

# M1 ENJMIN

## Bases de l'IHM

29 novembre 2017

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cubaud @ cnam.fr



le **cnam**  
École nationale du jeu  
et des médias interactifs numériques **enjmin**

IHM = ?

Interface homme-machine

Interface humain-machine

Interaction humain-machine

Interaction humaine médiatisée



1968 : S. Kubrick "2001 l'odysee de l'espace"



[Accueil](#) [Association](#) [Manifestations](#) [Publications](#) [Subvention](#) [Adhésions](#) [Ressources](#) [Espace membre](#)

## Association Francophone d'Interaction Homme-Machine

### Présentation

L'Association Francophone de l'Interaction Homme-Machine (**AFIHM**) a pour but principal de promouvoir le savoir et les connaissances du domaine de l'Interaction Homme-Machine et des divers domaines concourants au savoir et aux connaissances facilitant la conception, la réalisation et l'évaluation des systèmes interactifs actuels et futurs.

*L'Interaction Homme-Machine est la discipline qui se consacre à la conception, l'évaluation et la mise en œuvre de systèmes informatiques interactifs pour l'usage humain ainsi qu'à l'étude des phénomènes majeurs qui les entourent [Traduction de Hewett, T. et al., 1992 (chap. 2)].*

L'AFIHM offre aux chercheurs et praticiens de l'IHM un lieu d'échange de savoirs sur leurs domaines professionnels.

### Liste de diffusion

L'association dispose d'une liste de diffusion modérée de toutes les personnes intéressées par l'IHM (annonces

#### Adhésions

L'AFIHM offre au praticiens de d'échange et de domaines

[Bénéfices à adhérer](#)

Pour adhérer, [créer un compte membre](#)

