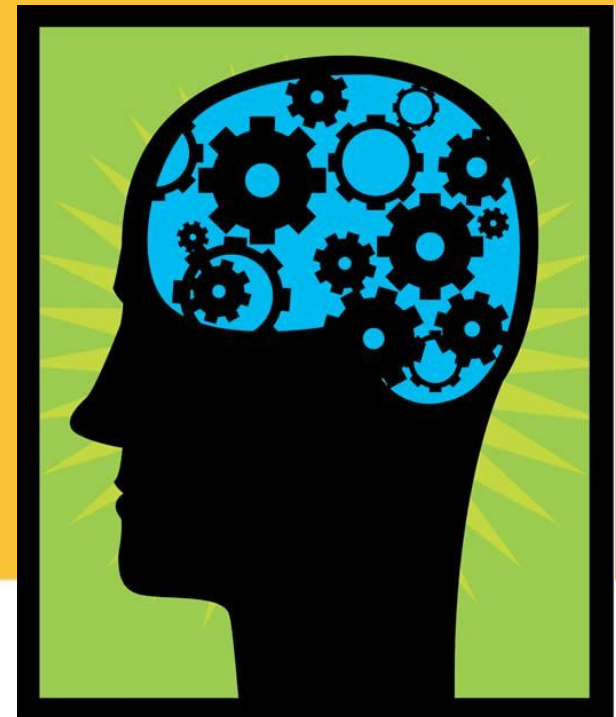


# Providing Independence to Elderly with Machine Learning

Lionel Ott

Work by Khai Zhan, Fabio Ramos, Steven Faux



- ▶ The World's population is ageing rapidly
- ▶ With age, strokes, and dementia cognitive problems become more frequent
- ▶ The level of dependence on family members and health professionals increases
- ▶ There is a shortage of skilled nurses and health professionals

**Can we do something about this?**



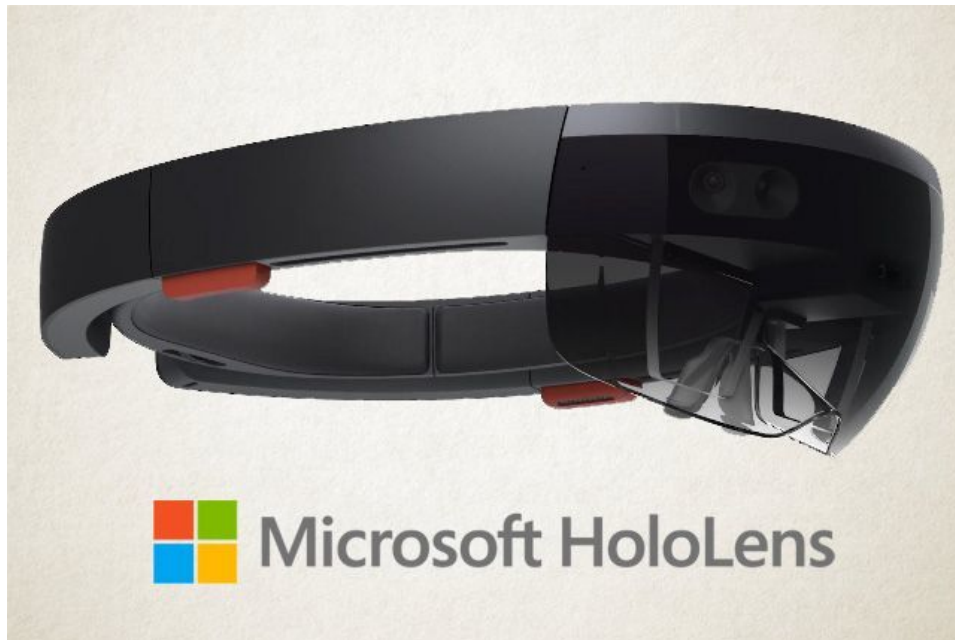
Automatic activity recognition for  
cognitive assistance and guidance



