

## **From Physical to Virtual Sensors (PVS)**

---

**Camilla Stormoen**

*INF-3983 Capstone Project in Computer Science ... December 2017*





# **Abstract**

**W3** Whats wrong with the word? / motivation 1-3 setninger

**Architecture - 1-3 setninger**

**Design- 1-3 setninger**

**Implementation - 1-3 setninger**

**Experiments - 1-3 setninger**

**Results - 1-3 setninger**

**Lessons learned/main conclusion - 1-3 setninger**

**Kutt heller etterpaa**

This dissertation present/describe ...



# Contents

<b>Abstract</b>	<b>i</b>
<b>List of Figures</b>	<b>v</b>
<b>List of Tables</b>	<b>vii</b>
<b>My list of definitions</b>	<b>ix</b>
<b>1 Introduction</b>	<b>1</b>
1.1 Motivation . . . . .	1
1.2 Contributions . . . . .	2
1.3 Assumptions . . . . .	2
1.4 Limitations . . . . .	2
1.4.1 A subsection . . . . .	3
<b>2 Background and Related Work</b>	<b>5</b>
2.1 Something . . . . .	5
<b>3 Architecture</b>	<b>7</b>
<b>4 Design</b>	<b>9</b>
<b>5 Implementation</b>	<b>11</b>
<b>6 Evaluation</b>	<b>13</b>
6.1 Experimental Setup . . . . .	13
6.2 Something!?. . . . .	14
6.3 Results . . . . .	14
<b>7 Discussion</b>	<b>15</b>
7.1 abcd . . . . .	15
<b>8 Contributions</b>	<b>17</b>

<b>9 Conclusion</b>	<b>19</b>
9.1 Future Work . . . . .	19
<b>10 Future Work?</b>	<b>21</b>
<b>11 Appendix?</b>	<b>23</b>
<b>Bibliography</b>	<b>25</b>

# **List of Figures**

3.1 Figure showing architecture . . . . .	8
---	---



# **List of Tables**

4.1 A table . . . . .	9
-----------------------	---



# **My list of definitions**

1.1	Some other definition . . . . .	3
1.2	Its raining dogs and cats . . . . .	3



# / 1

## Introduction

- mention focus on camera-sensors/data?!?[1]

This project will develop an abstraction for virtual sensors, and do a prototype of the abstraction on a set of computers with physical sensors.

The purpose is to provide for a more powerful and flexible sensor in the COAT monitoring of the arctic tundra. As such, a fox feeding station is the usage domain to be used for the prototype.

### 1.1 Motivation

The motivation!

- W3
- Problem definition: This project investigated ... x, with the purpose of y.

The motivation behind this project is that no single sensor may cover the sensing needs, and that sensing needs can change rapidly over time. Consequently, there is a need for sensor fusion, and allow for combining sensors at different computers.

## 1.2 Contributions

What was the contribution?

## 1.3 Assumptions

AVGRENSE, VIKTIG!! Something about motivation and stuff

## 1.4 Limitations

AVGRENSE, VIKTIG!!

### 1.4.1 A subsection

We can use the API to application programming interface (2API) do stuff, and write about what we did in a thesis!

This is some stuff, SMALLCAPS SMALLCAPSEMPHASIZED regularemphasized

Long ass glossary entry: a test glossary entry.

If the acronym University of Tromsø (uit) is displayed, then loadglentries works. Hello. This is a test: Camilla is cool!! (CAMILLA)

It is fun to use modern openMP technology!<sup>1</sup>

It is fun to use *modern openMP* technology! And it is fun to use Data-Driven Documents (D3) and version 5 of the HyperText Markup Language standard (HTML5).

1. This is a snarky footnote. Words and etc. Semantic web technologies are technologies that enable semantification of the Web as we know it today. Hopefully this spans some lines now.

Referencing figure 3.1 to test link.<sup>2</sup>

**The Definition 1. Some other definition**

**The Definition 2. Its raining dogs and cats**

2. This is another footnote.



# /2

## **Background and Related Work**

- Taking Sensor Networks from the Lab to the Jungle
- Wireless Sensor Networks for Habitat Monitoring
- Se de andre paperne Otto har sendt

### **2.1 Something**

gggg



# /3

## Architecture

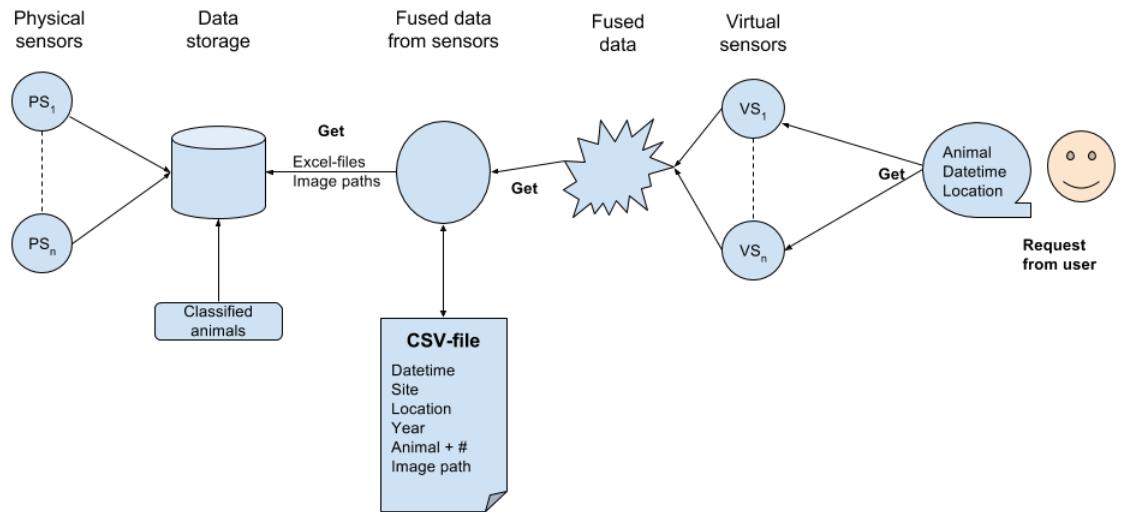
Functionalities, abstractions, tell it clean/neat.

