Reality Computing

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Reality Computing

- Introduction
- Micro Geo-Information
- Invisible Computing
- Conclusions

Introduction

- Reality computing
  - Information and communication technology everywhere, for everyone, at all times
  - Mobile and ubiquitous computing

- Traditional computing vs reality computing
  - Traditional computing: distance from user to subject matter ->∞
  - Reality computing: distance from user to subject matter ->0

Introduction

- In the next few years:
  - Radio tags will replace bar codes
  - Micro sensors (bio, optical, chemical) will be ubiquitous
  - Indoor positioning will reach a standard 15 cm precision

  Mobile phones will become scanners of a micro-geographic world and the main devices in reality computing

Introduction

- In the next few years:
  - Desktop computers will “disappear”
  - The desk and the walls will become our computers
  - Mobility will add to invisibility

  User interfaces will increasingly follow the invisible computing paradigm

Micro Geo-Information

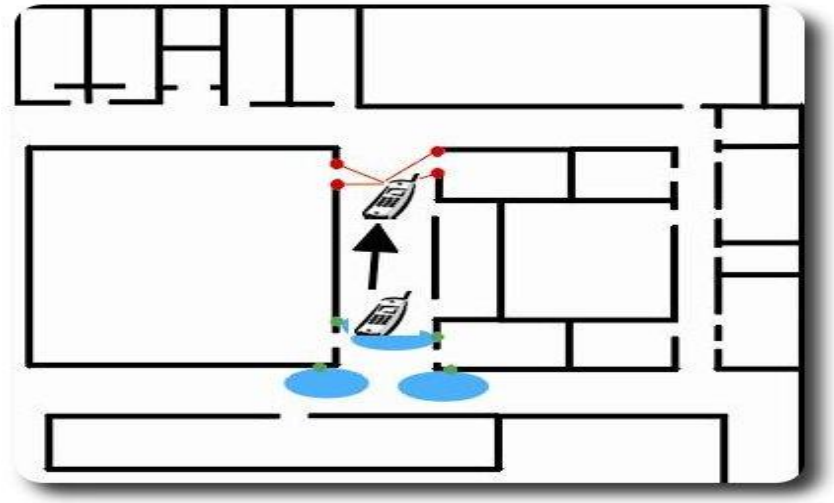
Indoor positioning
Location models
Current developments
In the next few years

Micro Geo-information

- Indoor positioning
  - Absolute Positioning
    - MIT Cricket (coordinates)

      http://nms.csail.mit.edu/projects/cricket/#technology
  - Relative Positioning (sets)
    - Active Badge

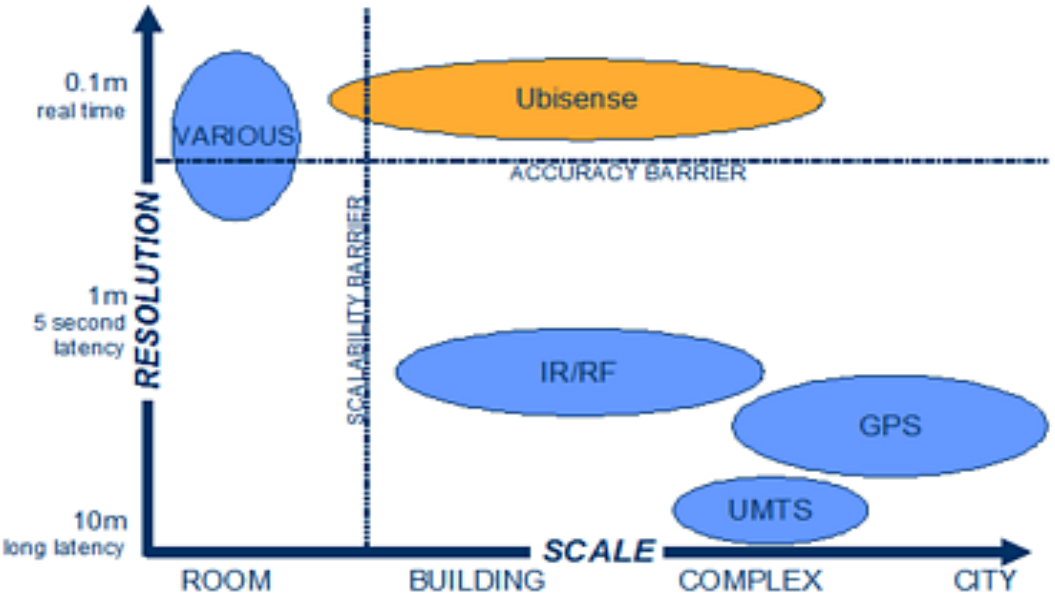
      http://web.media.mit.edu/~dmerrill/badge/Want92_ActiveBadge.pdf
  - Preferred solution: seamelss handover between absolute and relative positioning



*adapted from Kris Kolodiej and José Danado, “In Building Position”, GIM 04

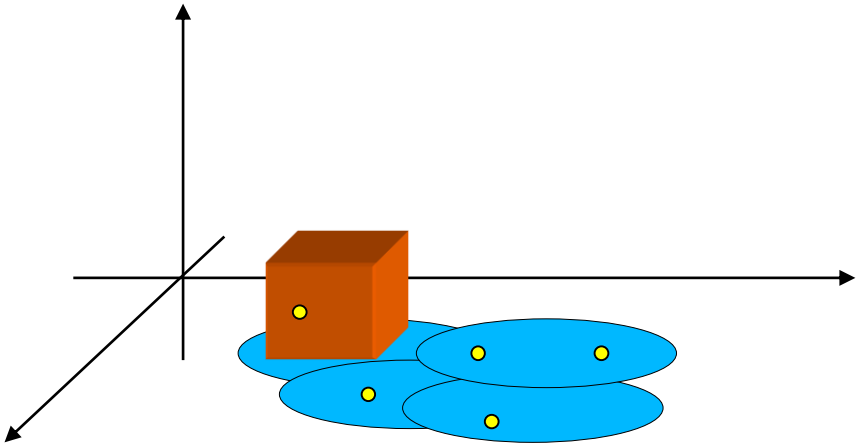
Micro Geo-Information

- Indoor positioning
  - Ultra-Wide Band Ubisense (http://www.ubisense.net) based technology. Much less affected by multi-path distortion of radio signals on walls, people and equipment
    - 15 cm 3D accuracy using Ubisensors and Ubitags

