

# Air Quality Mapping

Major Project – CS39440

Version 1.0 (Draft) – 8th February 2018

Robert Mouncer (rdm10@aber.ac.uk)  
Software Engineering MEng - G601  
Supervisor – Neal Snooke (nns@aber.ac.uk)

## Product Description

The Air Quality Mapping project will develop a monitoring and visualisation system for air pollution on public roads and in public areas.

Roughly 40,000 deaths within the UK are related to outdoor pollution levels, 9,000 of these deaths are in London alone. The education of communities about air pollution is a necessary step to combat climate change and reduce air pollution in urban areas. The aim is for a device to collect data on air pollution levels which will then display the information in a proactive way to the public. This information will be to educate the communities within areas about the quality of air that surrounds them.

A device will be designed and created to measure air quality levels and record a GPS location. The device should be a Raspberry Pi with compatible modules needed to take the measurements. Protocols will need to be considered to ensure the modules are compatible with the Raspberry Pi.

The air quality measurement will be a total volatile organic compound (TVOC) reading. Volatile organic compounds (VOC) can be generated from many different sources, including the burning of fossil fuels for automobility. Ideally a measurement of gases and particulates would be taken, but due to the extent of the project, measuring the TVOC in the air will act as a proof of concept for the full scope of what the project could be.

The air quality levels will be matched with a GPS location read by a GPS module on the device. The GPS location will be used to track where the air quality levels have been read.

The raspberry pi will use the python programming language to gather data as it is good for fast development. The application should be converted into C++ if the priority tasks are completed in time.

The data will be stored locally on the device until a known network (WLAN) is found. Once a known network has been successfully connected to, the data should be uploaded to either a server or file storage for further processing. Data that has been successfully uploaded will be deleted locally.

The project will then require an application to be created that can visualise the data in a proactive way. This application will use an online map providers API such as google maps or open street maps with an overlaying contour graph showing the pollution levels in different areas. The application should have various tools that can be used for educational purposes such as worst areas and what side affects you can experience in those locations.

A Kanban methodology will be used for this project to manage the work flow. The Kanban board is a nice way to visualise the work that needs doing, is in progress and the completed work. As agile methodologies are mainly used for teams rather than an individual, an individual process will need to be investigated and created.

A repository will be used on GitHub to store all files and source code for the project.

## Proposed Tasks

As there are two distinct tasks in this project, the device collecting data and the visual application. It has been decided to focus on one at a time. The visual application relies on the data collected from the device, and the only interaction between the two projects is the data.

**Investigation of air pollution** - It is necessary that it is fully understood what needs to be measured. An investigation should take place that will result in an understanding of air pollutants. VOC's will be measured but as a proof of concept for the full scale of what the project could be. An understanding of how VOC's are generated and the health hazards that can occur from VOC's entering our bodies will be necessary.

**Research and design of Hardware** - With little experience or knowledge of hardware, research should take place. This will involve compatibility, protocols and hardware selection. Once the hardware has been selected, a design task should take place to understand how the hardware will fit together, again research will be needed for the data sheets of the components and the protocols that will be used.

**Research for online map provider API's and GUI** - With no understanding of map API's, a lot of research will be necessary to understand how to use the API's to its full potential. Research of licenses will be necessary to understand what the API can be used for and any other conditions that may create problems. Research for GUI techniques and libraries will be necessary to create a proactive tool for visualising the data.

**Research of data filter techniques** - The data collected will need filtering to ensure it is reliable and can be used. Techniques will need to be researched on different filtering techniques.

**Development - Raspberry Pi Device for data collection** - Once the hardware has been put together and protocols between components is understood. Development for data collection should begin. The tasks at hand will be receiving data from components and saving it to an external SD card. Development of uploading data to online storage will also be a task. This task should be completed in Python later to be translated into C++.

**Development - Filtering of Data** - Once techniques have been researched the data should be filtered to ensure that the data is reliable and there are no inaccurate readings.

**Development - Visual Application** - Development of the visual application will require most of the attention. It is to be confirmed how the application will be created, whether in browser or as a separate application. GUI libraries will likely be used to create the contour plots.

**Supervisor Meetings and blog** - Each week a meeting with the supervisor should take place, this is to discuss the progress of the project and any technical challenges that might create a barrier for progress of the project. Each week a blog should be updated as a reminder of what has been completed and what has been learnt. This is for both the project owner and project supervisor.

## Project Deliverables

A list of deliverables that the project will contain:

**Outline Project Specification** - A document that states the work that will be carried out during the project. This document will be for others, including the supervisor, to understand what the project is about.

**Process Document** - A document to set the methodology that will be used during the project. This is to set in stone the process that will be undertaken during the project as it will be an adaptation of Kanban.

**Brief air pollution and hardware report** - This document will describe problems with air quality and health risks and why the hardware was chosen for the task.

**Requirements Document** - A document stating all the requirements needed for the project to be successful. This document will include functional and non-functional requirements that can be used to measure success of the project during testing.

**Data logging device with software** - The device's hardware should be complete with working software. This should log GPS and air quality and upload it for further processing.

**Visualisation application** - Software and Files should be produced to allow a visual representation of the data collected by the device. It should be easy to use and show the data in a proactive way.

**Mid-Project Demonstration** - A presentation should be completed with additional notes describing what was shown and discussed. Questions and answers should be documented.

**Test Report** - A fully documented set of results from testing both the data logging device and the visualisation application should be produced while testing is being carried out.

**Final Report** - This document will describe all work carried out during the project and should be submitted to Blackboard before the deadline date of the project.

**Final Demonstration** - A final demonstration of the work produced but no documentation will be created from this.

## Initial Annotated Bibliography

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

This report is aimed to educate what the affects of bad air quality can have on our bodies over a lifetime. It states what needs to be done to combat air pollution and one step is to “monitor air pollution effectively” and to use the results to communicate “proactively to the public”.

[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)

Each year the UK government release an air pollution report for the European commission.

[3] – Google Developers (2018), *Google Maps APIs*, Accessed 11 Feb. 2018 <https://developers.google.com/maps/>

Google maps API that may be used for the data visualisation tool.

[4] - Wiki.openstreetmap.org. (2018). *API v0.6 - OpenStreetMap Wiki*, Accessed 11 Feb. 2018 [https://wiki.openstreetmap.org/wiki/API\\_v0.6](https://wiki.openstreetmap.org/wiki/API_v0.6)

Open Street Map API that may be used for the data visualisation tool.