Project Lab: Resilient and Scalable Cloud Application with Physical Event Triggers (alias P08)

Zurich University of Applied Sciences
School of Engineering
InIT Institute of Applied Information Technology

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SCAD-EN HS21

Review of SCAD-EN HS20 projects

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VDP Analytics Service

Im Rahmen eines Praktikums im Modul Serverless and Cloud Application Development an der ZHAW School of Engineering wurde eine Client-Server-Applikation entwickelt, welche die VDP Messdaten aus einer CSV-Datei ausliest, verarbeitet und anschliessend mit zusätzlich generierten Insights wiedergibt.

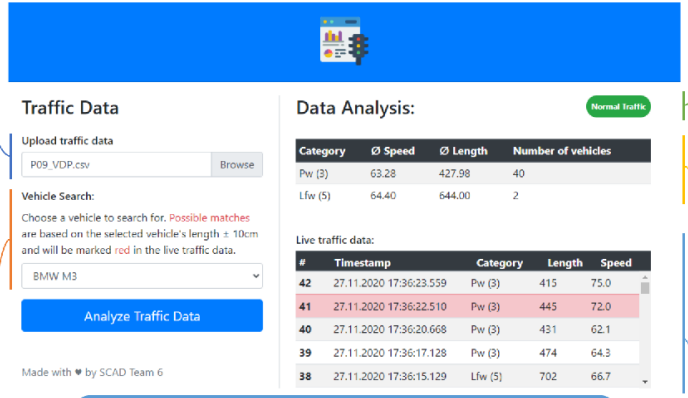
Nachfolgend eine Übersicht des Dashboards zur Interaktion mit der Applikation:

Hier kann eine CSV Datei mit Messdaten eines einzelnen Standorts hochgeladen werden.

Traffic Insights

Traffic Jam Warning => 5 vehicles / 10 seconds

Hier ist der Zustand des Verkehrs zu sehen. Eine Warnung wird angezeigt, sobald innerhalb von zehn Sekunden mehr als fünf Fahrzeuge passieren.



Hier werden die passierenden Fahrzeuge mit ihrem Zeitstempel, der Kategorie, der Länge und der Geschwindigkeit aufgelistet.

Police Insights

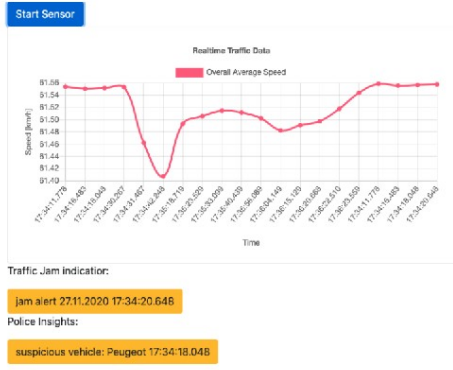
Hier kann ein Fahrzeugtyp aus der vorgegebenen Liste ausgewählt werden, um diese Fahrzeuge in den Daten rechts hervorzuheben.

Basic Insights

Hier wird pro Fahrzeugkategorie die Anzahl Fahrzeuge, deren Durchschnittsgeschwindigkeit und deren Durchschnittslänge angezeigt.

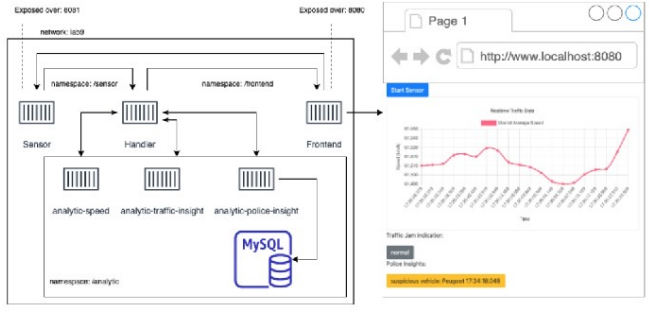
camassan, cuterjoe, difazdar, klingraf, trifunem

VDP Analytic Service



This Service consists of 7 containers. The communication of the realtime data works using socketio. Servers are using fastAPI and Flask. To locally deploy the containers docker-compose is used, where all connections are defined. This is a one-click solution.

The Data gets sent realtime from the sensor to the handler, at the correct time offset, defined in the csv file.
As the data comes in from the sensor, it is broadcasted to the connected analytic containers, that process the data realtime, and send the results back to the handler. From the handler, the analytic data is forwarded to the frontend where the data is displayed.