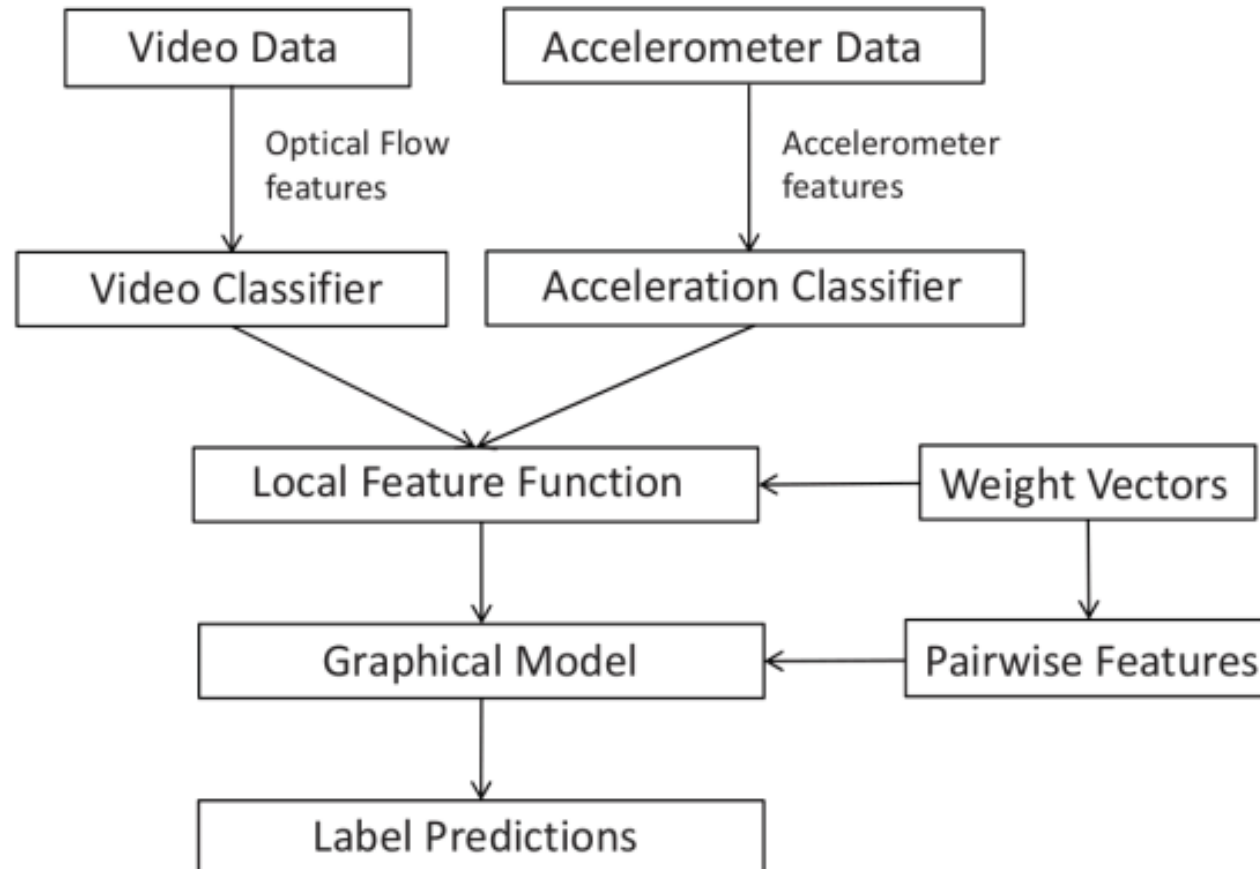
# SMART GLASS

**Integrated into Life**

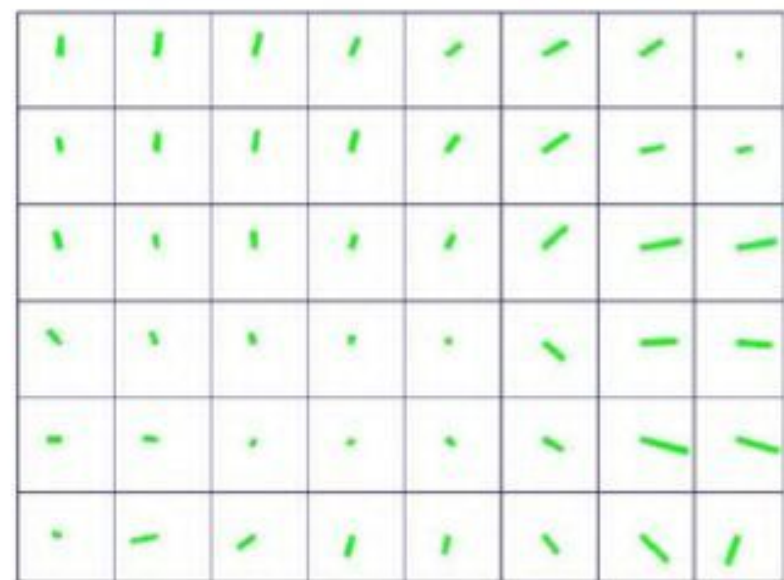
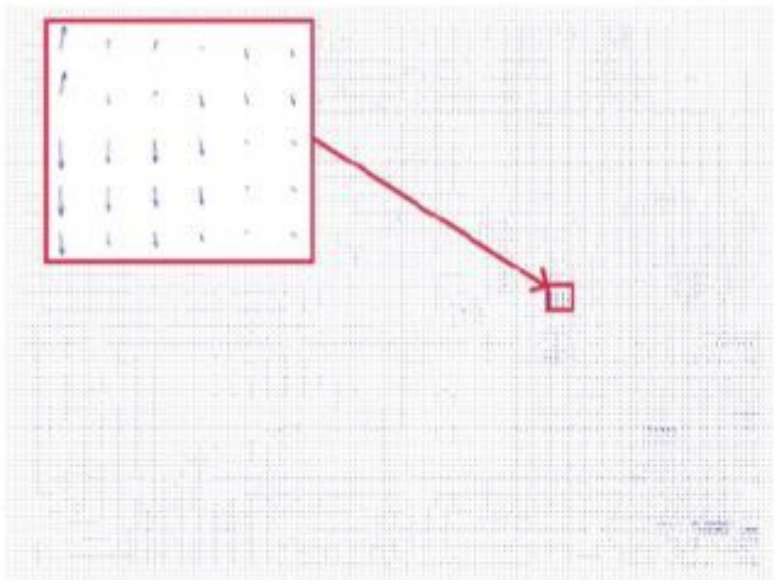
- ▶ Commercial products with similar hardware



