Interactive Multimedia Tabletops (IMT)

Professor: ***Manuel Graña Romay.***
Phd. Student: **Andoni Beristain Iraola**
Grupo de Inteligencia Computacional (GIC).
Universidad del País Vasco (UPV-EHU).

Contents

- Introduction
- Technical building blocks
- Interaction
- Group Interaction dynamics
- Practical developments
- References

Introduction

- Increase on people's multimedia digital data management needs.
- Ordinary computers are not suitable to work in groups.
- Current Human-Computer Interaction is usually reduced to screen, mouse and keyboard.
- Computer's full ingraining into society habits and daily life still in progress.

Introduction

Design goals for Interactive Multimedia Tabletops:

- Natural interaction.
- Audio-visually rich.
- Computer humanization and ubiquity.
- Group work.

Introduction

Interactive Multimedia Tabletop (IMT)

definition:

- Table-shaped furniture.
- Natural interaction methods.
- Multimedia as the main digital data type to manipulate and as a way to make interfaces more friendly.
- Collaborative work oriented.
- Interface with an underlying computer system.

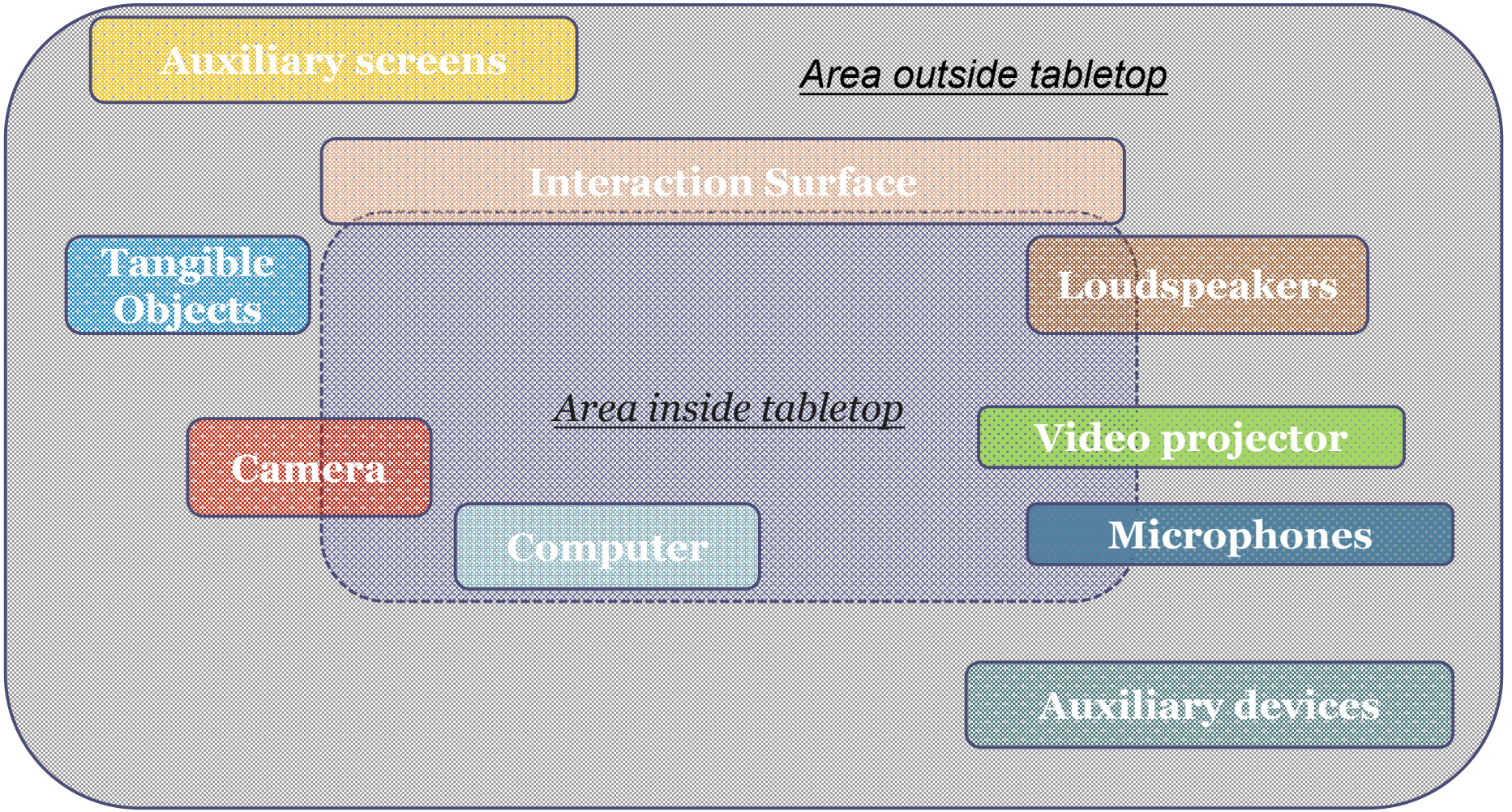
Introduction (DiamondTouch)

Introduction (Microsoft Surface)

Technical building blocks

- Many different components.
- Multiple different final setups.

