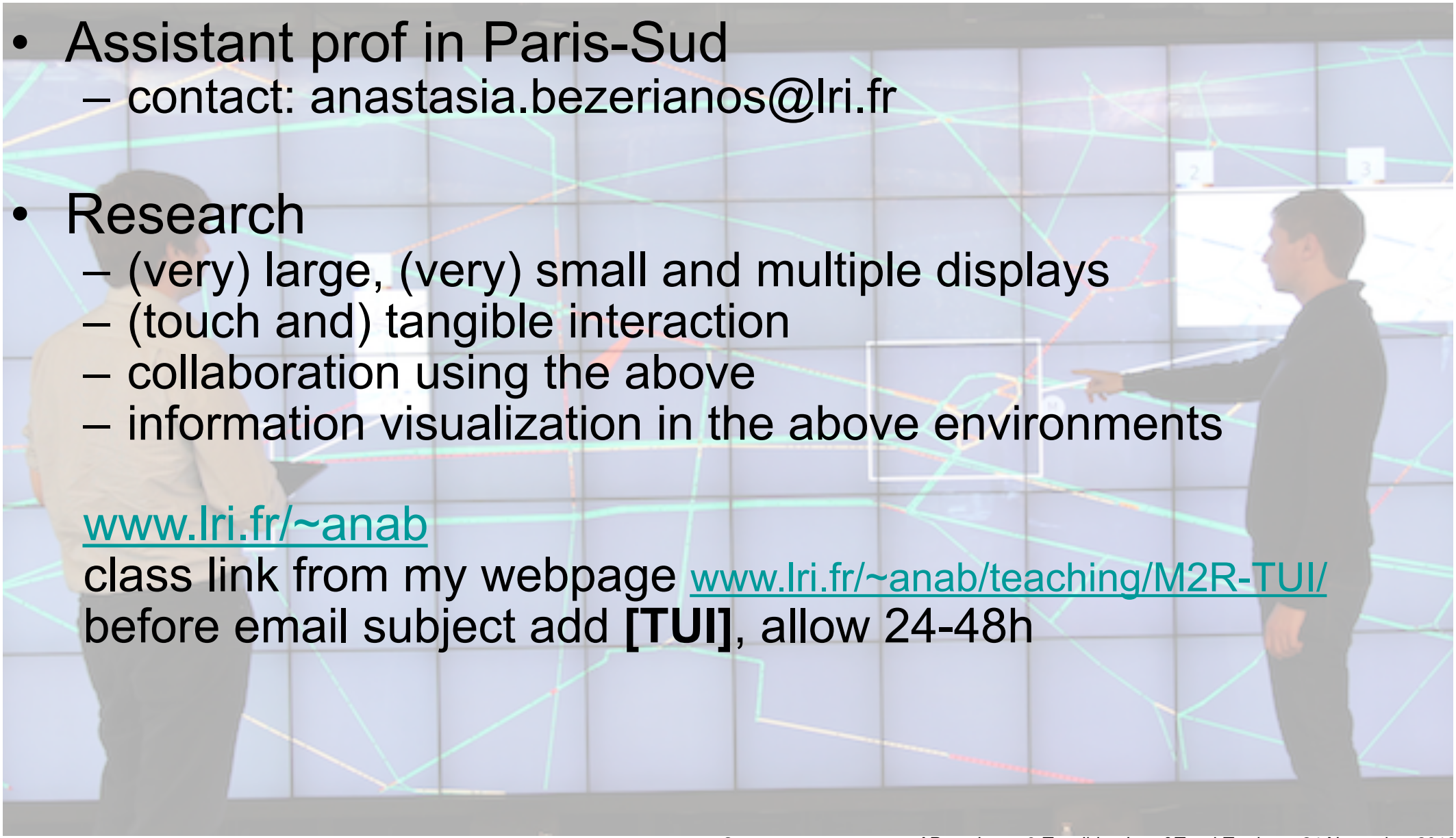
mixed reality
&
(tactile and) tangible interaction

Anastasia Bezerianos
&
Jeanne Vezien

about me



- Assistant prof in Paris-Sud
  - contact: anastasia.bezerianos@lri.fr
- Research
  - (very) large, (very) small and multiple displays
  - (touch and) tangible interaction
  - collaboration using the above
  - information visualization in the above environments

www.lri.fr/~anab
class link from my webpage www.lri.fr/~anab/teaching/M2R-TUI/
before email subject add **[TUI]**, allow 24-48h

class housekeeping

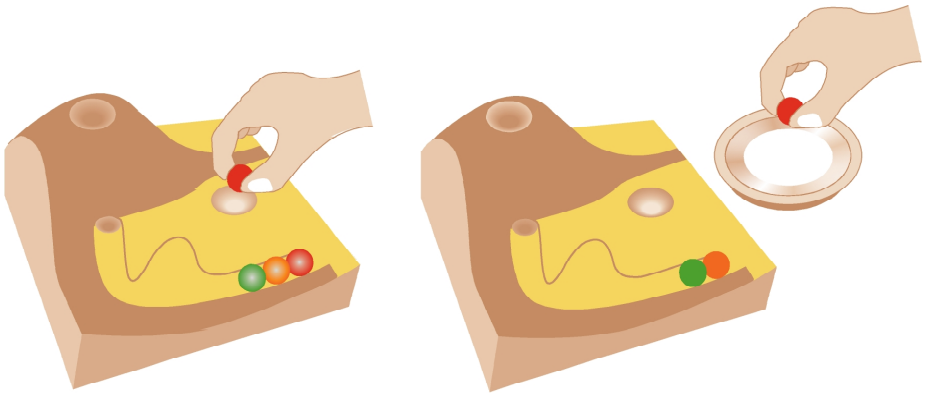
- Polls Dig.Fabrication + Gest.Mobile Interaction

