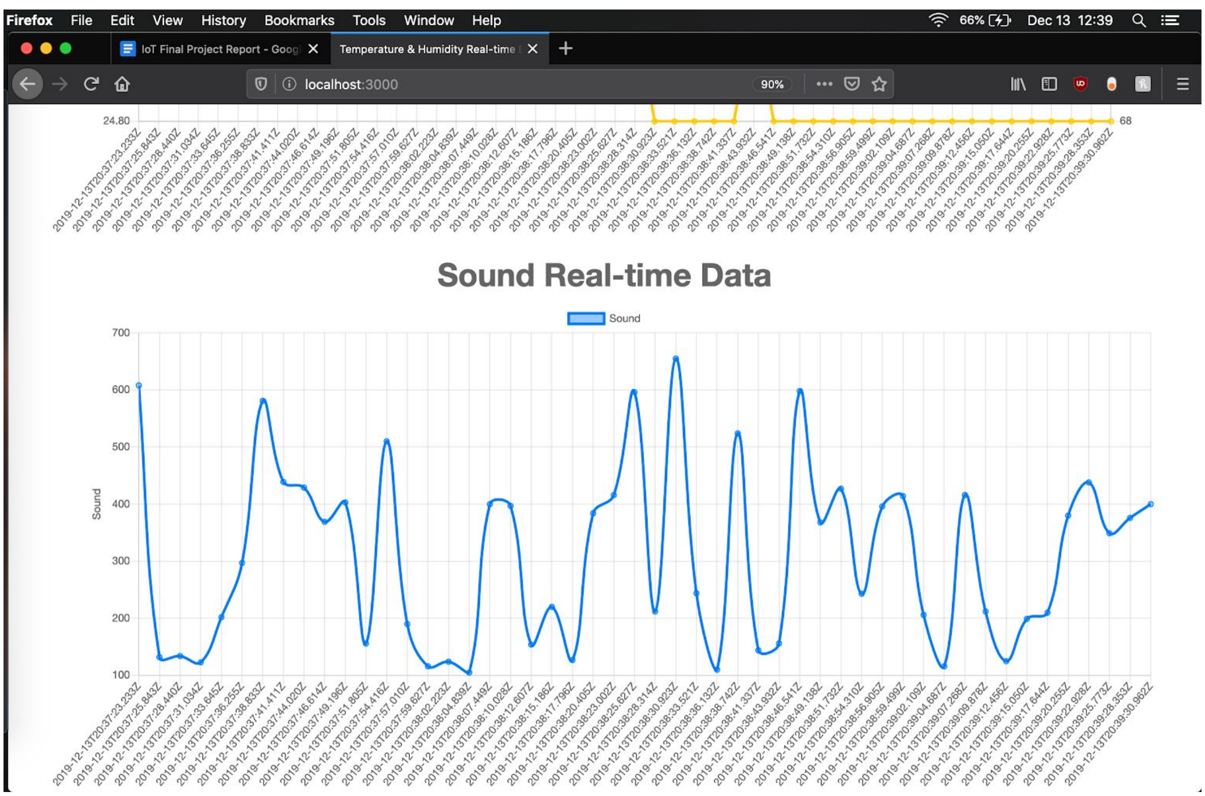
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IoT Final Project Report - Goog
Temperature & Humidity Real-time
localhost:3000
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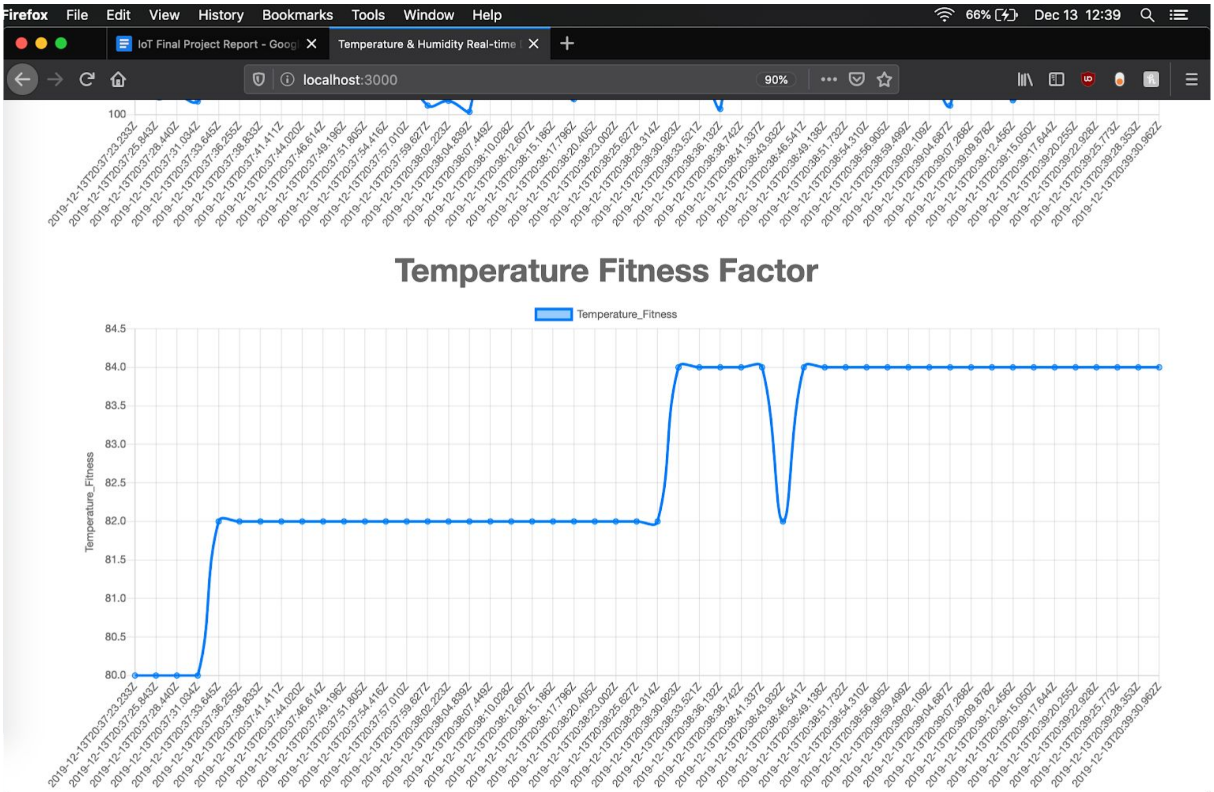
Sound Real-time Data
Sound
Sound
700
600
500
400
300
200