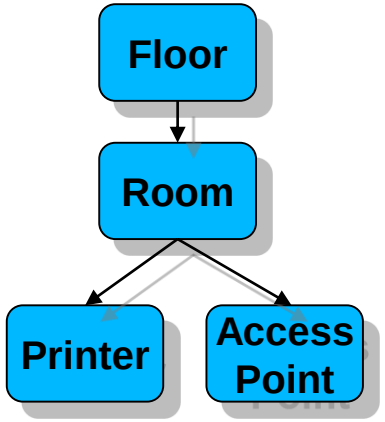


Micro Geo-Information

- Geometric location model
  - Locations and located-objects:
    - Points, areas, volumes – sets of coordinates tuples
  - Based on reference coordinate systems



- Symbolic location model
  - Locations: sets
  - Located-objects: members of sets
  - Refer to locations by abstract symbols
  - Hierachies-> spatial bar coding



From U. Leonhardt, 1998

http://www.doc.ic.ac.uk/~ul/pdf/thesis_w_bookmarks.pdf

Micro Geo-Information

- Location based services typology
  - Proximity and position- detection of objects
  - Fencing- detect areas where special movements occur
  - Navigation- instructions to go from an origin to a destination
  - Tracking- monitoring the movement of an object in space

- Indoor mapping
  - Built plans
  - Infrastructure (up to 10 cm error)
  - Map symbology is critical

- Interfaces
  - Mobile phones (up to 100x100 pixels)
  - Blackberry (250x120 pixels)
  - PDAs (240x320 pixels)

Micro Geo-Information

- Current developments: Colombo Center application
  - Mobile phone based system
  - Anchors: places or objects that were geo-referenced. They could be physical tags (with a number) or radio tags.
  - Spatial bar codes: the anchors had spatial bar codes that uniquely identified the place or object in the world. Each spatial bar code had an URL associated with it.
  - Phonemarks: storing anchor points for later exploration

* A. S. Camara e A. E. Dias, “Location Based Services for WAP Phone Users in a Shopping Centre”, G. Clark and J. Stilwell, eds. Applied GIS and Spatial Analysis, John Wiley, London, 2003

Micro Geo-Information

- Current developments: Colombo Center application
  - Store and Product Finders
  - Product Interaction
  - Parking Place Finder

* A. S. Camara e A. E. Dias, “Location Based Services for WAP Phone Users in a Shopping Centre”, G. Clark and J. Stilwell, eds. Applied GIS and Spatial Analysis, John Wiley, London, 2003

Micro Geo-Information

- In the next few years: security applications
  - Ubisense system (http://www.ubisense.net)
    - Detects intruders that do not carry Ubitags (inconsistency between passive sensors and location of Ubitag wearers)
    - Tracks visitors
    - Detects unauthorized movements of assets
    - Helps monitoring high security environments

Micro Geo-Information

- In the next few years: the infrastructure
  - Communications infrastructure
    - Cellular, Wi-Fi and Wi-Max, UWB, Bluetooth, readers and updaters compatible with Electronic Product Code
  - Positioning infrastructure
    - GPS, Gallileo, Telecom and Assisted GPS, Pseudo-GPS; WiFi based location, RFID based location, UWB based location
    - Tags and sensors
  - Location models
    - Towards hybrid systems (geometric and symbolic)
  - Content and interfaces
    - Indoor mapping and mobile devices

Invisible Computing

Invisible computing
Technological infrastructure
Interfaces
In the next few years

Invisible Computing

“The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.”

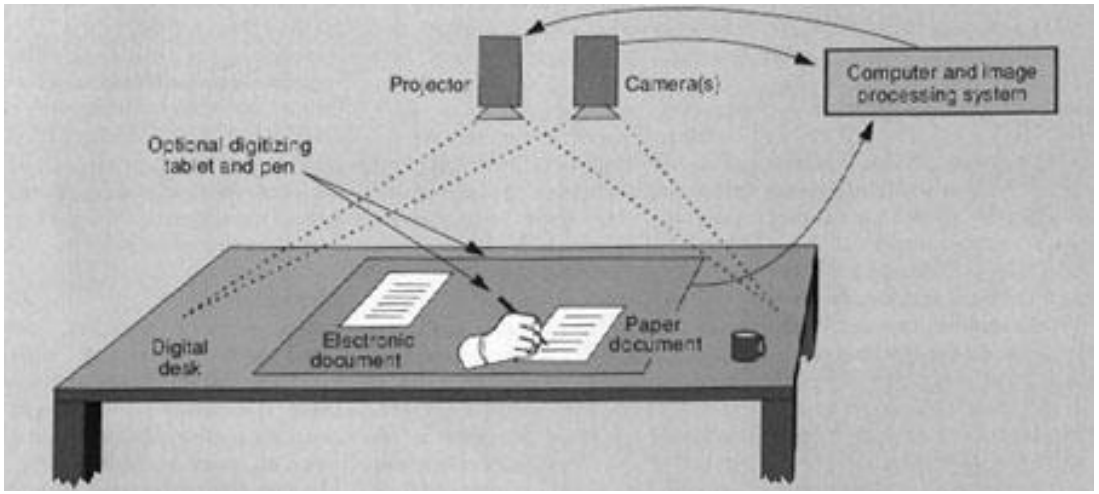
Mark Weiser, 1991

Home heating versus computing

- Boilers <-> Computer centers
- Fireplaces<-> Computer rooms
- Heaters <-> Networked personal computers
- Air conditioning <-> Ubiquitous computing

