Concept Description

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Proseminar Group: PS-703080-1, Team2

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1. System Overview

This software is a total solution for immediate and long-term indoor climate monitoring in office buildings. Based on the measurements the system not only improves the working conditions for Users in offices, but also offers the possibility of using and purchasing smart office applications based on the underlying long-term data.

For the analysis of the room climate, Arduinos with corresponding sensors for measuring temperature, humidity, air quality, noise pollution and light intensity are used. The devices are equipped with a light-emitting diode that provides live feedback on measurements and therefore are used to notify persons in a certain room of individually configurable measurement-violations.

The long-term monitoring of the indoor climate is ensured by data which is collected and displayed web-based under restriction of data-protection law.

Users have insight in daily, weekly and monthly measurements of their own office, conference-rooms and recreation rooms within their own department.

Head of Departments additionally are provided with cumulated data for all rooms of the corresponding department in the same manner as Users are.

Higher Management and Facility Administration have insight in cumulative data for the whole building to improve and react to general room-climate within the building.

For a better overview all data is graphically visualized in diagrams.

The features of the web-based monitoring application further include user management and sensor configuration as well as entering absences of Users in the system to take them into account in the evaluation of the collected data. As a convenient way for users to keep an overview of the conditions, users can subscribe to daily/weekly/monthly indoor climate reports via email.

2. Use Cases

2.1. Actors

Users

An Users has an account for the software and has access to the room climate data.

Facility Manager

The Facility Manager oversees configuring the limit values of the sensors and registering/deleting sensors of a specific room.

Department Manager

Has insights into cumulative room climate analysis and is responsible for the control of heating and air conditioning.

