

Control Aire 1.0

Sava Taha
Maria Osman
Amal Al-Ammari
Fernanda Sanchez Ubilla

KTH Royal Institute of Technology
January 2021

Abstract

The issue indoors is to keep track of bad air quality. One of the main factors behind lung diseases and allergies is poor air quality, which is usually caused by mildew and allergens particles like dust and smoke, excessive or inadequate levels of humidity and gases like radon. Our solution to this problem is to provide our customers to analyse the air quality with different parameters, register and save measured data on the Control Aire 1.0 website.

Keywords → Control Aire 1.0, LCD display, BME680, sensors, VOC, Celsius, kOhms, hPa, ESP8266 esp-01, ThingSpeak, PIR sensor, RTC DS3231, TFT ILI9340

1. Introduction

Air quality is strongly impacted by air pollution in today's busy society. Breathing in the condition of contaminated poor air quality indoors include mildew and allergens particles like dust and smoke excessive or inadequate levels of humidity and gases like radon and carbon monoxide. Therefore, mildew and allergens like pollen animal dander and dust mite will lead to poor health issues. Long term use of breathing in polluted air has been associated with infections of the lungs, tumours, and other health issues. It is therefore critical to regulate and monitor air quality in order to maintain a comfortable and healthy indoor climate. [1]

Volatile organic compounds (VOCs) can be evaporated and transported into the environment under atmospheric conditions and are among the most dangerous air pollutants. [2]

VOCs affect human beings' health, in the forms of fatigue, dizziness, confusion, nausea, and other problems. Long-term exposure to VOCs can also cause many diseases such as anaemia, liver injury, central nervous system disorder and cancer, primarily leukaemia. Moreover, it is common that older people often spend 95% of their time indoors. The current situation with Covid-19 allows more people to operate from their homes, creating an even higher risk for poor indoor air quality. [3]

Price and ease of use are other concerns that need to be improved for similar products in the market for example Airthings Wave Plus air quality measurer and Eva Room indoor Air Quality.

Control Aire 1.0 is a product that can quickly and continuously keep track of indoor air quality. The product is designed to display measured values on a large LCD (TFT-ILI9340) display. TFT-ILI9340 has a width of 40.63mm and a length of 66.35mm. [4] Furthermore, it is designed to register values on the Control Aire 1.0 website. The product will detect and measure the temperature, humidity, pressure and gas by one component named BME680. The gases that the sensor will detect are different types of VOC, compounds such as alcohol, aldehyde and nitrogen. [5]

The BME680 sensor is highly requested among our customer segment and provides a unique feature to our product. Our customer segment is focused on elderly people. The purpose of developing our product is to provide access to measurement data in order to prevent diseases such as asthma and allergies. Another reason is to manufacture a product that is adapted for older people to have control over indoor air quality, this is done by providing a large screen and a website that can be used on any device that has a network. There is a large interest and demand in measuring air quality indoors.

2. Design

TFT-ILI9340 LCD

The design of the product is focused on practicality and ease of use. The large (TFT-ILI9340) LCD display contributes user friendly reading values and is especially adapted for our customer segment. In idle mode, a digital clock is displayed on the LCD screen.

TFT LCDs are very convenient and saving energy in today's society, which is a number one priority to minimize greenhouse gases and ensure a better future for the next generations. There are many different features that can be used and programmed in this LCD for example different colours, figures and so on. [4] [6]

Arduino Uno software

To be able to connect the hardware with all components, Arduino Uno is used. Arduino Uno is a development card which is also used for software development. Arduino Uno has its own program called Arduino IDE; this is where codes can be uploaded on the development card.

Printed circuit board

A PCB is used in order to get the system compact and flexible. The PCB is also used concerning the design, it allows the product to be more accurate for its functionality.

Before the printing process was done the PCB had to be designed in Fritzing. The connection of the hardware such as cables had to be visually transferred from the physical breadboard to the simulated breadboard in the software. The second part was based on placing the components together in a way where every module would fit inside the designed PCB.

Lastly, the PCB had to be designed with measures and component placement in a specific way where the connection of wires would not short-circuit each other. This was achieved by designing two types of wires, button and lower layer.

After converting the PCB simulation to a Gerber file, the printer started cutting and shaping a PCB based on what was designed and made. Soldering had to be made where each component had to be placed together in their specific holes.