- ▶ Drinking
- ▶ Reading
- ▶ Standing up
- ▶ Sitting down
- ▶ Sitting
- ▶ **Walking**
- ▶ **Walk upstairs / downstairs**
- ▶ Washing hands
- ▶ **Watching TV**
- ▶ Writing
- ▶ ...

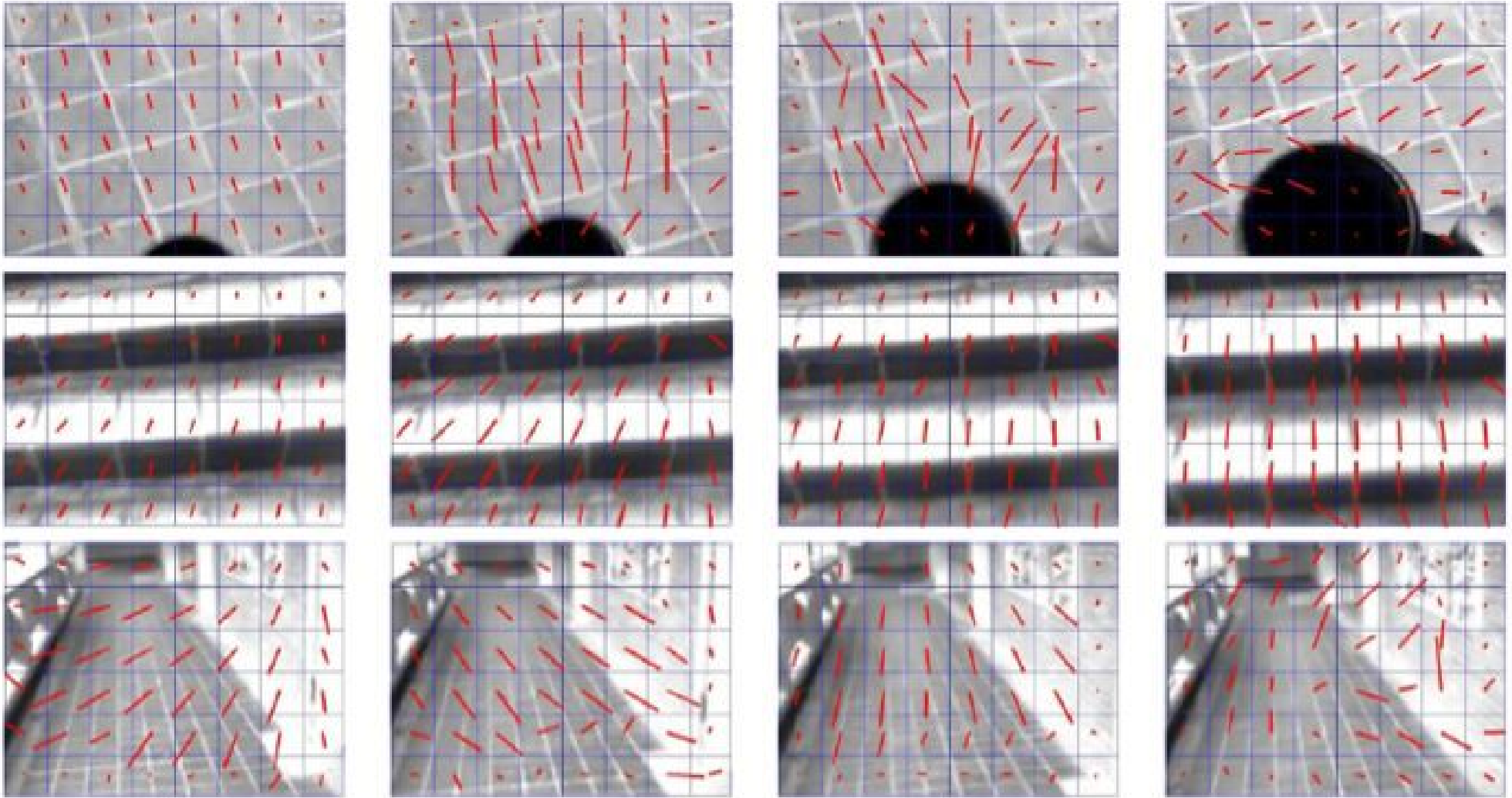


# Optical Flow Features

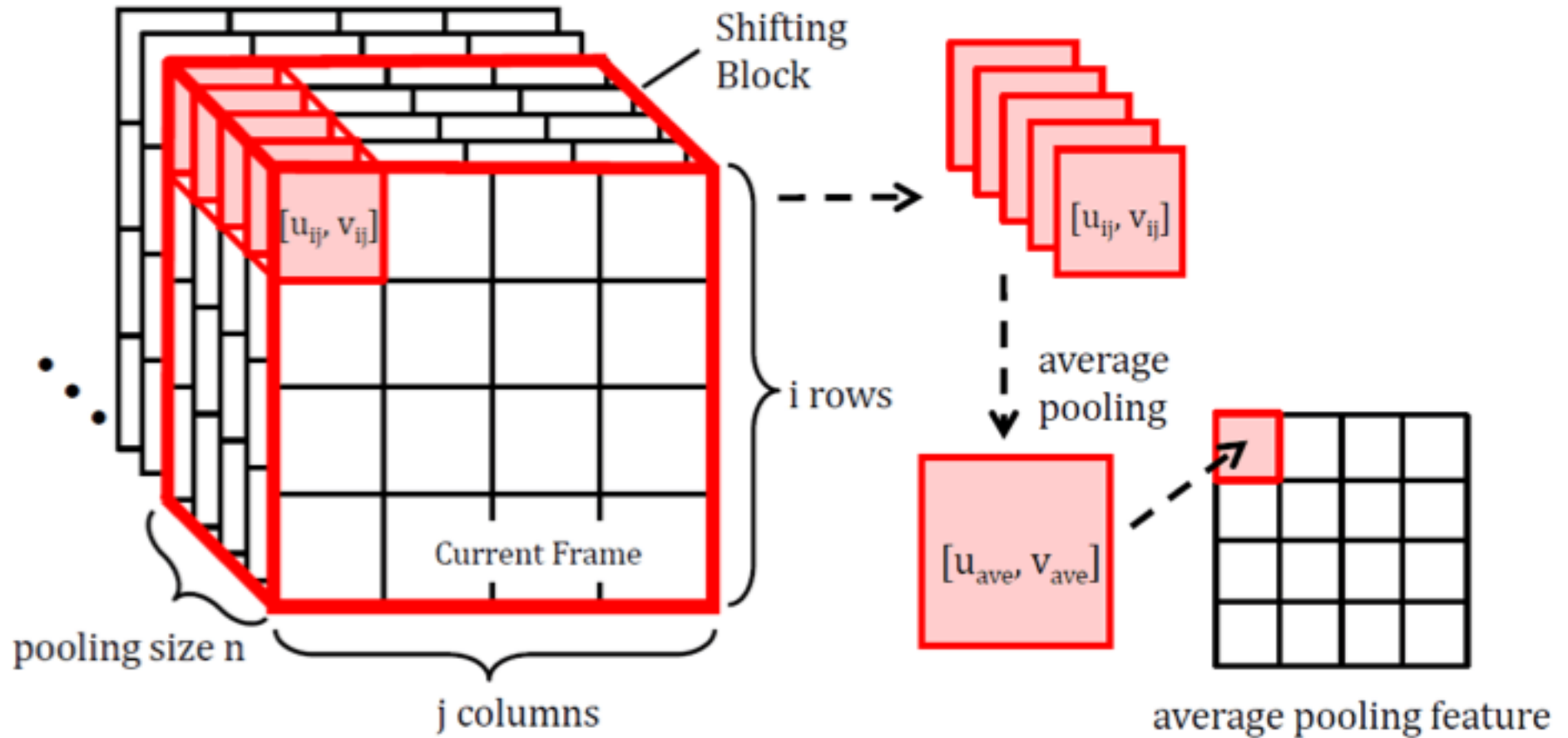