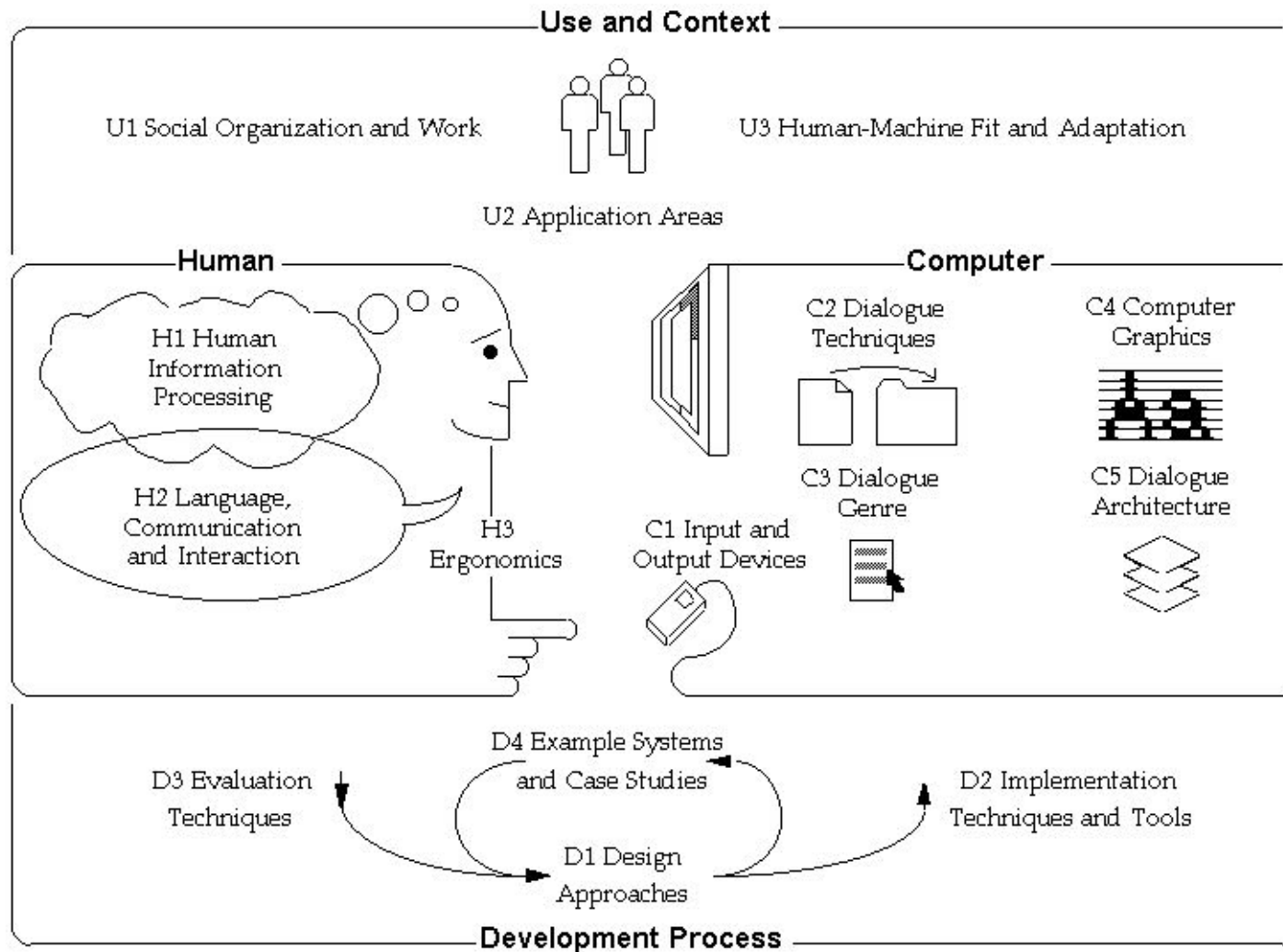
#### Tweets by

 AFIHM Retw

 **Emmanu**  
@epietriç

1yr postdoc posi  
cartography @te  
[@inria\\_saclay](#). C  
[@chi2016](#) if inter





<http://old.sigchi.org/cdg/index.html>

# pub : association mondiale ACM SIGCHI

you are here: [home](#)

## Welcome

SIGCHI is the premier international society for professionals, academics and students who are interested in human-technology & human-computer interaction (HCI).

To get involved you can [join SIGCHI](#), join one of our [mailing lists](#), become a [volunteer](#), or visit your [local SIGCHI chapter](#).

ACM SIGCHI is the field of HCI gathering a large online community. There are two ways to get involved:

1. Please take part in our research. It should be published in the journal.
2. Volunteer to help with the conference and serving as a role model for our passionate about HCI.

**CHI 2015 CROSSINGS SEOUL-KOREA**

**INTERACTIONS** JANUARY-FEBRUARY 2014 VOLUME XXI.1  
Association for Computing Machinery

**IX**

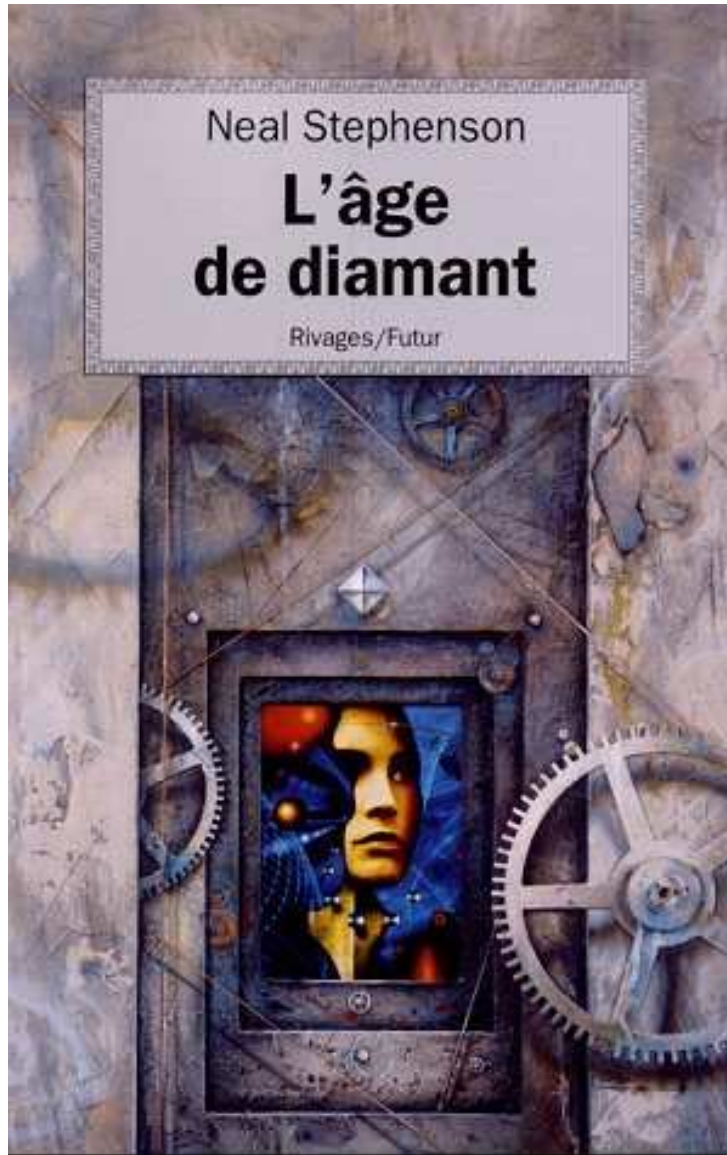
**Slow Change Interaction Design: A Theoretical Sketch**  
BY MARTIN A. SIEGEL & JORDAN BECK

