**Origin and concepts of air quality index**:

In addition to land and water, air is the prime resource for sustenance of life. With the technological advancements, a vast amount of data on ambient air quality is generated and used to establish the quality of air in different areas. The large monitoring data result is in encyclopaedic volumes of information that neither gives a clear picture to a decision maker nor to a common man who simply wants to know how good or bad the air is? One way to describe air quality is to report the concentrations of all pollutants with acceptable levels (standards). As the number of sampling stations and pollution parameters (and their sampling frequencies) increase, such descriptions of air quality tend to become confusing even for the scientific and technical community

As for the general public, they usually will not be satisfied with raw data, time series plots, statistical analyses, and other complex findings pertaining to air quality. The result is that people tend to lose interest and can neither appreciate the state of air quality nor the pollution mitigation efforts by regulatory agencies. Since awareness of daily levels of urban air pollution is important to those who suffer from illnesses caused by exposure to air pollution, the issue of air quality communication should be addressed in an effective manner. Further, the success of a nation to improve air quality depends on the support of its citizens who are well informed about local and national air pollution problems and about the progress of mitigation efforts

**Definition of air quality index:**

An air quality index is defined as an overall scheme that transforms the weighed values of individual air pollution related parameters (for example, pollutant concentrations) into a single number or set of numbers . The result is a set of rules (i.e. most set of equations) that translates parameter values into a more simple form by means of numerical manipulation .

If actual concentrations are reported in μg/m3 or ppm (parts per million) along with standards, then it cannot be considered as an index. At the very last step, an index in any system is to group specific concentration ranges into air quality descriptor categories..

**Present situation in INDIA(as well as in Chennai):**

//There have not been significant efforts to develop and use AQI in India, primarily due to the fact that a modest air quality monitoring programme was started only in 1984 and public awareness about air pollution was almost non-existent. The challenge of communicating with the people in a comprehensible manner has two dimensions: (i) translate the complex scientific and medical information into simple and precise knowledge and (ii) communicate with the citizens in the historical, current and futuristic sense. Addressing these challenges and thus developing an efficient and comprehensible AQI scale is required for citizens and policy makers to make decisions to prevent and minimize air pollution exposure and ailments induced from the exposure.//

**Indices calculated in the past:**

In the past, AQI has been based on maximum sub-index approach using five parameters i.e. suspended particulate matter (SPM), SO2, CO, PM10, and NO2 . However, the calculated AQI was always dominated by sub-index of SPM due to lack of data availability for other pollutants. So the air quality index is nowadays calculated with different parameters which provides sub-index for PM10, PM2.5, O3 , NO2 , and CO and has applied to continuous air quality monitoring network. This index was modified by IITM( Indian institute of tropical metrology ).

**Different indices of air quality:**

There are many indices that are now used to measure the air quality .Few of these include

* Greater Vancouver Air Quality Index (GVAQI)

Break point concentrations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Index** | **S02**  **24-hr (ppm)** | **CO**  **8-hr (ppm)** | **N02**  **1-hr (ppm)** | **03**  **1-hr (ppm)** | **TSP**  **24-hr(μg/m3)** | **PM10**  **24-hr**  **(μg/m3)** | C0H  1-hr (units) | Descriptors |
| 25 | 0.06 | 5 | 0.105\* | 0.051 | 60 | 25\* | 1.7 | Good |
| 50 | 0.11 | 13 | 0.21 | 0.082 | 120 | 50 | 4 | Fair |
| 100 | 0.31 | 18 | 0.53 | 0.153 | 400 | 100 | 6 | poor |

* Oak Ridge Air Quality Index (ORAQI)

|  |  |
| --- | --- |
| **Pollutant** | **Standard Value (24-hr Average)** |
| Photochemical Oxidants | 0.03 ppm |
| Sulphur Oxides | 0.10 ppm |
| Nitrogen dioxide | 0.20 ppm |
| Carbon Monoxide | 7.0 ppm |
| Particulate Matter | 150 μg/m3 |

* Other largely used indices include “green index” and “fenstock air quality index” and “Ontario air pollution index”.

**INDIAN** **air quality index:**

Indian National Air Quality Standards (INAQS) considers 12 parameters:

1)carbon monoxide (CO) 2)nitrogen dioxide (NO2 ) 3)sulphur dioxide (SO2)

4) particulate matter (PM) of less than 2.5 microns size (PM2.5) 5) PM of less than 10 microns size (PM10)

6) Ozone (O3 7) Lead (Pb) 8)Ammonia (NH3)

9) Benzo(a)Pyrene (BaP) 10)Benzene (C6 H6 ) 11)Arsenic (As) 12)and Nickel (Ni)]

The first eight parameters have short-term (1/8/24 hrs) and annual standards (except for CO and O3) and rest four parameters have only annual standards.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Pollutant** | **SO2** | **NO2** | **PM2.5** | **PM10** | **O3** | **CO (mg/m3 )** | **Pb** | **NH3** |
| **Averaging time (hr)** | 24 | 24 | 24 | 24 | 1 8 | 1 8 | 24 | 24 |
| **Standard(ug/m3)** | 80 | 80 | 60 | 100 | 180 100 | 4 2 | 1 | 400 |