# Optical Flow Features



# Optical Flow Features

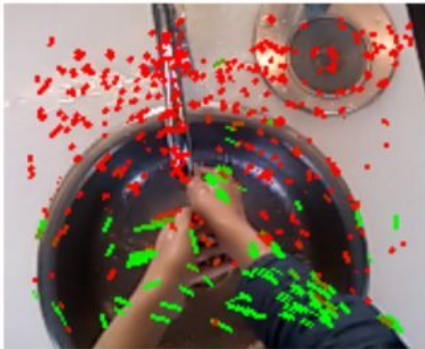




(a) Original Image



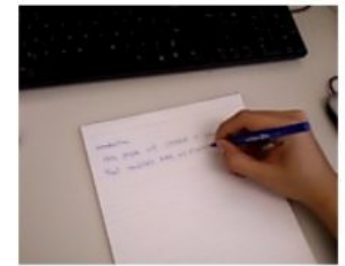
(b) Feature Set



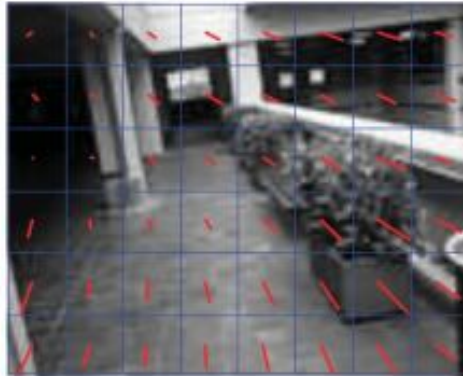
(c) RANSAC Classification



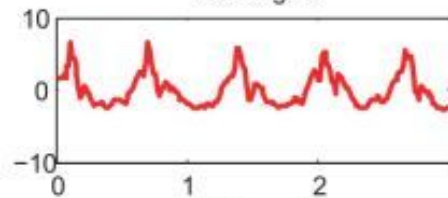
(d) Dense Motion Segmentation



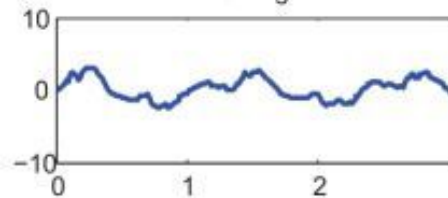