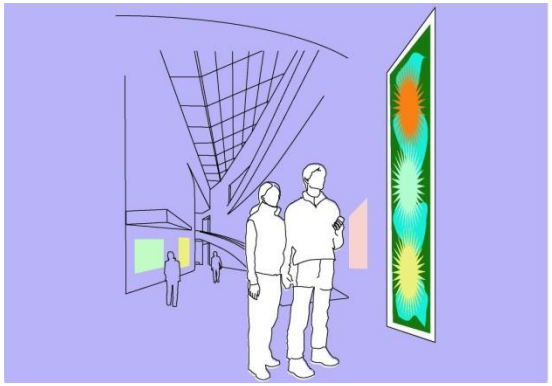
Inivisible Computing

- Invisibility is both factual and metaphorical
  - There is no computer in my desk; its top is my computer (Digital Desk)
  - The whiteboard is still on the wall but it is active (Liveboard)



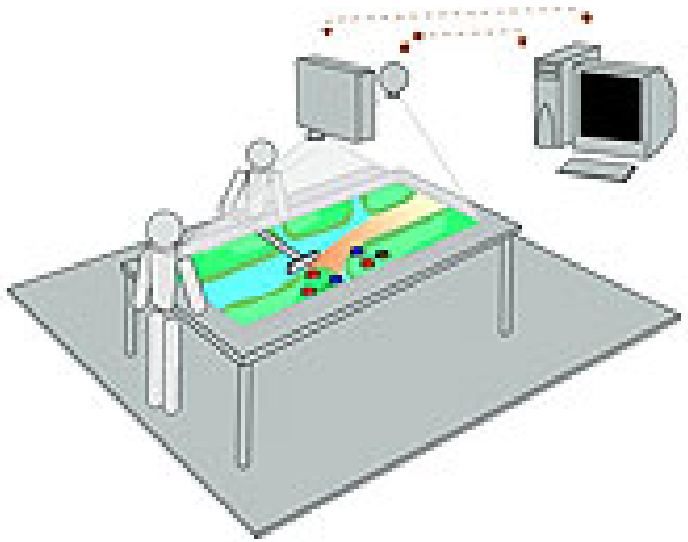
Invisible Computing

- Mobility adds to invisibility
  - Communication between mobile users is not affected negatively by significant changes in user locations
  - User access to information and processing systems available locally or remotely is not negatively affected by changes in his/her location
  - Distance between a mobile user and points and objects of interest approaches zero. Access to remote information systems that describe those points and objects may be performed locally



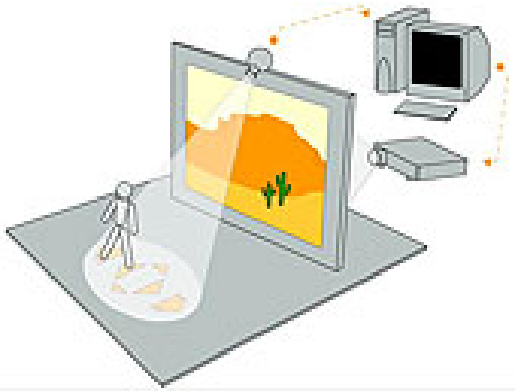
Invisible Computing

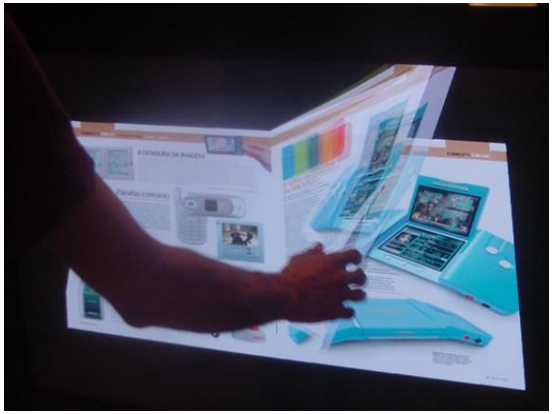
- Technological infrastructure
  - Sensors
  - Processing systems
  - Projection systems
  - Displays
  - Interfaces
    - Movement recognition
    - Tangible interfaces
    - Voice
    - Mobile control
    - Augmented reality
    - Wearables

