Evaluation and implementation of a web-based 2D/3D visualisation for smart building control – State of the art and challenges

Smart Public Building 2018

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Who am I?

Marc Philipp Jensen

Graduate of the Bachelor Programme (HFT)

- Information Logistics

Student in the Master Programme (HFT)

- Photogrammetry and Geoinformatics

Co-Founder BuildingScout

- EXIST funded Spin-Off

Topic

EVALUATION AND IMPLEMENTATION OF A WEB-BASED 2D/3D VISUALIZATION FOR SMART BUILDING CONTROL

Research objectives

- From visualisation only to interaction
- Requirements for input data
- Solution for visualised building management

Research Findings and Background

Background

- Visualisation for facility management (FM) assets
- *Focus*: Fire Safety and Technical Maintenance
- *Conclusion*: Facility Managment / Building Management more dependent on visualisation of spatial information

Current Situation and Challenges

- Geospatial Information Systems (GIS) can be used to visualise huge sets of data to allow quick insight
- Desktop GIS and FM tools often complex and difficult to use
- A solution for quick and mobile access is the utiliation of web technologies
- IoT going from Private Homes to Public Buildings lead to even more complex structures requiring flexible solutions

Examlpe 1: HFT Campus Platform

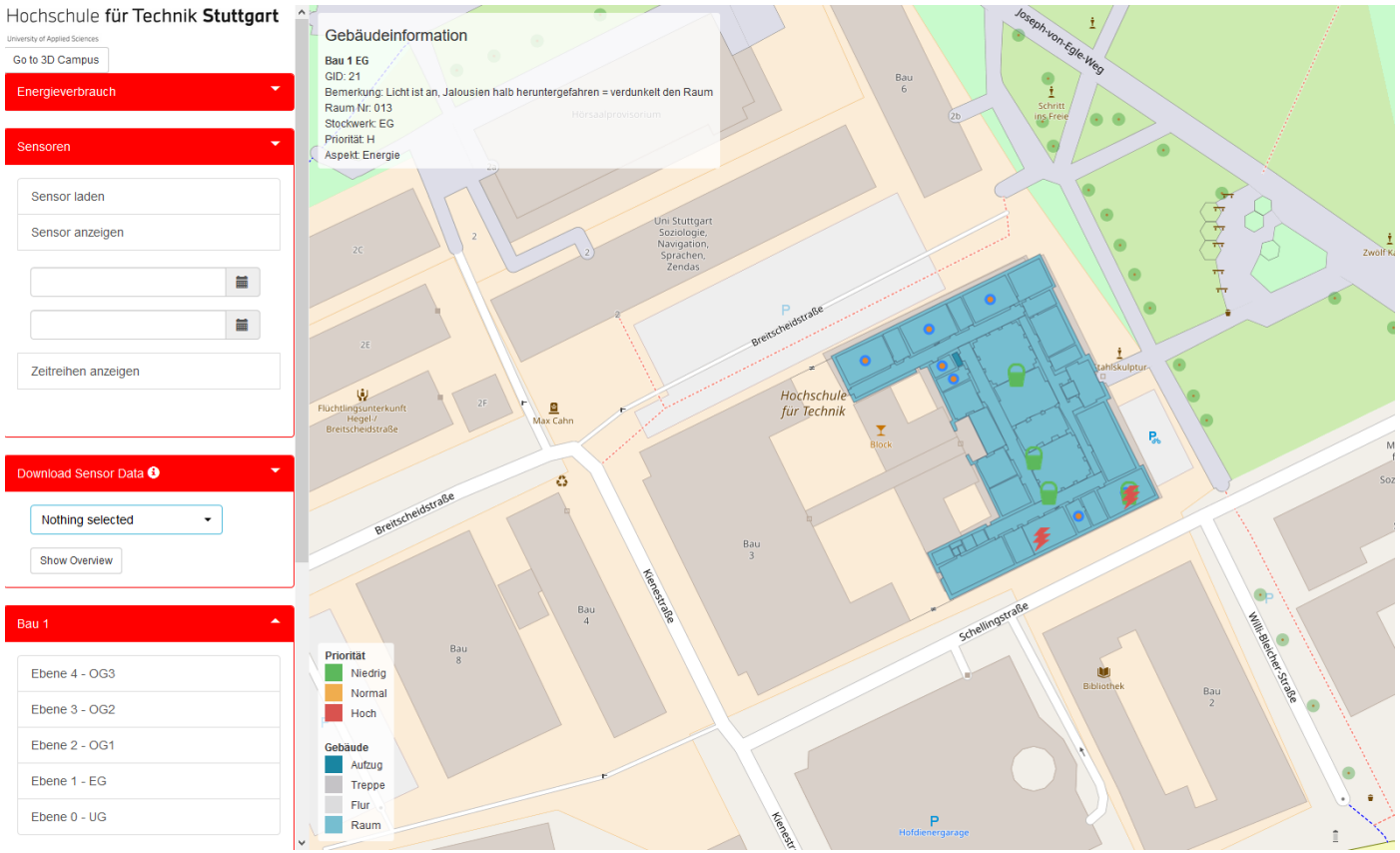
Continuous development

- Visualisation of environmental and safety relates issues collected by students
- Integration of sensor data, view timeseries and realtime data

Simple Setup

- RaspberryPI connected to a temperature and humidity sensor
- Sensor data stored in a database
- Visualisation using web mapping

Examlpe 1: HFT Campus Platform



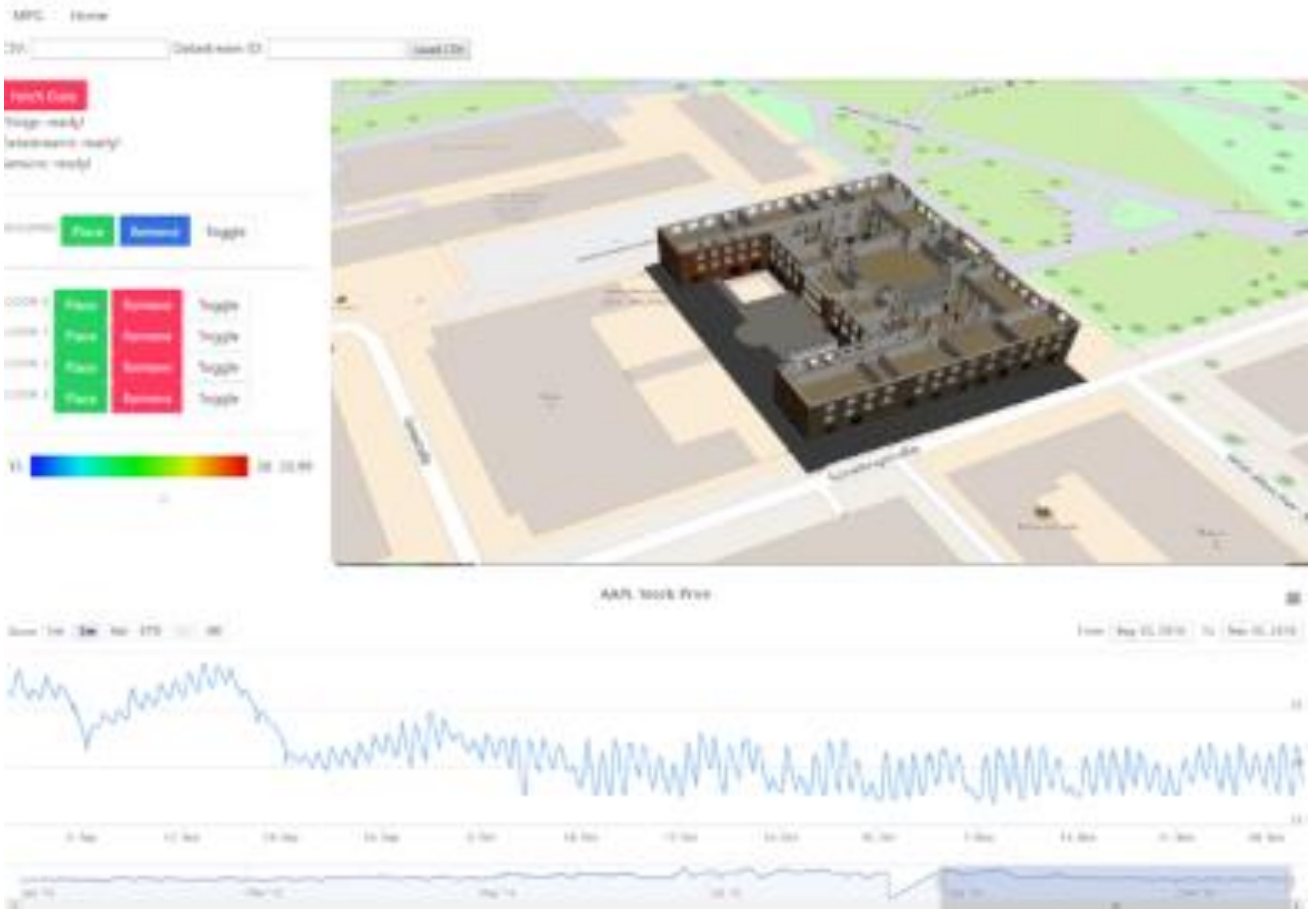
Source: http://campus.hft-stuttgart.de

Examlpe 2: 3D Sensor Visualisation

Next Step going from 2D to 3D

- Sensor positioning in a 3D building model
- Actual HFT temperature data for every lecture room
- Visualisation time series of temperature data

