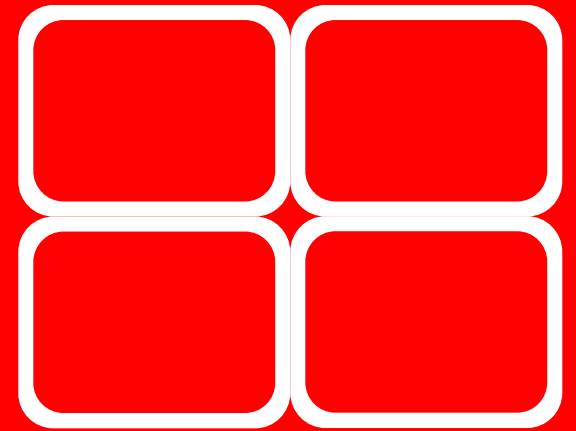
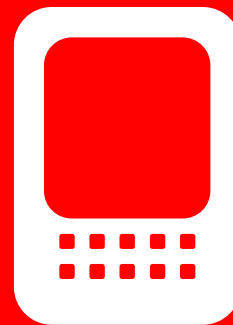
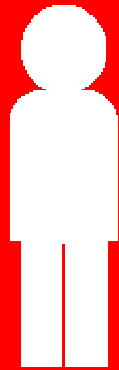
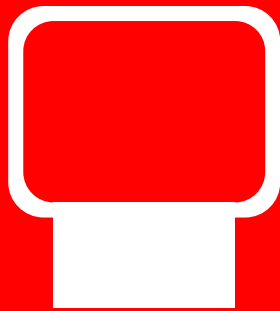


THE ECOSYSTEM OF DISPLAYS



Outline

- **Scenario and Motivations**
- **Requirements**
- **Specifications**
- **Services Delivered, Functionalities**
- **Adaptation**
- **Coordination**
- **Open Issues and Future Work**



Scenario and Motivations

- Pervasive deployment of *dumb* displays
- Persasive networking infrastructures
- High-density of mobile devices (smart phones, PDAs, ...)
- Increasing availability of low-cost sensing devices
- Huge number of potential usage scenarios (shopping malls, hospitals, schools, transportation stations...)



Requirements

- Pervasiveness
- Self-Adaptation
 - (*Time, Space and Service* domain. Different *Granularity Levels*)
- Self-Healing
- Coordination
 - (Among Several Displays)
- *Best-Effort* Design
 - (Implicit and Explicit Inputs)
- Openness and Extensibility
 - (from building to city-wide scale)



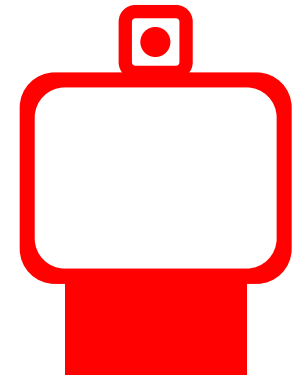
Specifications

Hardware

- Static (single, multiple) or mobile displays.
- Networking capabilities. Displays have to communicate with **each other** and be able to **retrieve multimedia content from remote sites.**
- Interactive Capabilities.

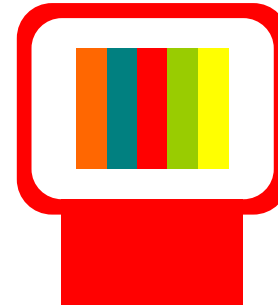
Interactive Capabilities, more detailed

- Vision sensors (age, gender, crowds, emotions...)
- Audio Sensors (age, gender, emotions, speech, noise...)
- Tangible interfaces
- Environmental sensors (temperature, humidity...)
- External mobile devices (RFID, BlueTooth, Wi-Fi...)