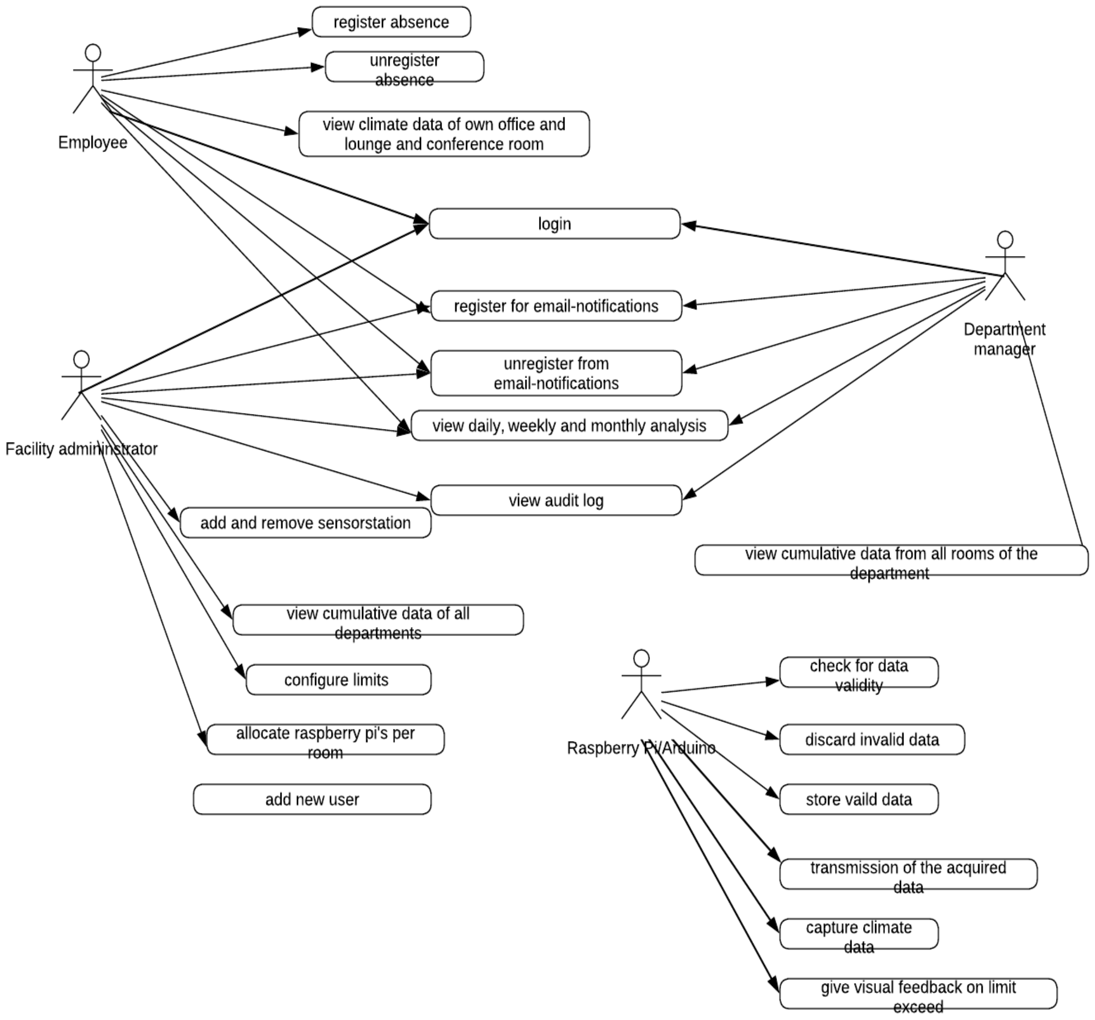
RasberryPi/Backend

The raspberry pi's are receiving the data from the sensors and are checking them for validity. Valid data is then stored in a database.

Sensors

The sensors capture various room climate informations such as temperature, humidity, airquality, etc.

2.2. Use-Case Diagram


Employee
register absence
unregister absence
view climate data of own office and lounge and conference room
login
register for email-notifications
unregister from email-notifications
view daily, weekly and monthly analysis
view audit log
Department manager
Facility admininstrator
add and remove sensorstation
view cumulative data from all rooms of the department
view cumulative data of all departments
configure limits
allocate raspberry pi's per room
add new user
Raspberry Pi/Arduino
check for data validity
discard invalid data
store vaild data
transmission of the acquired data
capture climate data
give visual feedback on limit exceed

2.3. Use Cases

2.3.1.Employee

Register absence

- **Precondition:** User have to login and have the role “Users” or higher.
- **Procedure:** The user selects an interval of absence days (from – to) and register themselves for that interval as absent.
- **Success**: The user has been registered for that interval of days for its absence.
- **No success:** -
- **Involved Classes:** Users, Absence, AbsenceReason, SchedulerTaskConfig

Unegister absence

- **Precondition:** User have to login and have the role “Users” or higher and has already registered for absence.
- **Procedure:** User selects which days or an interval of days he/she wants to unregister.
- **Success**: Days or the interval of days have been unregistered.
- **No success:** -
- **Involved Classes:** Users

View climate data of public rooms

- **Precondition:** User have to login and have the role “Employee” or higher.
- **Procedure:** User selects from which room the data should be retrieved.
- **Success**: User sees the data from the selected room.
- **No success:** User gets an email with a failure report.
- **Involved Classes:** Users, Room, Department, Measurement

View climate data of own office

- **Precondition:** User have to login and have the role “Users” or higher and also the user has to be register as employee of that office.
- **Procedure:** User submits on the tab/button his own office to view the data.
- **Success**: User see’s the view of data of his/her own office.
- **No success:** User get a failure email with the report.
- **Involved Classes:** Users, Room, Department, Measurement

2.3.2.Facility Manager

Add sensor station

- **Precondition:** User has to login and has the role “Facility Manager” or higher. The sensor station must not be damaged.
- **Procedure:** User registers a sensor station for a particular room (possible requirements e.g. room number, sensor id, etc.)
- **Success**: Sensor for the selected room has been added.
- **No success:** -
- **Involved Classes:** Facility Manager, Department, Room, Sensor

Remove sensor station

- **Precondition:** User has to login and has the role “Facility Manager” or higher. The sensor station must be already registered.
- **Procedure:** User selects the room and the sensor to be removed.
- **Success**: The sensor for that room has been successfully removed.
- **No success:** -
- **Involved Classes:** Facility Manager, Department, Room, Sensor
-

View cumulative data of all departments

- **Precondition:** User has to login and has the role “Facility Manager” or higher. Sensor stations must be registered. The connection between the sensors, raspberry pi and backend must be stable.
- **Procedure:** User can click on a tab/button to view all cumulative data of all departments.
- **Success**: User gets a view (graphical or numerical) of all departments.
- **No success:** User gets an email notification.
- **Involved Classes:** Facility Manager, Department, Sensor, Measurement

Configure limits

- **Precondition:** User has to login and has the role “Facility Manager” or higher. The connection between the sensors, raspberry pi and backend must be stable.
- **Procedure:** User selects the sensor station and then proceed to the configuration of limits in the shown dialog.
- **Success**: Limits have been changed and saved.
- **No success:** -
- **Involved Classes:** Facility Manager, Department, Room, Sensor

Allocate Raspeberry Pi’s per room

- **Precondition:** User has to login and has the role “Facility Manager” or higher.
- **Procedure:** User submits the tab/button to select the room and then allocates the raspberry pi to that room.
- **Success**: Rasberry Pi is allocated to that room and can exchange data with the sensor station and the backend.
- **No success:** -
- **Involved Classes:** Facility Manager, Department, Room

2.3.3.Department Manager

View climate data from all rooms of the department

- **Precondition:** User has to login and has the role “Department Manager”.
- **Procedure:** User submits on the tab/button his department to view the data.
- **Success**: User can view the selected data.
- **No success:** User receives an error message
- **Involved Classes:** Department, Room. SensorStation
- **View cumulative data from all rooms of the department**
- **Precondition:** User has to login and has the role “Department Manager”.
- **Procedure:** User submits on the tab/button his department to view the data.