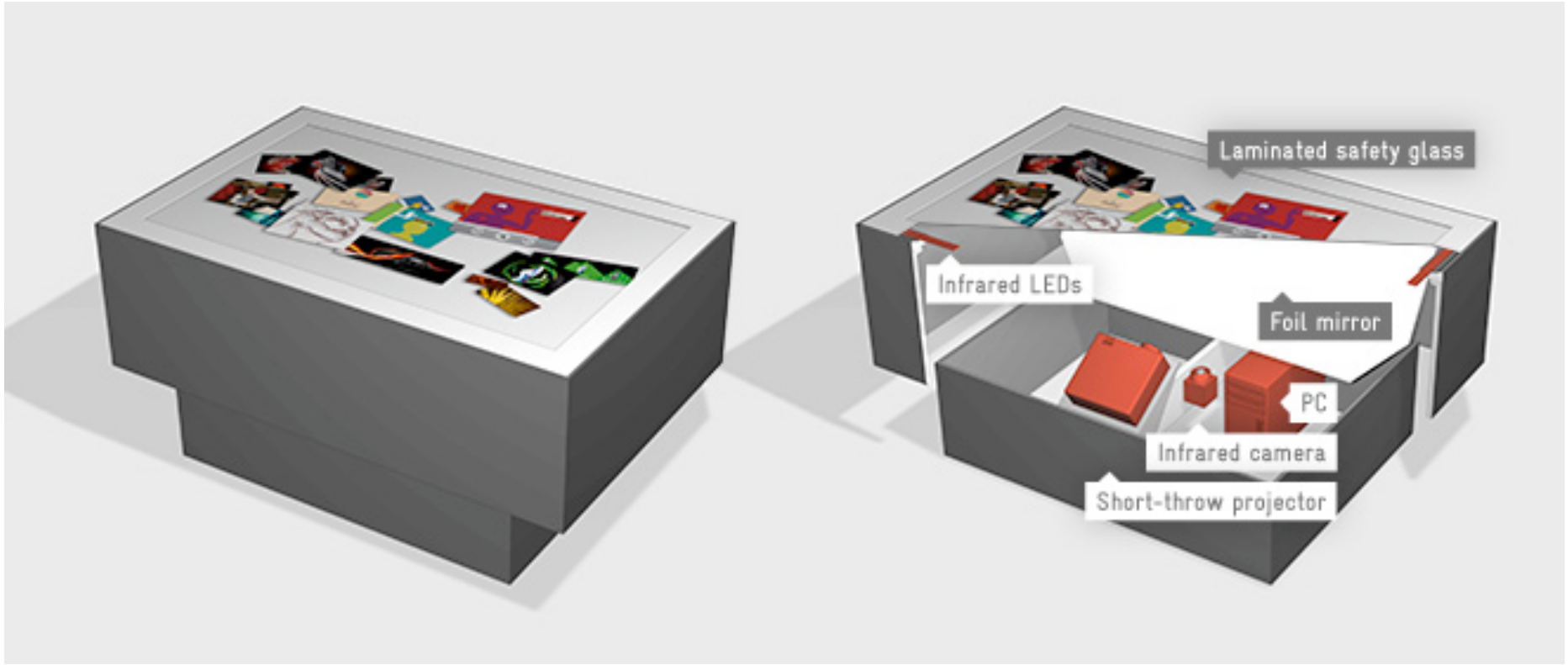
Technical building blocks



Technical building blocks

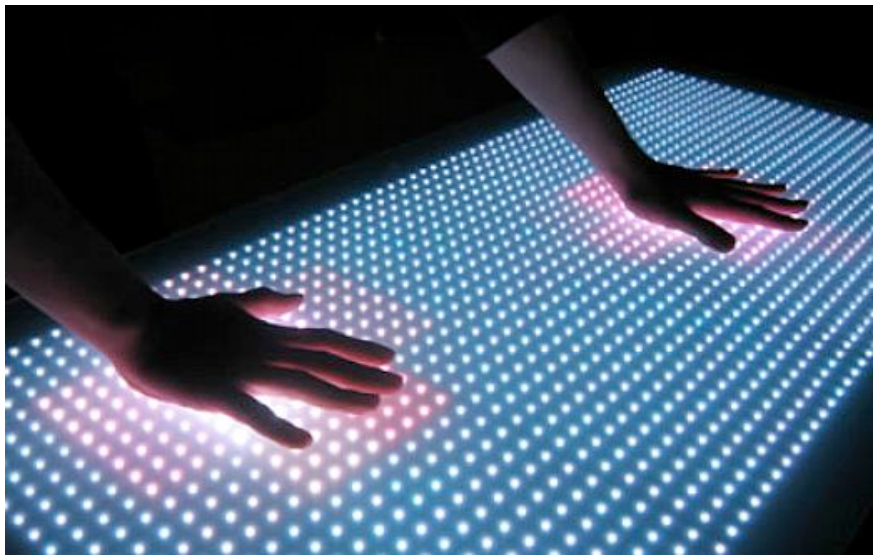
- Tabletop:
  - _ Similar to an ordinary table.
  - _ Ubiquity.
  - _ Standing or sitting on chairs.
  - _ Comfortable size and height, depending on user number and task.

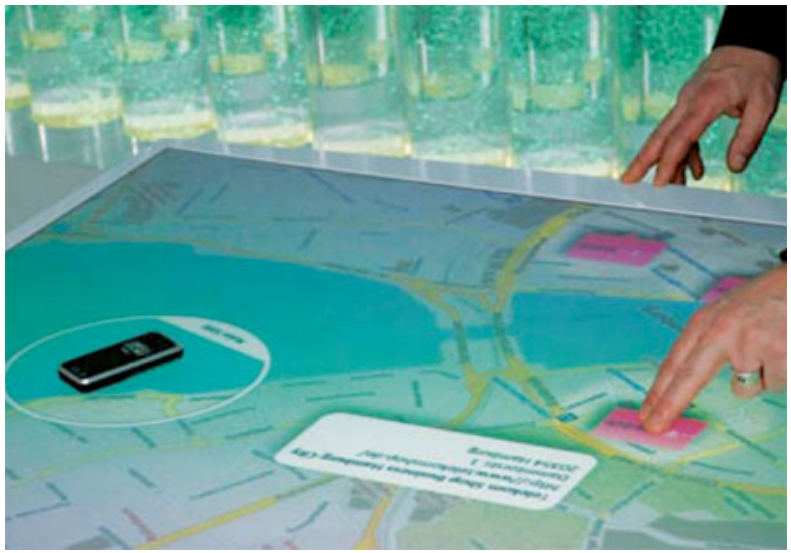
Struktable


Laminated safety glass
Infrared LEDs
Foil mirror
PC
Infrared camera
Short-throw projector

