

Thermal Grace - VHUB Comfort-as-a-Service IoT System

HW & SW Realization Report

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Introduction

Within the scope of a semester project at Fontys ICT Delta a software and hardware system was realized. The stakeholder, Vitality HUB, was looking for a modular and mobile solution for its research. Current implementation provides a perceived thermal comfort sensing and personalized advice application. The document covers the realization process, the end product and provides links to all resources and outcomes.

Previous work (Background)

The project underwent multiple iterations evolving from 3Beam AIoT LED Black Board to Beets modular components for smart offices to the final version as Thermal Grace Perceived Thermal Comfort IoT System. The process followed a feedback loop approach with coaches, company mentors and stakeholders.

Based on the main Fontys requirement to back up the concept with real world validation and stakeholders Vitality HUB was selected as a client and their internal demand for modular kit with sensors as a real market. The realised prototype is representing a case-oriented solution - it is sensing and analysing perceived thermal comfort of VHUB visitors and workers. It is capable of providing HVAC and personalized thermal comfort advice with AI. It is envisioned as a way forward for smart building automation.

Shifting from external product design (Black Board, matrix, knobs and buttons hardware prototyping) to problem-solving with AI and sensors is what concludes the background and research phase that was spanning since TMC semester 5 internship. The prototype was realized following the V-model and in strict compliance with the main stakeholder requirements.

Table 1: previous work documentation

Project Plan	Vitality HUB Perceived Thermal Comfort Project Plan.pdf
Requirements	Vitality HUB Perceived Thermal Comfort Requirements.pdf
C4 Software Architecture Design	Software Architecture Design v2.pdf
Hardware Architecture Design	Hardware architecture technical specification.pdf

Demo

Table 2: demo videos and the presentation

Demo v.1	https://youtu.be/vrhQb1QjbCg
Demo dashboard v.2 (multi-user)	https://youtu.be/Dp8xyD23VpI
Presentation	system_specs/Thermal Grace.pdf

Realization

Table 3: code and kanban board links

GitHub	https://github.com/thermalGrace/sensors_to_HA
Kanban Board	https://github.com/orgs/thermalGrace/projects/1

Conclusion

The report provides sufficient information about the realized prototype. It is using cloud AI free tier with gitHub models to analyse data combined from physical sensor nodes, weather API, results of pyThermalComfort PMV/PPD calculation for each visitor. Design documents cover C4 SW architecture and provide the hardware details with networking (MQTT) information. The project ended in the Verification & Validation (V&V0 step of the V-model cycle. The way forward is to design the protocol and conduct the phase. Then it can be packed into a physical case and mounted at WPVH or more R&D can be conducted before actual user testing.