

The Case for Ambient Sensing for Human Activity Detection

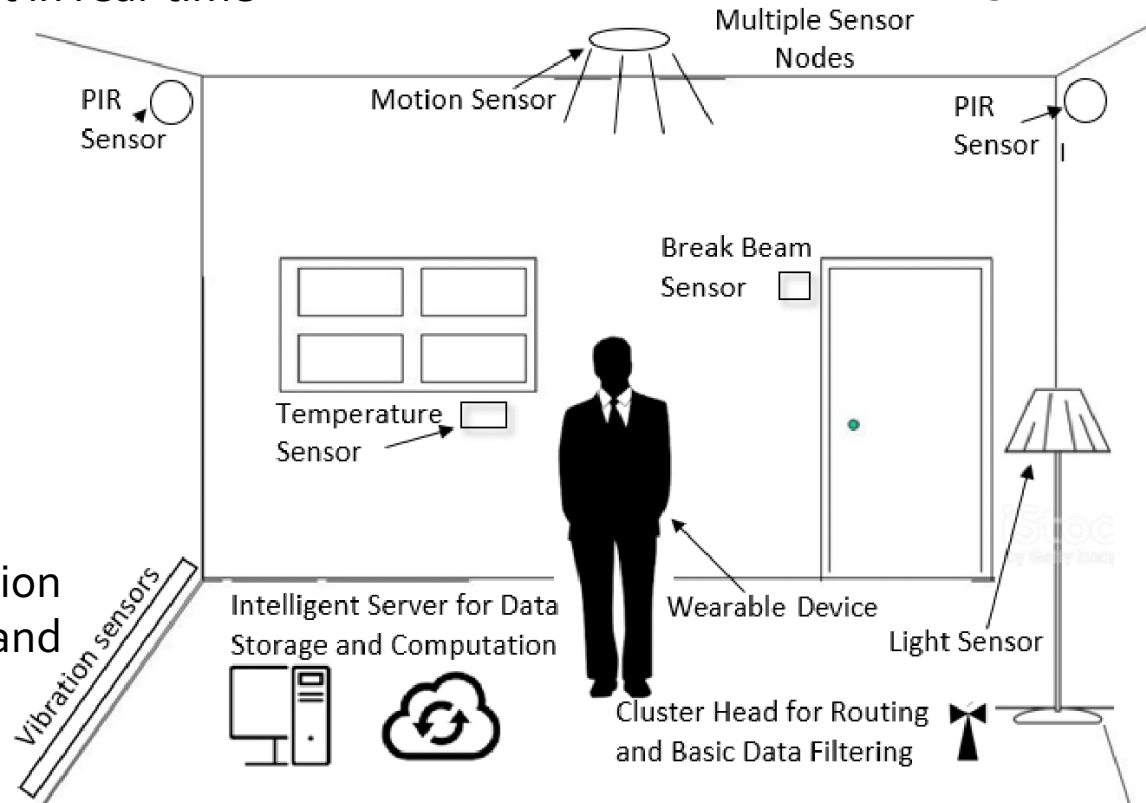
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Smart Space for Human Activity Detection

