

Background

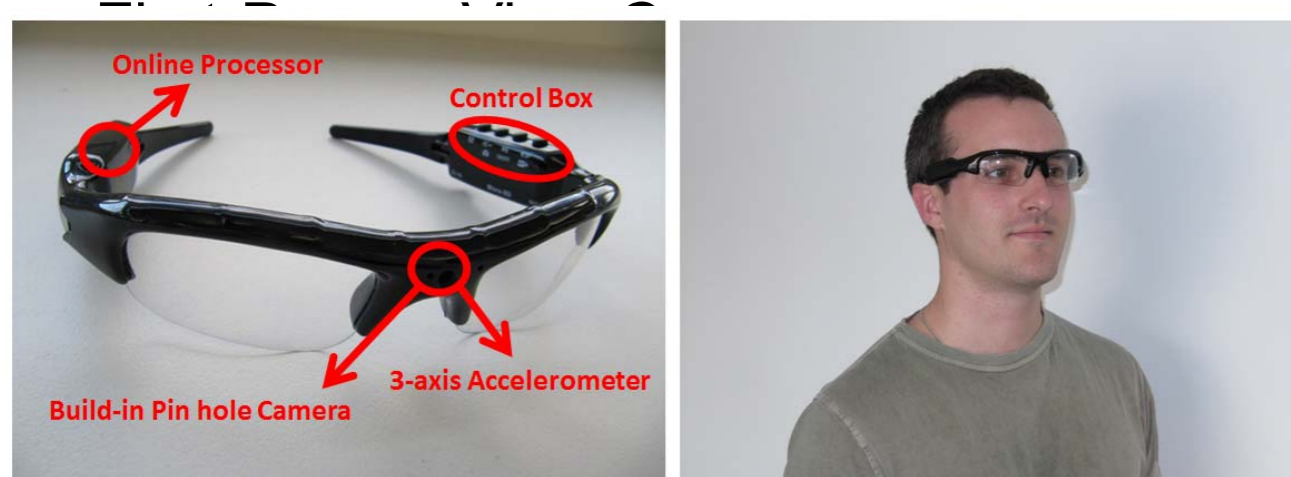
Sustainable living is a lifestyle that attempts to reduce an individual's or society's use of resources, including natural or human. In recent years, rapid aging of world's population, associated with the shortage of nurses, poses unprecedented challenges to the existing healthcare system of many countries.

Objective

- Recognise human Activities of Daily Living (ADLs) from embedded heterogeneous sensors
- A portable and wearable device
- Elderly and patient monitoring
- Saving human resources

Smart Glasses

- Built-in 3-axis Accelerometer



System Overview

Local Feature Extraction

- Accelerometer
- Video

Local Feature Classification

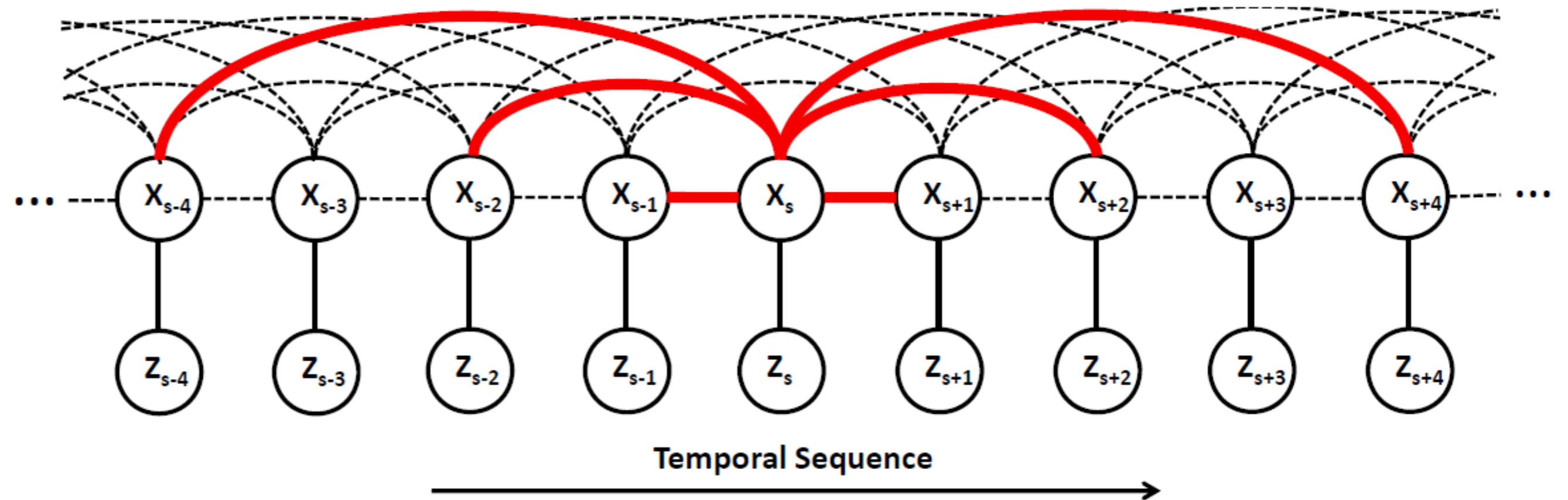
- Best Classifier for Each Feature
- Optimal Settings

Feature Integration

- Activity Categorisation
- Weighted Feature Vector Training

Structure Classification

- Multi-Scale Conditional Random Fields
- Pairwise Weight Training
- Model Inference