Cloud-Native Data Analytics for VDP

Process and Display IOT-Traffic-Data severless and in real time.
Save up on maintenance costs and minimize overscaling.

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Use the newest Cloud Computing Services

Take advantage of the newest Cloud Computing Service Functionalities by deploying the service to the Google Cloud via Google Cloud Run.

Container as a Service

Containerize your application using Docker. Containers require less system resources than traditional or hardware virtual machine environments because they don't include operating system images.

What is serverless computing?

Serverless computing is a method of providing backend services on an as-used basis. A serverless provider allows users to write and deploy code without the hassle of worrying about the underlying infrastructure.

Why serverless?

A company that gets backend services from a serverless vendor is **charged based on their computation** and do not have to reserve and pay for a fixed amount of bandwidth or number of servers, as the service is **auto-scaling.**

See our solution

Visit our github repository to see how we created a cloud-native application to gain further insights into the VDP data.

https://github.com/sverbach/P09_VDP_Analytics_Service_Mirror

Indoor/Outdoor positioning basics

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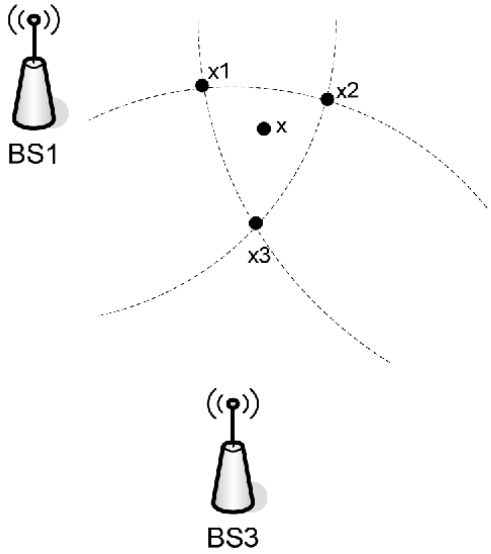

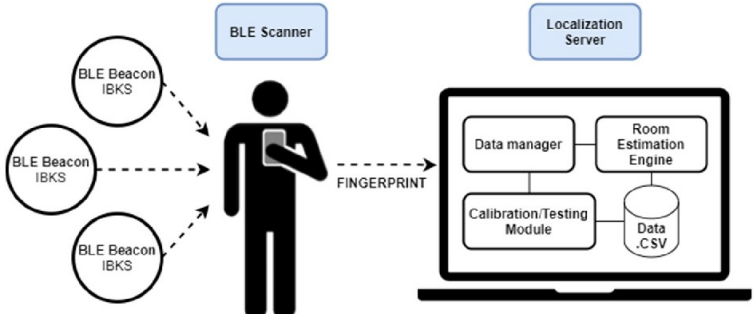

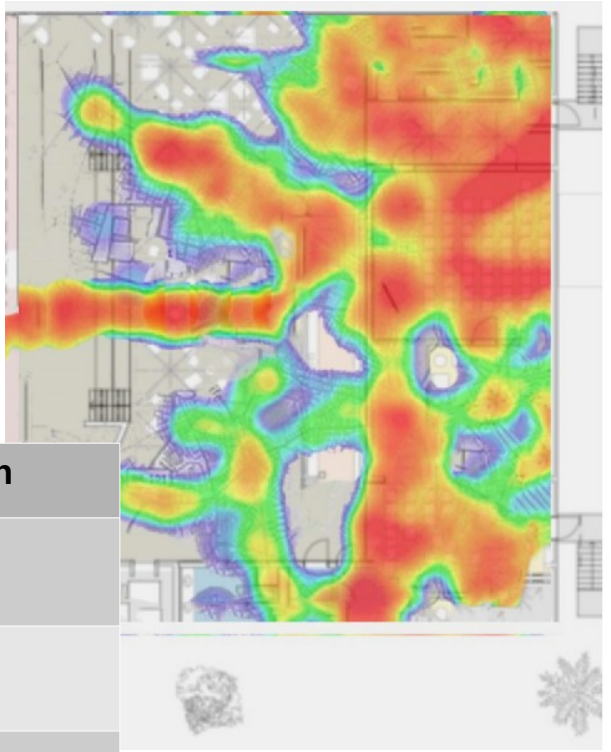

Technology	Range	Frequency	Cost	Accuracy	Domain
WiFi / 802.11	100m	2.4 & 5 GHz	high (AC)	~few m	indoors
BLE (UWB)	LoS 70m (200m)	2.4 (3.1-10.6) GHz	low	1m (10cm)	mixed
GPS (Galileo, ...)	global	1228 & 1557 MHz	high (battery)	5m	outdoors

(GSM, ...)