Examlpe 2: 3D Sensor Visualisation



Source: http://gisstudio.hft-stuttgart.de/cesium.html

Use Case for a Public Building:

Indoor Maps for interactive IoT control

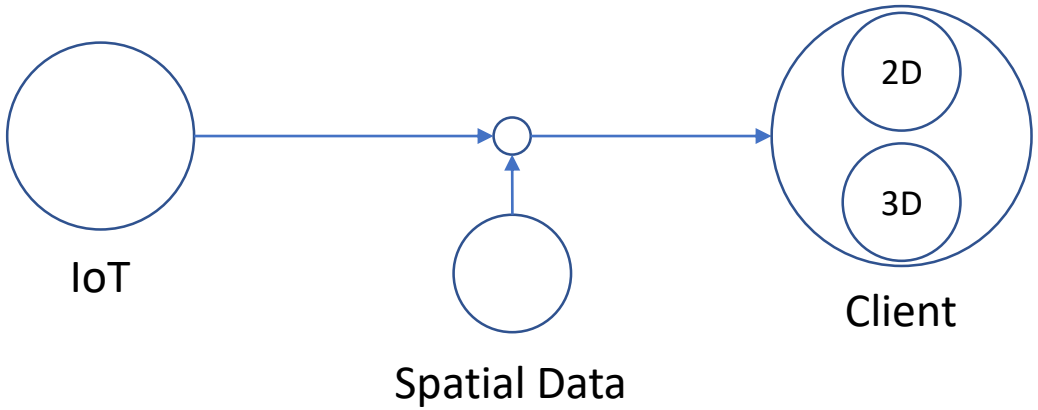
- Maps are a familiar method for navigation
- Different ways to visualise data in maps: e.g. colors or icons
- Faster assessment for multi-building management

Objectives

- Provide an overview of a facility without physical presence
- Intuitive navigation through a building
- Allow interaction with the devices

What is required

- From visualisation only to interaction
- Use IoT framework to allow device communication
- 2D and 3D data of a Public Building
- A web interface to allow the user the positioning of devices
- Web GIS and web mapping to process and visualise the data



Idea and visualisation approach

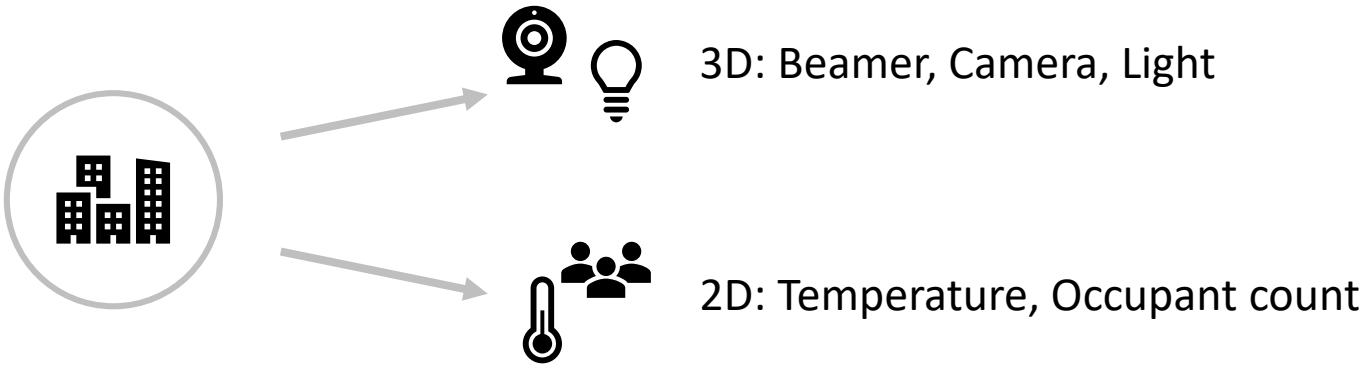
- Create Visualisation Groups for devices and sensors