Services Delivered

- **Advertising**
- **Navigation**
- **Information**
- **Entertainment**
- **Ambient display**

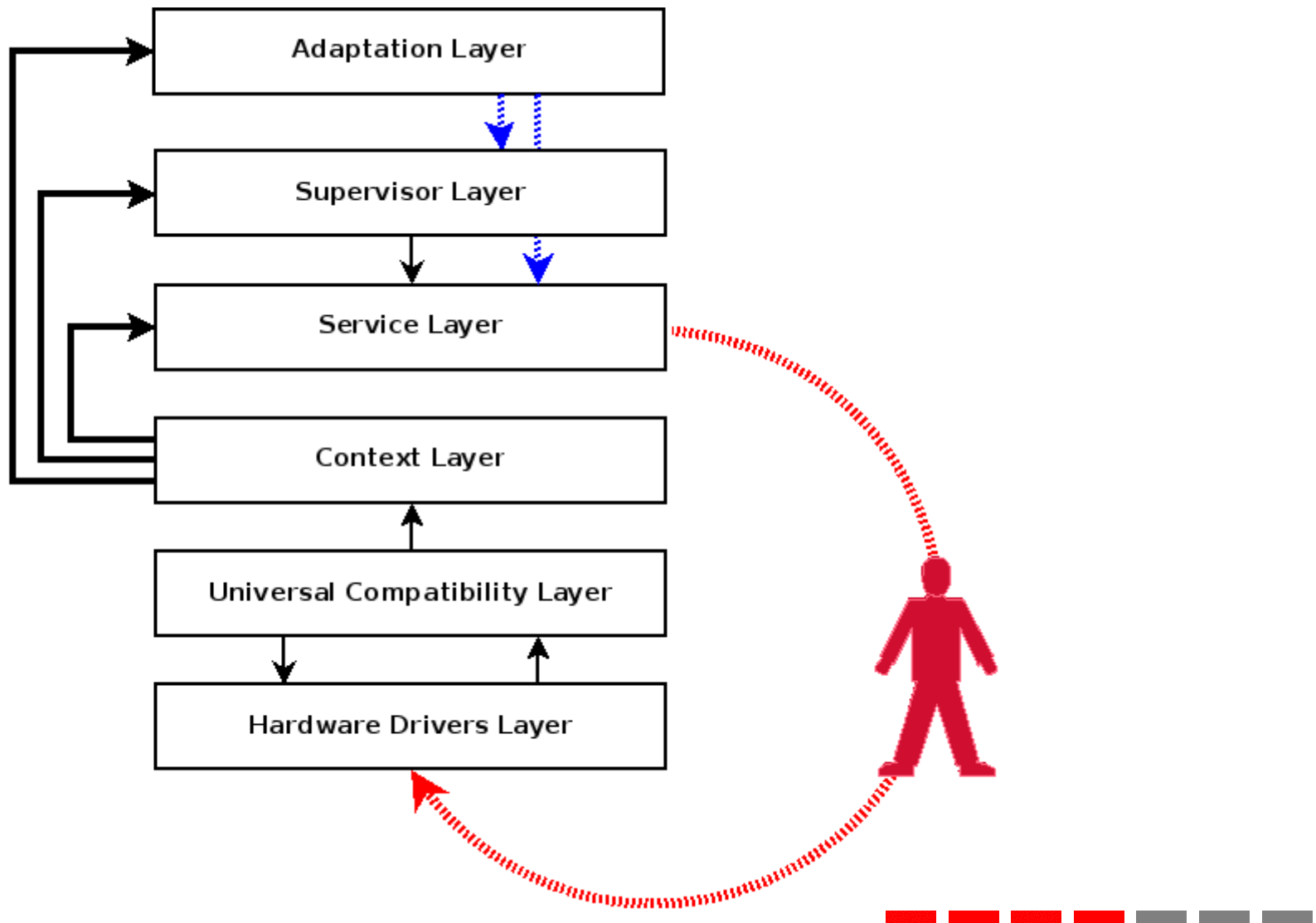


Functionalities of Services

- **General**
 - Combinations of services
 - Emergency overrides
- **Advertising**
 - Adaptation based on sensing capabilities (statistical pattern matching)
 - Coordination among several devices (e.g. don't see always the same ad)
 - Feedback loop from the users, to improve the quality of suggestions
 - Flexible fares
- **Navigation**
 - Floor plans
 - Different paths adaptation
 - Continuous navigation