- Evaluation
  - group assignment combining both AR+TUI
    - 1 exam (presentation of your project)
    - presentation (ideally) during a public exhibition
  - class participation 1 paper summary + presentation (in pairs)
    - select a research article of your choice in the field of **AR**, **TUI**, **Touch, Fabrication for TUI** or **UbiComp** (from provided list)
    - Email summary/critique on Sunday before presentation (1 page)
    - Short presentation and critique (10min + questions)
    - Volunteers for next week

TUI & AR distinction?

tangible interaction

- input
- real objects a *medium* to interact with digital

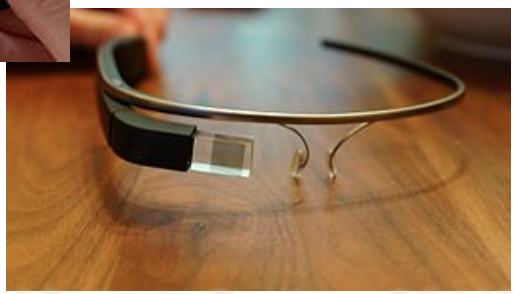


[Bishop, 1992]

augmented reality

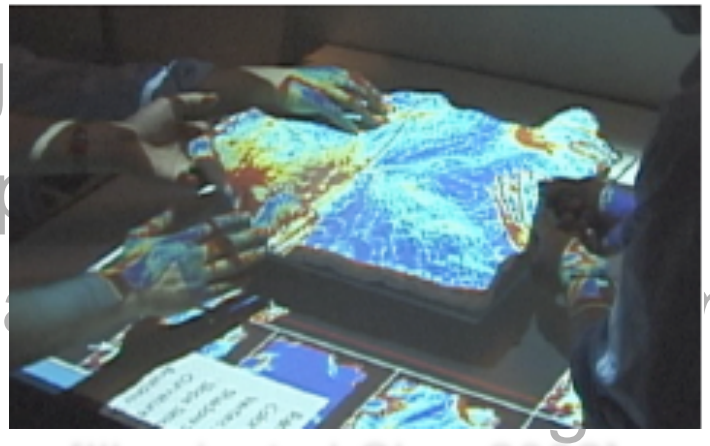
- output
- real-life *view* augmented with digital channels

[Wikitude, 2008]



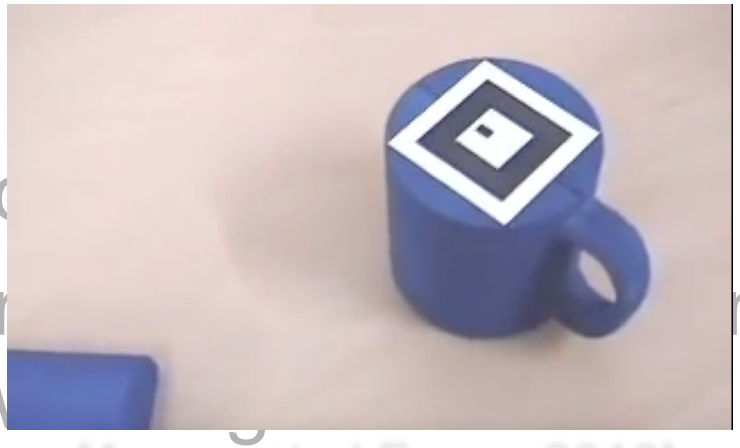
[GoogleGralss, 2011]

TUI & AR distinction?



[Illuminated Clay, 2002]

http://youtu.be/tL449hP_H6A



[Augmented Foam, 2010]

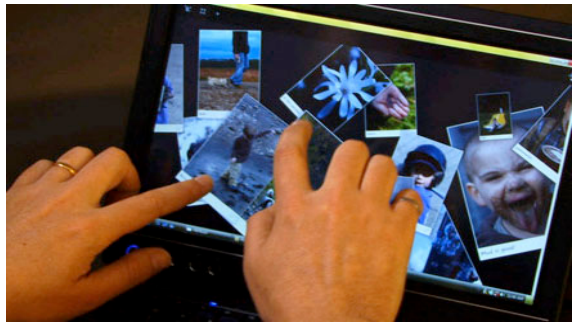
http://youtu.be/Ym1vk0PV4Sw

[Augmented Surfaces, 1999]

http://youtu.be/M-G3CeIlGs4

[GoogleGralss, 2011]

tangible interaction



tangible interaction

"A tangible user interface TUI is a user interface where users interact with digital information through the physical environment. [...] The purpose of TUI developpement is to empower collaboration, learning and design by giving forms to digital information, thus taking advantage of human abilities to grasp and manipulate physical objects and material."