# Motion Segmentation Features



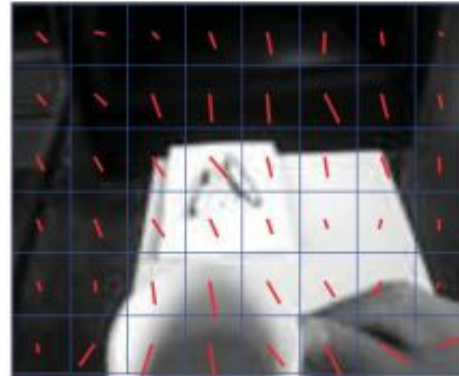
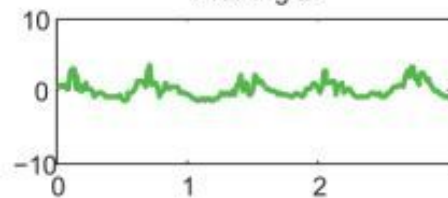
Walking X



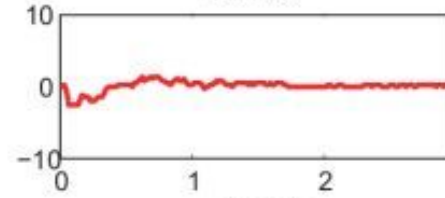
Walking Y



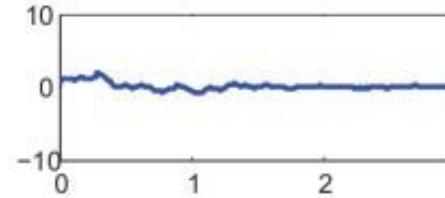
Walking Z



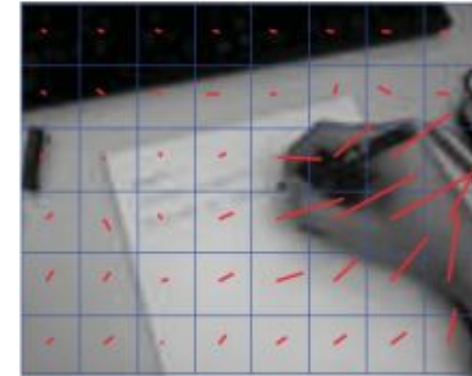
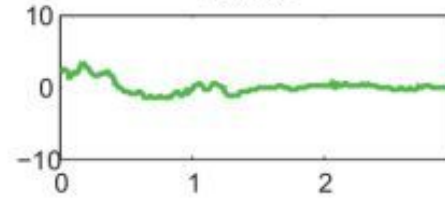
Drink X