- **Success**: User sees the cumulative data from all rooms of his/her department,
- **No success:** User receives an error message,
- **Involved Classes:** Department, Room. SensorStation

2.3.4.Facility Manager/Department Manager

View audit-log

- **Precondition:** User has to login and has the role "Facility Manager", "Department Manager" or higher.
- **Procedure:** User submits on the tab/button.
- **Success**: User gets a view of the timestamp, the user and the event occurred.
- **No success:** -
- **Involved Classes:** Facility Manager, Department Manager, AuditLog

2.3.5.Users/Facility Manager/Department Manager

Register for email notifications

- **Precondition:** User has to login and has the role "Employee" or higher and must be active.
- **Procedure:** User goes to his/her user settings and submits the daily, weekly, monthly or off button.
- **Success**: User gets email notification of the selected interval.
- **No success:** -
- **Involved Classes:** Users, MailInterval

Unregister for email notifications

- **Precondition:** User has to login and has the role "Users" or higher and must be active.
- **Procedure:** User goes to his/her profile and submits the "OFF" button to unregister hisself.
- **Success**: User does not get any further notifications as email.
- **No success:** -
- **Involved Classes:** Users, MailInterval

View daily/weekly/monthly analysis report

- **Precondition:** User has to login and has the role "Users" or higher.
- **Procedure:** User submits on tab/button to view the report.
- **Success**: A view with the daily, weekly and monthly report will appear to the user.
- **No success:** -
- **Involved Classes:** Users, Room, Department,Measurement,Sensor

2.3.6.Rasberry Pi/Backend

Check for data validity

- **Precondition:** Data was successfully received from the Arduino sensors in intact form.
- **Procedure:** Every transmitted data gets checked by a predefined condition on validity.
- **Success**: Data was intact and will either be discarded or stored in the database.
- **No success:** -

- **Involved Classes:** SensorStation

Discard invalid data

- **Precondition:** Data was checked and doesn't fulfil the predefined condition.
- **Procedure:** The invalid data will be discarded and therefore not stored in the database.
- **Success**: Data was not stored in the database.
- **No success: -**
- **Involved Classes:** SensorData

Store valid data

- **Precondition:** Data was checked and fulfils the predefined condition.
- **Procedure:** Makes a call to the specific REST method and stores it via POST in the database.
- **Success**: Data is stored in the database
- **No success:** Data won't be stored in the database
- **Involved Classes:** Sensor,Measurement,Room,Department

2.3.7.Sensors

Give visual feedback on limit exceed

- **Precondition:** Limit has been individually set and is configured, Sensor is active and working
- **Procedure:** Sensor measures a certain value, System checks if the measurement exceeds the limit
- **Success**: The visual feedback on limit exceeded is provided by the defined color/flashing of the given LED
- **No success:** visual feedback is provided if limit not exceeded, no visual feedback provided if limit is exceeded
- **Involved Classes:**

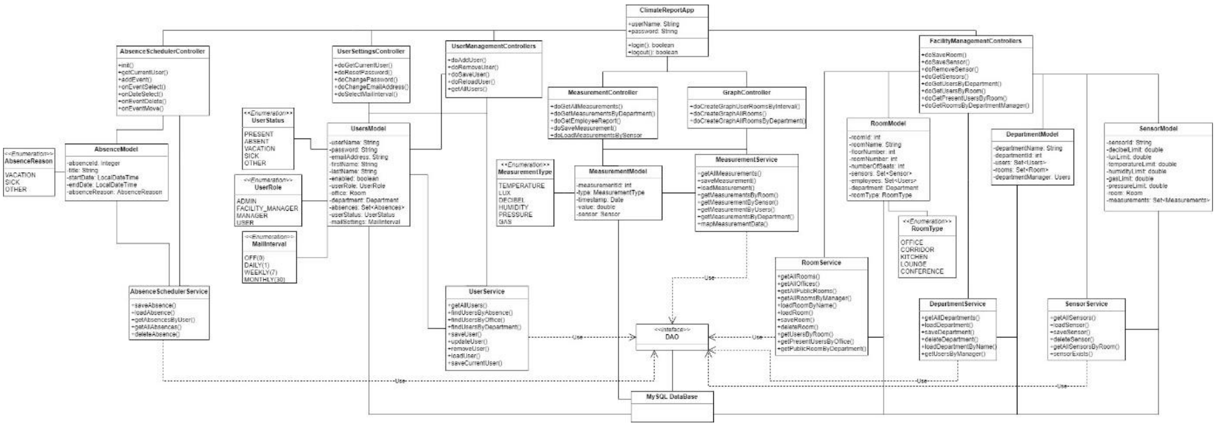
Capture climate data

- **Precondition:** Arduino is running and connected to the system, sensors are working
- **Procedure:** The sensors measure climate data permanently in given time intervals
- **Success**: data is captured
- **No success:** no data is captured
- **Involved Classes:**

