Intelligent Algorithms for Processing Data from Sensors
An Overview

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Introduction

- Smart environments
  - Detect a state of the user, predict his future behavior and adapt to his needs.
  - Use multimodal user interfaces, data mining algorithms, planning and decision making algorithms etc.

- An overview of the two smart environment aspect:
  - Sensor systems
  - Intelligent algorithms
Sensor Systems

- Centralized vs. decentralized
- Wireless sensor networks
Wireless Sensor Network
Implementation guidelines

- Sensors should support the same wireless communication standard
  - e.g., WirelessHART, IEEE 1451, ZigBee/802.15.4, ZigBee IP in 6LoWPAN

- Operating system should be selected that supports the selected hardware:
  - TinyOS
  - LiteOS
  - Contiki
  - RIOT
Data collection
• In a real environment
• In laboratory
• Through simulation

Data preprocessing
• Filtering
• Conversion

Machine Learning
• Supervised vs. unsupervised
• Incremental vs. batch learning
Data Collection Approaches

- In a real environment
  - The most realistic data
  - Not suitable for controlled experiments

- In laboratory
  - Enables control of data quality

- Through simulation
  - The quickest and cheapest solution
  - Applicable only when the simulator is available
Data Preprocessing

- Filtering
  - Filtering reduces noise in data obtained from sensors
  - Filters: low-pass, high-pass, median, Kalman filter

- Conversion
  - Conversion of time-series data to vector space data suitable for machine learning
  - Techniques: sliding-window technique, overlapping-sliding-window technique
  - Example of attributes: average, median, stdev, min, max, the number of local extrema.
Machine Learning Algorithms

- Supervised vs. unsupervised
  - Labeled data – decision tree, SVM, Naïve Bayes
  - Unlabeled data – clustering techniques

- Incremental vs. batch learning
  - Incremental – adapts to the changes in user’s behavior
  - Batch – less time-consuming

- Data Mining Software
  - Weka, Orange, R, Matlab
An overview of the intelligent algorithms for processing data from sensors.

The overview was focused on:

- Sensor networks – decentralized networks are recommended in the literature,
- Intelligent algorithms – techniques for:
  - data collection
  - data preprocessing, and
  - machine learning.