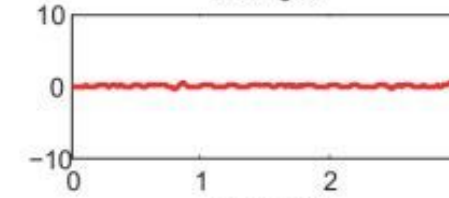
Drink Y



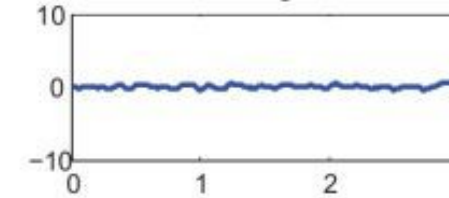
Drink Z



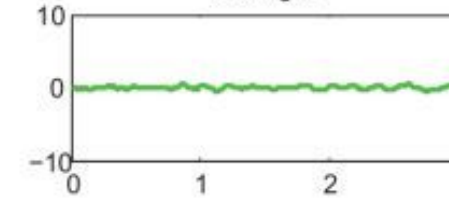
Writing X



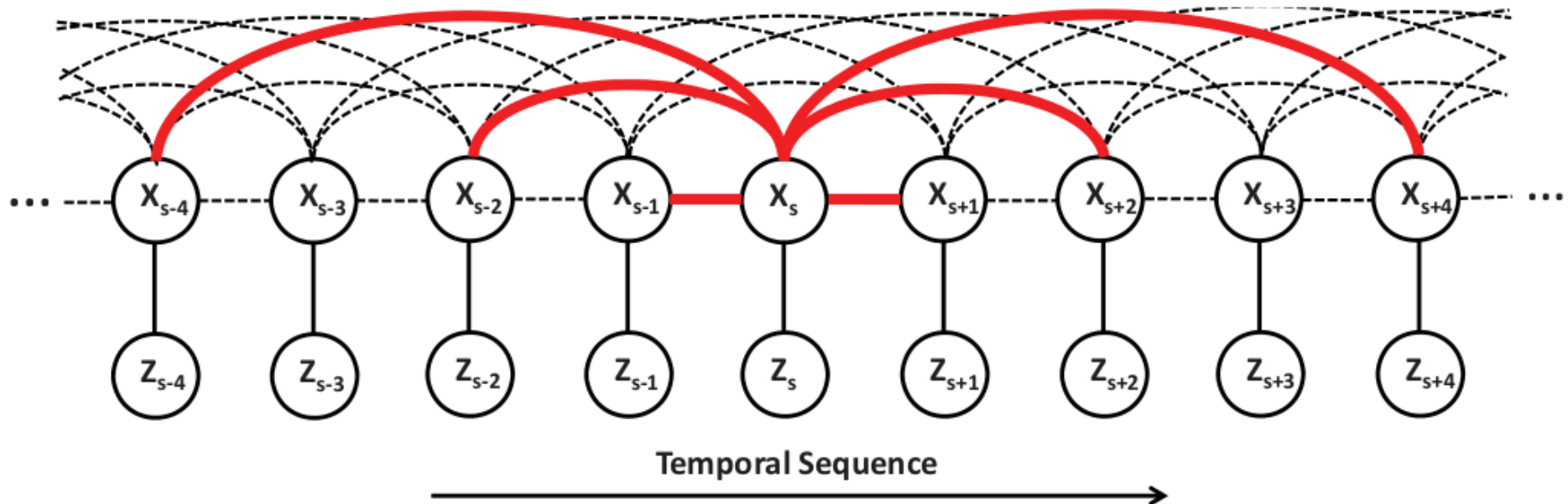
Writing Y