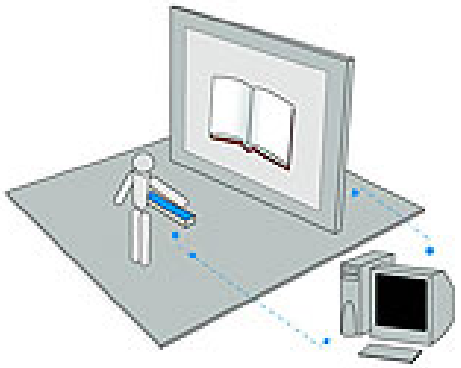


Invisible Computing

- Interfaces
  - Movement recognition

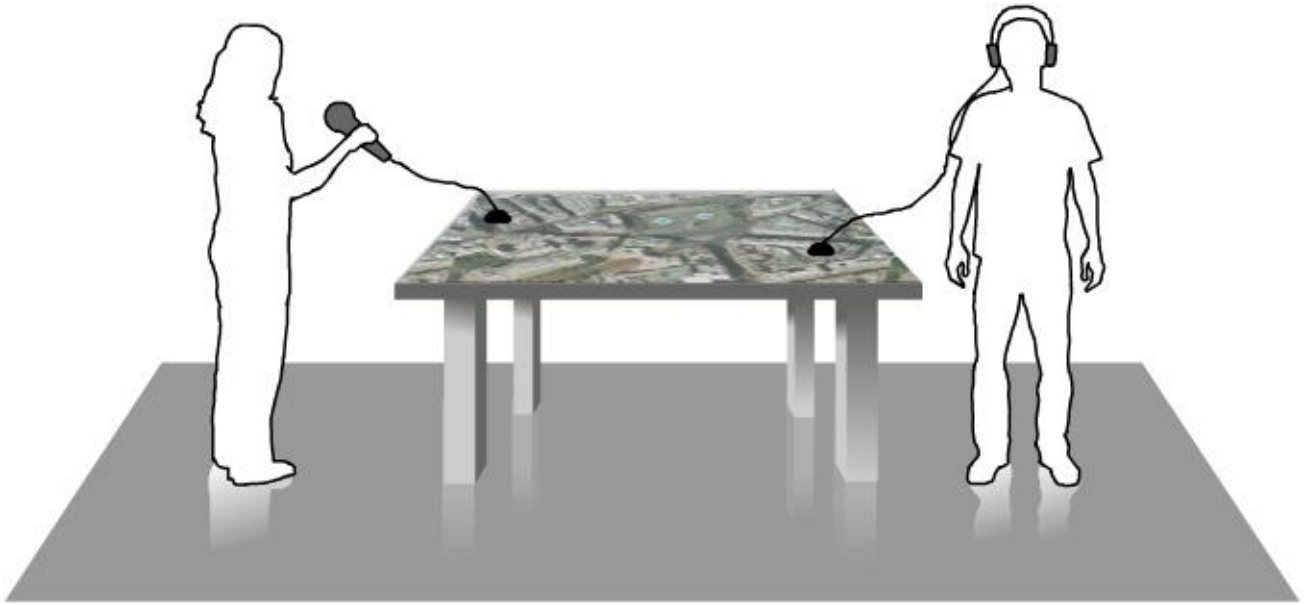






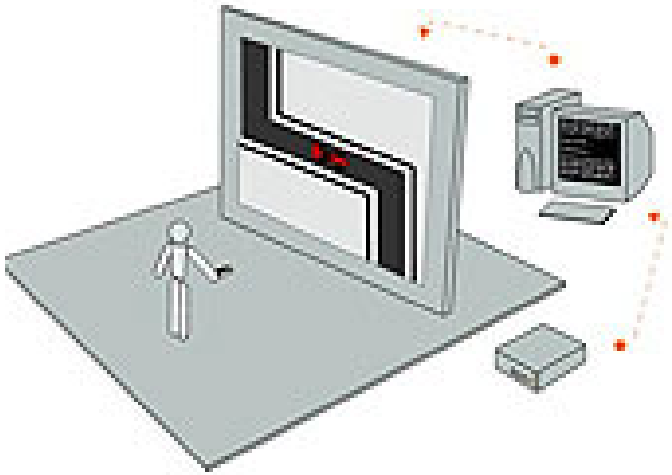
Invisible Computing

- Interfaces
  - Tangible interfaces and voice



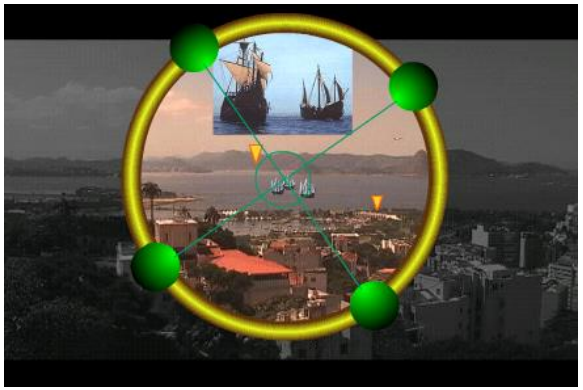
Invisible Computing

- Interfaces
  - Mobile control



Invisible Computing

- Interfaces: augmented reality
  - Virtual sightseeing
    - Superimposition of text, images and videos on real images using a fixed device