WIKIPEDIA (01/2015) & I. ISHI, TANGIBLE BITS: BEYOND PIXELS. IN PROC. OF TEI '08, 2008.

[Bishop, 1992]

http://vimeo.com/19930744

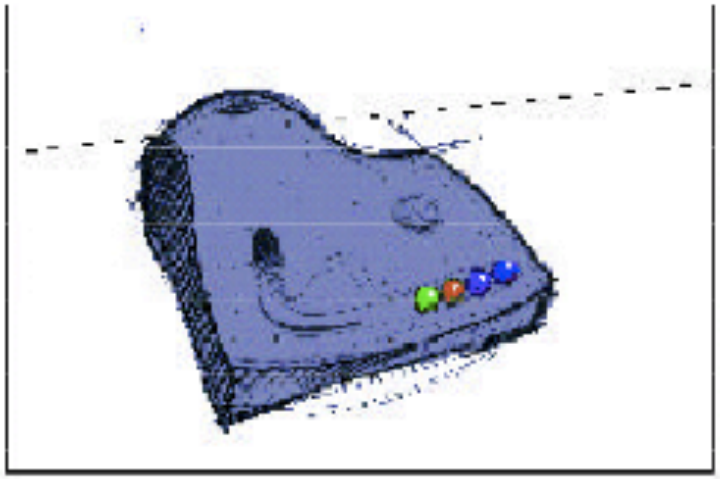
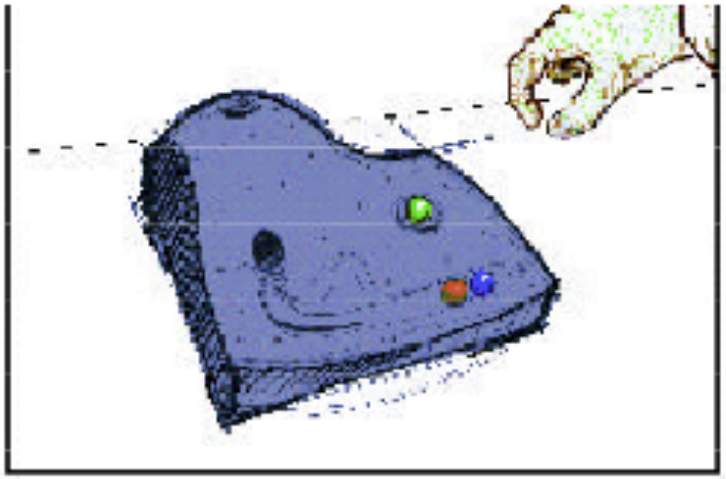


Figure 6.i Incoming messages await...



The user listens to a message... Figure 6.ii

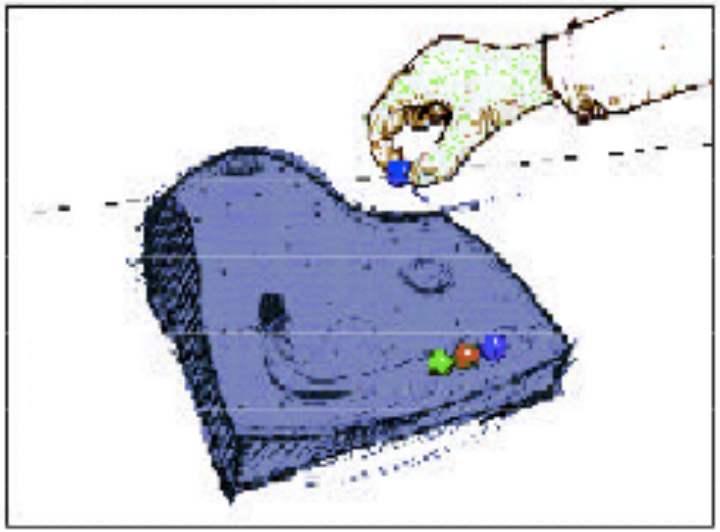
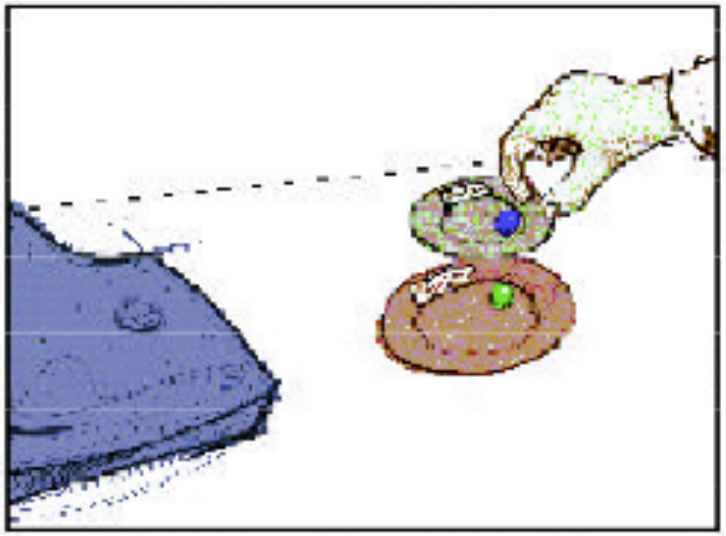