- Equipped with sensors.
- Perceive and react in real-time

- Data pre-processing on edge computation device



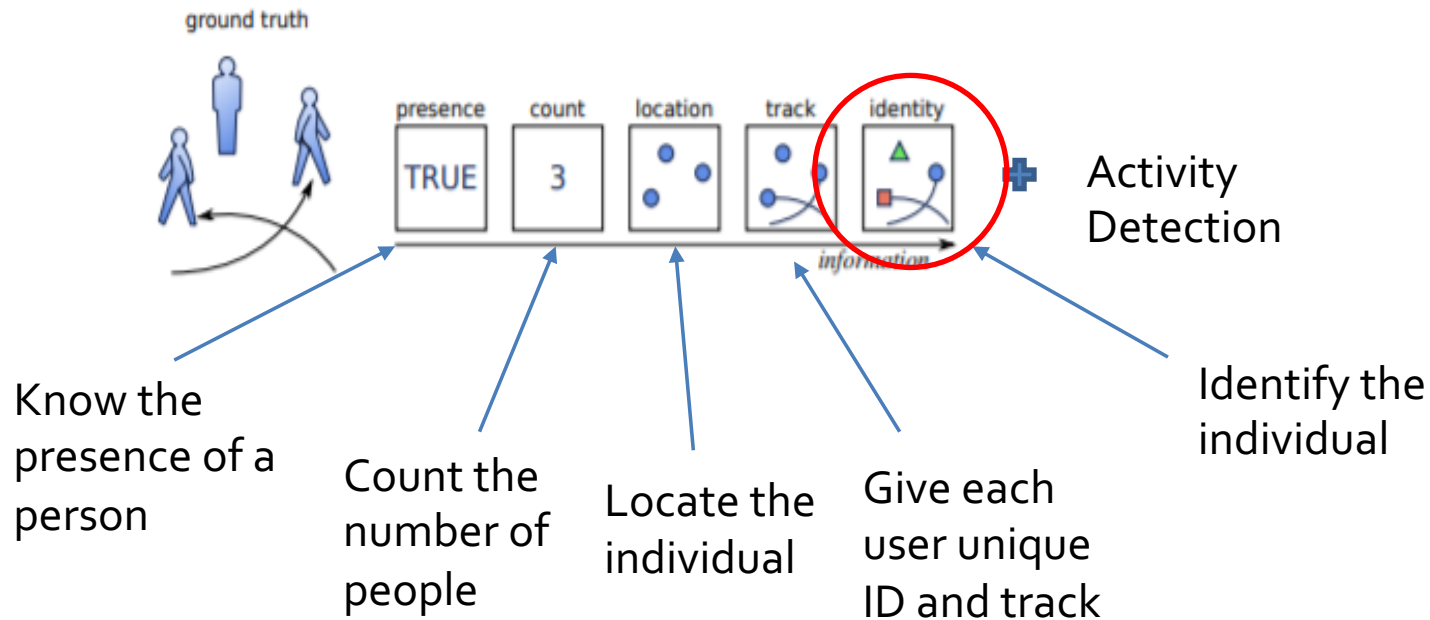
- Constant interaction between human and environment

- Storage and final decision making on remote vs. edge device

Introduction

- Smart IoT Space: Environment equipped with sensing elements with the ability to perceive and interact with user in real-time
- Sensing elements communicate remotely over the internet with computational and storage elements
- Data filtering and processing takes place in stages
- Effort to provide user with timely and seamless service

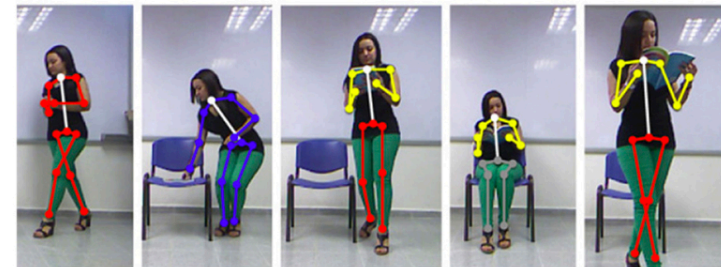
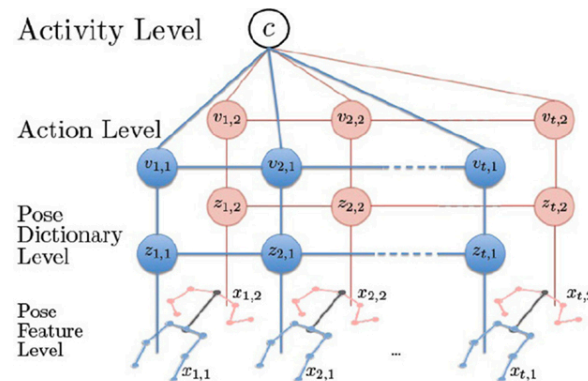
Tracking Humans in Smart Spaces



What is necessary vs. not?