Technical building blocks

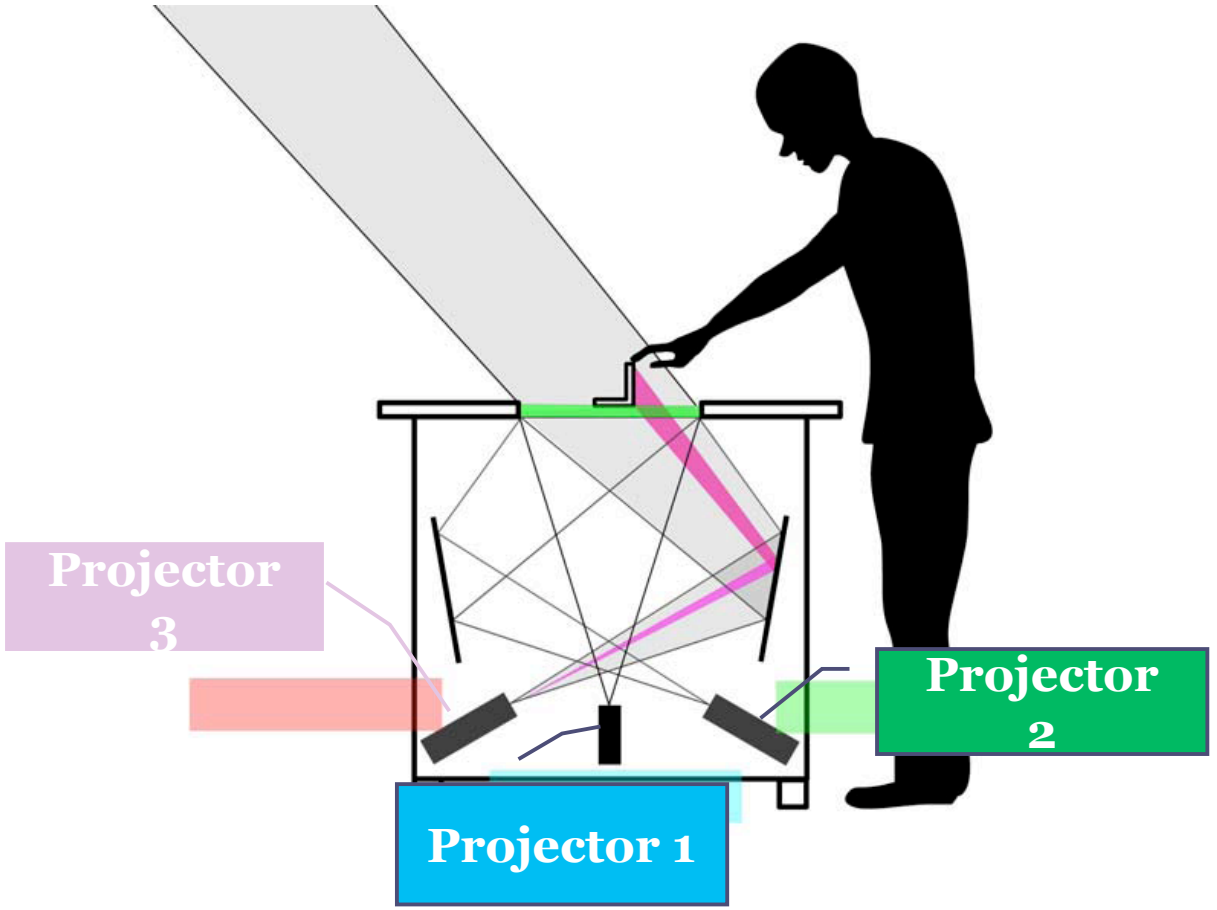
- Interaction surface:
  - _Flat screen LCD monitor or acrylic transparent surface. Depending on the configuration.
  - _Protective layer on it. Improve hardness and protect from environmental lighting.
  - _Light polarization layer for background segmentation in Computer Vision techniques.





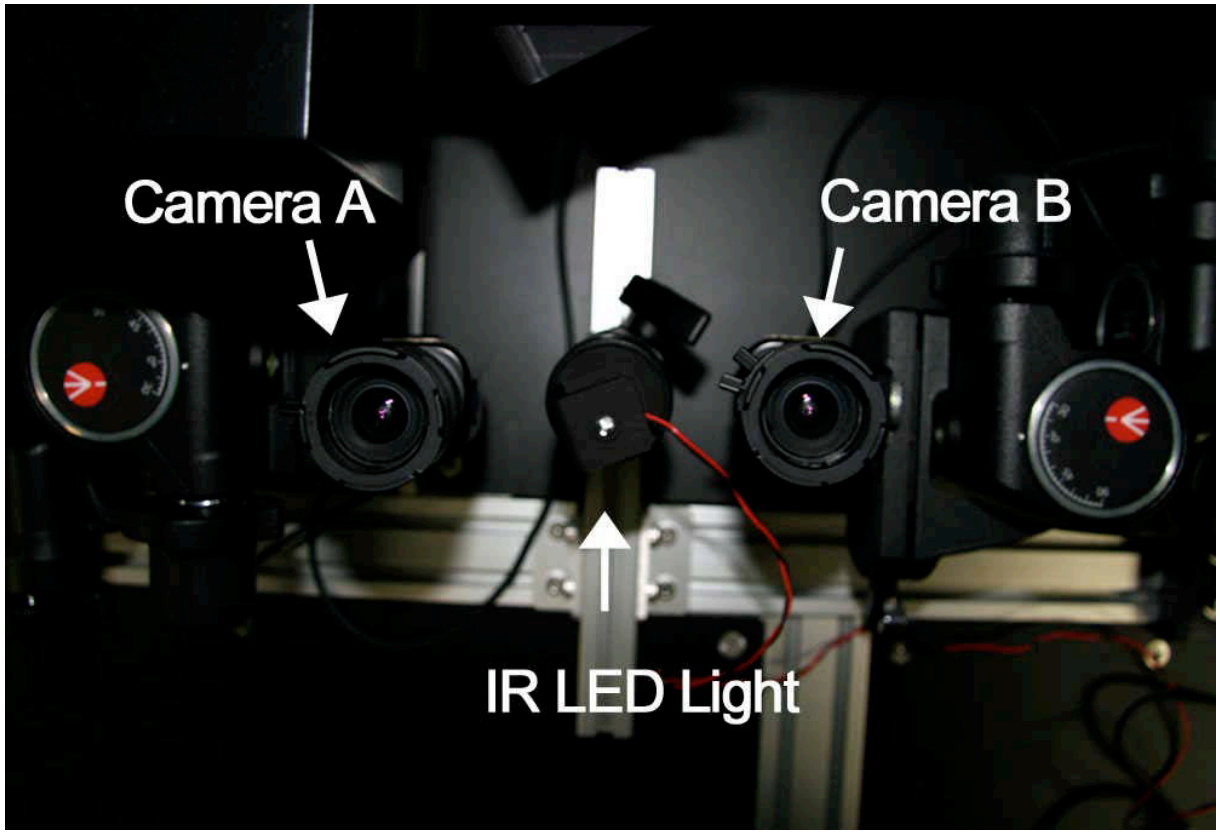
Technical building blocks

- Video projector:
  - _Projected through the surface or over it.
  - _One or several projectors.
  - _Require controlled environmental lighting.


