Sensordata for Crisis Management

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Geospatial Sensor Webs – Münster 2018
■ EU-Project in Horizon 2020 framework

■ **Integrated solution** to support forecasting, early warnings, transmission and routing of the emergency data, **aggregated analysis** of **multimodal data** and management the **coordination** between the **first responders** and the **authorities**

■ [http://beaware-project.eu/](http://beaware-project.eu/)
EU-Project in Horizon 2020 framework

Goal: Design, validate and promote responsive systems/solutions for effective resilience of Cultural Heritage (buildings) against climate change effects

Semantic Modeling of cultural heritage, risks climate effects, materials, sensors, simulation models, …

http://www.heracles-project.eu/
Process chain „from Sensor to the decision“

Architecture and Methodology:
J. Moßgraber, Ein Rahmenwerk für die Architektur von Frühwarnsystemen, DOI:10.5445/KSP/1000066509
SENSORS AND SENSORDATA
Internet of Things (IoT)

- Interdomain topic
- IoT
  - Network between heterogeneous sensors, devices and software systems
  - Goal: New functionalities
- Semantic Interoperability?
  - Understanding the meaning of the exchanged data
OGC SensorThings API

Standard for the exchange of Sensordata and Metadata.

- Sensor-Web-Enablement-Light: SWE for IoT
- Similar to Sensor Observation Service (SOS), but:
  - RESTful
  - JSON
  - Adapts OASIS OData URL patterns and queries
  - Supports ISO MQTT
The OGC SensorThings API data model
FROST Server

- "Fraunhofer Open Source SensorThings API Server".

- First Open Source (GNU Lesser General Public License 3.0) implementation

- https://github.com/FraunhoferIOSB/FROST-Server

- https://www.iosb.fraunhofer.de/?80113
AGGREGATION AND INTEGRATION
Visualizing Sensordata
Integrating analysis algorithms
Visualizing Sensordata
Integrating analysis algorithms
SEMANTIC MODEL
What are Semantics?

**Semantics** *(from Ancient Greek: sēmantikos, "significant")* is the linguistic and philosophical study of meaning.
Domains of the beAWARE Ontology
Representing natural disasters in the beAWARE ontology
Representing natural disasters in the beAWARE ontology
Ontology Visualization
The gap between raw data and Semantics
From the Metadata of a Sensor…

Accelerometer

Accelerometer measure acceleration caused by shocks or structural influences. The sensors can identify individual frequencies and their impact on the observed object. The picture below shows the accelerometers on the roof of the Gubbio Palace.

In the pictures below sample charts of possibly obtained data is shown. The left picture shows the accelerometer amplitudes (positive values). The right picture shows a frequency analysis and depicts the occurrence of specific frequencies and their distribution. In the right column sample data in text files is provided as content.
... to the Rawdata of the Sensor
Semantic Queries

<table>
<thead>
<tr>
<th>Q</th>
<th>CQ11 - What is the priority of a specific incident?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>CQ12 - Which is the type of a specific incident?</td>
</tr>
<tr>
<td>Q</td>
<td>CQ14 - Which humans are involved in a specific incident?</td>
</tr>
<tr>
<td>Q</td>
<td>CQ15 - Are humans involved in an incident?</td>
</tr>
<tr>
<td>Q</td>
<td>CQ16 - Location with most people at risk?</td>
</tr>
<tr>
<td>Q</td>
<td>CQ17 - Which location suffers a specific impact?</td>
</tr>
<tr>
<td>Q</td>
<td>CQ21 - What is the task assignment of a specific FR?</td>
</tr>
<tr>
<td>Q</td>
<td>CQ22 - What is a FR's location?</td>
</tr>
<tr>
<td>Q</td>
<td>CQ25 - Traffic Situation</td>
</tr>
<tr>
<td>Q</td>
<td>CQ5 - Which location is the origin of a specific media item?</td>
</tr>
<tr>
<td>Q</td>
<td>CQ6 - Which location does a specific incident relate to?</td>
</tr>
<tr>
<td>Q</td>
<td>CQ7 - Location with most incidents</td>
</tr>
<tr>
<td>Q</td>
<td>CQ8 - When did a specific incident occur?</td>
</tr>
</tbody>
</table>
Semantic Data Fusion – Competency Questions

- Resulting Ontology can be queried via SPARQL
- Some predefined queries (Competency Questions) are running on top of ontology and the results are included into the ontology.
- Example: Retrieve all incidents which affect humans

```sparql
SELECT ?incident
WHERE {
  ?incident a <#Incident> .
  ?impact <#isCausedByIncident> ?incident .
  ?human a <#Human> .
  ?human <#participantIsDetectedBy> ?detection .
  ?detection <#hasDetectionConfidence> ?detectionConfidence .
  FILTER (?detectionConfidence > 80)
}
GROUP BY (?incident)
```
Semantic Queries

CQ14 - Which humans are involved in a specific incident?

Ontology

Semantic Query

Alternative Query

BASE <http://beaware-project.eu/beAWARE/>

SELECT ?human
WHERE

{ ?incident a <#Incident> .
  ?impact <#isCausedByIncident> ?incident .
  ?human a <#Human> .
}
DECSION SUPPORT
Understanding the Situation

Palace of Gubbio

The Consoli Palace was built between 1332 and 1349. The Palace has a rectangular shape, and a very articulated distribution of volumes divided into 9 levels. The main façade overlooking the square is made of ashlar stone and it stands for over 44 meters up to the top of the bell tower. The entryway is through a fan-shaped staircase leading to the “Amengo”. This hall has two multi-paned windows positioned on the two sides of the Gothic style portal decorated with a XVI-century fresco in the lunette. In the main floor, six windows with round centre in pairs, divided by pillars, are present, while the battlements is supported by small pointed arches.
Understanding the Situation

Flooded Via Carlo Scarpa

The Via Carlo Scarpa is flooded.

The Via Carlo Scarpa was flooded due to heavy rains. The powerhouse was suffered water damages and was shut down for safety reasons.
Spatial understanding
Support for SOPs by using Workflows - BPMN
Send a report
Public Alerts

Receive public alert from authority
Notification on new alert

Public Alert (Extreme)
Hot temperatures. Look for rooms with air condition.
Questions?