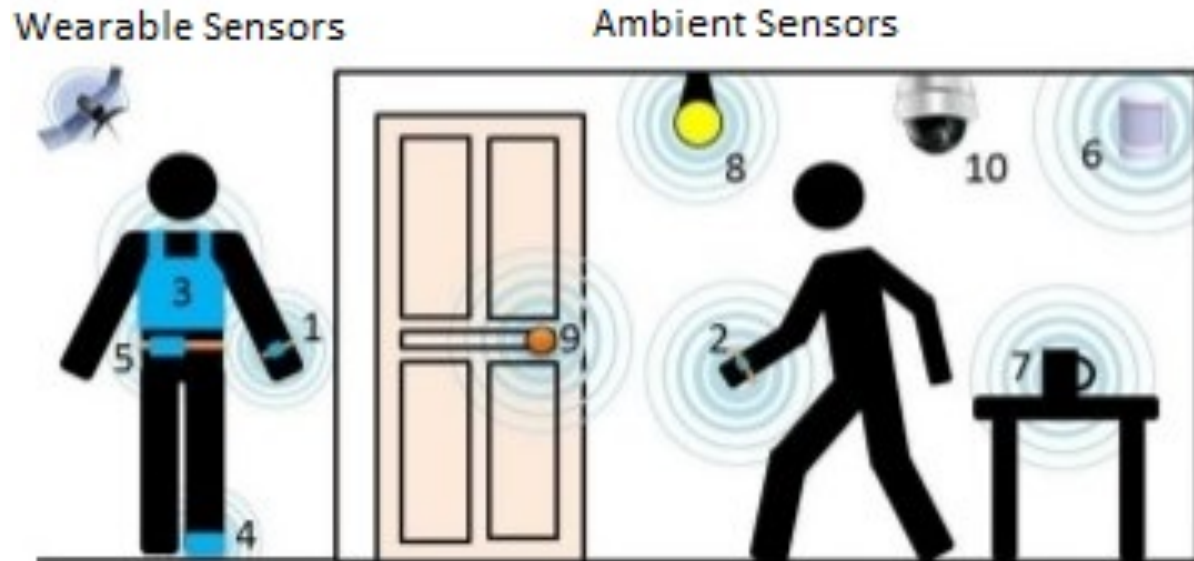
Activity Detection with Image/Video

- + Highest accuracy
- + Obtaining ground truth is easy
- +/- Application of complex methods possible
- - Person identification – privacy concerns
- - Large amount of data
- - Costly data processing
 - Usually not applicable to mobile devices, edge devices, etc.