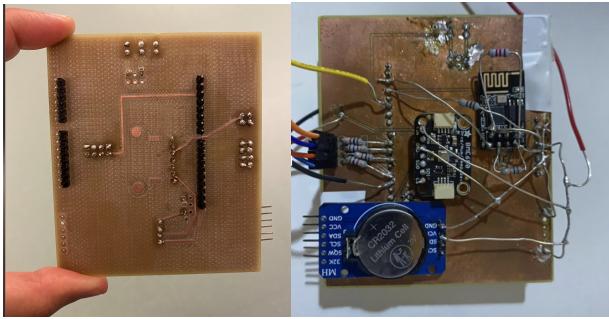


Figure 1: First picture is the back of the printed circuit board; second picture displays the front.

3D-design

The following design was created in the software Solidworks, where it is a program used for modelling and designing components.

The design of the product was inspired by the webpage Thingiverse. It is an online page where many design ideas created by individuals with different backgrounds are shared through a digital design file. To be able to 3D-print the designed product, the project has to be converted to an STL file, so the 3D printer can print out.

In figure 2 there are four pictures with the product 3D design from different angles. The small hole in the middle of the front (picture 3 figure 2) is where the movement sensor will be placed, the above empty square is where the LCD display will be attached and inside, behind the front the PCB and Arduino will be placed inside there and shut with a cover.

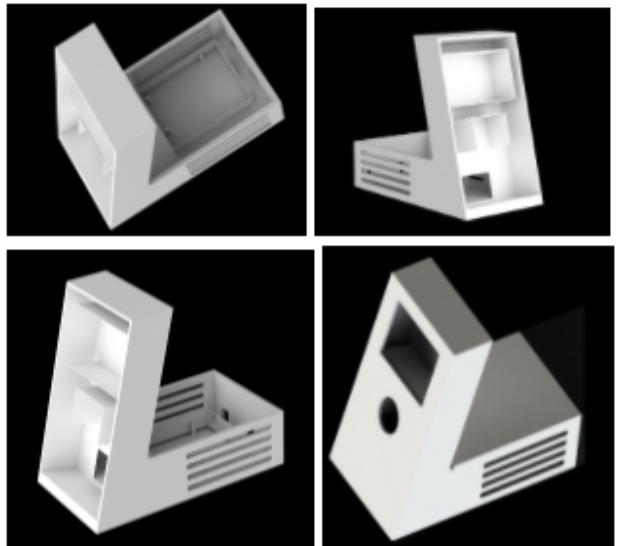


Figure 2: The four images are illustrations of the 3D design in different angles.

3. Evaluation

The ideal indoor temperature values in summer or winter are around 18 to 20 Celsius degrees. Temperatures over 24 Celsius degrees are unsafe and bad for heart conditions. Temperatures under 9 Celsius degrees could be a risk for hypothermia. [7]

Humidity is the measure of the moisture level in the air around humans. Humidity levels are ideally between 30-50%. Increased above 50% humidity levels indoors can negatively impact the internal body temperature. Other issues can be growths of fungus, mould and dust, which can cause breathing difficulties. Low humidity levels can cause health problems as well as electrical components can be damaged if the humidity is not correctly customised. [8]

The gas detecting function including VOCs is resistance where the measured value detects harmful gases.

To evaluate the system, the product runs in two modes. In idle mode, the product displays a digital time clock. In motion mode, the PIR sensor detects movements. In this mode, measurement data is displayed on the TFT LCD at the same time as data is sent to the ThingSpeak channel.

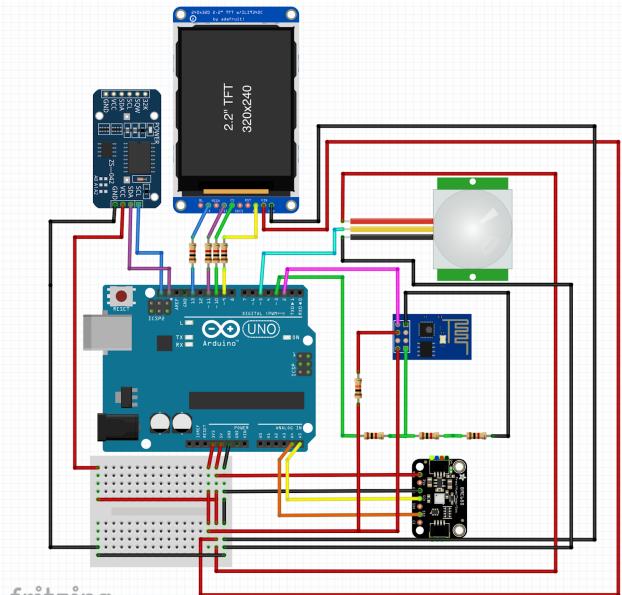


Figure 3: Breadboard connection on Fritzing

ThingSpeak is a tool for IoT analytics that helps you to aggregate, visualize, and analyse live cloud data feeds. You can upload data from your devices to ThingSpeak and generate instant live data simulation as well as send updates. [9]