Group of Active Devices

- Describes a device affecting a single location

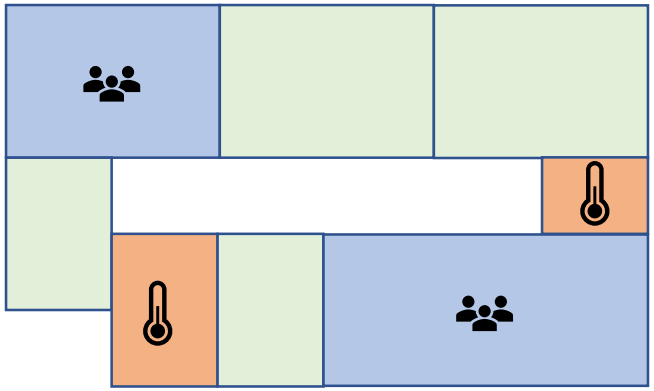
Group of Passive Sensors

- Describes an area and provides information

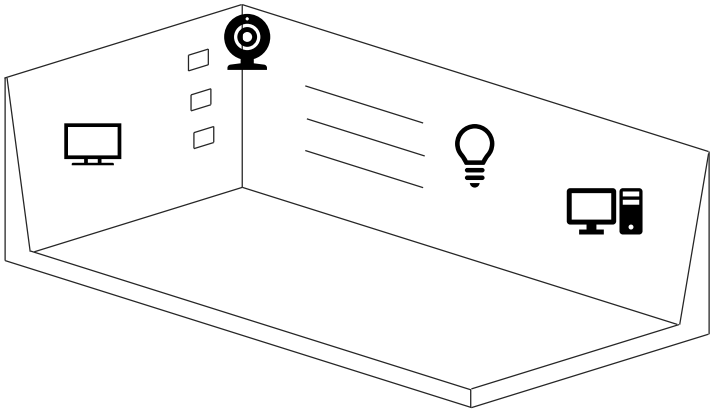


Idea and Planned Approach

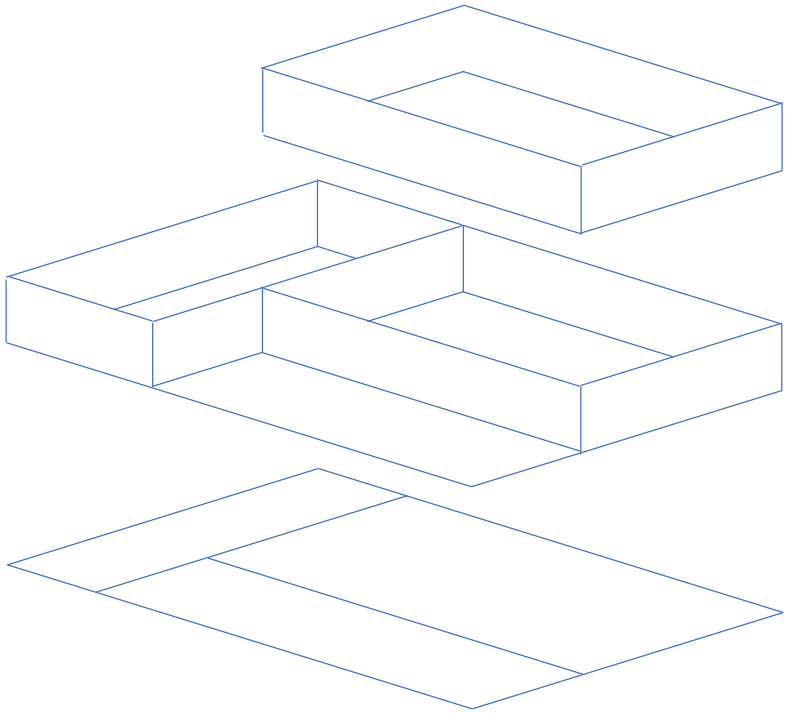
Passive visualisation (2D)



Active visualisation (3D)



Floorplan, full storey, single room



Data Storage and Web Technology

Micro Web Service

- Implementing a Rest API for data exchange

Source: https://nodejs.org/en/about/resources/

PostgreSQL

PostGIS

- PSQL Extention providing spatial capabilities

Source: https://github.com/voodootikigod/logo.js

JavaScript

- High popularity and versatile ecosystem

Node.js

- To building a network application

Source: https://wiki.postgresql.org/wiki/Logo

Web Mapping

Leaflet.js

- Very mobile friendly and lightweight

Source: https://github.com/Leaflet/Leaflet/blob/master/src/images/logo.svg

OpenLayers

- Feature rich library

Source: https://en.wikipedia.org/wiki/File:OpenLayers_logo.svg

Extension of the libraries through plugins

Free and Open Source

Virtual Globes

- Display 3D object on a virual globe
- Display Big Datasets e.g. City Models as 3D Tiles