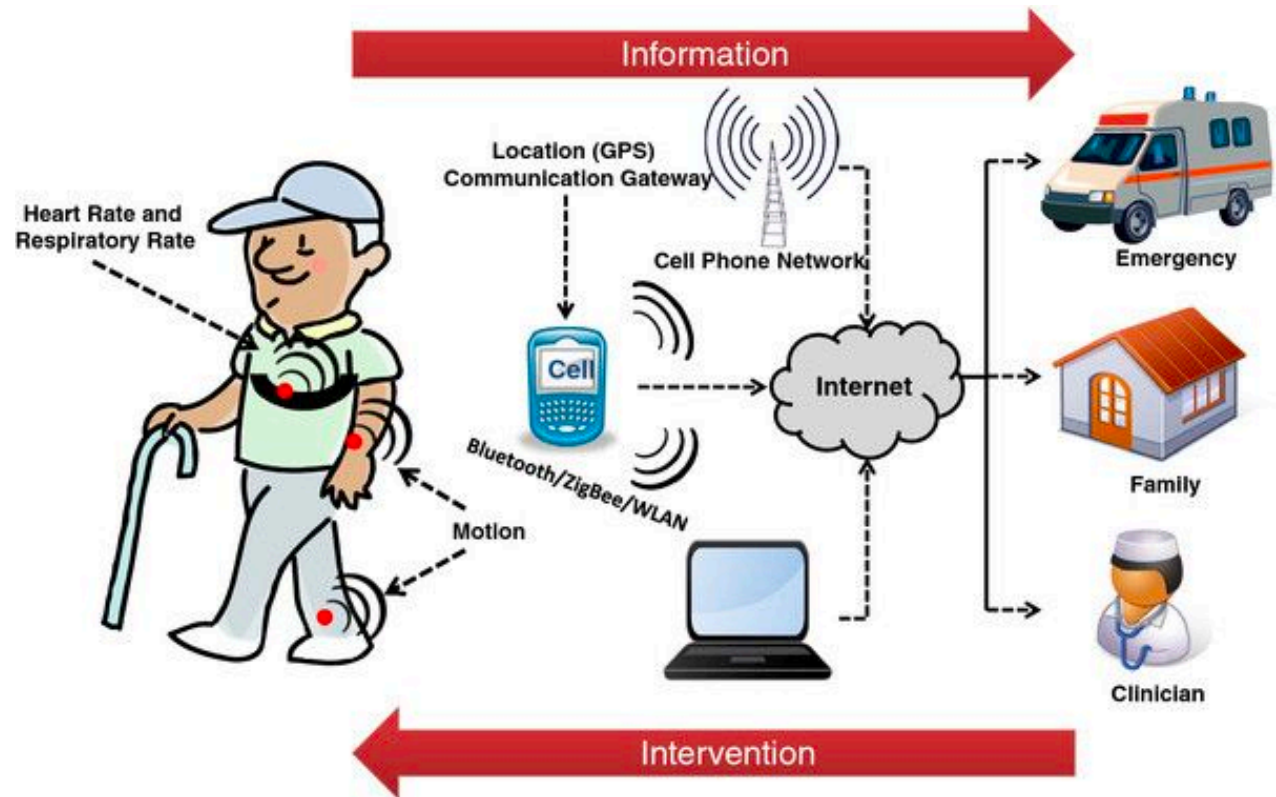
Another option: Wearable devices

- Concerns:
 - Privacy
 - Non-compliance
 - Subject-dependent
 - Cost
 - Comfort issues
 - How to observe ground truth



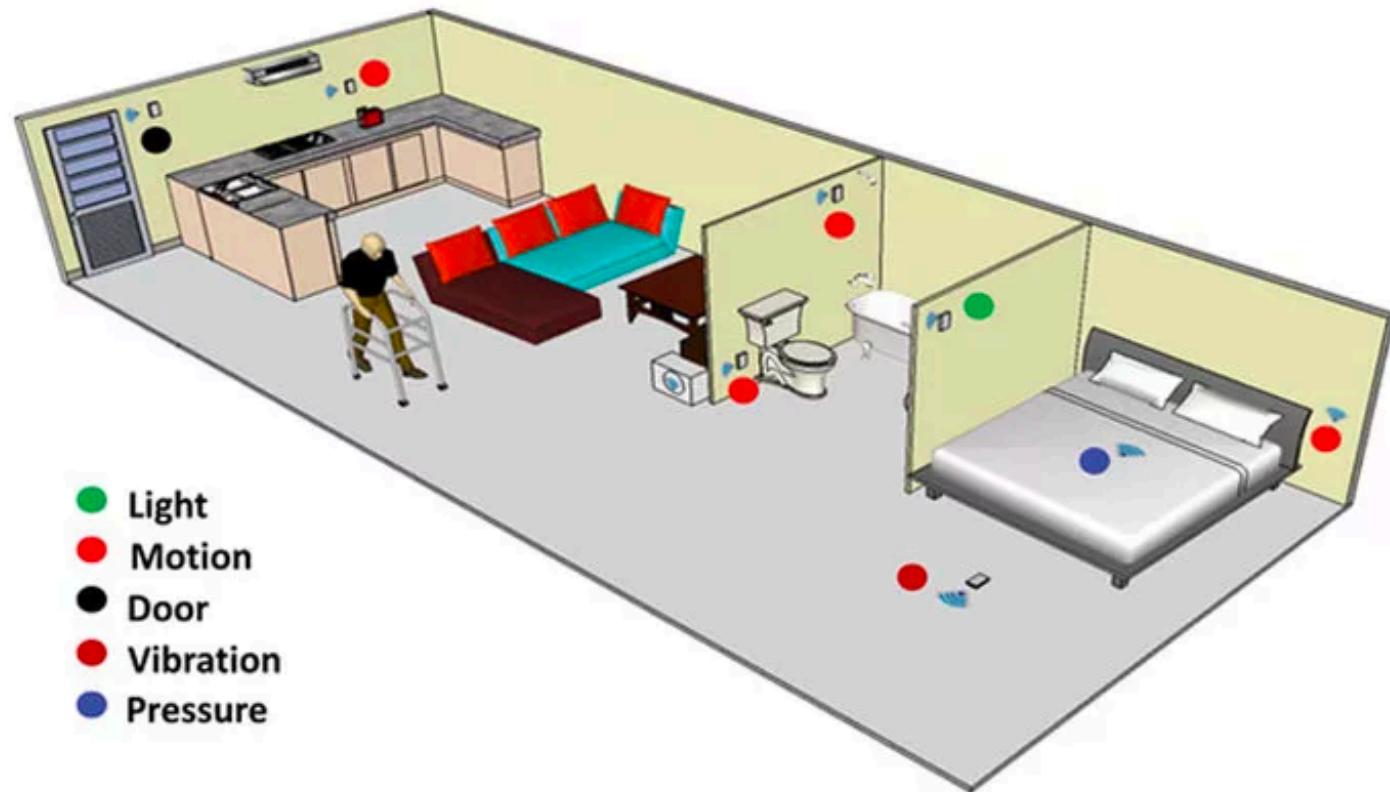
Example Scenario

Elderly health care



Ambient Sensing

- Sensors placed in the environment, not on people
- No sensor that can identify people