Projector 3
Projector 2
Projector 1

Technical building blocks

- Video Camera:
  - _Color, grayscale, infrared, 3D.
  - _One or several cameras.
  - _Require controlled environmental lighting.

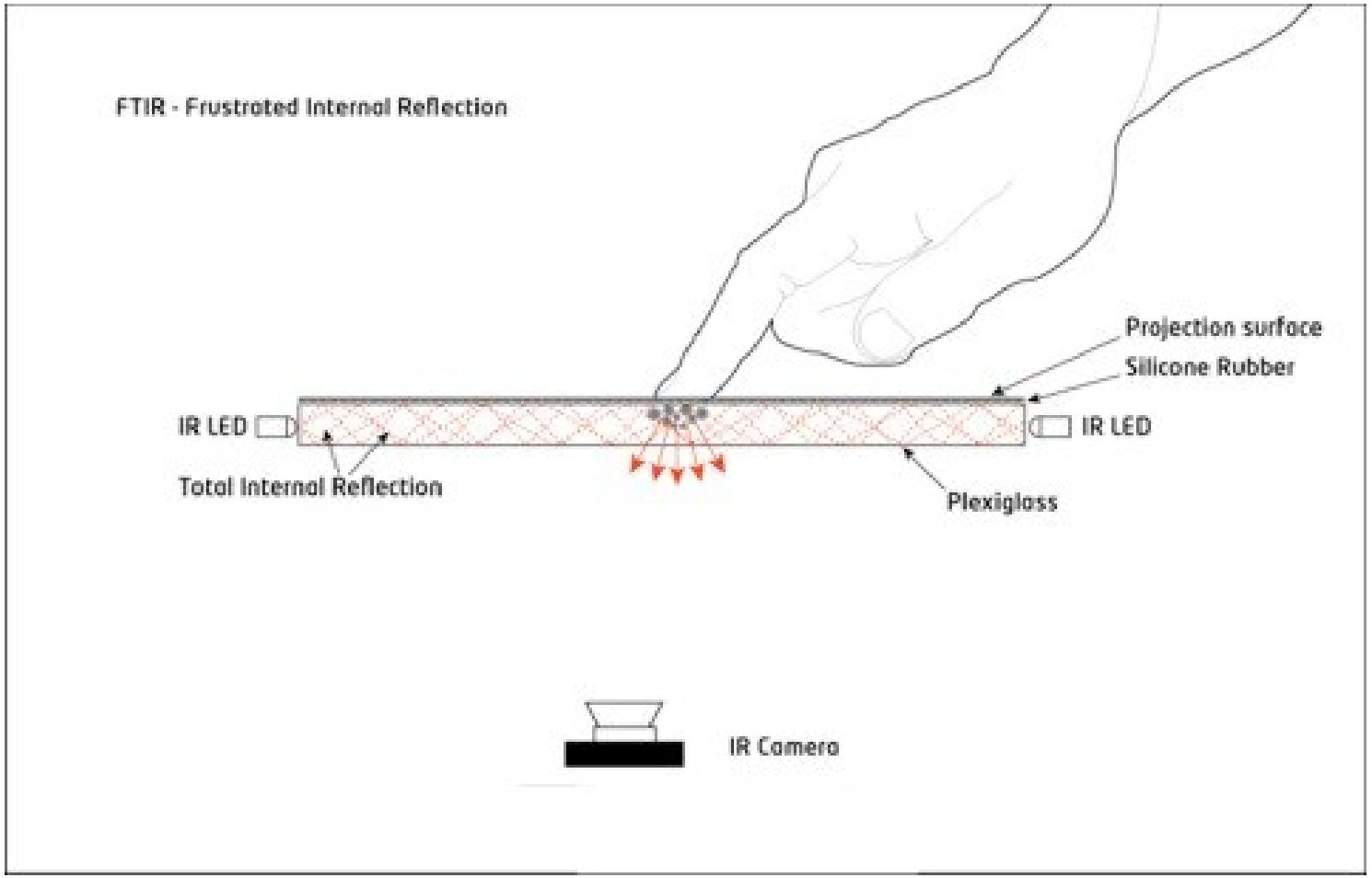

Camera A
Camera B
IR LED Light

Technical building blocks

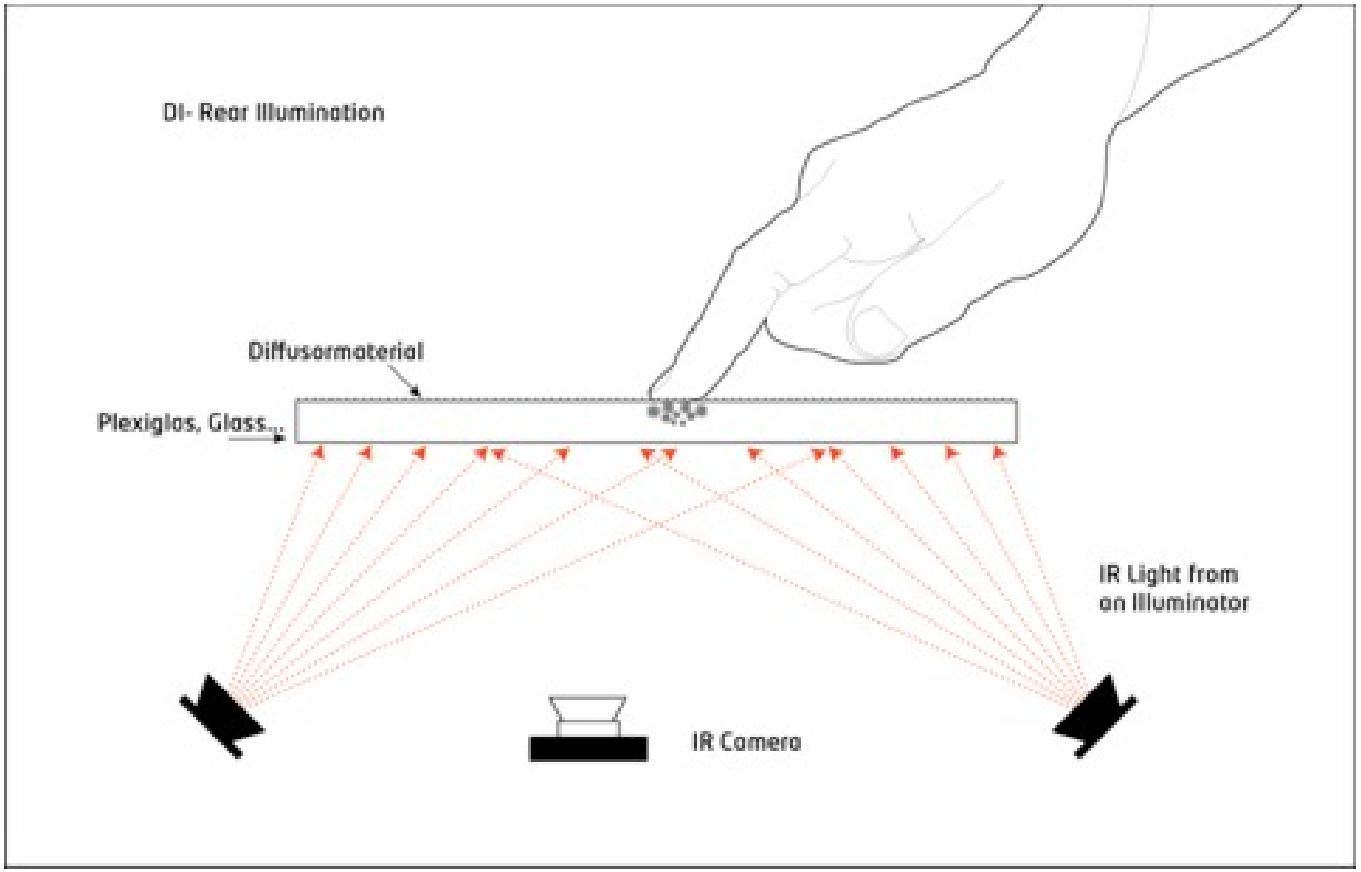
- Multitouch surface:
  - _Computer Vision techniques: FTIR, Difussed Illumination.
  - _Capacitive. The human shunt and The human transmitter
  - _Acoustic.
  - _Surface computing.

Multitouch

FTIR- Frustrated Total Internal Reflection



