Low-cost user-friendly air quality monitor marketed towards people with allergies.

Requirements:

- Specialized towards people with allergies.

- Low power consumption.

- Remote data access.

- User friendly.

- Low price.

Parts:

3 sets of 3 LEDs(Red, Yellow, Green). Using these to represent pollution levels save a lot more money than using screens, and since we are implementing remote data access, the user could get the actual numbers via an app. This is also cheaper than using RGB LEDs, although the price of both options wouldn't have made any realistic impact anyways.

PM10 sensor. A range of Elecbee sensors offers pretty cheap prices(from 15 to 20 euro), alternatively a PM2105L sensor can be used due to it's low power consumption, although I haven't been able to easily find it's price.

VOC sensor. Something based on a Sensirion SGP30 module, known for it's cheap price and low power consumption.

ESP32-S3 micro-controller. Has a deep sleep mode, cheap, built-in Wi-Fi and BLE, although Wi-Fi most probably wouldn't be utilized do it's high power consumption.

Some design thoughts:

Why no CO2 censor or direct CO2 measurements?

Because particles are our priority. High CO2 levels are an indicator of poor ventilation, however so are the high particle levels and also the first way of dealing with both is the same, opening a window for better air ventilation. So we only measure eCO2(estimated CO2) that is gotten via detecting other gases(in our case VOCs) as we don't need the accuracy of a dedicated CO2 censor.

Lower power consumption.

Well specific to sensors, if the sensor uses fans and pumps then it consumes quite a lot of power, thus optics measurements are preferred. Secondly, a more general rule is taking only periodic measurements and not utilizing both of the sensors at the same time(important to not overload the power source) which isn't much of problem considering the nature of air quality measurements.

Since the user wouldn't necessarily follow the schedule by which the device is on, we can add a button that specifically turns on the MCU(more like wake it up from deep sleep mode) so that the user can connect to it through Bluetooth to get the readings on the app.

Battery choices.

I decided to go with AA batteries for the choice of power supply. The main reason is that this way we can off-load the responsibility of buying them to the consumer, instead of shipping the Li-ion / LiPo battery with the product, not to mention that those would need a charge controller which adds even more to the price.

The choice falls on two LiFeS2 AA batteries. Which supply a good voltage for our circuit, can provide much higher current to our sensors and the MCU which might allow us to even use Wi-Fi and/or to run the measurements on shorter periods, perform great on lower temperature environments. The only thing is that it's not rechargeable, which isn't a negative, quite the opposite it's a positive since we don't need to design a charging circuitry for it and the responsibility of buying these batteries are on the consumer anyways.

At the end we end with a product that should cost around 30-40 euro(closer to 30) which is decently less than other air monitors and is actually a lot more comparable to air quality monitors that don't even have PM2.5/10 sensors.