Figure 6.iii ...the user moves the message



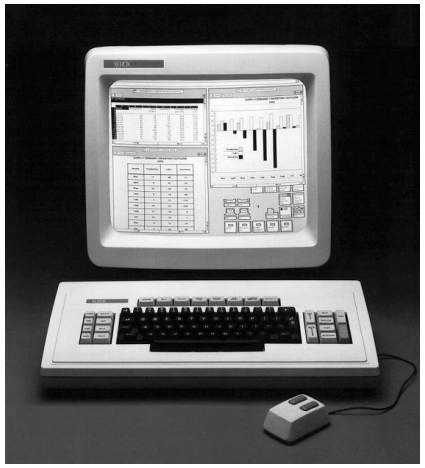
...to each roommate's in-tray. Figure 6.iv

The answering machine physically instantiated incoming voice messages with marbles, which can then be selected and played back in any order. To listen to a message the user picks up a marble and adds it to a special play indentation on the machine. To call back to the person that left the message, the user picks up the marble and places it in a call back indentation on an augmented telephone. Then, the message can be deleted or the user can also choose to store messages, outside of the machine in a receptacle. In this way the user can categorize or organize messages for various people.

GUI vs. TUI [Ishii 2006]

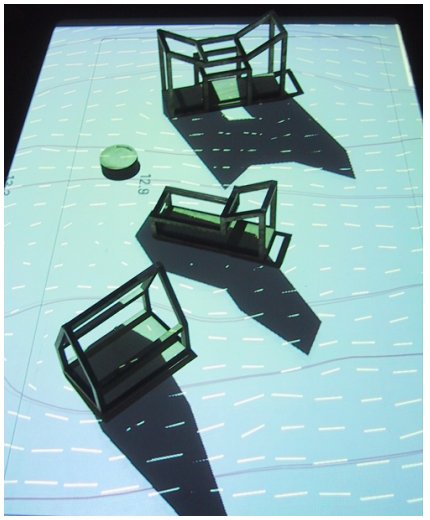
Tangible User Interface

- Tangible representation as interactive control to manipulate the information and computation
- Continuity between physical and digital representation in design



Xerox Star

vs



Sensetable

Graphical User Interface

- Intangible representation (pixels on a screen)
- Generic input devices as “remote-controllers”

GUI vs. TUI [Ishii 2006]

Tangible User Interface

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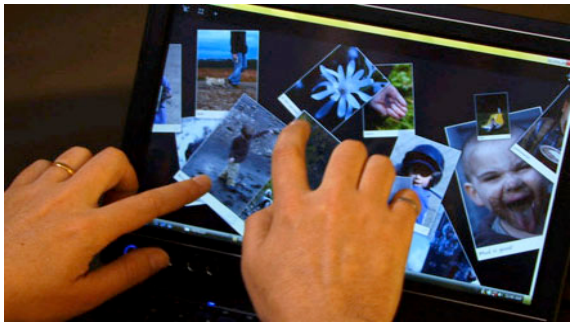
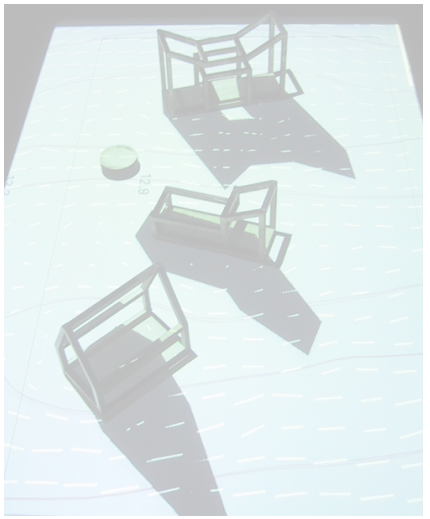
Xerox Star





Sensetable

Graphical User Interface

- Intangible representation (pixels on a screen)
- Generic input devices as “remote-controllers”

GUI vs. TUI [Ishii 2006]

characteristics
space-multiplexed input / output
dedicated devices
spatial awareness
reconfigurability

advantages
direct physical manipulation
two handed interaction + prehensile behavior
parallel input + collaboration
context sensitive input
spatial reasoning
one-to-one mapping between control and controllers