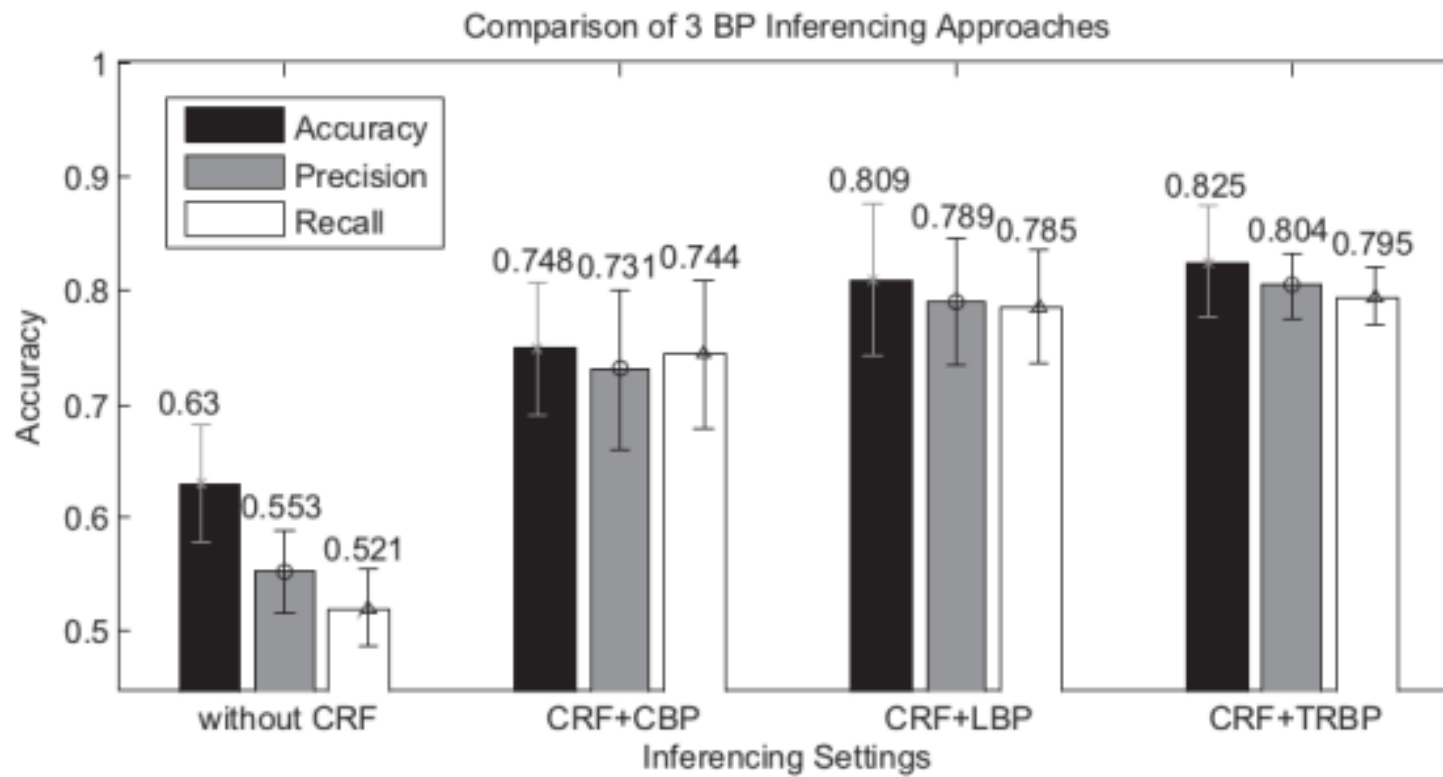


Writing Z

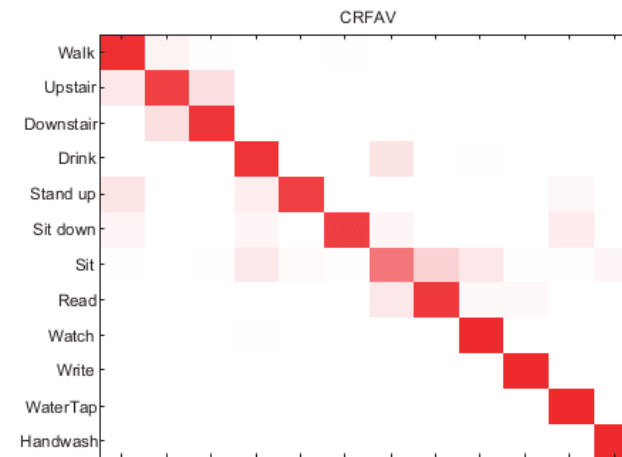
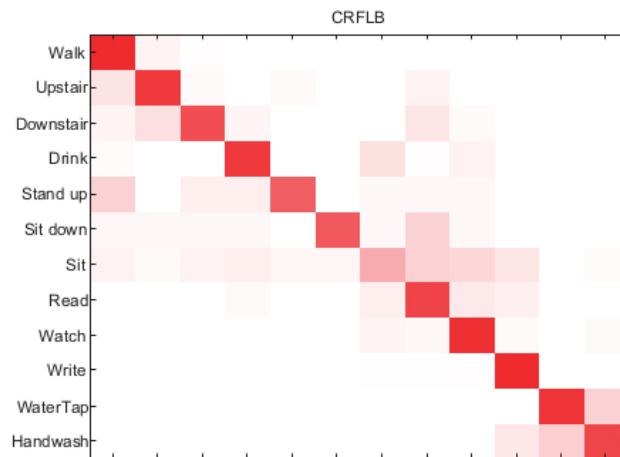
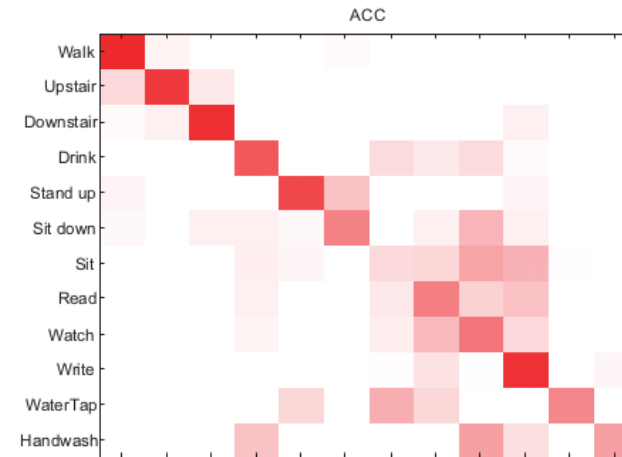
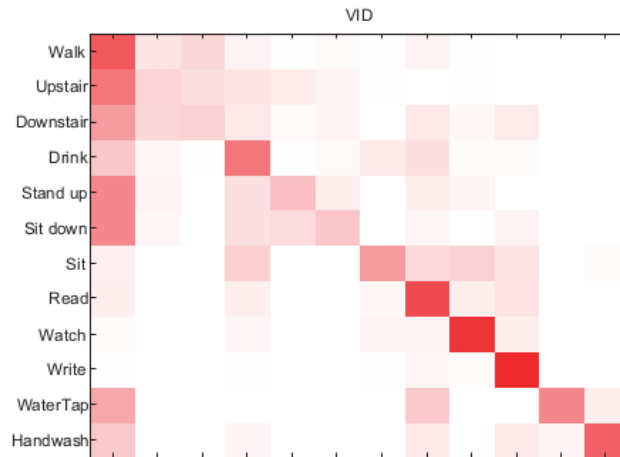