Transmission of the acquired data

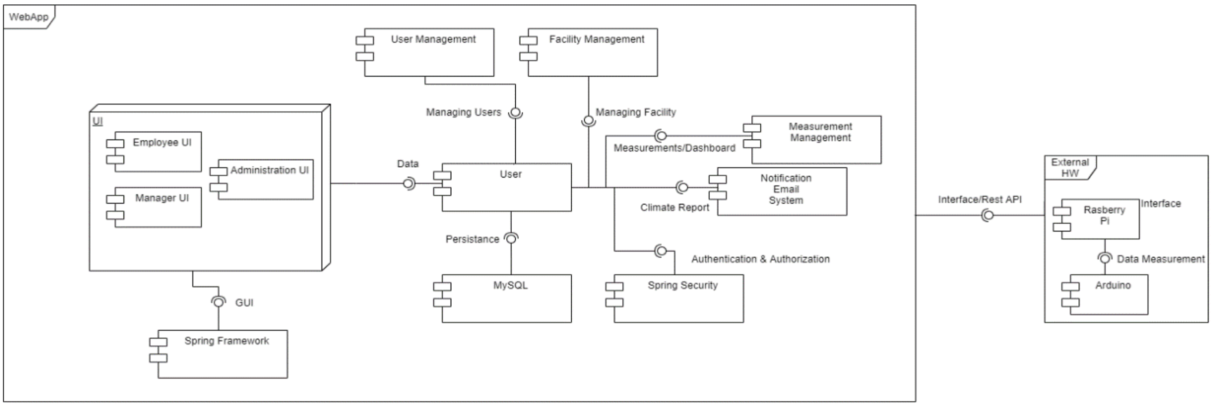
- **Precondition**: Data is captured by the sensors, Arduino is connected to the system
- **Procedure:** Data is transmitted via defined Bluetooth standard to the system where further processing takes place
- **Success**: All Data is transmitted correctly
- **No success:** Data is not transmitted, corrupt or only partially transmitted
- **Involved Classes:**

3. Class Diagram



4. SW-Architecture

4.1. Component Diagram



4.2. Selected Technologies

4.2.1.Java

Java is an object-oriented programming language by Sun Microsystems (Oracle). Its benefit is that it runs on a virtual machine and is therefore platform independent. The server part this system is written in Java.

4.2.2.Spring

Spring is an open-source framework for Java. It supports the programmer by providing the Simplifies development with Java and promotes good programming practices. Additionally, Spring Boot used, which facilitates the rapid implementation of an independent, executable system.

4.2.3.Java Server Faces (JSF)

JSF is a framework standard for developing graphical user interfaces for web applications.

4.2.4.Prime Faces

A component framework like Prime Faces extends a JSF implementation. It enables that easy generating of JavaScript and Ajax.

4.2.5.Apache Maven

Maven is a build management tool based on Java and also is primarily intended to manage Java programs. Developers should be like that in all areas be supported, so that very little custom configuration is required.

4.2.6.MySQL Database

H2 is a relational database management system written in Java and available as an open-source software for Java is available. SQL or JDBC can be used to address ORM is also possible in combination with Hibernate.