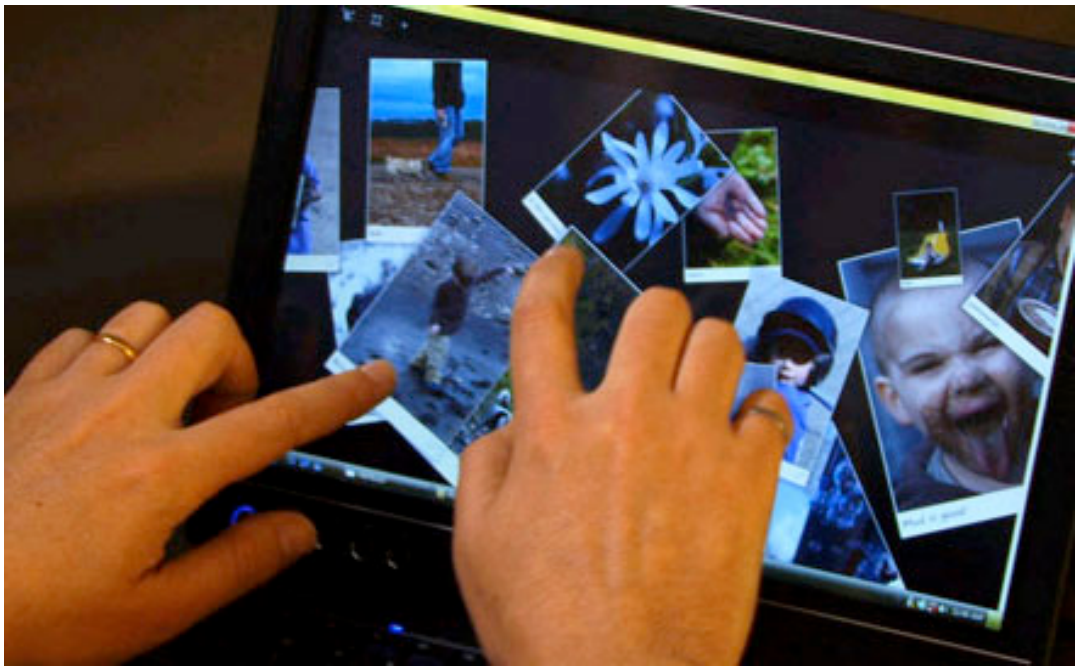
tangible interaction

physical objects & physical space

tangible interaction

physical objects & physical space

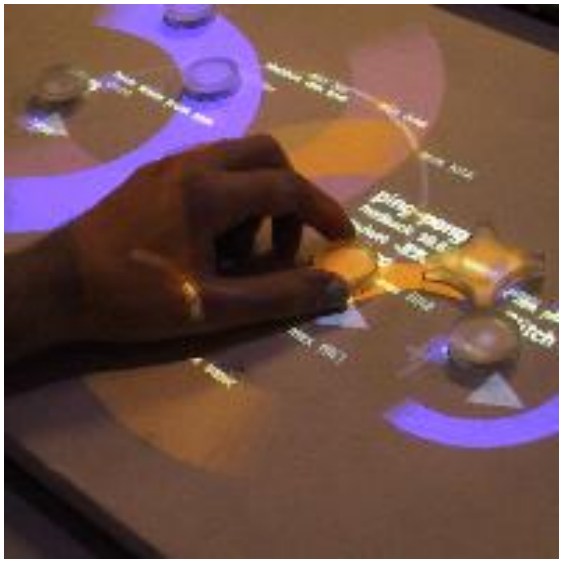
touch screens



tangible interaction

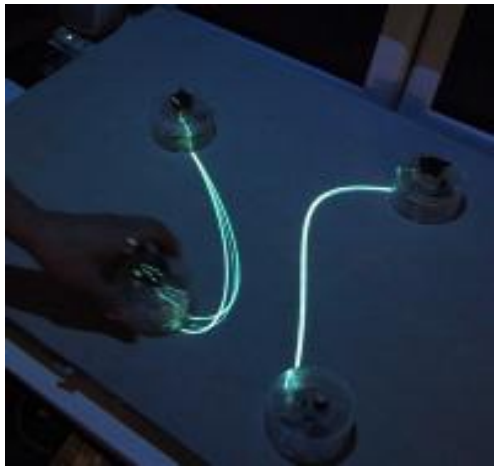
physical objects & physical space

tangible bits



Audiopad (James Patton)

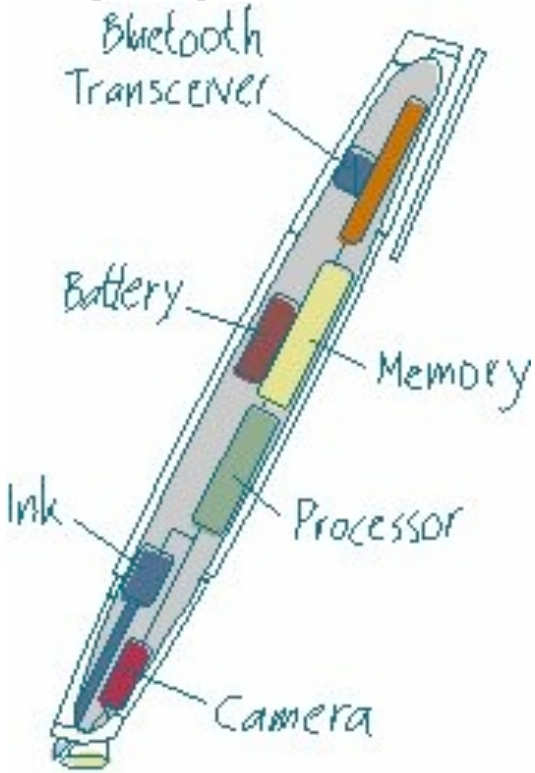
Sensetable (James Patton)