BLE beacons: Linux & Proxity apps

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```
[bluetooth]# scan on
Discovery started
[CHG] Controller 24:EE:9A:D9:C5:41 Discovering: yes
[NEW] Device 0C:B5:BD:FD:19:B2 0C-B5-BD-FD-19-B2
[NEW] Device 5E:B6:BF:24:06:CB 5E-B6-BF-24-06-CB
[NEW] Device B0:5C:DA:CD:24:97 B0-5C-DA-CD-24-97
[NEW] Device BE:E9:2F:B0:06:FA BE-E9-2F-B0-06-FA
[NEW] Device D0:D2:B0:99:6D:E2 D0-D2-B0-99-6D-E2
[NEW] Device 52:19:71:E5:A2:B0 52-19-71-E5-A2-B0
[NEW] Device 5C:3A:AD:EB:A7:5B 5C-3A-AD-EB-A7-5B
[NEW] Device 50:DE:06:98:4A:90 50-DE-06-98-4A-90
[NEW] Device 94:53:30:A1:2C:DA KD-65XD7505
[CHG] Device BE:E9:2F:B0:06:FA UUIDs: 0000fe78-0000-1000-8000-00805f9b34fb
[CHG] Device BE:E9:2F:B0:06:FA ManufacturerData Key: 0x0065
[CHG] Device BE:E9:2F:B0:06:FA ManufacturerData Value:
  01 c9 05                                         ...
[NEW] Device 78:3F:FC:CC:60:F5 78-3F-FC-CC-60-F5
[DEL] Device 5C:3A:AD:EB:A7:5B 5C-3A-AD-EB-A7-5B
[CHG] Device 52:19:71:E5:A2:B0 RSSI: -84
[CHG] Device 94:53:30:A1:2C:DA TxPower: 7
[CHG] Device 94:53:30:A1:2C:DA UUIDs: 0000110a-0000-1000-8000-00805f9b34fb
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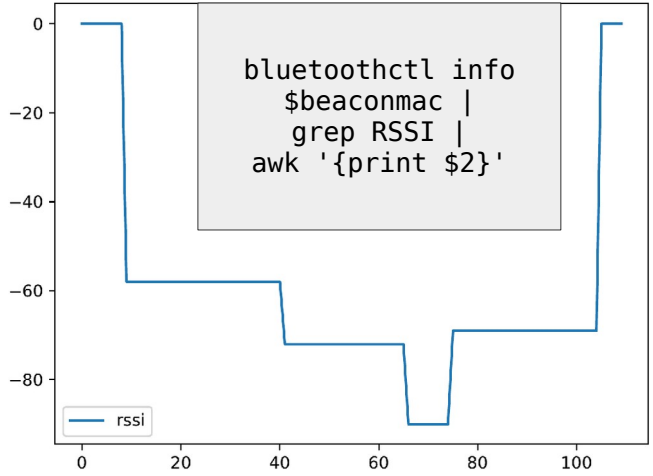

proxity

locations designer,
in-app notifications,
webhook trigger (HTTP)
→ functions / SR containers / APIs in LR containers

for Android & iOS

Project scoping

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Build and demonstrate a complex application that is

- event-driven
- attached to the physical world
  - «cyber-physical», «phygital»
- cloud native in many ways
  - service-oriented design & architecture
  - execution technologies
  - runtime characteristics
  - deployment
- fun to use or useful
- of high quality

Cloud-native application characteristics

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Application runtime considerations

Scalability [V12]
- accomodation of many requests
- spikes/surges vs. idle periods (elasticity)
- must not fail (could have controlled delays)

Resilience [V13]
- fault tolerance vs. idealistic availability/reliability
- imperfect conditions → must not fail (could gracefully degrade)