Difussed Illumination



Technical building blocks

- Loudspeakers and microphones.
  - _Cocktail effect between users.
  - _Unintended execution of actions.
  - _Users usually have to wear additional devices.

Technical building blocks

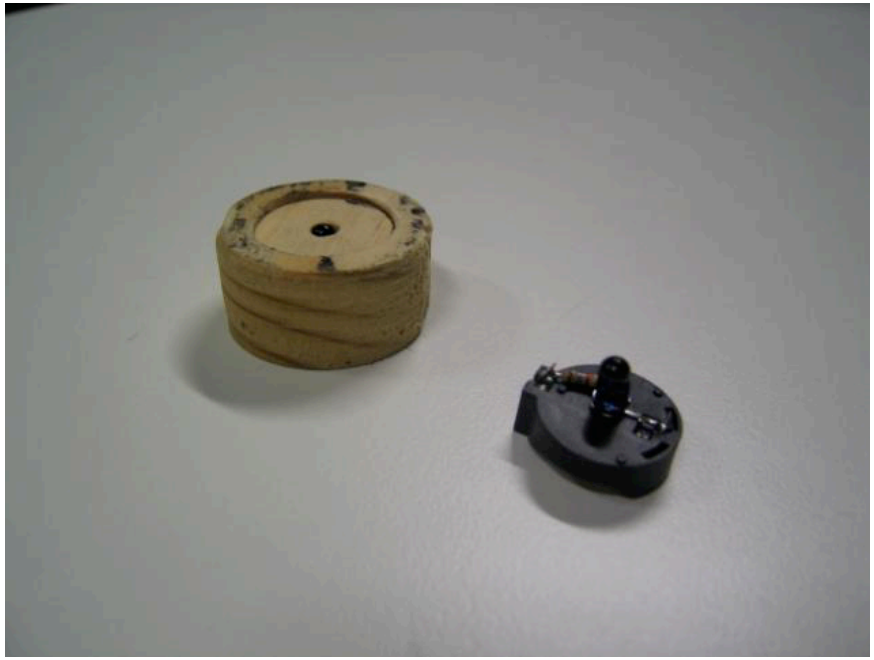
- Computer system
  - _High requirements:
    - Multimedia management.
    - Computer Vision techniques overload.
    - Speech processing.
    - Some multitouch techniques.
  - _In some cases one computer for user input processing and another for the system itself.