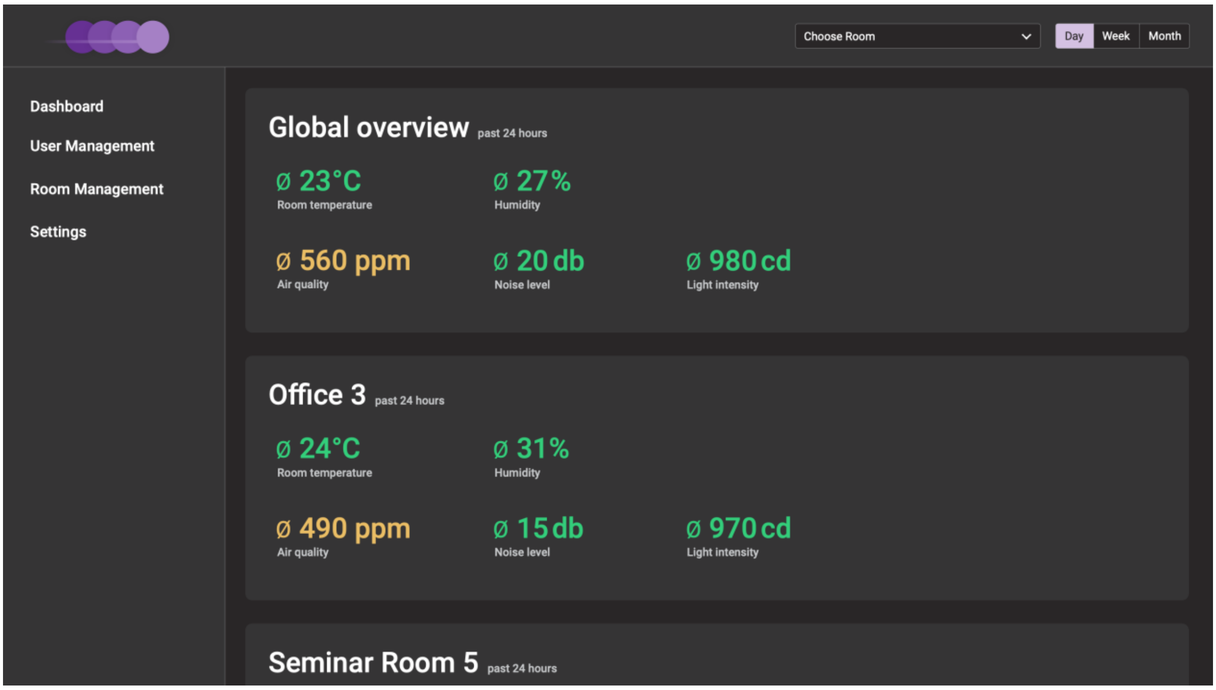
4.2.7.JUnit

JUnit is a framework for testing Java programs, this project will use it written automated unit tests.

4.2.8 Docker Compose

Docker compose is a framework to deploy the web application as well as the MySQL database.