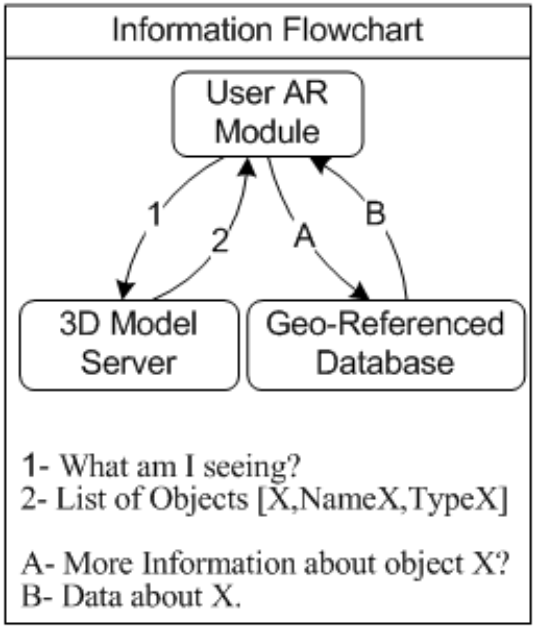


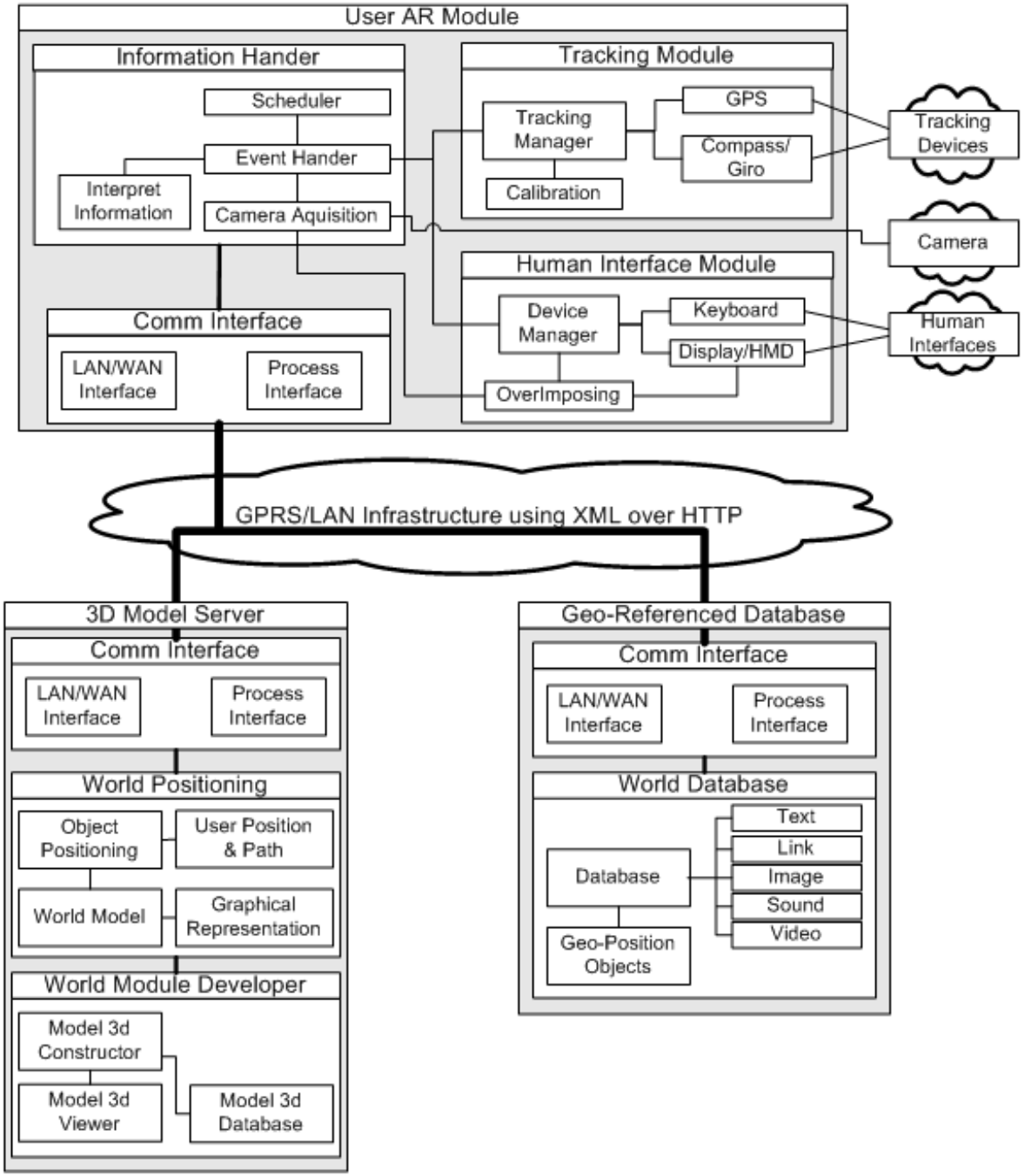
Invisible Computing

- Interfaces: augmented reality
  - Dynamic augmented reality
    - YDreams has developed a technology that enables the insertion and control of virtual elements in a real scene:
      - One can be a virtual actor in a real movie scene
      - One can participate in a car race driving a virtual car against real cars

Invisible Computing

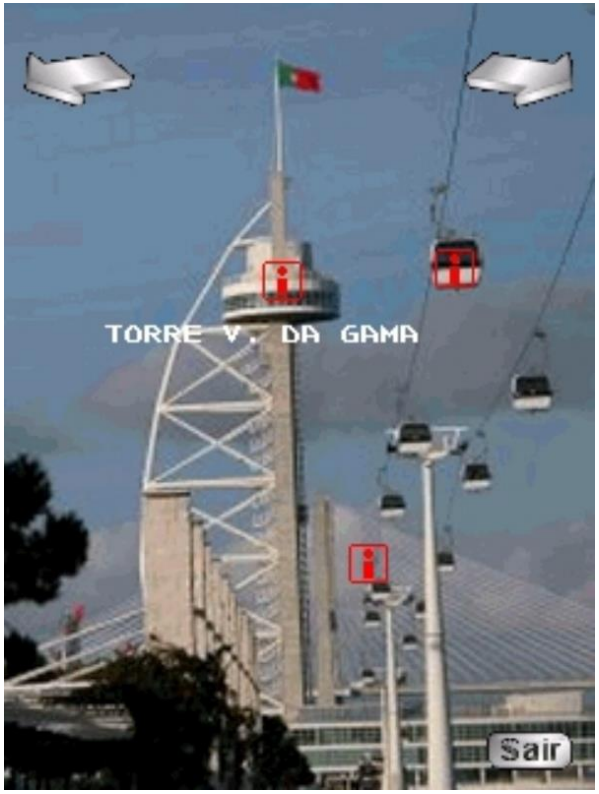
- Interfaces: augmented reality
  - Mobile augmented reality
    - Superimposition of text and images over real images in real time using Head Mounted Displays and PDAs




