Breathe to Succeed – Monitoring of air quality in enclosed spaces

Category: environment, health, air pollution

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Motivation
Improving air quality is very important. It can deliver substantial health benefits. Reducing air pollution levels means reducing premature deaths and diseases from stroke, heart disease, lung cancer, and both chronic and acute respiratory diseases, including asthma. In schools the air quality has an impact on your brain's performance. If the air is bad the concentration will start to lack and therefore the students can't take the best out of the class anymore. In supermarkets it would be interesting to find out what impact it might has on the food that is stored there or if it maybe stimulates your consumption. And, in gyms or sport halls it is important to have fresh air because the performance in the sport depends on it. You can't reach the same level with bad air. Especially in Minergie houses this has to be controlled often to be sure that the system of these houses works all right.
To dive deeper into the topic, we need to find out what kind of element we can filter in the air and which ones harm you at a certain amount.

Approach:
The main idea here is to monitor the air quality of a room or a certain place. To do this, a monitoring system can be made using ESP32 boards and a central Raspberry Pi server. Then it can be attached to different sensors and a display that should show the index. Depending upon the index, the air quality can be determined how good or bad it is in a certain place.

Things that might be needed to complete the project:
1. Raspberry Pi (3 or 4) for central server, ESP32 for each sensor cluster
2. Breadboard and wires
3. Sensors:
    - PMS5003 PM Sensor for air pollution detection
    - MP503 VOC Sensor for detection of volatile organic compounds
    - CO2 sensor (unsure which one, MQ7?)
    - RHT03 for measurement of Temperature and Humidity
4. OLED Display board

Techniques

Technically, the system would consist of a network of low-level data collection devices distributed across the site. Each device can be fairly basic, only consisting of a cluster of air quality sensors, practically – a PM2.5 (air particulate pollution), CO2 (carbon dioxide), VOC (volatile organic compounds), ozone gas, possibly expanded to other more specialized sensors in spaces with special requirements (factories, fireplaces, etc.) and a basic microcontroller with access to WIFI such as an ESP32 chip. Sensor data is collected regularly (around once per second, or once per 5 seconds) and occasionally casted to centralized server over WIFI.

The central location can be a regular computer, a server, or a Raspberry Pi 3 or 4 connected to an OLED display to offer constant visualization. The collected data can later offer valuable insights into the air quality over time and over various locations through visualization and analysis. The visualization can be displayed through a web app for easy remote access. Further, the data can be used to control air quality machines, turning them off when not required, for energy savings.

Evaluation

To judge our approach and to ensure that our device is working properly, we will measure the values of multiple test rooms. We will conduct experiments to ensure that our initial values change if we change the environment, e.g. if the humidity in a room we monitor changes if we bring a pot of water to boil. Other experiments include monitoring if the temperature sinks if we open a window or if the detected level of CO_2 rises after spending some time in a room with the windows closed.

We will proceed to make a live demonstration of or device during our final presentation, monitoring the quality of the air in the classroom.