The permissible levels based on concentration levels:

The obtained values of concentrations are converted into particular numbers by multiplying by weighted means.

|  |  |
| --- | --- |
| **AQI category** | **AQI range** |
| Good | 0-50 |
| Satisfactory | 51-100 |
| Moderately-polluted | 101-200 |
| Poor | 201-300 |
| Very poor | 301-400 |
| Severe | 401-500 |

**AIR QUALITY MONITORING:**

1. **Online Monitoring network**:

These are automated air quality monitoring stations which record continuous hourly, monthly or annually averaged data. In India, ~ **40** automatic monitoring stations are operated where parameters like PM10, PM2.5, NO2 , SO2 , CO, O3 , etc. are monitored continuously. Data from these stations are available almost in real-time. Thus such networks are most suitable for computation of AQI sub-indices, as information on AQI can be generated in real time. For AQI to be more useful and effective, there is a need to set up more online monitoring stations for continuous and easy availability of air quality data for computation of AQI for more Indian cities.

1. **Manual Monitoring network:** The manual stations involve mostly intermittent air quality data collection, thus such stations are not suitable for AQI calculation particularly for its quick dissemination. In India, air quality is being monitored manually at **573** locations under National Air Monitoring Programme (NAMP). In most of these manually operated stations, only three criteria pollutants viz. PM10, sulphur dioxide (SO2 ) and nitrogen dioxide (NO2 ) are measured, at some stations PM2.5 and Pb are also measured. The monitoring frequency is twice a week. Such manual networks are not suitable for computing AQI, as availability of monitored data could have a lag of 1-3 days and sometimes not available at all. However, some efforts are required to use the information in some productive manner.

**DIFFERENT SENSORS THAT CAN BE POSSIBLY USED FOR MEASUREMENTS**:

**Measuring using co2 sensor**:

Our CO2 sensors measure the CO2 concentration by means of non-dispersive infrared technology (NDIR) that ensures longer service life and maximum accuracy compared to chemical sensors. So they enable extremely energy and cost-saving ventilation on an as-needed basis for room climate being as draught-free and non-tiring as possible.

TELAIRE T6613/6615 CO2 SENSORS also MQ131(low concentration sensors)

SITE: AAS-T63172-003-091614-web.pdf

Cost: around 2000-3000

**Link of website used**:

<https://www.spec-sensors.com/product-category/digital-gas-sensors-iot/>

<https://www.sensorsmag.com/components/particulate-matter-sensing-for-air-quality-measurements>

**Measuring co:**

1)

We can add Carbon Monoxide sensing to our IoT application with our digital CO sensor module that provides a calibrated and temperature compensated output. Our range of intrsests is around 10-200 ppm.It is dangerous if we are exposed to more than 100ppm.

0 to 1000 ppm Carbon Monoxide sensor with digital output Using this sensors.

Cost:$75.0

Sensor number: Sku: 968-034

2)

Instead we can also opt for cheaper sensors which would measure at lesser range and lower accuracy.one such sensor is MQ7.It works based on HMOS(hot metal oxide sensor). A hot metal oxide is heated till it becomes sensitive to ozone gas. Resistance changes according to concentration of ozone .

Cost: RS 200-300

* Advantages of using such a sensor is that 1) it has long life 2)Apt for ambient and portable ozone monitoring
* Few disadvantages include 1)high power consumption 2)Heating required

**Measuring NO2,SO2,O3,H2S,ETOH,**:

ULPSM (ultra low powered sensor meters )NO2 sensors are used.

It has very low power consumption and a simple analog sensor signal output. The ULPSMconverts the sensors linear current signal output to a linear voltage signal , while maintaining the sensor at its ideal biased operation settings.

Spec sensors:

1. Sku: 968-047(NO2 alone)
2. sku: 968-045(costly, but measures all the above mentioned gases)

Cost: Rs 3000 (approx.)

**Contents Includes:**

* **Digital Gas Sensor platform**
* **One sample of every SPEC Sensor – including NEW O3 and NO2 sensors!**
* **UART to USB Adapter**
* **Link to Setup and logging Utility**
* **Link to full design documentation**
  + **Parts List (BOM)**
  + **Gerber/Design files**

**Components Used in Design:**

* **Texas Instruments LMP91000**
* **Microchip PIC24F16**
* **SiLabs SI7021**
* **MicroChip MCP604**
* **Intersil ISD60002**

**Easily add any SPEC Sensor to your design with our Digital Gas Sensor Developer Kit.**

**MEASURING PARTICULATE MATTER**:

# Particulate Matter Sensor SPS30

COMPANY: SENSIRION

LINK : <https://www.sensirion.com/en/environmental-sensors/particulate-matter-sensors-pm25/>

Cost: $ 50(approx.)

This sensor has a sensitivity of 10ug/m3 .Its measurement principle is based on laser scattering .This enables accurate measurements throughout its lifetime .Average lifetime is about eight years . Its small and easily portable and very much suited for compact devices used for measuring air quality.