Developing an IoT prototype for Climate Data Acquisition using Arduino

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EDGE IMPULSE

MOTIVATION

- Global climate change is a pressing concern.
- The quality of the air also affects the change in the climate.
- This research aims to determine the air quality index of different regions and its impact on human health and the environment.

OBJECTIVES

The research objective is to collect essential data about the surrounding and understand the various causes of poor air quality index and methods to improve it. Moreover, the generated data can be stored and analyzed for future use.

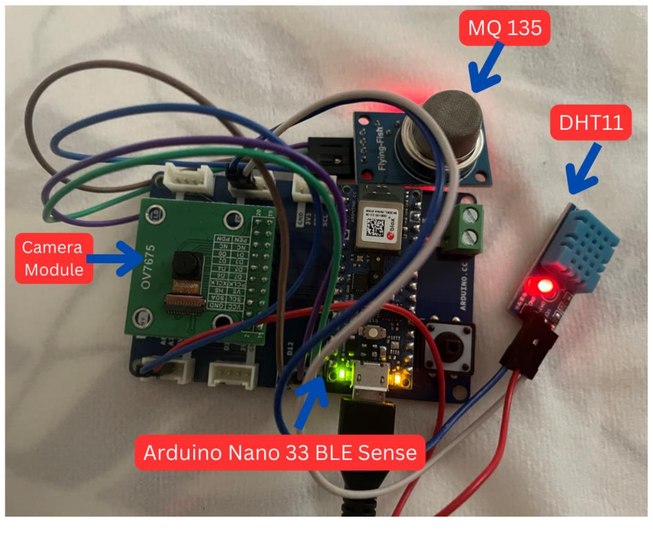
IMPLEMENTATION

Arduino Nano 33 BLE Sense: A tiny development board with a Cortex-M4 microcontroller, motion sensors, a microphone and BLE - fully supported by Edge Impulse.

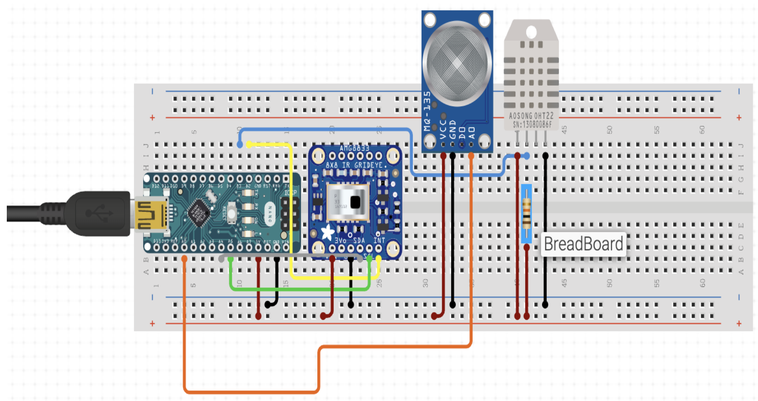
OV7675 camera module: A low-voltage color CMOS image sensor that supports the full functionality of a single chip VGA (640×480) camera in a small footprint package.

MQ135: Input voltage: DC5V Power consumption (current): 150mA, DO output: TTL digital 0 and 1 (0.1 and 5V)

DHT11: A temperature and humidity combined sensor with calibrated digital signal output. It is a reliable sensor for determining temperature and humidity.



PROPOSE SYSTEM DESIGN



- The Arduino Nano 33 BLE Sense measures the surrounding's pressure and temperature.
- The DHT11 measures humidity, and the MQ135 provides air quality of three levels, low, medium or high. Additionally, the level of CO2, Acetone, Benzene and SO2 is also captured by the MQ135 sensor.
- Lastly, the camera module collects hexadecimal values of the object and converts it into an image which is later stored in a database.

The system generates values based on five levels:

If ppm > 0 and ppm < 50 then the AQI is good

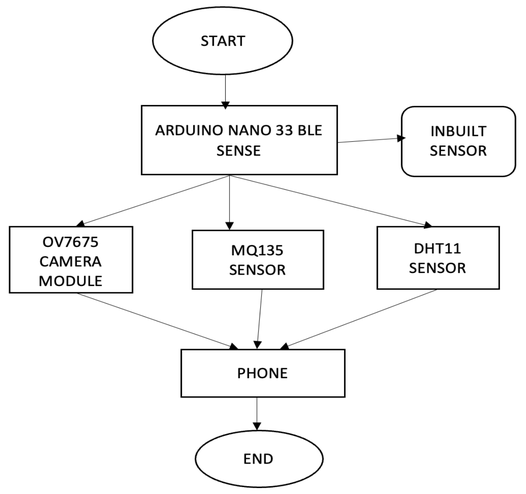
If the ppm > 51 and ppm < 100 then the AQI is moderate