1. GUI Prototype



Global overview past 24 hours

ø 23°C Room temperature

ø 27% Humidity

ø 560 ppm Air quality

ø 20 db Noise level

ø 980 cd Light intensity

Office 3 past 24 hours

ø 24°C Room temperature

ø 31% Humidity

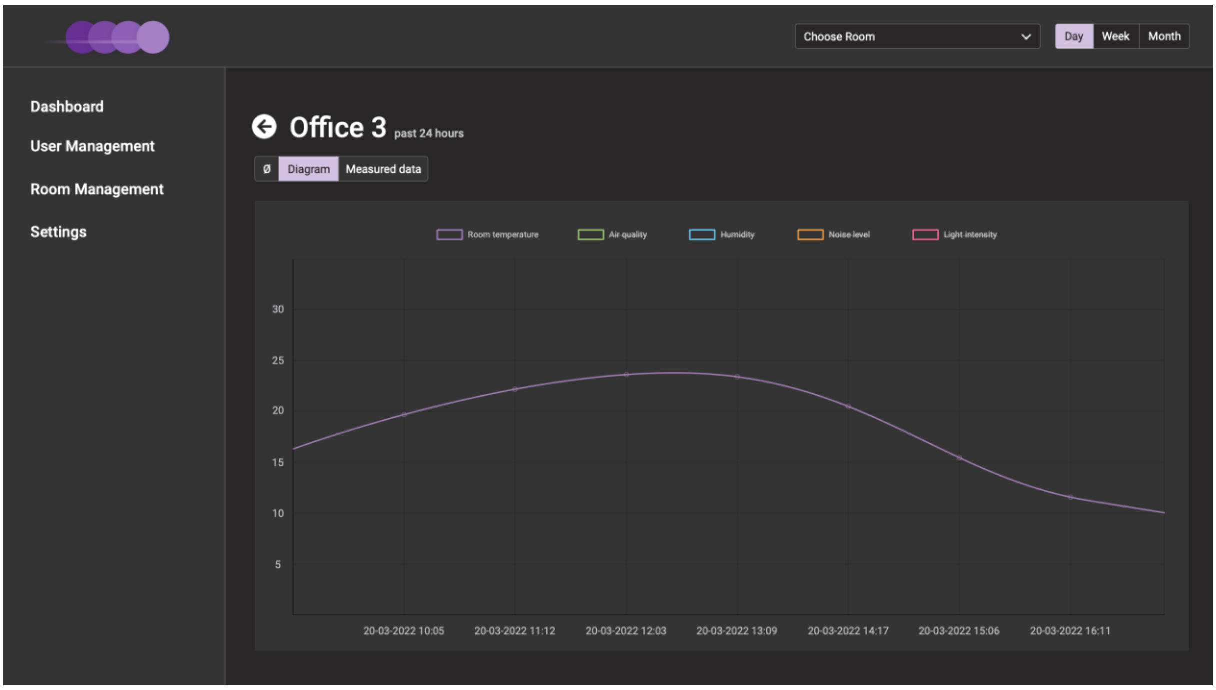
ø 490 ppm Air quality

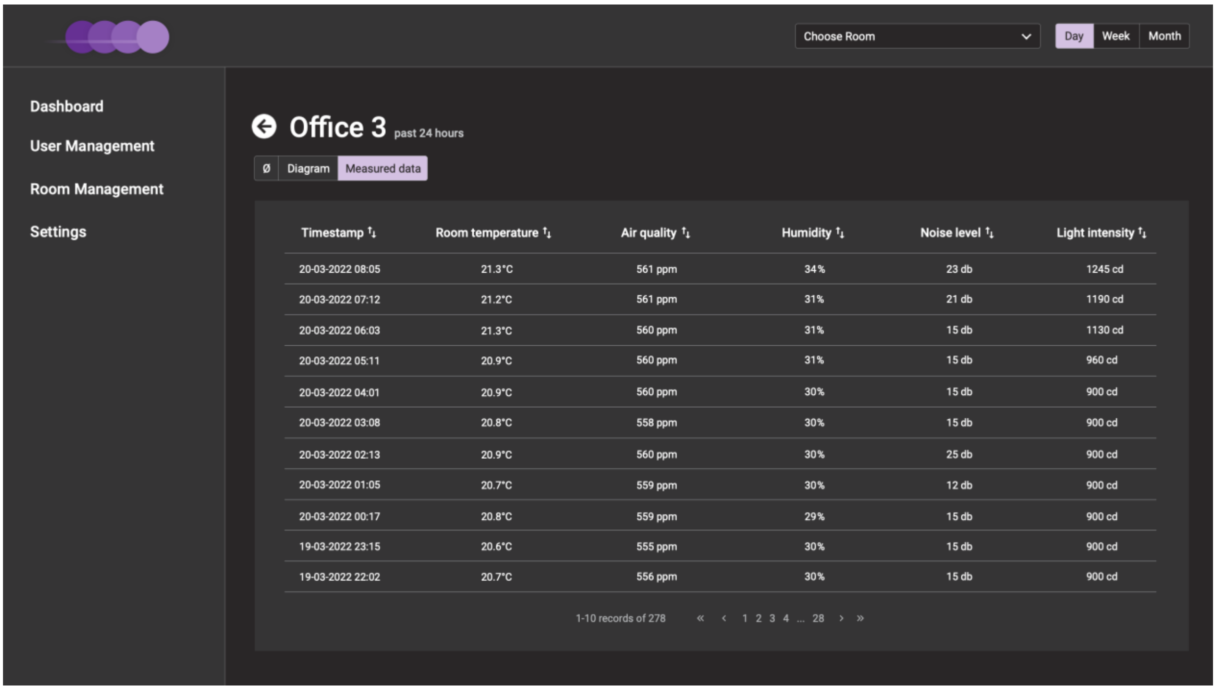
ø 15 db Noise level

ø 970 cd Light intensity

Seminar Room 5 past 24 hours

Dashboard / Starting page (view of Admin user)



