**Major Project**

The task is to create a device that will fit in vehicles to measure air quality in different areas for visual comparison. This is to show what humans are breathing into their lungs in different areas. This data could then be used to relate to deaths in the areas caused from breathing in pollutants. The air quality values will be visualised using a separate online application. Many tasks need to be thought about:

* The hardware
* Hardware architecture
* Software interaction with the hardware
* Language to run on the hardware
* Storing the data
* Transferring the data from the device (to a possible server? Or online web storage)
* Retrieving data for the visual application
* Displaying the data that is appealing
* Implement various tools to easily filter visual data

Assumptions:

* Microcontroller will be needed
* Data will be uploaded via WiFi to a server or data storage

**The problem (based on air pollution report [1])**

“Each year in the UK, around 40,000 deaths are attributable to exposure to outdoor air pollution” 9.5K of these deaths are in London alone. The air pollution causes and increases the chance of health risks, this can out a strain on the British health service, even more than there already is. This pollution can start effecting life less than 1 month old

At the start of 2017, London pollution level hit a 10 out of 10 on a air quality index.

“Research is beginning to point towards effects on growth, intelligence, and development of the brain and coordination.”

“The health problems resulting from exposure to air pollution also have a high cost to society and business, our health services, and people who suffer from illness and premature death. In the UK, these costs add up to more than £20 billion every year.”

The report summarises actions that should be taken into account to combat the situation and resolve the problem. One item on this list is to “monitor air pollution effectively” using the results to educate the public in a proactive way that everyone can understand. This project aims to complete this task.

**The Hardware**

Air quality sensors are not a common component, this means that the sensor can be expensive when detecting all the criteria air pollutants (known internationally for measuring air quality levels). As this is the case, a sensor will be used that can detect particulates, a single gas or multiple gases from the known pollutants and will act as a “proof of concept”. A microcontroller will be needed to handle the data. I propose a distro of linux is used for the operating system on the microcontroller as it is free and has plenty of online support.

Sensor



Product name: Air Quality click mikroBUS™

Link: <https://uk.rs-online.com/web/p/products/8829020/?grossPrice=Y&cm_mmc=UK-PLA-DS3A-_-google-_-PLA_UK_EN_Semiconductors-_-Semiconductor_Development_Kits%7CProcessor_And_Microcontroller_Development_Kits-_-PRODUCT+GROUP&matchtype=&gclid=EAIaIQobChMInNOv1ZSF2QIV4bvtCh3ggA5rEAQYCSABEgJrfPD_BwE&gclsrc=aw.ds>

Detection: ammonia , nitrogen oxides, benzene, smoke and CO2

Comments: used with a microbus socket. Esentially plug in and use but needs the microbus socket and library to use. Documentation does not state whether this is used for gas detection or gas concentration values.

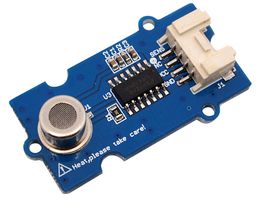


Product name: ams IAQ-CORE P, Air Quality Sensor (also ams IAQ-CORE C available but unsure what the difference is).

Link: <https://uk.rs-online.com/web/p/colour-light-sensors/1024163/>

Detection: CO2 and Volatile Organic Compounds (VOCs)- very large range of particulates

Comments: Uses I2C which is well supported by various microcontrollers. Site states indoor use. Gives output reading rather than just detection. Fast Response.



Product name: Grove Air Quality Sensor

Link: <http://cpc.farnell.com/seeed-technology/101020078/grove-sensor-air-quality/dp/MK00300?CMP=KNC-GUK-CPC-GEN-SHOPPING-SEEED-STUDIO-MK00300&gross_price=true&mckv=s1zE0zX66_dc|pcrid|224646285066|kword||match||plid||pid|MK00300|&gclid=CjwKCAiA-9rTBRBNEiwAt0Znw2GxHWOgwjvXHWYbyOyD9FsqonG5A0l7nQ8xzBFHJP3l3xnieg-7tRoC3mUQAvD_BwE>

Detection: carbon monoxide, alcohol, acetone, thinner, formaldehyde and other slightly toxic gases.

Comments: Does not state whether it detects or returns a reading. No datasheet online. Unknown socket.

GPS

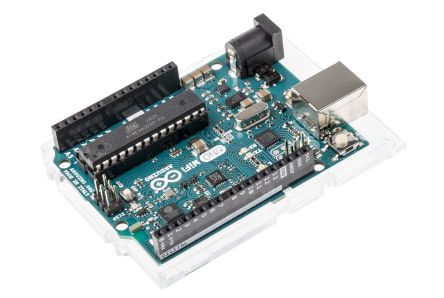


Product name: PmodGPS GPS Receiver

Link: <https://uk.rs-online.com/web/p/processor-microcontroller-development-kits/1346455/>

Comments: Easy to wire. Uses UART. Doesn’t require additional hats

Microcontroller



Product name: Arduino UNO Wifi Development Board

Link: <https://uk.rs-online.com/web/p/products/1113737/?intcmp=UK-WEB-_-BP-PB2-_-Jan-17-_-arduino>

Pros:

* Plenty of libraries and good online community
* Low power
* Cheap
* Supports Wifi
* Open Source
* IDE uses C++ but other languages can be used

Cons:

* Less powerful than other microcontrollers
* No OS
* Bad IDE
* No GPS



Product name: Raspberry Pi 2 Model B

Link: <https://uk.rs-online.com/web/p/processor-microcontroller-development-kits/8326274/>

Pros:

* Cheap
* Easy to install Linux
* Easy connectivity with components
* Supports languages that can be installed on linux
* Online community
* Uses its own OS rather than IDE

Cons:

* Closed Source
* Processing power not great (but should be good enough)
* Needs additional components for WiFi
* No GPS



Product name: Raspberry Pi 3 Model B

Link: <https://thepihut.com/collections/raspberry-pi/products/raspberry-pi-3-model-b>

Pros:

* All those of the Model 2
* Wireless LAN installed

Cons:

* Closed Source
* Processing power not great (but should be good enough)
* No GPS

**The Data**

The data that needs to be collected will be GPS and an air quality value. The GPS location will be used to identify where in the world the air quality value has been read. The air quality value will be used when visualising the data and will represent the air pollution level in that area.

The data will need filtering. Filtering techniques will need to be studied to remove any unacceptable data that may reduce the quality of data collected.

**Collecting Data**

A portable microcontroller will be needed to collect data for both GPS location and air quality. As distance is eventually limited on online map providers (e.g. you can’t measure centimetres) a few readings every m^2 would create an accurate averaged reading. The microcontroller will need to start collecting data as soon as it possibly can from power on. Using an operating system may slow the first reading time down.

**Storing Data**

Data needs to be stored as a network connected to the internet is not always possible.

**References**

[1] – The Royal College of Physicians (Published 2016) - [*Every breath we take: the lifelong impact of air pollution*](https://www.rcplondon.ac.uk/file/2914/download?token=qjVXtDGo)*, Accessed – 01/02/2018* [*https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution*](https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution)

[2] – Department for Environment, Food & Rural Affairs (Published September 2017) – *Air pollution in the UK 2016, Accessed 04/02/2018* [*https://uk-air.defra.gov.uk/library/annualreport/viewonline?year=2016\_issue\_2&jump=3*](https://uk-air.defra.gov.uk/library/annualreport/viewonline?year=2016_issue_2&jump=3)