Recognising activity from accelerometer data in real-time

User Activity recognition
Recognising activity from accelerometer data in real-time
Using state of the art classification and supervised learning [1]
Implemented by extending the accelerometer probe
J48 classification decision tree
Sampling data -> classification
Features (time and frequency domains):
- Mean value, Standard deviation, Correlation
- Acceleration vector intensity mean value
- Energy and Entropy

Computes Calories Burned:
\[
\text{Energy} = T \cdot \text{MET} \cdot \text{CB}
\]
\[
\text{Temperature} = \sum \text{energy} \cdot (e(x))
\]

ExposureSense: Weighed exposure computation with regards to the activity performed and the pollution level at that location.

Air Quality monitoring
Fine grained air quality monitoring at city level
Static sensors:
- few fixed station, mainly used for calibration
- more accurate and expensive sensors
Mobile sensors:
- attached to buses and trams in Lausanne and Zürich (Switzerland)
- cheaper and less accurate sensors
- but large number and mobility allows for good coverage and accuracy

Data used in this project is collected by OpenSense ETH Z [2] [3]

ExposureSense
Integrating Daily Activities with Air Quality using Mobile Participatory Sensing
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System Architecture
Based on a modular and connected architecture

Sensor Abstraction
Extending the Funf framework [4]
Different kind of sensor probes:
- internal sensors
- external sensors
- virtual sensors
- network resources
Probes can have processing and storage capabilities
Supports definition of full processing pipelines (e.g. activity recognition)

Mobile client
Tabbed interface showing real-time activity and exposure
Decoupled front-end using Android broadcast mechanism
- Raw sensor data
- Frequency domain & accelerometer data view
- Activity/air quality & timeline data view
- Map data view

References:

Pluggable Sensor
Extending the sensing capabilities
Further developments of the gasMobile pluggable sensors [5]
External sensors plugged and powered by the micro-USB port
Communication via Virtual Serial port and TTL to USB adapter
Multiple sensors managed by ATMega 168P micro-controller:
- proximity sensor
- SGX Sensortech MICS-2614 O3 Sensor
- humidity and temperature sensor

Participatory Sensing
acting as both consumer and contributor
Application stores the activity, location and other collected data locally
Users can choose to send these data to a central server
Global Sensor Network (GSN) server is used for stream processing
Server can then compute aggregated statistics and models
Finally the users can also query these aggregated models