tangible interaction

physical objects & physical space

digital paper and augment paper

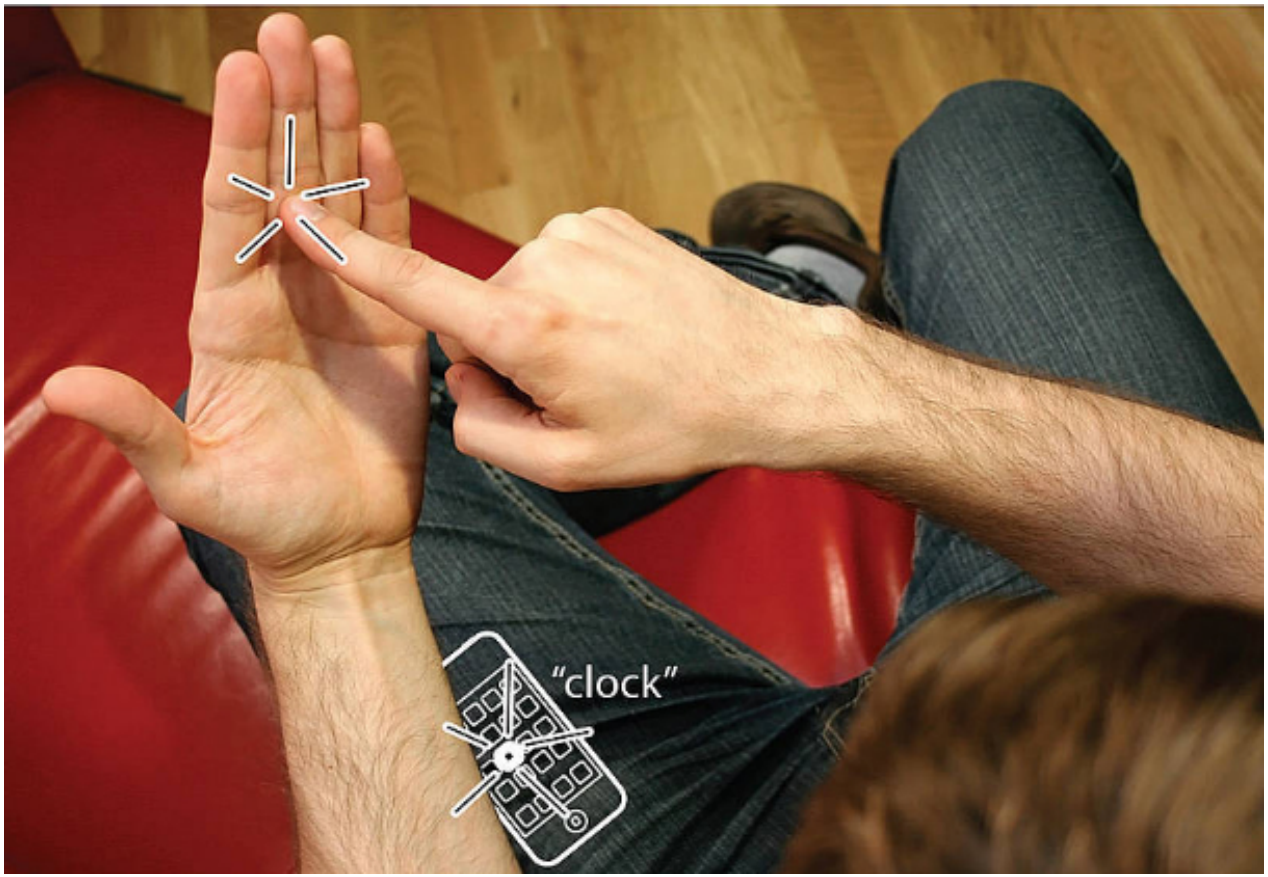


Anoto pen

tangible interaction

physical objects & physical space

on body



Sean Gustafson et al.

tangible interaction

physical objects & physical space

mobile and things (internet of things)

everything (Ubicomp)

UFO (concept) [© Yankodesign, 12]

The MediaCup [Gellersen et al., 99]

