

AGGREGATION OF SEMANTIC SENSOR DATA

Graduation proposal

by

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ACRONYMS

API	application program interface	3
JSON	javascript object notation	3
OGC	open geospatial consortium	3
OWL	web ontology language	7
RDF	resource description framework	3
REST	representational state transfer	7
SensorML	sensor modelling language	3
SOS	sensor observation service	3
SSN	semantic sensor network	3
SSW	semantic sensor web	3
SWE	sensor web enablement	3
W3C	world wide web consortium	3
XML	extensible markup language	3

1 | INTRODUCTION

This document should include:

- motivation / problem field /relevance
- position in the academic and professional debate
- problem statement, objectives, research questions
- approach, theoretical framework, methodology
- references
- preliminary project set up and results

an introduction in which the relevance of the project and its place in the context of geomatics is described, along with a clearly-defined problem statement

1.1 PROBLEM STATEMENT

How to find the sensor data you need?

How to combine sensor data from different sources?

How to make sense of the bulk of sensor data?

Wang et al. (2015b), Corcho and Garcia-Castro (2010), Ji et al. (2014), Huang and Javed (2008)

Sensor data discovery Janowicz et al. (2013)

Sensor data fusion Wang et al. (2015a)

2 | RELATED WORK

a related work section in which the relevant literature is presented and linked to the project;

2.1 SENSOR WEB

open geospatial consortium (OGC) sensor web enablement (SWE) standards such as sensor observation service (SOS) and sensor modelling language (SensorML) (Botts et al., 2007), (Botts et al., 2008)

Different data formats: extensible markup language (XML) (SWE), EXI (world wide web consortium (W3C)) and javascript object notation (JSON) SensorThings application program interface (API) (Zanella et al., 2014)

Sensor data discovery (Goncalves, 2014) and visualisation (Yoo, 2014)

2.2 LINKED DATA

Linked Data (Berners-Lee et al., 2001)

OSM as Linked Data (Auer et al., 2009)

Publishing geodata as resource description framework (RDF) and mapping on-the-fly (Missier, 2015)

2.3 SEMANTIC SENSOR WEB

semantic sensor web (SSW) (Sheth et al., 2008), (de Mel et al., 2011), (Bakillah et al., 2013)

W3C semantic sensor network (SSN) ontology (Compton et al., 2012)

Three layer model

Adding semantics to SOS (Henson et al., 2009)

Extending RDF with the ability to represent spatial and temporal data (Koubarakis and Kyzirakos, 2010)

Research on connecting smart devices to SSW (de Vera et al., 2014)

2.4 INTERNET OF THINGS

More and more devices connected to the internet. Also a growing amount of research on using sensors of smart devices. (Waher, 2015), (Calbimonte et al., 2011), (Žarko et al., 2015)

OpenIoT platform (Calbimonte et al., 2014)

2.5 SMART CITIES

The role of sensors in smart cities ([Zanella et al., 2014](#))

The role of [OGC](#) standards in smart cities ([Percivall, 2015](#))

3

RESEARCH OBJECTIVES

the research objectives and/or research questions are clearly defined, along with the scope (ie what you will not be doing);

3.1 RESEARCH QUESTION

How can the semantic sensor web improve the discovery, integration and aggregation of distributed sensor data?

3.2 OBJECTIVE

Develop a method to semantically link sensor metadata to real world objects for spatial, semantic and temporal data aggregation.

3.3 SCOPE

focus on [OGC's SWE](#) standards / [SOS](#) and [W3C's SSN](#) ontology. Not going into evaluation of different standards. Not specifically focussing on smart devices.

4 | METHODS

overview of the methodology to be used;

4.1 STANDARDS

4.1.1 Sensor Web Enablement

[SOS](#) and [SensorML](#), or [Sensorthings API](#)?

4.1.2 Semantic Web

[RDF](#) (on-the-fly)

SPARQL, geo-SPARQL or stSPARQL, etc. and which query engine?

4.2 ONTOLOGIES

web ontology language ([OWL](#))

[SSN](#) ontology

4.3 MIDDLEWARE

Creating own middleware to link sensors semantically and retrieve aggregated data

representational state transfer ([REST](#))ful service

5 | PLANNING

time planning—having a Gantt chart is probably a better idea than just a list;

5.1 GANTT CHART

Planning of the Thesis

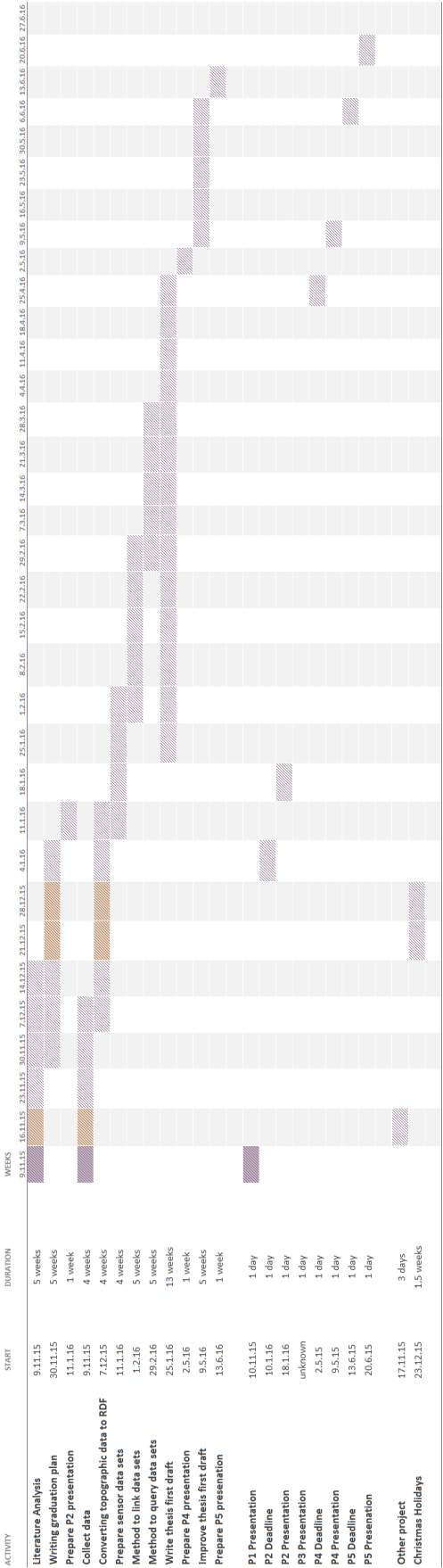


Figure 5.1: GANTT chart showing the planning of the thesis

6 | TOOLS AND DATA

since specific data and tools have to be used, it's good to present these concretely, so that the mentors know that you have a grasp of all aspects of the project;

6.1 DATA

Topographic data
Sensor data (different sources)

6.2 DATABASE

Oracle?

6.3 SERVER

Or localhost?

6.4 PROTOTYPE

Use Python programming language and Flask for server sided scripts
Perhaps with Python's **Request** library for making POST or GET requests.

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COLOPHON

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