CesiumJS

- Interaction with time series and special CZML

Source: https://www.cesium.com/logos/

iTowns

Source: https://github.com/iTowns/itowns

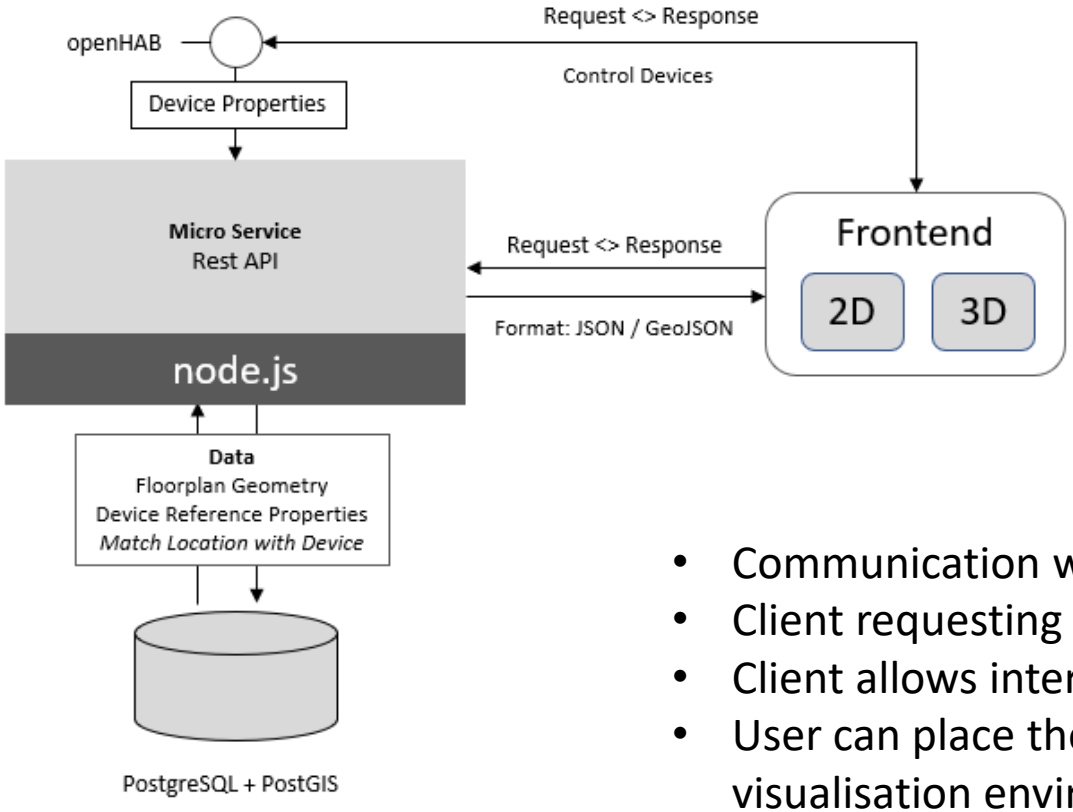
Free and Open Source

Suggested System

- Web service based on Node.js
- PostgreSQL database
- JavaScript web client

- Devices can be visualised in either 2D or 3D, but follow the assigned group in the first place
- Allow external sensors and information, e.g. HFT Campus Portal RaspberryPI demonstrator

Suggested System



- Communication with openHAB
- Client requesting data to visualise 2D/3D
- Client allows interaction with the spatial node
- User can place the virtual devices in the visualisation environment

Possible Barriers

Production of input data can be time consuming

- Digitizing of floor plans or 3D modelling of buildings

Possible Solution

- GIS: Use spatial data from external source e.g. OSM
- Photogrammetry: Use point clouds for 3D models

Data Protection and Privacy

- General Data Protection Regulation

- Restrict visualisation to public areas of a building
- Restrict data access and device control
- Open Source

Objectives and Summary

- Evaluate workflow to generate Input Data
- Evaluate best visualisation: e.g. 2D only, 3D only or both
- Possibility to integrate external sensors

- Should be Open Source
- Alternative to expensive commercial products
- Solution for Public Buildings and Institution

Objectives and Summary

- Collaboration for Data collection, e.g. Input Data
- Use the spatial data for additional purposes, e.g.
  - Integration of external sensor data
  - Integration of room planning
- Help building awareness and provide information for the students

Thank you.