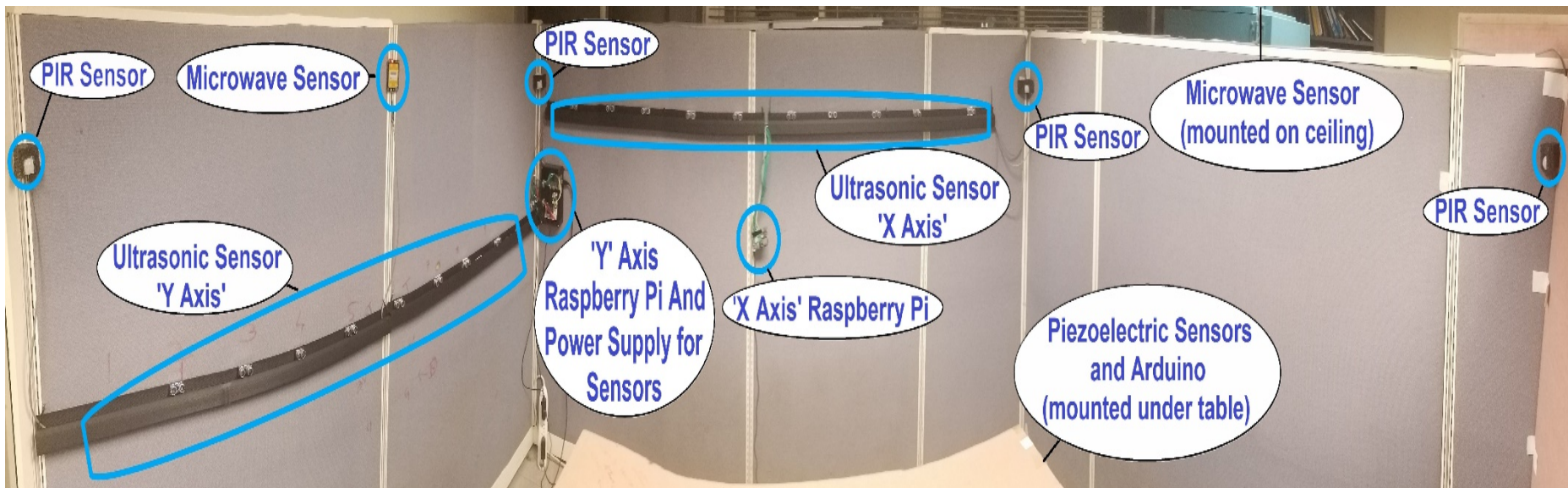


Comparison

	Multimedia	Wearable	Ambient sensing
Data source	Image, audio, video	Various wearable sensors	Ambient sensors
Preprocessing	Necessary	Might be necessary	Usually no
Classification	SVM, ANN, DT, BN, etc.	SVM, ANN, DT, BN, etc.	SVM, ANN, DT, BN, etc.
Applications	Surveillance, security, etc.	Health-care, fitness, fall detection, etc.	Smart spaces, elderly care, etc.
Overhead	High	Low to medium	Low
Ground truth	Easy to obtain	Might be difficult to obtain	Difficult to obtain
Multiple people	Suitable	Not very suitable	Suitable
Privacy	Low	Low	High

Our Setup

- Ultrasonic sensors, PIR sensors, microwave sensors, piezoelectric sensors, thermal sensors
- Small microcontrollers/computers as edge devices (Arduino, Raspberry Pi)



Challenges with Ambient Sensing

From our setup:

- Finding the correct set of hardware
 - Small ambient sensors are prone to error, breakdown, etc.
- Where to place the sensors
 - Door, ceiling, floor, wall, etc.
- Obtaining the ground truth
 - Initially the activities should be manually noted to correlate with the ambient sensor data
- Identifying unique people in the environment (not who they are)

Questions?