100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66% Dec 13 12:39
IoT Final Project Report - Googl
Temperature & Humidity Real-time
localhost:3000
90%
Temperature Fitness Factor
Temperature_Fitness
Temperature_Fitness
84.5
84.0
83.5
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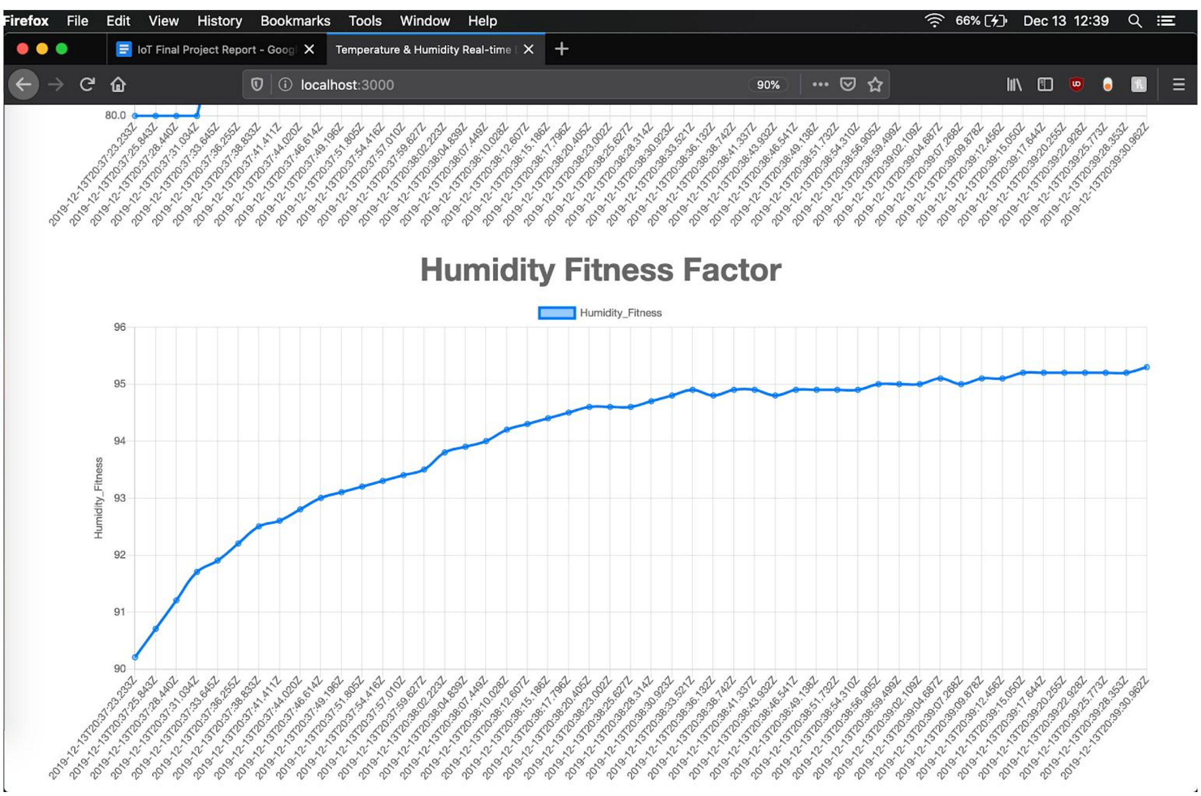
82.0
81.5
81.0
80.5
80.0


