

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

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# **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 ...



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# **My list of definitions**



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## Introduction

- Mention focus on camera-sensors/data, and not other sensors?!?[1]
- Talk a little bit about COAT in general?

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!!

- Mention focus on camera-sensors/data, and not other sensors?!

### 1.4.1 A subsection

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## **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

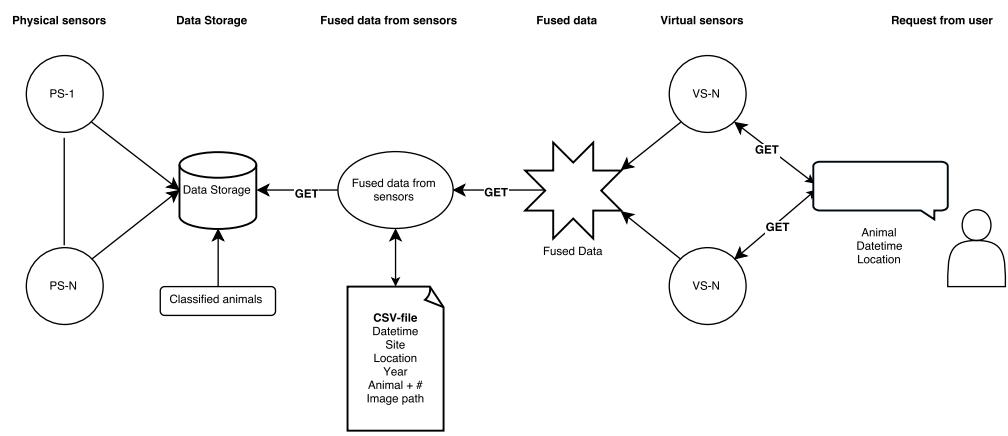
Functionalities, abstractions, tell it clean/neat.

There are 6 components in the system: physical sensors, data storage, fused data, virtual sensors and the user. However, the main components in the system are the data storage, the fused data, the virtual sensors and the user. In this chapter, we will describe the architecture of the data storage, fused data, virtual sensors and the user. The architecture of the system is presented in Figure 3.1.

### 3.1 Physical Sensors and Data Storage

The physical sensors transmit their data to the data storage. The data storage consists of (several set 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 red-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 specific animal. The virtual sensor receive its result from the fused data from the CSV-file.



**Figure 3.1:** Figure showing the system architecture.

Finally, the data/pictures is displayed to the user/biologist through a user interface(?) /image-shower (Python OpenCV library).

### **3.2 Fused Data**

### **3.3 Virtual Sensors**

### **3.4 Result from Virtual Sensor to User**



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## 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?

Rekursiv traversering av directories og leser metadata fra bildene (ca 1,6 mill bilder) - Lagres i en dictionary hvor datetime og sted er key og image pathen er value).

Ca 16-17000 rows i et excel-ark. Leser ut info som dyr, antall, sted, datetime, site, year og putter i en string.

Disse sammenlignes og de som matcher blir skrevet til en CSV-fil.



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## Implementation

Threads, data structures, language ... Pandas (dataframe<sup>1 2</sup>), CV2 (show image), exifread, Python 2.7, missing testing (CPU, memory, time?)

The system is implemented and written in Python 2.7<sup>3</sup> because .. (frameworks available in this language??).

To visualize/show pictures, a Python library called OpenCV<sup>4</sup> was implemented. To read exif/metadata from pictures, we used a Python library called exifread 2.1.2<sup>5</sup>.

1. <https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.html>
2. <http://pandas.pydata.org/pandas-docs/stable/>
3. <https://www.python.org/>
4. <https://opencv-python-tutroals.readthedocs.io/en/latest/>
5. <https://pypi.python.org/pypi/ExifRead>



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## 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, *nordkynn, nordkynn.2011.xlsx*.

New time Finding folders and metadata takes: 1:46:17.406581 Reading excel file takes: 0:01:07.686779 Comparing takes: 19:03:11.177869 Overall time is 20:50:36.271415  
Med alle bilder m/mETADATA og hele nordkynn og varanger

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





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## Contributions



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## Conclusion

### 9.1 Future Work





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## **Future Work?**





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## Appendix?

readme, source code, dataset measurement RAW



# Bibliography

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