Scenarios

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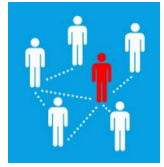
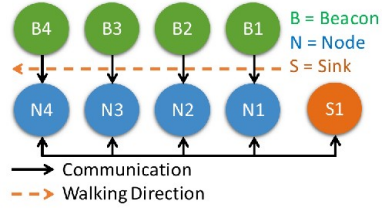
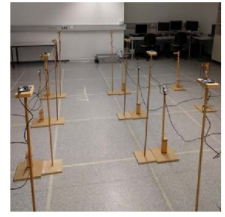
Computer = mobile device (primarily smartphone/tablet)
Beacon = mobile or stationary
Context = location + time + … → might involve other data sources

- Device to device
  - ~ SwissCovid app
  - Proxidating

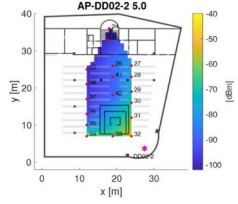


- Device to beacon
  - Presence → alert, traffic counting [HS20 VDP]
  - Proximity → information/recommendation/help, navigation





- Device to multiple beacons
  - Localisation indoors/outdoors



One more scenario… March 2022

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proxity

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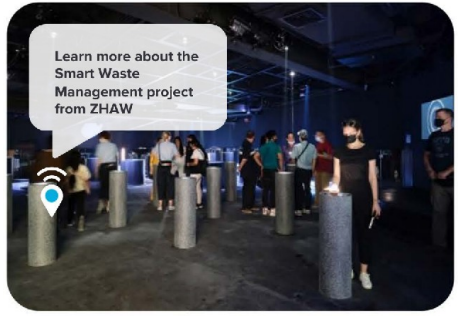
Interactive Swiss Pavilion Expo Dubai

Better user experience, a new level of visitor engagement, feedback and location data



Formalities

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Submission deadline: 31.12.2021

8 points

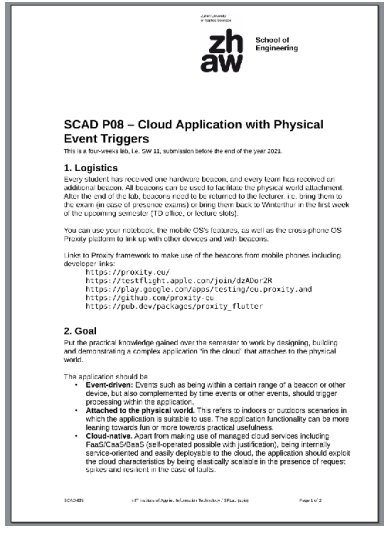
→ 2 for creative idea, «cyber-physical» approach and addressing the subgoals

→ 4 for runtime cloud-nativeness in particular

→ 2 for presentation + video pitching

Feedback: until 07.01.2022

+ intermediate feedback during labs



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SCAD P08 – Cloud Application with Physical Event Triggers

This is a four-weeks lab, i.e. CW 51, submission before the end of the year 2021.

1. Logistics

Every student has received one hardware beacon, and every team has received an additional beacon. All beacons can be used to facilitate the physical world attachment. After the end of the lab, beacons need to be returned to the lecturer, i.e. bring them to the exam (in case of presence exams) or bring them back to Winterthur in the first week of the upcoming semester (TD office, or lecture slots).

You can use your notebook, the mobile OS's features, as well as the cross-phone OS Proxity platform to link up with other devices and with beacons.

Links to Proxity framework to make use of the beacons from mobile phones including developer links:

https://proxity.cu/
https://testflight.apple.com/join/dzADer2R
https://play.google.com/apps/testing/cu.proxity.and
https://github.com/proxity-cu
https://pub.dev/packages/proxity_flutter

2. Goal

Put the practical knowledge gained over the semester to work by designing, building and demonstrating a complex application "in the cloud" that attaches to the physical world.

The application should be

- **Event-driven:** Events such as being within a certain range of a beacon or other device, but also complemented by time events or other events, should trigger processing within the application.
- **Attached to the physical world.** This refers to indoors or outdoors scenarios in which the application is suitable to use. The application functionality can be more leaning towards fun or more towards practical usefulness.
- **Cloud-native.** Apart from making use of managed cloud services including FaaS/CaaS/DaaS (self-operated possible with justification), being internally service-oriented and easily deployable to the cloud, the application should exploit the cloud characteristics by being elastically scalable in the presence of reques: spikes and no/client in the case of bulb.