Technical building blocks

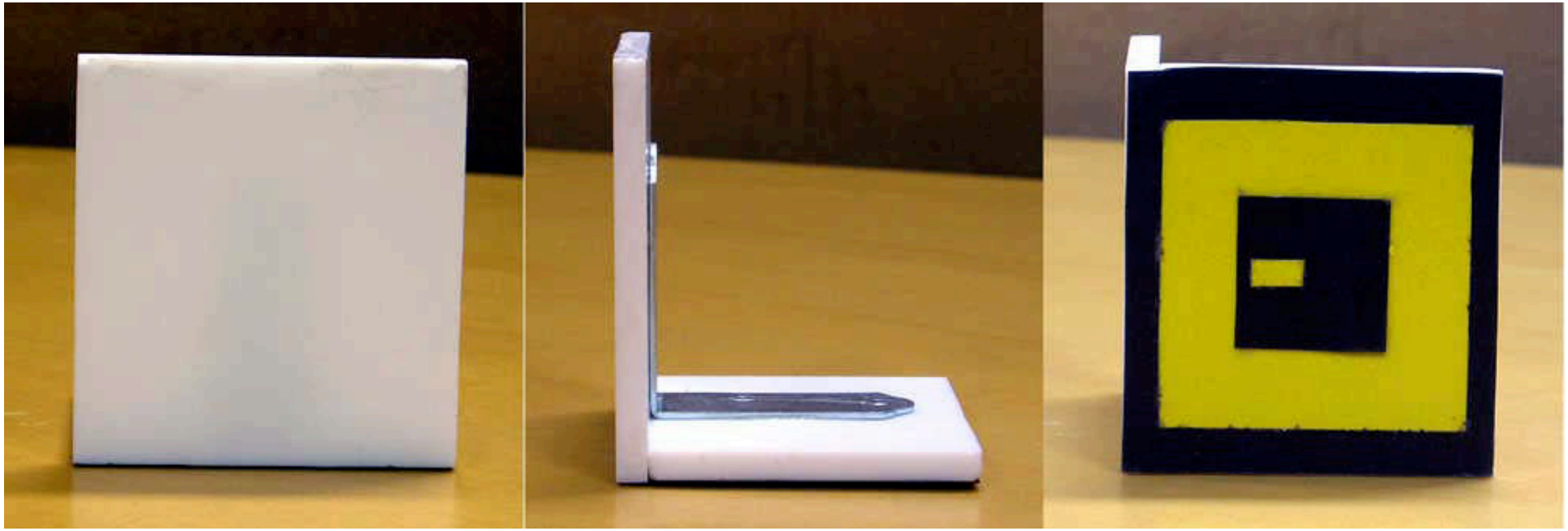
- Auxiliary screens:
  - _Purpose:
    - Remote collaboration.
    - Personal work.
  - _Usually vertical.

Technical building blocks

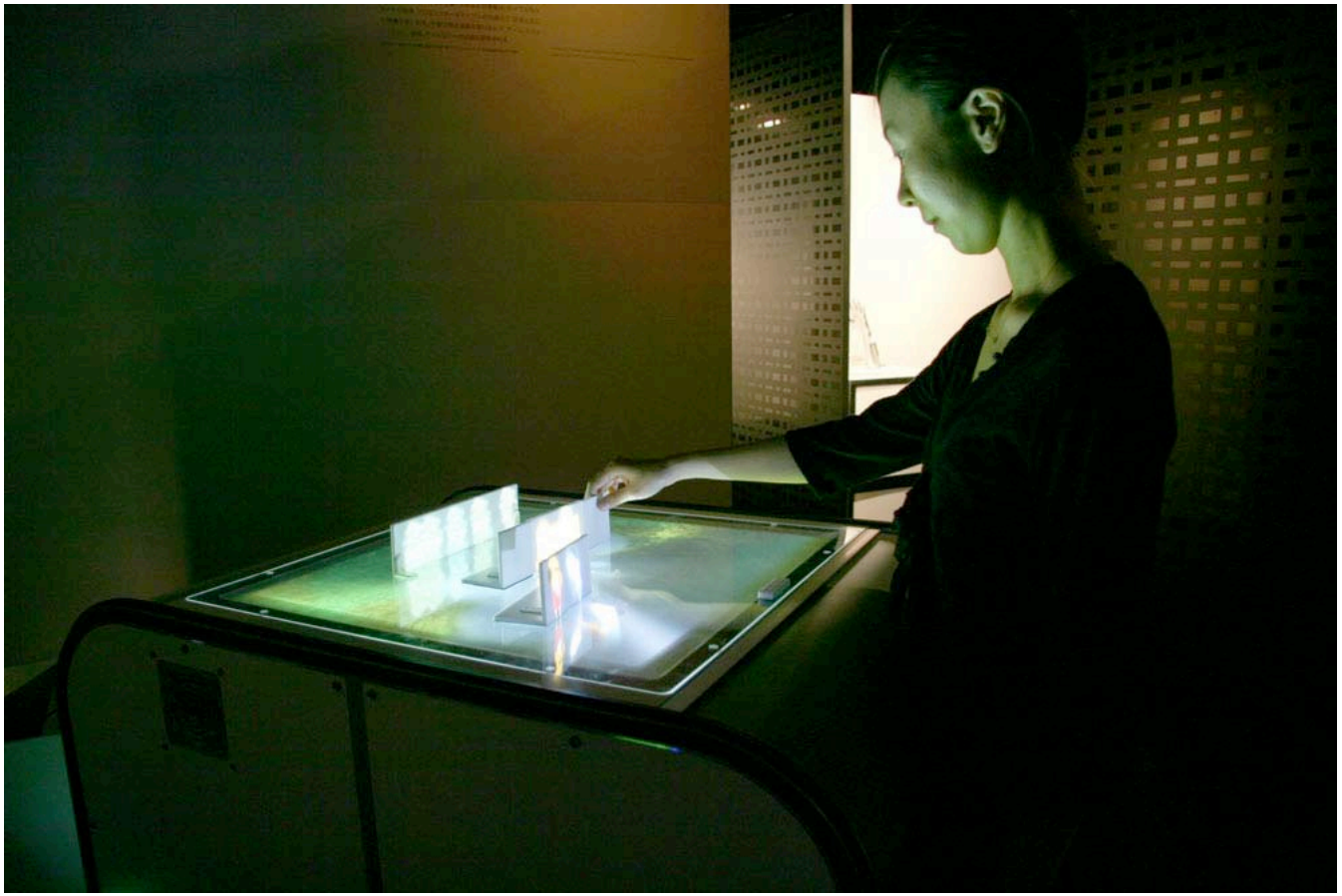
- Tangible objects.
  - _Wired or wireless electronic interface, or Computer Vision based detection.
  - _Usually position and rotation
  - _Distinction between personal objects on the tabletop and actuators.



Tangible objects



Tangible objects



Technical building blocks

- Auxiliary devices.
  - _Keyboard.
  - _Mouse.
  - _PDA.
  - _Laptop.
  - _Usually external, but also internal.


Jeff
Lazy Days
To Zion
Superstar
When It Hurts So Bad
Steven
Extreme
Jen's Zune
Books

Interaction

- Natural interaction methods in the IMT.
  - _ Hand gestures:
    - Ordinary hand gestures over the tabletop surface.
    - Multitouch gestures on the tabletop surface (Surface Computing).
  - _ Voice:
    - Speech recognition.
  - _ Actuator based:
    - Physical objects to interact with data.
    - Virtual objects to interact with data.
  - _ Combination of previous methods.