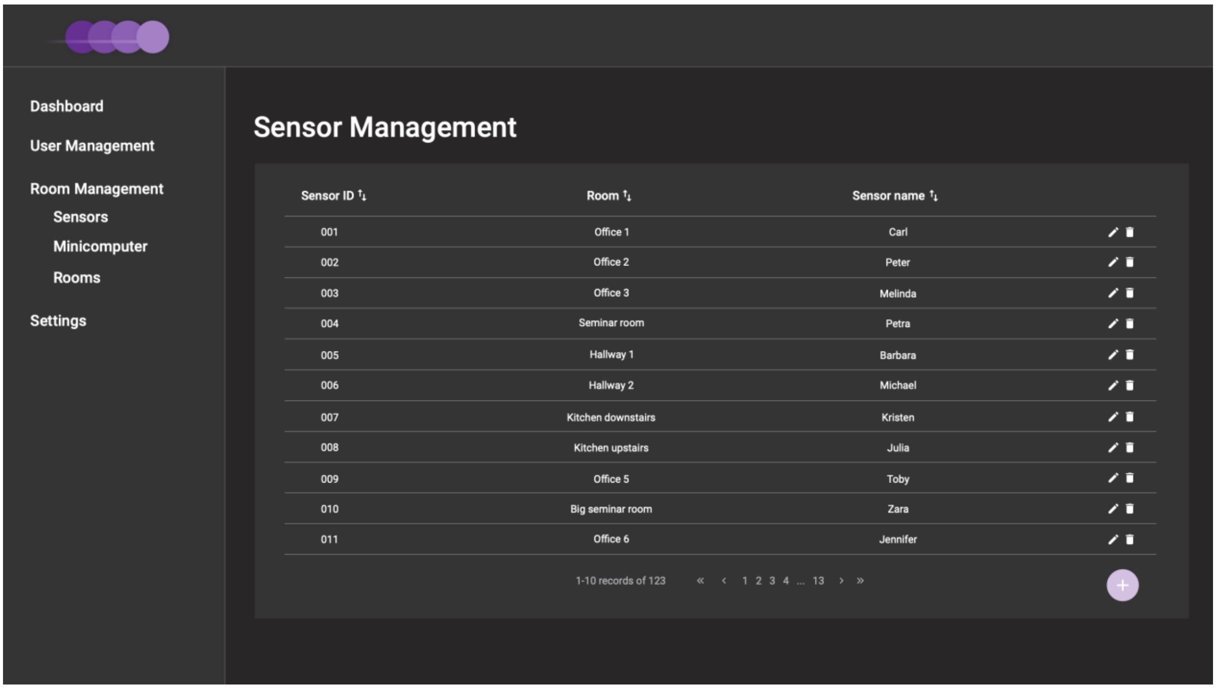


Timestamp ↑↓	Room temperature ↑↓	Air quality ↑↓	Humidity ↑↓	Noise level ↑↓	Light intensity ↑↓
20-03-2022 08:05	21.3°C	561 ppm	34%	23 db	1245 cd
20-03-2022 07:12	21.2°C	561 ppm	31%	21 db	1190 cd
20-03-2022 06:03	21.3°C	560 ppm	31%	15 db	1130 cd
20-03-2022 05:11	20.9°C	560 ppm	31%	15 db	960 cd
20-03-2022 04:01	20.9°C	560 ppm	30%	15 db	900 cd
20-03-2022 03:08	20.8°C	558 ppm	30%	15 db	900 cd
20-03-2022 02:13	20.9°C	560 ppm	30%	25 db	900 cd
20-03-2022 01:05	20.7°C	559 ppm	30%	12 db	900 cd
20-03-2022 00:17	20.8°C	559 ppm	29%	15 db	900 cd
19-03-2022 23:15	20.6°C	555 ppm	30%	15 db	900 cd
19-03-2022 22:02	20.7°C	556 ppm	30%	15 db	900 cd

1-10 records of 278 « ‹ 1 2 3 4 ... 28 › »