Architecture



Adaptation

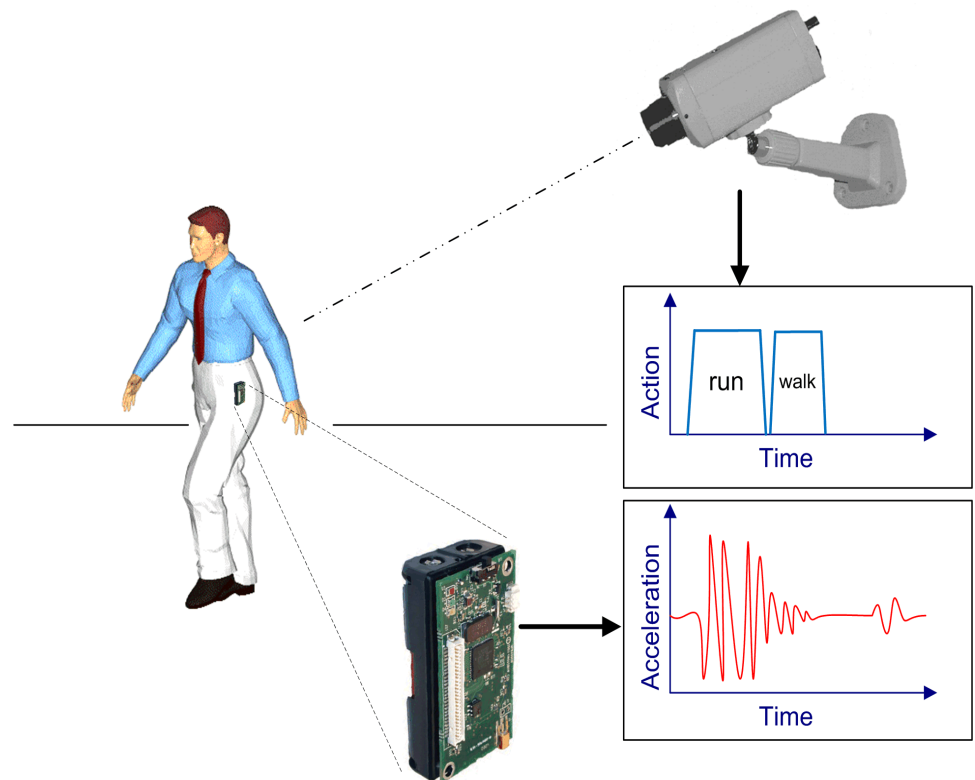
- **Short term**
 - Habits, Age, Gender, Crowd size, Emotions, Digital Logs (*All about Diary*)
- **Medium term**
 - Usage Patterns (suggest immediately the most appropriate service)
- **Long term**
 - Hardware and Algorithms changes

DEFINITION: short, medium and long time scales refer to the approximate frequency an adaptation is required



Adaptation: Tracking Example

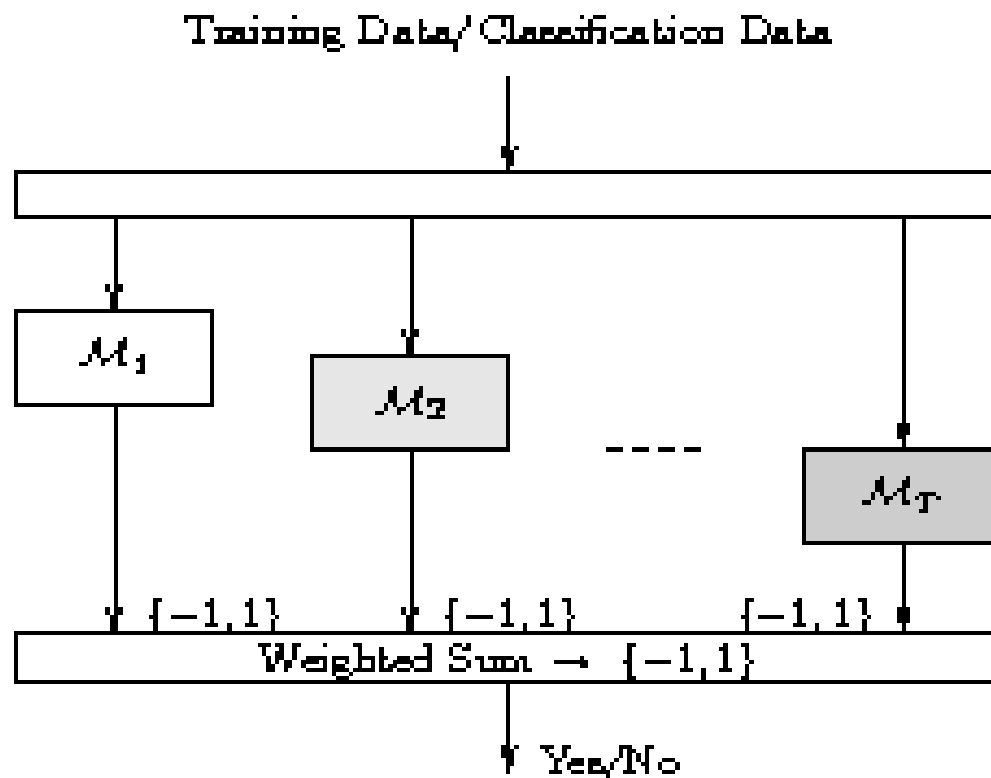
- In order to build a smart and adaptive system, it is important to exploit at best the most of the sensing capabilities.
- In this example: *Accelerometer* and *Video Camera*