Interaction

- Direct interaction.
  - _Operating on the virtual object itself. Each abstraction layer makes the interaction less direct.
  - _Direct interaction methods are the most common in everyday life, therefore, they are the most natural.
  - _Natural interaction <-> Direct interaction.

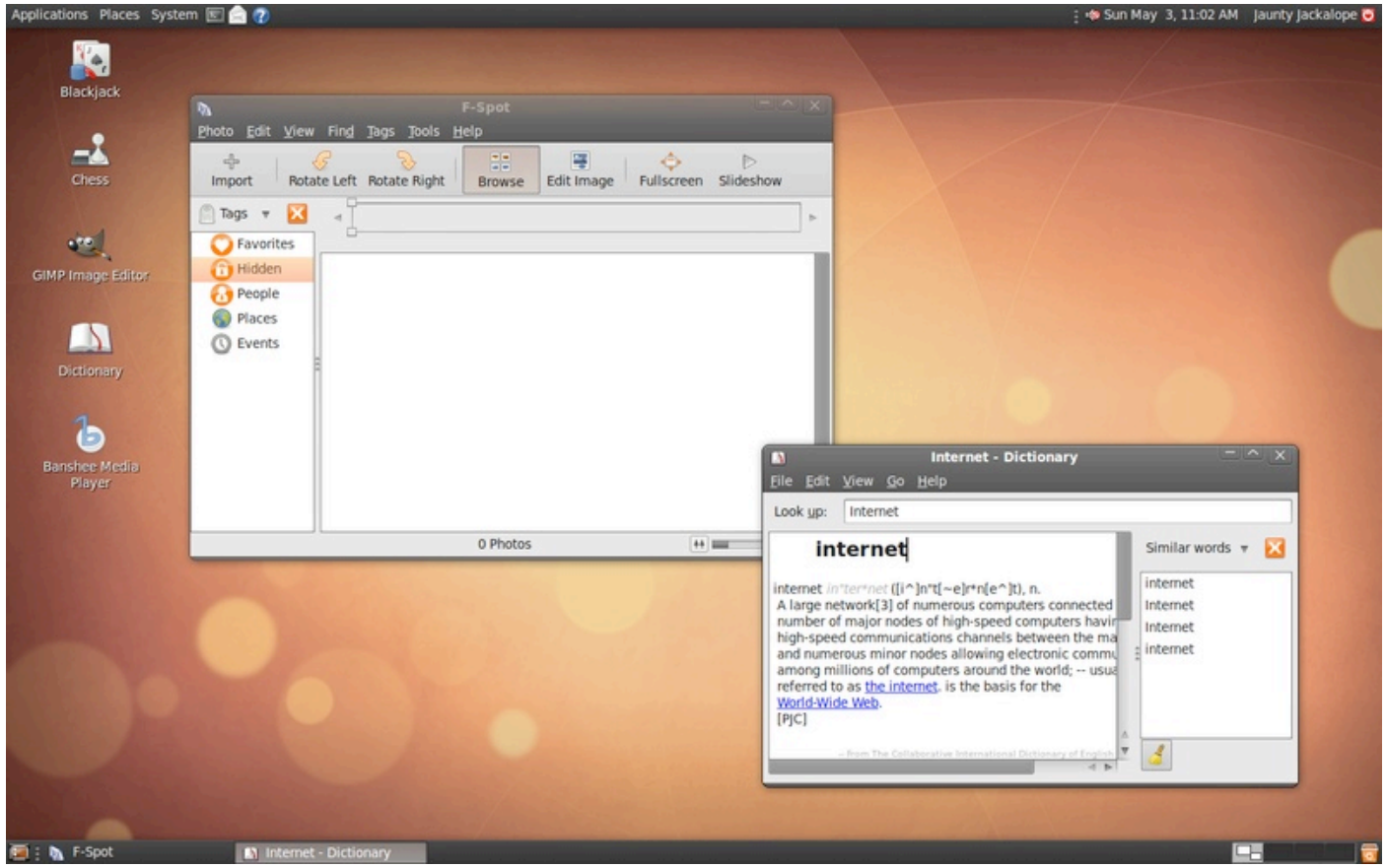
Interaction

- Interaction Languages
  - _Natural -> simulate the interaction method of the application context in reality.
    - Doe not require learning.
    - Allow for ambiguity.
  - _Symbolic -> artificial language designed under specific criteria.
    - Require a learning step.
    - More efficient.

Interaction

- GUI: Graphical User Interface.
  - _User Interface to interact with electronic devices.
  - _Graphical icons and visual indicators.
  - _Direct manipulation of the graphical elements.
  - _Current interaction standard.

Interaction. GUI Example.



Description: GNOME Graphical User interface in Linux Ubuntu

Interaction. TUI I

- TUI: **Tangible** User Interface.
  - _First introduced by Ishii and Ullmer at the CHI conference in 1997 (**Ishii1997**).
  - _Original definition: Graphical interfaces which augmented the real physical world by adding digital information to everyday use objects and physical environments.
  - _Complete review at **Fishkin2004** and **Kim2008.**

Interaction. TUI II

TUI: "An user makes use of his hands to manipulate one or several physical objects by means of physical gestures, then a computer recognizes them, communicates its state and offers a suitable response."

Interaction. TUI III. Reactable

Description: Universitat Pompeu Fabra. http://www.reactable.com

Group interaction dynamics

- Object access issues:
  - _Virtual object management on the IMT workspace.
  - _Privacy.
  - _Multiple access.
  - _Physical limitations to reach distant objects in direct interaction.

Group dynamics

- Territoriality:
  - _Spatial distribution of the tabletop workspace.
  - _Personal, group and storage territories.
  - _User amount and distribution.
  - _Tabletop size.
  - _Territory distribution is performed instantly by users with minimal communication.

Group dynamics

- User Collisions:
  - _Different actions performed by two or more users interfere with each other.
  - _Unavoidable in direct interaction, and frequent.
  - _Courtesy rules between users to solve them.
  - _Consistency management by the underlying system.