Detail view: diagram

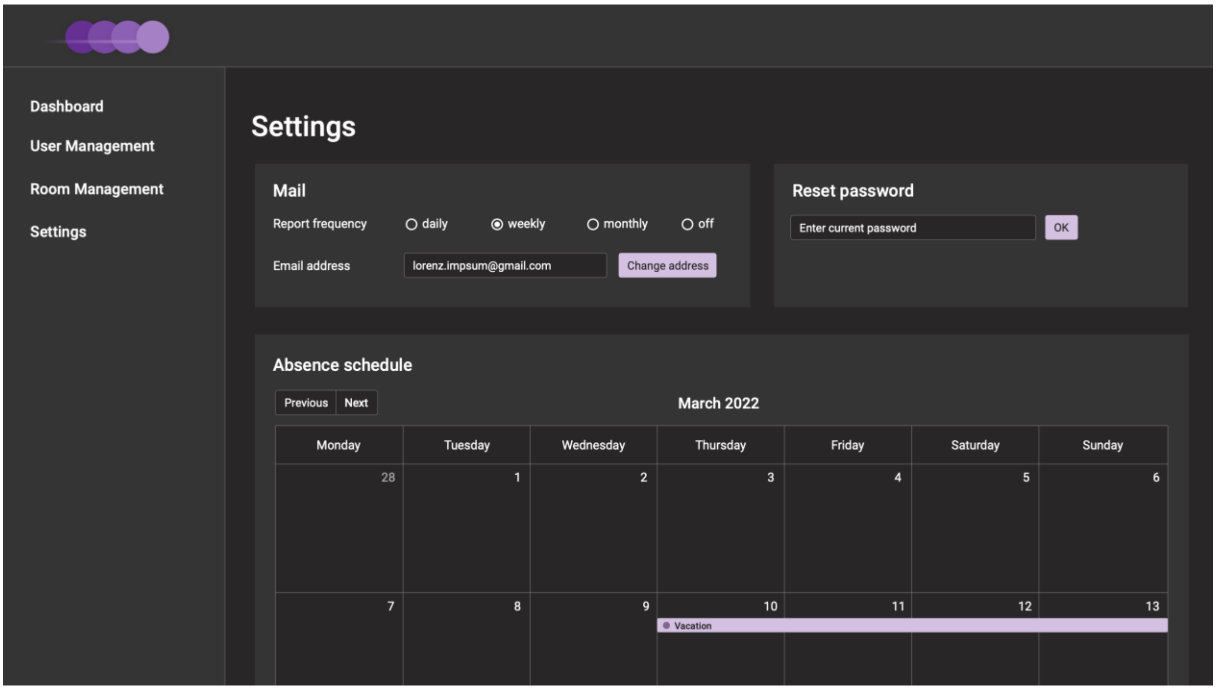
Detail view: table



Sensor Management

Sensor ID ⇅	Room ⇅	Sensor name ⇅	
001	Office 1	Carl	✎ 🗑
002	Office 2	Peter	✎ 🗑
003	Office 3	Melinda	✎ 🗑
004	Seminar room	Petra	✎ 🗑
005	Hallway 1	Barbara	✎ 🗑
006	Hallway 2	Michael	✎ 🗑
007	Kitchen downstairs	Kristen	✎ 🗑
008	Kitchen upstairs	Julia	✎ 🗑
009	Office 5	Toby	✎ 🗑
010	Big seminar room	Zara	✎ 🗑
011	Office 6	Jennifer	✎ 🗑

Room management: sensor management (similar view for minicomputer, user and room management)



Settings

Mail

Report frequency ○ daily ● weekly ○ monthly ○ off

Email address lorenz.impsum@gmail.com

Reset password

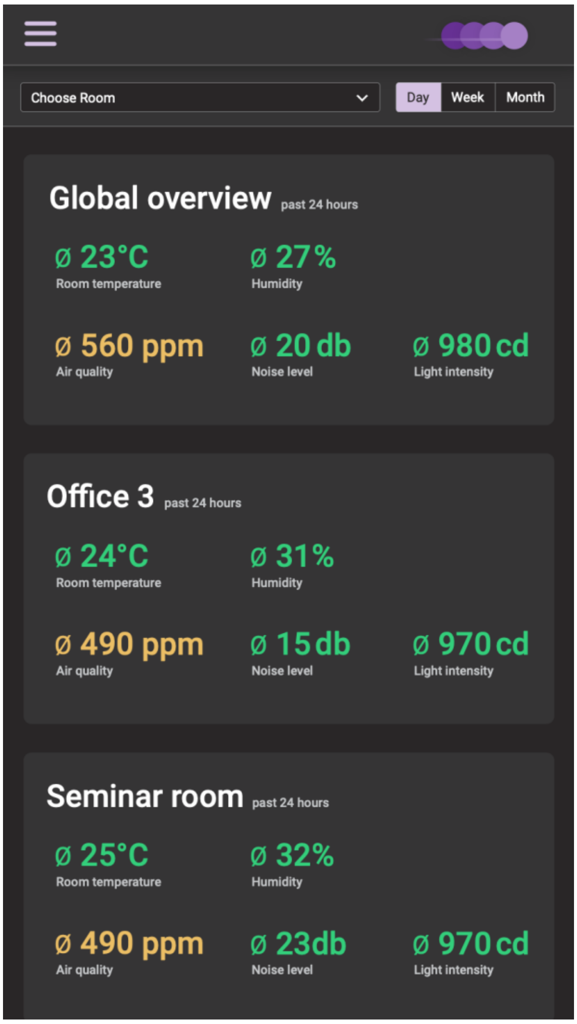
Enter current password

Absence schedule

March 2022

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
28	1	2	3	4	5	6
7	8	9	10 ● Vacation	11	12	13

Settings



Global overview past 24 hours

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ø 980 cd Light intensity

Office 3 past 24 hours

ø 24°C Room temperature
ø 31% Humidity
ø 490 ppm Air quality
ø 15 db Noise level
ø 970 cd Light intensity

Seminar room past 24 hours

ø 25°C Room temperature
ø 32% Humidity
ø 490 ppm Air quality
ø 23db Noise level
ø 970 cd Light intensity

Dashboard (mobile view)

Project Plan

Milestone	**Deadline ***
Concept Description	17.03.2022
Circuit Diagram	24.03.2022
ER-Diagram, Basic Framework and Basic Class implementation including Database setup	04.04.2022
Basic functionality (create/edit users, connection between raspberry and backend)	24.04.2022
Basic implementation of all required features	02.05.2022
Fine tuning of features; Deployment (Docker), final Tests	16.05.2022
End of Project	19.05.2022
Documentation – Acceptance-Test	26.05.2022
Systemtest and Report writing	13.06.2022
Final Project Results	23.06.2022

*Increment of two weeks

Name	**Responsibility**
Ioannis Deligiannidis	Backend
Leonie Katharina Geyr	Frontend
Christina Bruckl	Hardware and Arduino Software
Thomas Krabichler	Backend
Kevin Rimml	Backend