- Physical sensors??
- Datastore (DAO)
- Fused data
- Virtual sensors
- Result from virtual sensor to user

This section describes the system architecture(, functionality of individual components and how they operate together). A three-layered architecture: data storage, fused data, virtual sensors.??

The physical sensors transmit their data to the data storage. The data storage consists of images from different sensors and excel-sheets containing information about each picture. The fused data retrieves its data from the data storage and store the fused data into an CSV-file.

The virtual sensors are divided into animal-sensors, e.g. one raven-sensor, one arctic fox- sensor etc. The user types in what animal it wants to see, where it is and the date-time and the search is redirected to the sensor related to that



**Figure 3.1:** Figure showing architecture

specific animal. The virtual sensor receive its result from the fused data from the CSV-file.

Finally, the data/pictures is displayed to the user/biologist through a user interface(?) /image-shower (Python OpenCV library). The architecture of the system is presented in Figure 3.1.

# / 4

## Design

Client/Server, p2p, put/get, pub/sub, protokoller etc.. BESKRIV INTERAKSJONEN MELLOM ENHETENE!!

Virtual sensors probably uavhengige prosesser, ikke threads ettersom man evt vil addere flere sensorer og unngå å starte alle sensorer på nytt igjen.. Er de virtuelle sensorene servere eller publisher?

Content left	Content right
--------------	---------------

**Table 4.1:** A table

**Listing 4.1:** Small C program

```

#include "stdio.h"
#define e 3
#define g (e/e)
#define h ((g+e)/2)
#define f (e-g-h)
#define j (e*e-g)
#define k (j-h)
#define l(x) tab2[x]/h
#define m(n,a) ((n&(a))==(a))

long tab1[]={ 989L,5L,26L,0L,88319L,123L,0L,9367L };
int tab2[]={ 4,6,10,14,22,26,34,38,46,58,62,74,82,86 };

main(m1,s) char *s; {
    int a,b,c,d,o[k],n=(int)s;
    if(m1==1){ char b[2*j+f-g]; main(l(h+e)+h+e,b);
        printf(b); }
    else switch(m1-h){
        case f:
            a=(b=(c=(d=g)<<g)<<g)<<g;
            return(m(n,a|c)|m(n,b)|m(n,a|d)|m(n,c|d));
        case h:
            for(a=f;a<j;++a)
                if(tab1[a]&&!(tab1[a]%(long)l(n)))
                    return(a);
        case g:
            if(n<h) return(g);
            if(n<j){n-=g;c='D';o[f]=h;o[g]=f;}
            else{c='\r'-'`';n-=j-g;o[f]=o[g]=g;}
            if((b=n)>=e)
                for(b=g<<g;b<n;++b)o[b]=o[b-h]+o[b-g]+c;
            return(o[b-g]%n+k-h);
        default:
            if(m1-e) main(m1-g+e+h,s+g); else *(s+g)=f;
            for(*s=a=f;a<e;)*s=(*s<<e)|main(h+a++,
                (char *)m1);

    }
}

```

# /5

## Implementation

Threads, data structures, language ... Pandas (dataframe), CV2 (show image), exifread, Python 2.7, missing testing (CPU, memory, time?)

The system is implemented and written in Python 2.7<sup>1</sup> because .. (frameworks available in this language??).

To visualize/show pictures, a Python library called OpenCV<sup>2</sup> was implemented. To read exif/metadata from pictures, we used a Python library called exifread 2.1.2<sup>3</sup>.

1. <https://www.python.org/>  
2. <https://opencv-python-tutorials.readthedocs.io/en/latest/>  
3. <https://pypi.python.org/pypi/ExifRead>



# / 6

## Evaluation

metrics, define (CPU, memory, latency.), benchmarks (mirko, kernel... How to measure, where done, PSEUDOCODE

Time Finding folders and metadata takes: 1:43:13.488799, Reading excel file takes: 0:00:17.413845, Comparing takes: 4:43:30.705587, Overall time is 6:27:01.608355. Med alle bilder m/metadata og hele fotoboks2011, *ordkynn, ordkynn.2011.xlsx*.

This chapter describes the experimental setup and metrics used to evaluate the implemented system.

### 6.1 Experimental Setup

All experiments was done on a Lenovo ThinkCenter with an Intel® Core™ i5-6400T CPU @ 2.20GHz × 4, Intel® HD Graphics 530 (Skylake GT2), 15,6 GiB memory and 503 GB disk. It ran on Ubuntu 17.04 64-bit.

## 6.2 Something!?

## 6.3 Results

What does the result say? Each eksperiemnt, result, meaning



# 7

## Discussion

Idea, architecture, design, results, andre løsninger, "arch har scaleproblem?"

### 7.1 abcd





# 8

## Contributions



# /9

## Conclusion

### 9.1 Future Work





**10**

## **Future Work?**





# 11

## Appendix?

readme, source code, dataset measurement RAW



# Bibliography

- [1] Robert Sedgewick *Algorithms in C - parts 1-4*. Addison-Wesley Publishing Company, 3. Edition, 1998.