- ▶ Conditional random field (CRF)
- ▶ Exploit temporal relation between observations
- ▶ Solved using belief propagation





# Activity Prediction Results



VID  
CRFLB

Vision  
CRF on Vision

ACC  
CRFAV

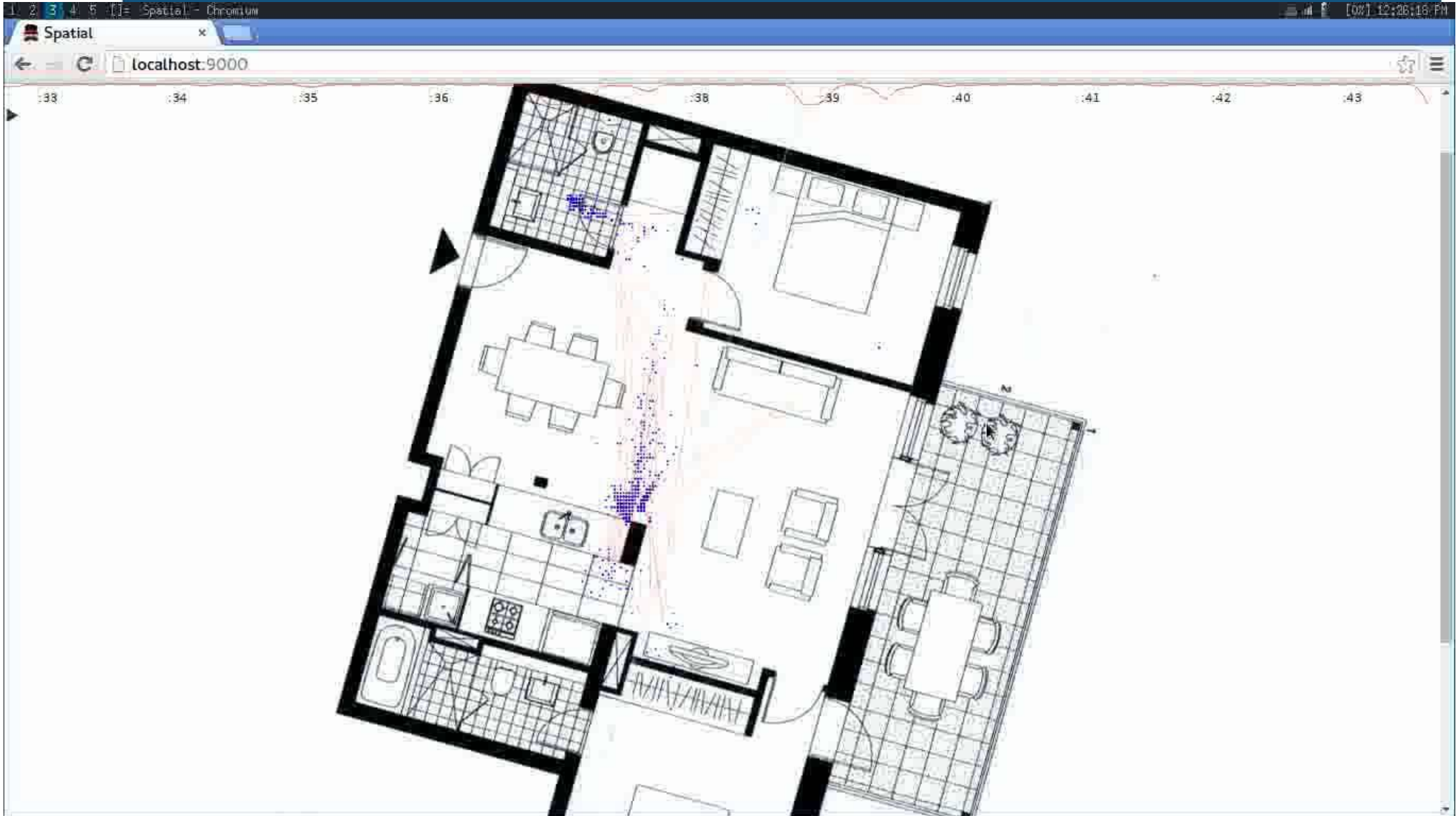
Accelerometer  
CRF on vision + accelerometer

# Activity Traces

- ▶ Traces of motion through the environment
- ▶ No instrumentation of the environment
- ▶ Annotate traces with environment type and activity
  
- ▶ Living room, watching TV
- ▶ Kitchen, drinking
- ▶ Etc.



# Activity Traces



- ▶ Sensors provide multitude of information
- ▶ Different sensors are better suited for different applications
- ▶ Machine learning allows to make sense of the raw data
- ▶ Deciding which sensors and algorithms work is a multidisciplinary problem