If the ppm > 101 and ppm < 200 then the AQI is unhealthy

If the ppm > 201 and ppm < 300 then the AQI is very unhealthy

If the ppm > 301 then the AQI is hazardous to health

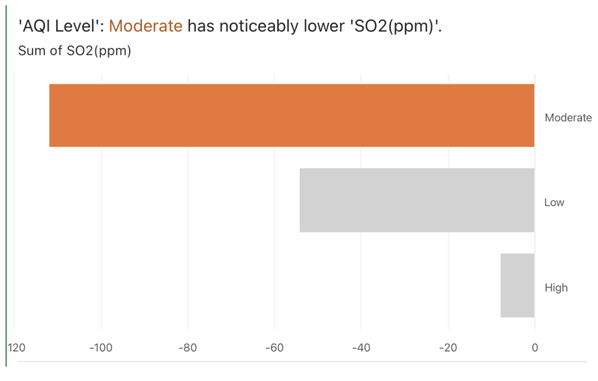
Pseudo Code



The flow chart explains the process of collecting data using the sensor. The proposed system uses Arduino Nano 33 BLE Sense, a board with multiple inbuilt sensors. This board is connected to an OV7675 camera module, an MQ135 sensor and a DHT11 sensor. This connection is attached to a shield board, and the real-time data is displayed on a mobile screen.

SYSTEM EVALUATION

The system analysis is done based on the amount of particle matter in the air. The table shows different values for pressure, average humidity and average air quality. The graph depicts the AQI level against the threshold value. We also provide a sample image that we collect from the camera module.



'Humidity' and 'Air Quality' by 'Pressure'

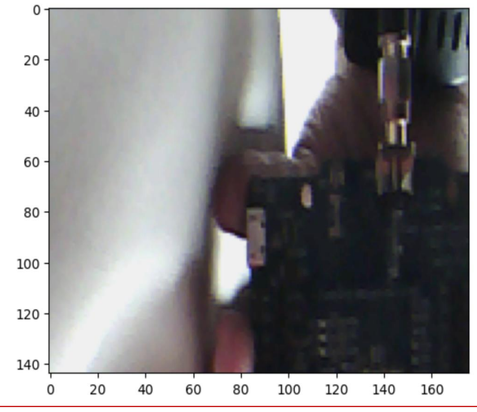
Pressure	Average of Humidity	Average of Air Quality
95.56 kPa	63.00%	94.5
98.56 kPa	62.50%	149
99.56 kPa	61.90%	94.8
97.56 kPa	61.67%	95
96.56 kPa	60.00%	95
Grand Total	**61.84%**	**100.526316**

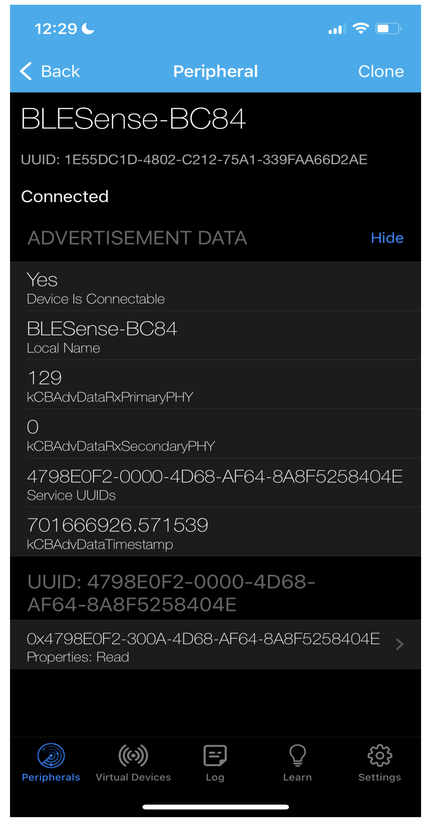
Pressure = 99.56 kPa
Temperature = 25.82 C
Humidity = 60.00 %
Air Quality: 96
AQI Moderate
raw = 945
Nitrogen = 65.87
Co2 = 422.79
Acetone = -76580.91
Benzene (ppm): -9.83
SO2 (ppm): -9.83

```
    image[i] = [r,g,b]

image = np.reshape(image,(144, 176,3)) #QCIF resolution

# Show the image
plt.imshow(image)
plt.show()
```





CONCLUSION

To conclude, the proposed model helps understand the AQI of a particular area, collect, store and analyze it to determine which region needs to be taken care of.