tangible interaction

physical objects & physical space

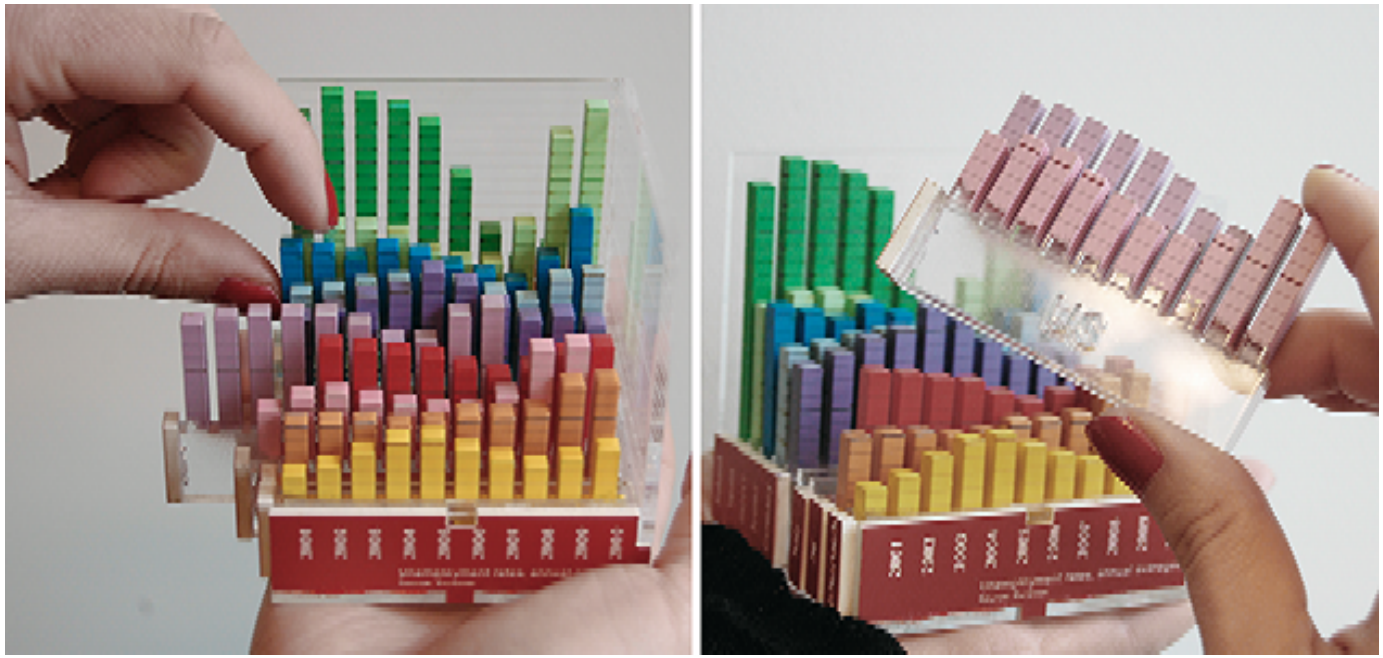
- subtle and around us
- ambient

Ambient Orb

tangible interaction

physical objects & physical space

fabrication



Yvonne Jansen et al.

tangible interaction

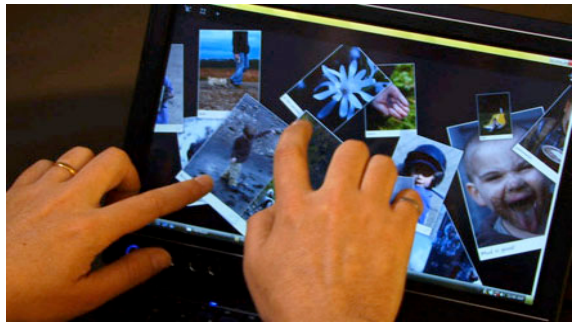
class goal

overview of the field (we will try ☺️ …)