User AR Module
Information Hander
Scheduler
Event Hander
Interpret Information
Camera Aquisition
Tracking Module
Tracking Manager
GPS
Compass/ Giro
Calibration
Tracking Devices
Camera
Human Interface Module
Device Manager
Keyboard
Display/HMD
OverImposing
Human Interfaces
Comm Interface
LAN/WAN Interface
Process Interface
GPRS/LAN Infrastructure using XML over HTTP
3D Model Server
Comm Interface
LAN/WAN Interface
Process Interface
World Positioning
Object Positioning
User Position & Path
World Model
Graphical Representation
World Module Developer
Model 3d Constructor
Model 3d Viewer
Model 3d Database
Geo-Referenced Database
Comm Interface
LAN/WAN Interface
Process Interface
World Database
Database
Text
Link
Image
Sound
Video
Geo-Position Objects

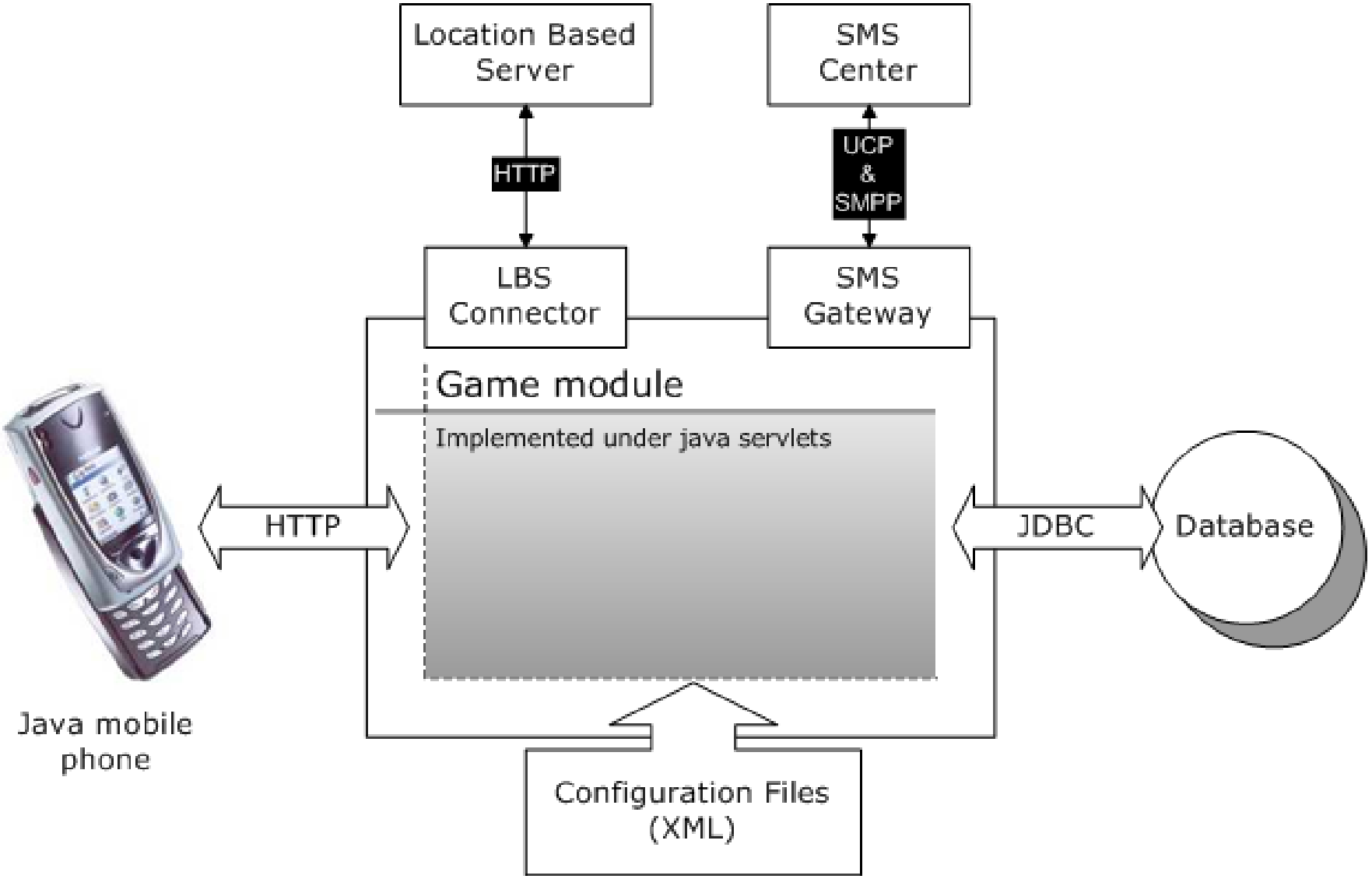
Invisible Computing

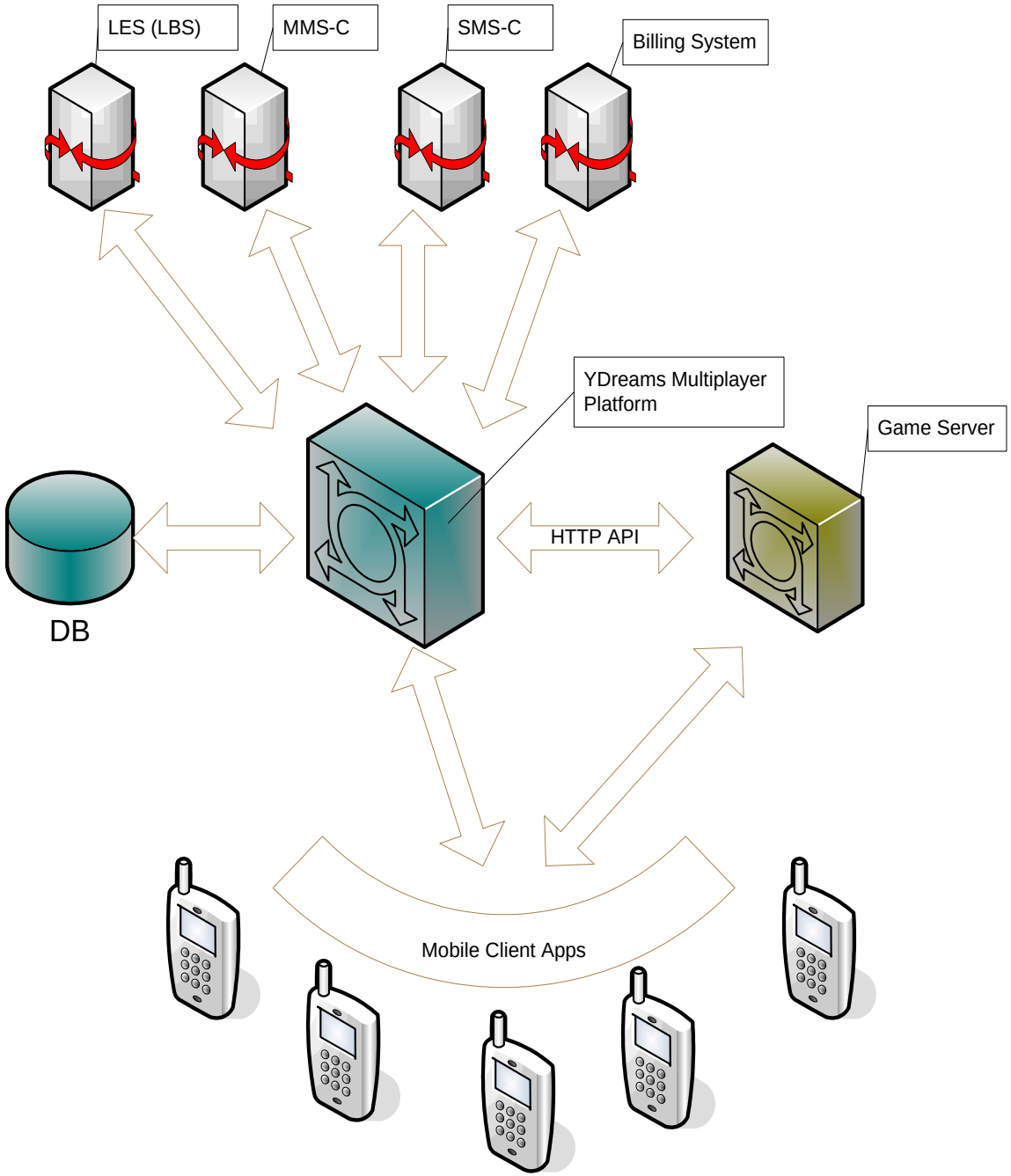
- Interfaces: augmented reality
  - Mobile augmented reality
    - PDA example



Invisible Computing

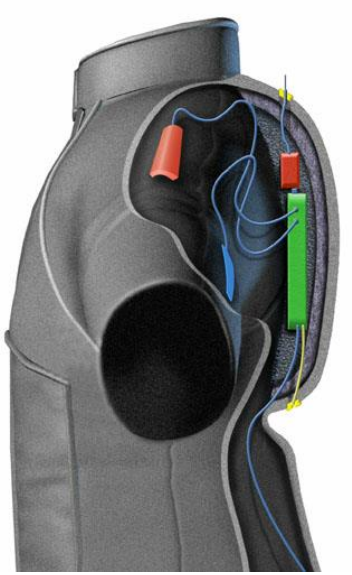
- Interfaces: wearables
  - Mobile devices
    - Location based gaming
      - Undercover and Undercover 2
      - Multi-player, strategy based games using Navteq maps

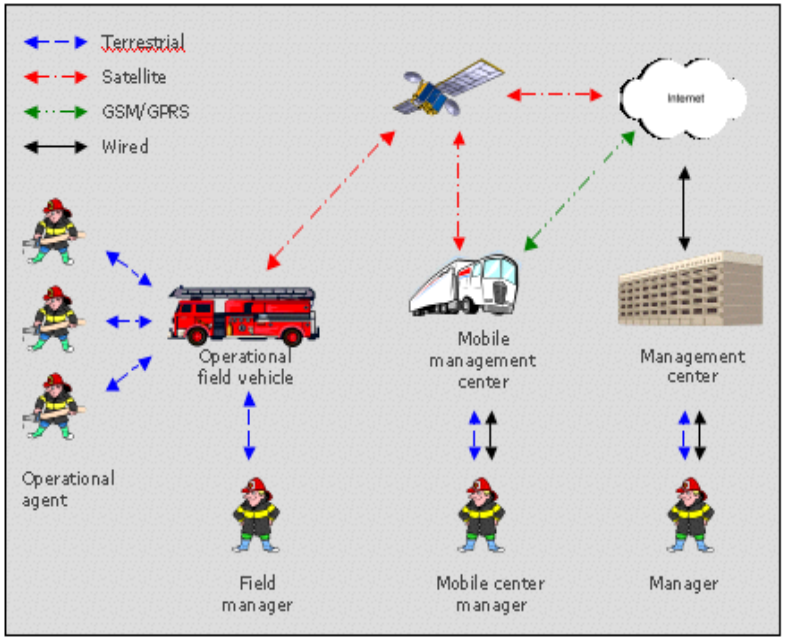

Location Based Server
SMS Center
HTTP
UCP & SMPP
LBS Connector
SMS Gateway
Game module
Implemented under java servlets
HTTP
JDBC
Database
Java mobile phone
Configuration Files (XML)


LES (LBS)
MMS-C
SMS-C
Billing System
YDreams Multiplayer Platform
Game Server
HTTP API
DB
Mobile Client Apps