Firefox File Edit View History Bookmarks Tools Window Help
66% Dec 13 12:39
IoT Final Project Report - Googl
Temperature & Humidity Real-time
localhost:3000
90%
Humidity Fitness Factor
Humidity_Fitness
Humidity_Fitness
96
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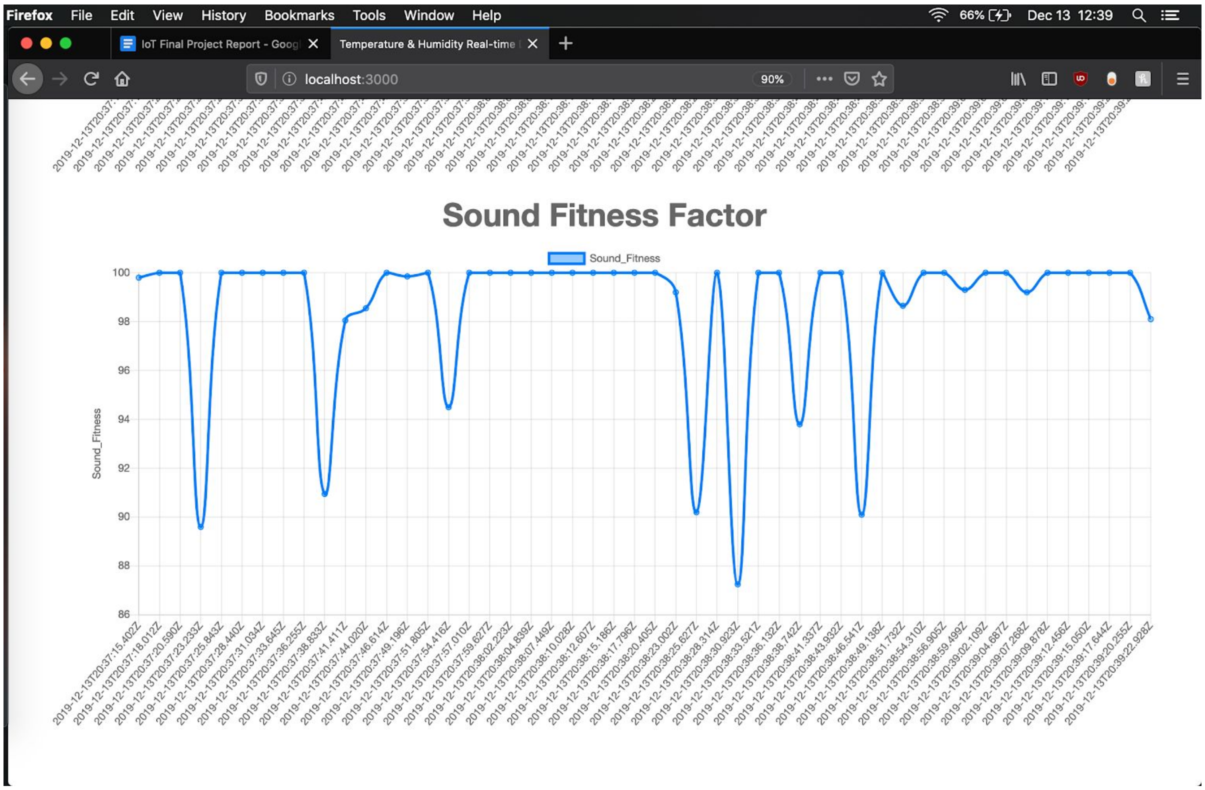
93
92
91
90



9) Benefits

- The user doesn't have to be physically present to make the device sense and send the data to the cloud
- Our system has very low power consumption so it is environment friendly and can be kept running for extended durations
- The system is plug-n-play and requires very little configuration and consumes minimal network bandwidth

10) Conclusion

We were successfully able to demonstrate a Workplace Environment Monitor which when placed records sensor data and sends it to the cloud. On the cloud, we process and visualize the data to help users improve office spaces.