touch, tangibles, fab, ambient displays, UbiComp

technology + interaction design

challenges



mixed reality
&
(tactile and) tangible interaction


touch

touch interfaces

~~technology and frameworks~~

touch & multi-touch design

tables, walls,

~~mobiles~~

touch interfaces

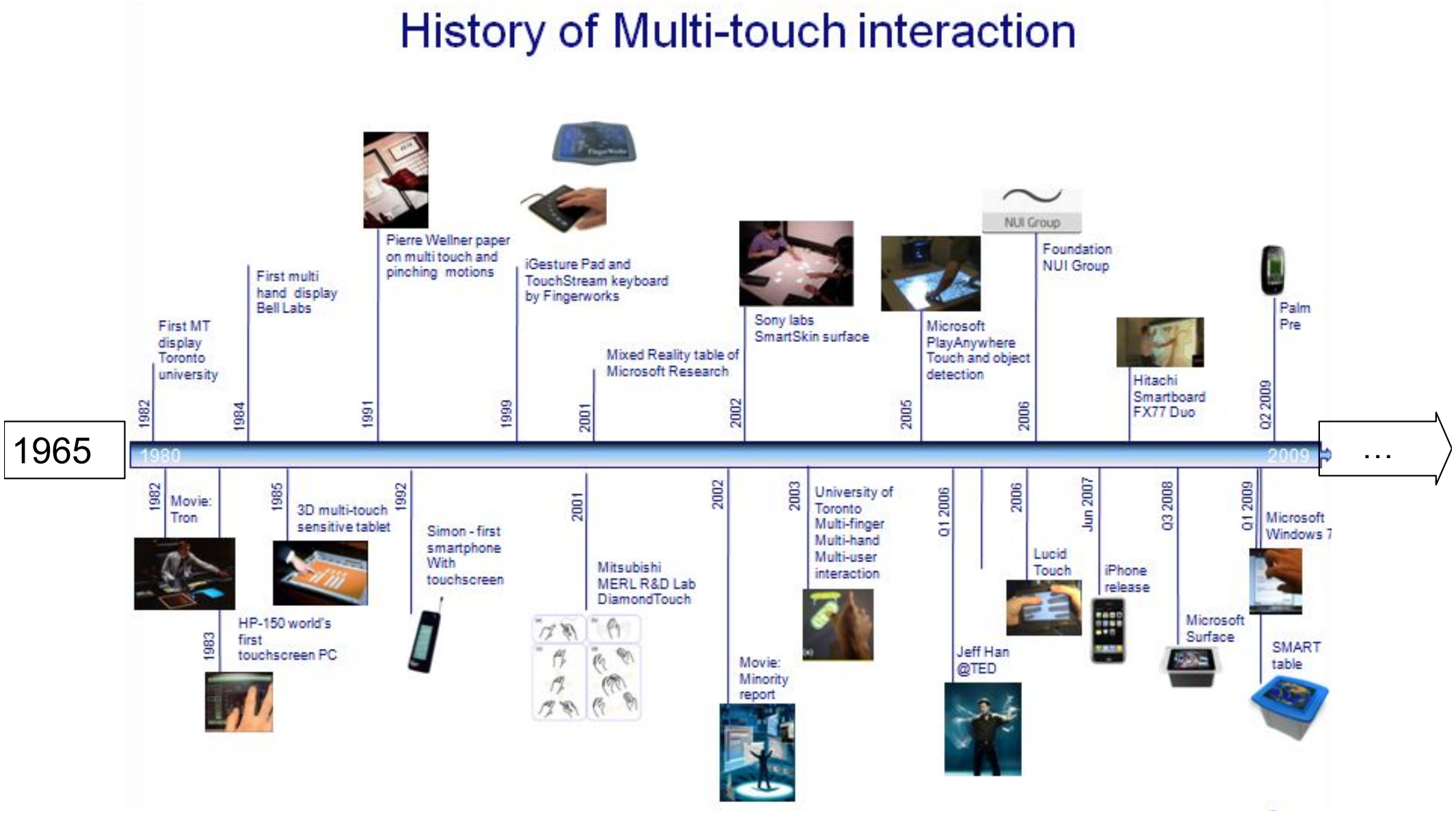
~~technology and frameworks~~

touch & multi-touch design

tables, walls,

~~mobiles~~

History of Multi-touch interaction



early times

Known and Loved' and adapted slides from Stephane Huot

1965 - **Touch Screen Technology**

[E.A. Johnson, Royal Radar Establishment, UK] : capacitive

1972 - **PLATO IV Touch Screen Terminal**

[CERL, University of Illinois, USA] : IR beams

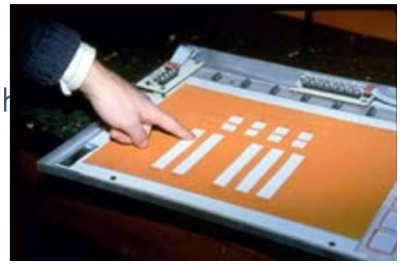
1982 - **Flexible Machine Interface**

[N. Mehta, University of Toronto] : 1st multi-touch system (optical)

1984 - **Multi-Touch Screen**

[B. Boie, Bell Labs, USA] : 1st multi-touch screen

(capacitive, excellent response time)



1985 - **Multi-Touch Tablet**

[Input Research Group, University of Toronto]

1st multi-touch tablet (capacitive, arbitrary number of simultaneous touches with location and degree of touch for each)

... and other early prototypes...

the revolution (1)

Known and Loved' and adapted slides from Stephane Huot

1991 - **Digital Desk** [P.Wellner, Xerox EuroPARC, UK]
1st AR system with hands, fingers and objects sensing, and advanced direct manipulation techniques (e.g. pinch)

1992 - **Simon** [IBM & Bell South]
1st 'Smartphone', with a touch screen (single-touch)

1995 - **Graspable/Tangibles Interactions** [University of Toronto]
concept and implementation of sensing physical objects
[Fitzmaurice, G.W., Ishii, H. & Buxton,W. (1995)]

1998 - **FingerWorks** [Elias & Westerman, FingerWorks, USA]
commercial multi-touch tablets and pads, with a ge
library of gestures (acquired by Apple in 2005)

the revolution (2)

Known and Loved' and adapted slides from Stephane Huot

2001 - **Diamond Touch** [Mitsubishi Research Labs, Cambridge, USA]
multi-touch table with user identification and library of touch interactions

2002 - **SmartSkin & Augmented Surfaces** [J. Rekimoto, Sony CSL, Japan]
collaborative AR surfaces that can sense hand and finger gestures

2003 - **Lemur & MT displays** [JazzMutant/Stantum, Bordeaux, France]
1st commercially available multi-touch transparent display

touch everywhere (1)

2004 - **TouchLight** [A.Wilson, Microsoft Research]
rear-projection and digital image processing for multi-touch input

2005 - **FTIR** [J. Hann, ...]
introduce FTIR technology for touch sensing, found Perceptive Pixel (acquired by Microsoft)

2005 to now - **Research on multi-touch interaction** [Wilson, Moscovitch, Benko, ...]
design, evaluation, etc. to address usability, performance, precision, ...

2007 - **iPhone** [Apple, USA]
1st mainstream well-designed multi-touch device, with a whole 'ecosystem'...

2007 - **MS Surface I** [Microsoft, USA]
1st MT table to transition from research to commercial application




touch everywhere (2)

2010 - **iPad** [Apple, USA]
1st mainstream MT tablet, success story similar to iPhone...

~2010 - **3M and many commercial MT displays**
commercial touch displays and overlays were already mainstream (e.g. Elo)
but 3M introduced the 1st high-end, robust and affordable MT displays

~2010 – **PQLabs**
1st commercial high-end IR based multi-touch overlays (small to large sizes)

... to be continued...