Invisible Computing

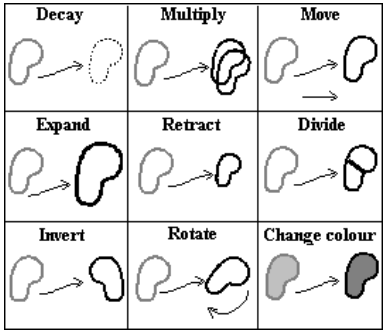
- Interfaces: wearables
  - Intelligent garment
    - Positioning, vital and environmental sensors, communication devices and PDAs embedded in garment

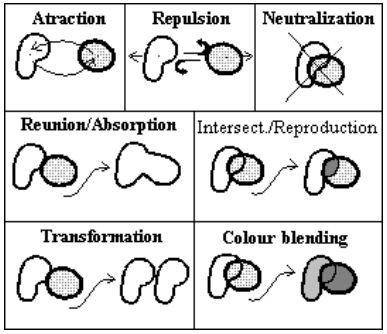


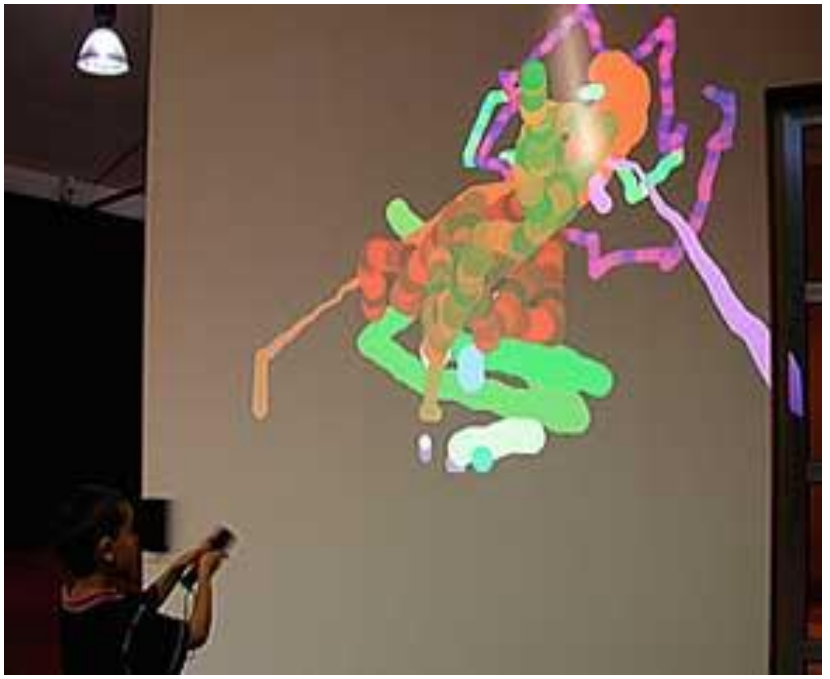


Invisible Computing

- In the next few years
  - Chemical reactions and cellular automata
  - Pictorial calculus as an inspiration

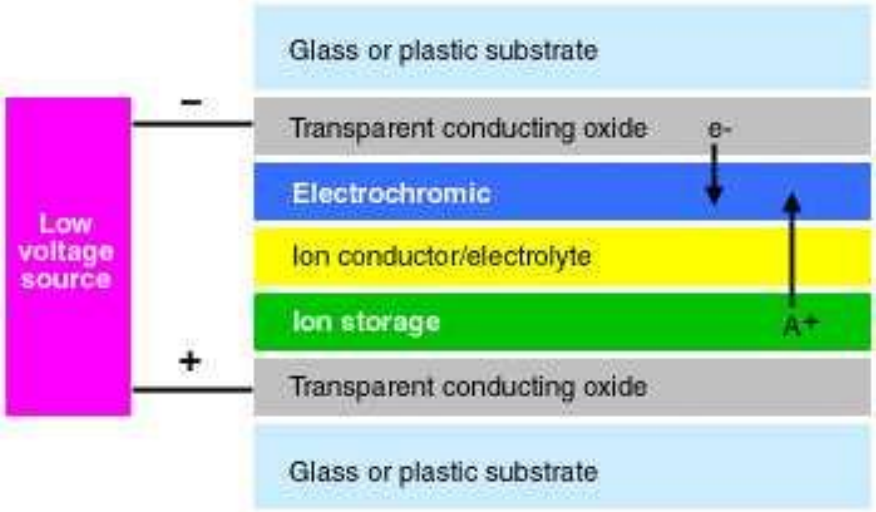


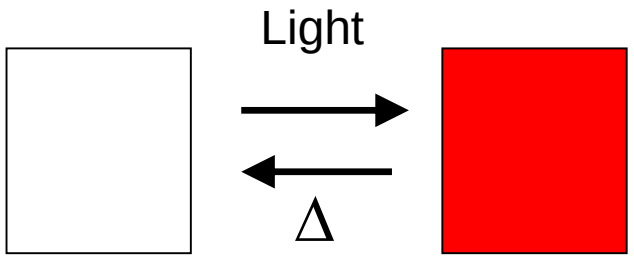




Invisible Computing

- In the next few years
  - Electro generated chemiluminescence's*:* recombination of different electro generated molecules emitting light
  - Electro chromic devices:
    switch the materials colors by voltage potential
  - Photo chromic devices: multistage bio-inspired molecules (Flavylium salts) controlled by light, temperature and pH





Conclusions

- Mobile phones will become scanners of a micro-geographic world where every object will be radio-tagged and sensors will be pervasive
- Human communication will be complemented by human-object communication
- One transition pre-programmed computing may not be digital
- Interfaces will increasingly follow the invisible computing paradigm

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