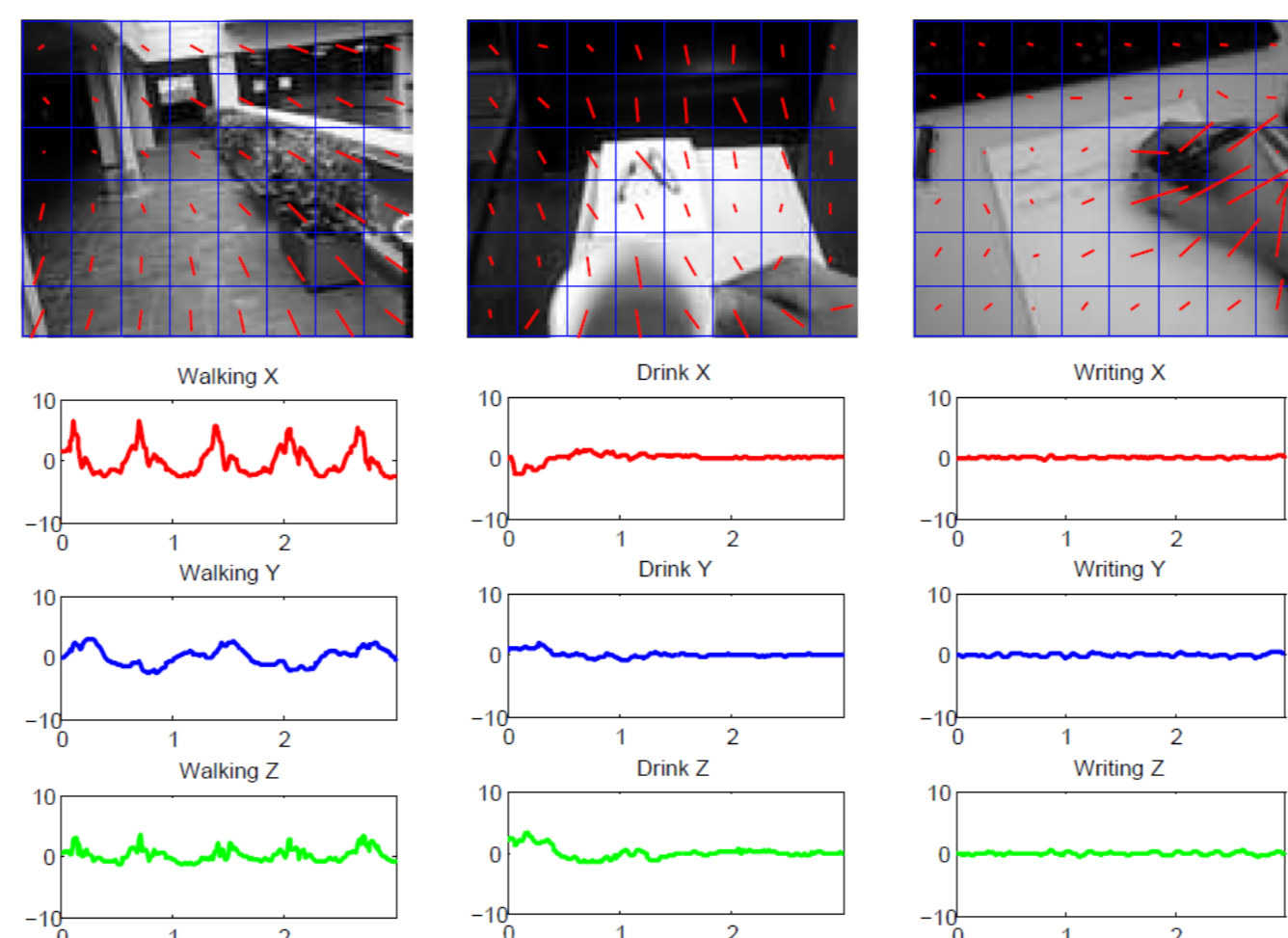
Local Feature Extraction

Video Feature Extraction

- Dense Optical Flow Features
- Mean Flow Vector Over Patches
- Average Pooling Process Over Time

Accelerometer Feature Extraction

- 13 Time-Domain Features
- 20 Frequency-Domain Features



Local Feature Classification

Video Classification

- LogitBoost with 150 Decision Stumps

Accelerometer Classification

- Support Vector Machine with Linear Kernel

Feature Integration

- Locomotive and Stationary Activities
- Raw Features → Probabilistic Domain
- Observations → Hidden Nodes

Structure Classification

Location Potentials

- Dense Optical Flow Features
- Mean Flow Vector Over Patches
- Average Pooling Process Over Time

Multi-Scale Pairwise Potentials

- Multi-Scale Edges (e.g. the red edges from X_s)
- Each Edge is Assigned with a Probabilistic Transition Matrix

Experiments

Mobile Device

- CPU: 1GHz processor
- RAM: 512M
- Video: 15Hz with 144 x 176 resolution
- Accelerometer: 80Hz for all 3 dimensions

Data Collection

- 40 Datasets with 30mins recorded ADLs

Activities

	Activity	Average Duration
1	Walking	154.99 sec
2	Going Upstairs	59.05 sec
3	Going Downstairs	55.14 sec
4	Drinking	15.72 sec
5	Stand Up	1.71 sec
6	Sit Down	2.32 sec
7	Sitting	46.08 sec
8	Reading	45.21 sec
9	Watching TV/monitor	253.58 sec
10	Writing	112.78 sec
11	Switch Water-Tap	1.67 sec
12	Hand-Washing	10.39 sec

Results

- Outperforms conventional methods on ADLs by 20-40%
- Overall Accuracy: 90.04%