+ la revue

Neal Stephenson

# L'âge de diamant

Rivages/Futur

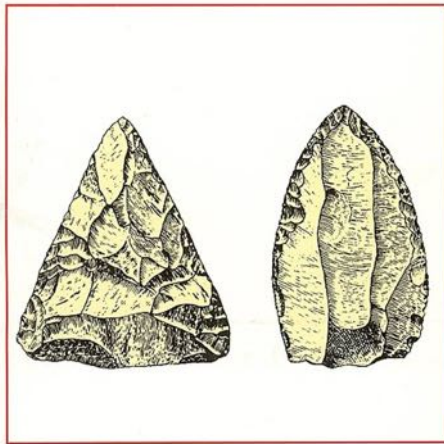




# (re)lire Leroi-Gourhan

## L'homme et la matière

André Leroi-Gourhan



Sciences d'aujourd'hui

Albin Michel

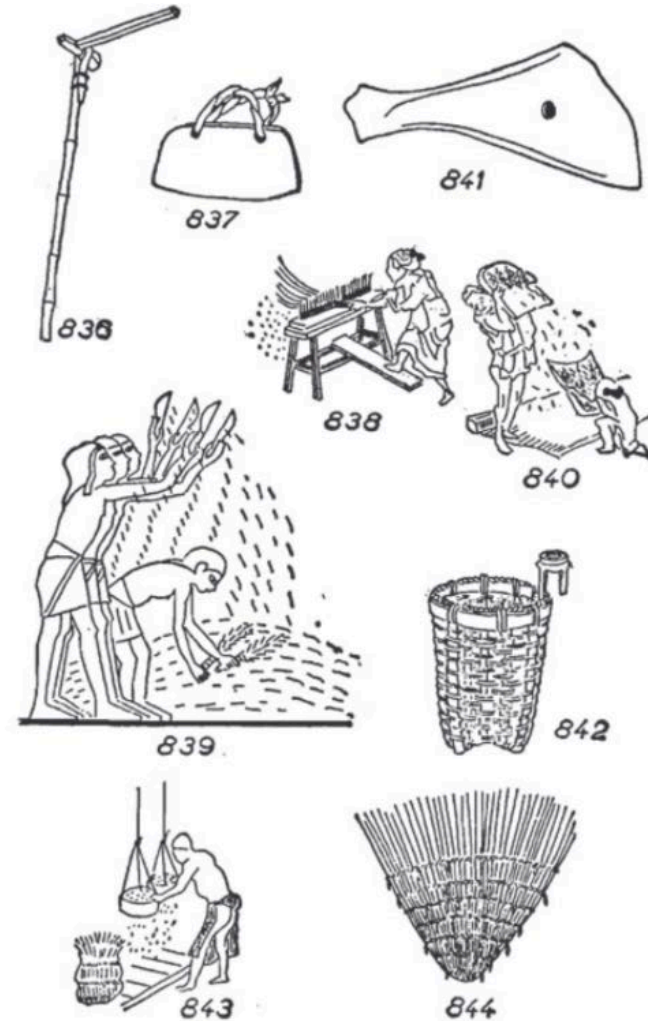
## Milieu et technique

André Leroi-Gourhan



Sciences d'aujourd'hui

Albin Michel



Exercice :  
nommer un logiciel sans IHM

Exercice :

calculer la proportion d'heures de formation  
à l'IHM par rapport au total d'une licence