Adaptation: Tracking Example

- **Boosting:** a mechanism to maximize our utility function by taking advantage of multiple sensing capabilities

*Yoav Freund, Raj Iyer, Robert E. Schapire and Yoram Singer,
An efficient boosting algorithm for combining preferences.*



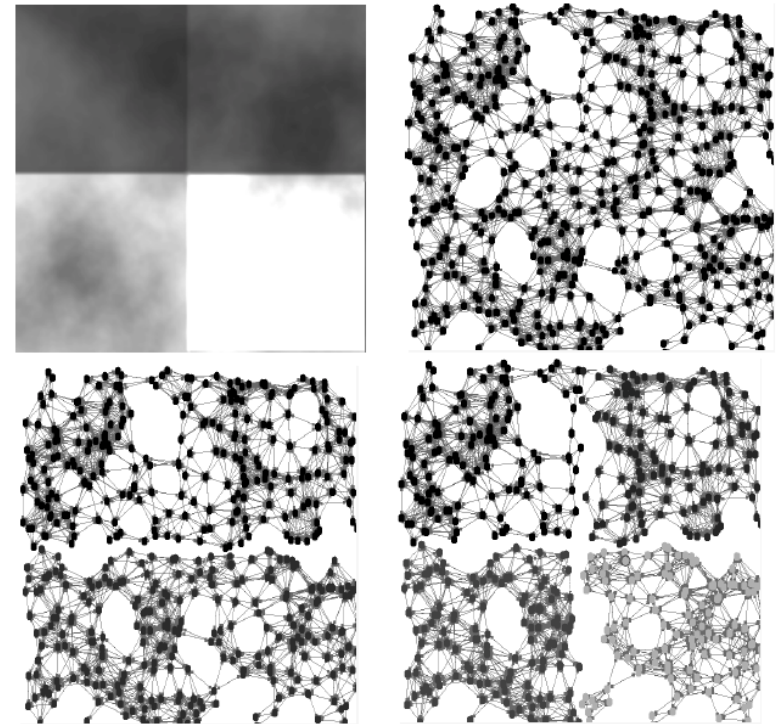
Collaboration of Screens

- Avoid showing the exact same ad to the same person twice (maybe different variants)
- Coordinate to show different parts of the same ad
- Follow the user along his/her path and provide him/her with navigation information
- Show huge pictures over multiple displays
- Knowledge Exchange (Self-Adaptation)
- Distributed Heartbeat Control (Self-Healing)



Collaboration: Knowledge Exchange

- Knowledge exchange is important for adaptation
- Depending on each screen's situation, some knowledge may be more useful within a specific group of screens
- Aim:
 - clustering of screens by similarity of situation
- Possible solution:
 - a distributed partitioning algorithm



Self-organizing Spatial Regions for Sensor
Network Infrastructures

(Nicola Bicocchi, Marco Mamei, Franco
Zambonelli)



Open Issues & Future Works

- Profile definitions
- Learning and adaptation to user habits
- Privacy concerns (features cache)
- Social perception of the system