Figure 4: The product detects temperature, humidity, pressure and gas through BME680, which is connected to Arduino. Thus, measured data will be sent via Wi-Fi module (ESP8266) to ThingSpeak channel where registered data will be stored in the form of graphs. The user can thereby get access to the stored data from any smartphone or computer.

The program runs a function test in figure 5 where it measures data based on normal room temperature/humidity/pressure/gas conditions compared to measurements where these are affected by external environmental changes.

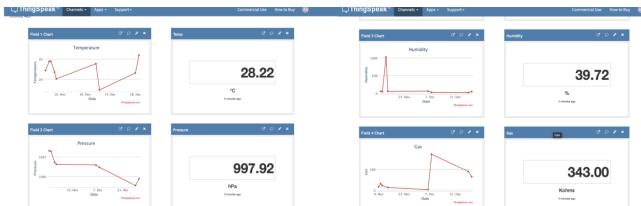


Figure 5: The data is sent and registered every 15 seconds for one month. As a user, there is a possibility to choose the timescale on the ThingSpeak channel. The timescales provided are: daily, hours, minutes and seconds.

The temperature is measured in Celsius degrees ($^{\circ}\text{C}$), the humidity is measured in percent (%), the pressure is measured

in Pascal (hPa). Lastly, the gas measured in Ohms (kOhms). The built-in variable resistor in the BME680 sensor changes its values according to the concentration of gas. If the concentration of gas is low, the resistance increases, if the concentration of gas is high, the resistance will decrease.

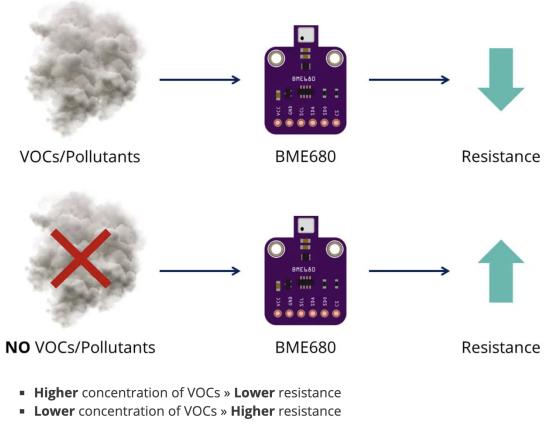


Figure 6: High resistance value indicates good air quality and no VOCs/pollutants, low resistance value indicates VOCs/pollutants in the air. [10]

Sensor	Accuracy
Temperature	+/- 1.0 °C
Humidity	+/- 3 %
Pressure	+/- 1 hPa

Figure 7: BME680 precision sensor can measure humidity with an accuracy of ± 3 percent, barometric pressure with an absolute precision of ± 1 hPa and temperature with an accuracy of ± 1.0 $^{\circ}\text{C}$. [10]

In future plans, the product can be developed further. One of the ideas is to attach the device with other products such as air humidifier, air cleaner and ventilation. Secondly, a sound function can be added in the system to detect low quality to make it suitable for all individuals mainly with vision problems.

Additionally, the design can be further developed in complementation of practicality. The idea is to provide the customers button pressures that will guide them into desired settings. The design can grow into being more user friendly, which can include a colour coding scheme that indicates how hazardous the air quality is on the TFT LCD display.

4. Conclusions

Poor air quality can mean dangerous gases, increased temperature, or increased humidity, leading to serious health conditions. By keeping an eye on air quality, precautionary measures can be taken to reduce health risks. Therefore, Control Aire is recommended for those who want to keep track of indoor air quality and at the same time make healthier choices in everyday life.

The product developers have specified extra around design; a light and user-friendly product was a high priority. The product's special TFT-LCD screen has a high resolution

and makes reading easier. The product allows you to place it wherever you want.

Control Aire 1.0 is a modern, yet useful product that is multifunctional. In idle mode, the product displays a real time clock. When movements are detected the measured air quality values will be displayed on the screen and be saved on the website.

Improvements can be done for the future developer, there are a few features that can be added. The plan is to connect a humidifier, and a setting for sound system for different measurements.

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