# **Plan de l'exposé :**

**1. historique IHM  $\leq$  WIMP**

**2. au-delà du WIMP**

**3. la captation**

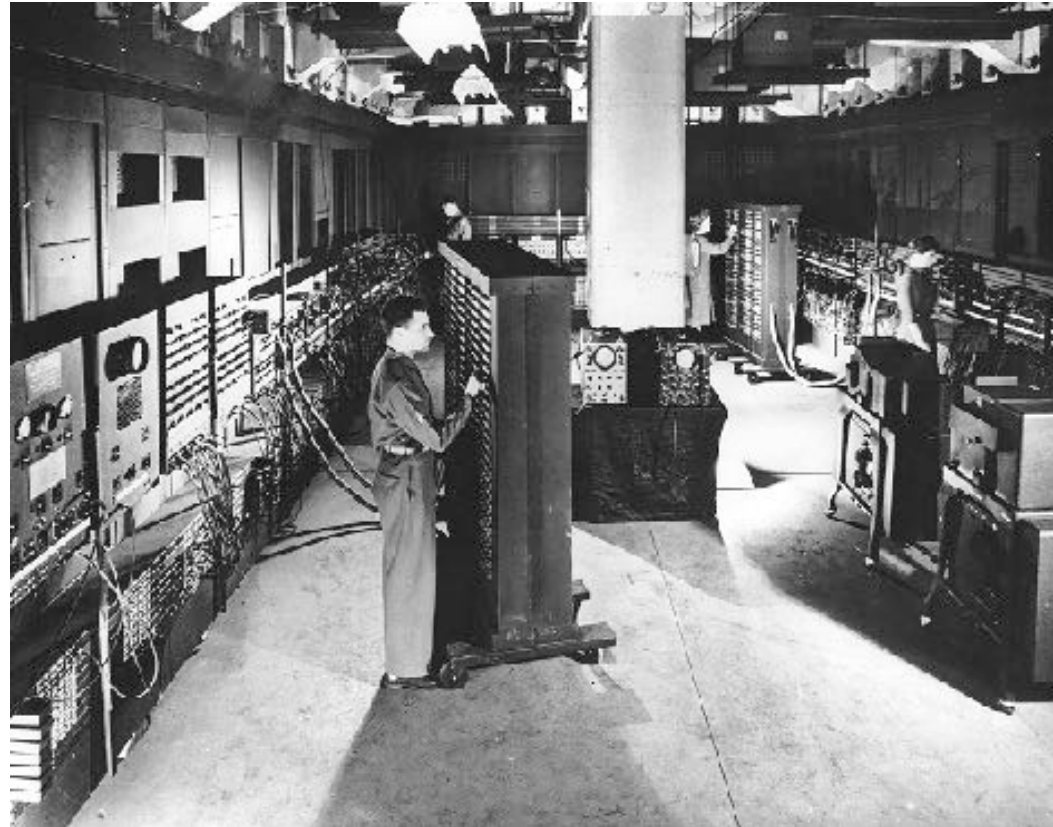
**(pause ?)**

**4. l'immersion**

**5. l'augmentation**

**6. les objets malins**