Group dynamics

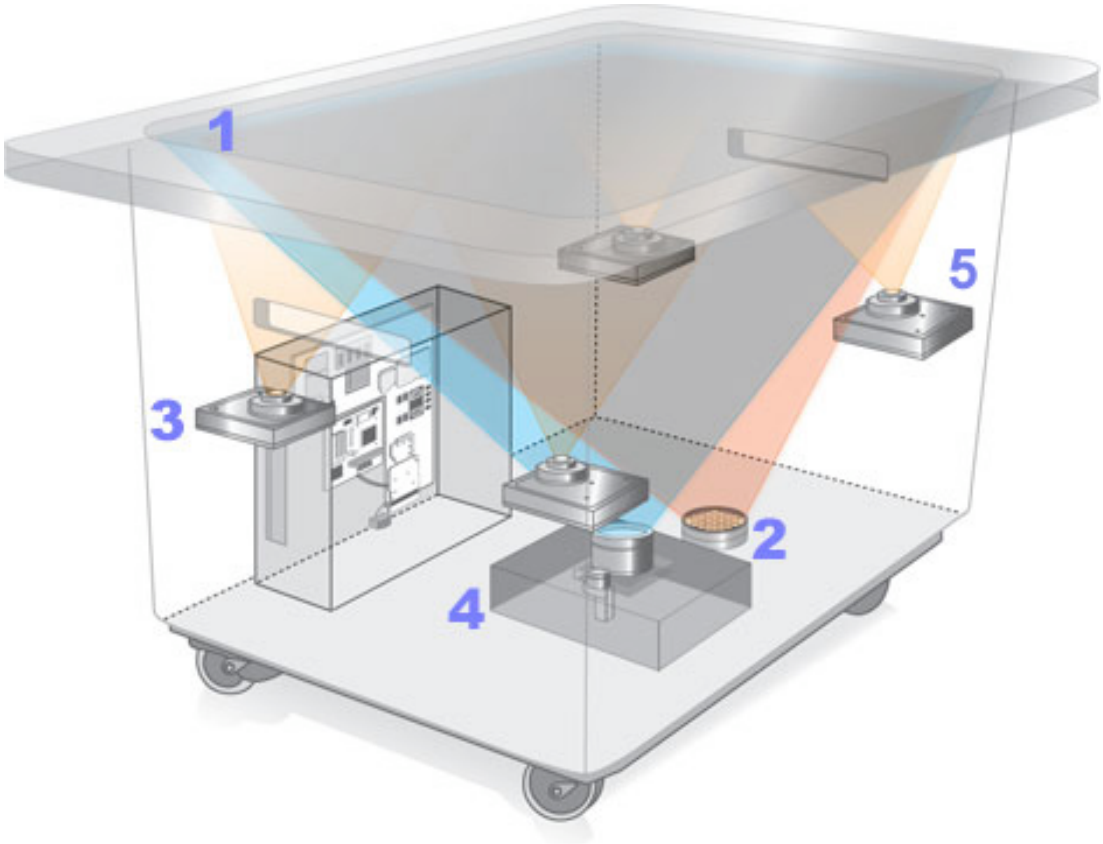
- Remotely working in groups:
  - _Working between several geographically distant IMT in a common group task.
  - _Distant users' presence perception.
  - _Local users' perception about how they are seen by distant users.
  - _Communication between local and distant users.
  - _Coherence management between different IMT.
  - _Managament of subgroups among different IMT.

Practical developments. Microsoft Surface

- Multitouch interaction and actuator based.
- Video projector.
- Infrared light for multitouch, using diffused illumination.
- State of the art pc, with a modified version of Windows Vista.
- Developed Software: Image viewer, Paint, games, mobile phone information,...

  _Still no group work management.

Practical developments. Microsoft Surface II



1. **Diffuser acrylic surface.**
2. **Infrared light source.**
3. **Computer. Intel Core 2 Duo. 2 GB. 256 MB. Graphics card.**
4. **Projector.**
5. **Four infrared cameras, with a net resolution of 1280x960.**

Practical developments. Microsoft Surface III

Practical developments. MERL DiamondTouch

- Initially only a multitouch surface, but many full prototypes developed.
- Multitouch using capacitive technology.
  - Users must wear a device or touch a surface to close the electric circuit.
- One or several video projectors.
- Speech processing available in several prototypes.
  - Users wear microphones and headphones.
- Software: architecture, Google Maps, games,...
- Special emphasis to group work.
- Further information at **Dietz2001.**

Practical developments. MERL DiamondTouch

Practical developments: ViCAT: Visualisation and Interaction on a Collaborative Access Table

- Hand gestures.
  - _Overhead camera.
- Speech:
  - _Processing for interaction.
  - _To communicate with other remote tabletop users.
- Additional vertical screen to see distant users.
- Further information at **Chen2006.**

Practical developments: ViCAT: Visualisation and Interaction on a Collaborative Access Table

References

1. **Ishii1997:** H. Ishii and B. Ullmer, Tangible bits: towards seamless interfaces between people, bits and atoms, in CHI '97: Proceedings of the SIGCHI conference on Human factors in computing systems. New York, NY, USA: ACM, 1997, pp. 234-241.
2. **Fishkin2004:** K. Fishkin and P. Kenneth, A taxonomy for and analysis of tangible interfaces, Personal Ubiquitous Comput., vol. 8, no. 5, pp. 347-358, 2004.
3. **Kim2008:** M. Kim and M. Maher, The impact of tangible user interfaces on spatial cognition during collaborative design, Design Studies, vol. 29, no. 3, pp. 222-253, May 2008.
4. **Dietz2001:** P. Dietz and D. Leigh, Diamondtouch: a multi-user touch technology, in UIST '01: Proceedings of the 14th annual ACM symposium on User interface software and technology. New York, NY, USA: ACM, 2001, pp. 219-226.

References

5. **Chen2006:** F. Chen, P. Eades, J. Epps, S. Lichman, B. Close, P. Hutterer, M. Takatsuka, B. Thomas, and M. Wu, Vicat: Visualisation and interaction on a collaborative access table, Horizontal Interactive Human-Computer Systems, International Workshop on, vol. 0, pp. 59-62, 2006.

Contact Information

- Grupo de Inteligencia Computacional (GIC):
  _http://www.ehu.es/ccwintco.
- Manuel Graña Romay:
  _ccpgrrom@si.ehu.es
- Andoni Beristain Iraola:
  _beristainandoni@yahoo.es