Project Report

First airbenders

Comfort Home report

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## Abstract

This report describes our approach, progress and results regarding an autonomous sensor module and corresponding application.

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Comfort Home

# Introduction

Initially, the project group wanted to achieve an automatic climate environment that does not necessarily need constant human regulation. This can be achieved through a sensor module that sends measurements to an application that then analyses and visualizes the results. Furthermore, air quality can be improvement by means of a ventilation box, which is controlled automatically or by the user himself. You’ll learn more about the approach, planning, designs, necessary means and more in the upcoming sections.

# Procedure

This sections contains information on the approach and the planning. It showcases the setup in order to achieve the wanted result and associated problems and solutions.

## Project background

As mentioned in the introduction, the project group wanted to achieve an automatic climate environment that does not necessarily need constant human regulation. This is a general description, as it doesn’t clarify the values to be measured and the corresponding actions to be taken based on these measured values. The values to be measured are: carbon dioxide, volatile organic compounds, humidity and temperature. Several sensors are programmed in order to measure these values:

* CM1106 sensor to measure carbon dioxide;
* SHT30 sensor to measure temperature and humidity;
* IAQ-Core sensor to measure volatile organic compounds.

These sensors are connected to an STM32 Nucleo-64 development board with an STM32F303RE microcontroller unit. An ESP8266 microcontroller is connected to the STM32 Nucleo-64 development board in order to send the measured values to a C# application. These values will be stored and visualized in the aforementioned C# application in order to take adequate actions, which is performed either automatically by the application or manually through the user interface of the C# application. The ventilation box, which is a fan wired to an Arduino, is connected to the computer which also runs the C# application. All the aforementioned sensors, boards and application have to be manually programmed in order to build an autonomous system that can improve the indoor air quality. Among other things, the planning follows in the upcoming paragraph.

## Project statement

Project aim and purpose

The project should provide for an autonomous system that improves the indoor air quality.

### Project planning

The project group refers to the following document to get a better understanding of the project planning and communication:



### Project objectives

The objective of this project is to accomplish a system that has several sensors working together on top of a development board in order to communicate with an application which stores and visualizes data and handles the indoor climate through a ventilation box.

### Out of scope

The sensor module will not contain a graphical interface, i.e. it will not have any other interaction as for powering on/off and showing the current statuses using the built-in LED’s.

### Benefits Identification

The general purpose of this project is to improve individual knowledge and teamwork skills in the form of goal-oriented collaboration. This will also benefit future projects, as each member now has the necessary skills to fulfil deadlines and deliver a full-fledged product. As so, in addition, a physical product will be delivered as a result of the acquired skills.

### Research of previous/existing projects

Previous HTTP servers have been made, which servers as a general template for the necessary connection between the application and sensor module. In addition, existing libraries for each sensor will be used as an example to get a general concept, and thus will be heavily modified in order to meet customer demand and the intended result. Existing products such as thermostats (with a graphical interface) have also been used by the project group as an existing concept to get ideas.

### Equality and diversity

The target group for this are people owning/renting a house who have difficulties ventilating and understanding the indoor air quality and which are willing to buy a system that (automatically) visualizes and improves this. However, the graphical user interface should be accessible to anyone of any age who is able to understand and read from it.

### Results

This sections contains information on the implementation and results. It showcases the necessary tasks, designs and architecture to make a fully coherent system.

# Process and results

## System architecture

The system architecture can be described as follows: multiple sensor modules can be connected to the HTTP server (C# application). Next, the server sends the data to the worker, which processes it and sends it to the readings, which stores the data in a database and visualizes it in the user display. The fan then can be either adjusted manually, using the user interface, or controlled automatically by the system.

A picture containing screenshot

Description automatically generated

## Wiring diagram

The wiring diagram contains information on the wiring of the sensors and connections between the application and the Nucleo-F303RE (sensor module) and Arduino Uno (ventilation box).

A screenshot of a cell phone

Description automatically generated

## State diagram

A state diagram is used to describe the behaviour of systems. There are two state diagrams for each subsystem: the embedded board (sensor module) and the C# application.

*Embedded board states*

A screenshot of a cell phone

Description automatically generated

*C# application states*

A screenshot of a cell phone

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## Control flow chart

The control flow chart visualizes the communication between the sensors, application and ventilation box.

A picture containing clock

Description automatically generated

# Conclusion and recommendations

It was joyful to have worked on this project. The project group would encourage anyone willing to improve their indoor air quality to build a similar system, depending on their needs. It gives great fulfilment once the system is up and running. The system could be expanded by adding more sensors to the sensor module, or simplified by removing sensors or by removing the ventilation box to only visualize the readings. You are only limited to your own boundaries!

# Evaluation and reflections

The teamwork was slow and there were many setbacks due to the current COVID-19 pandemic. However, we managed to get back up and improve the teamwork process. We managed to organize the teamwork online through GIT, mail and messenger. This has been a great learning experience and will definitely be an encouragement for future projects, since we have come through difficult times through cooperation.