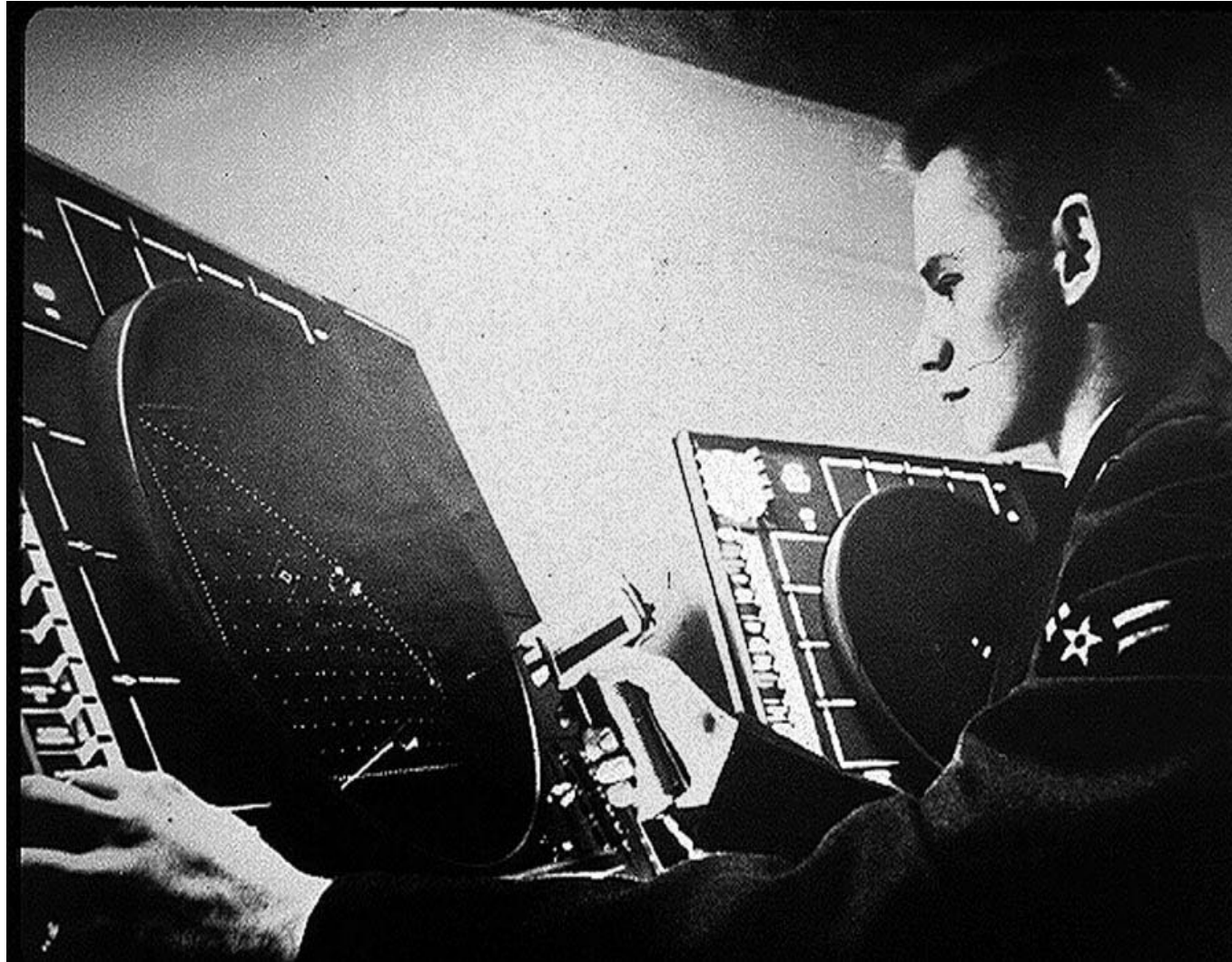
# (1) Historique de l'IHM



ENIAC - 1945

## Le temps-réel : projet Whirlwind MIT, 1950



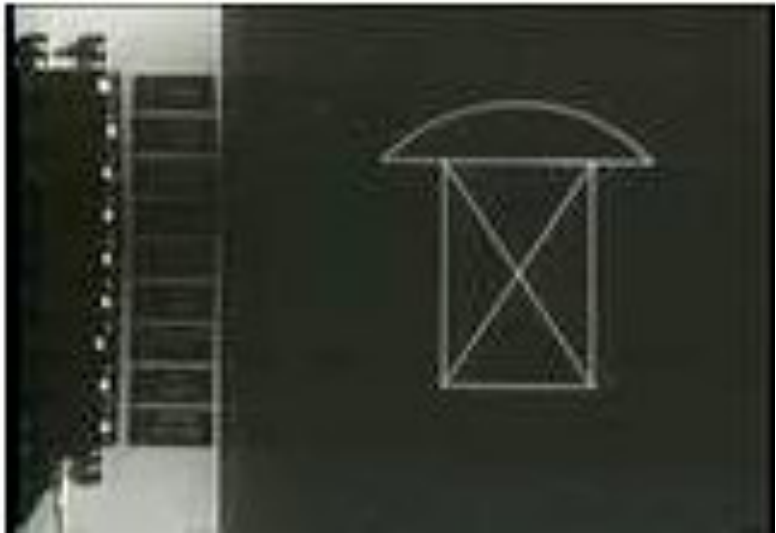


défense aérienne (SAGE)



1961 : Ivan Sutherland sur TX1 (MIT)

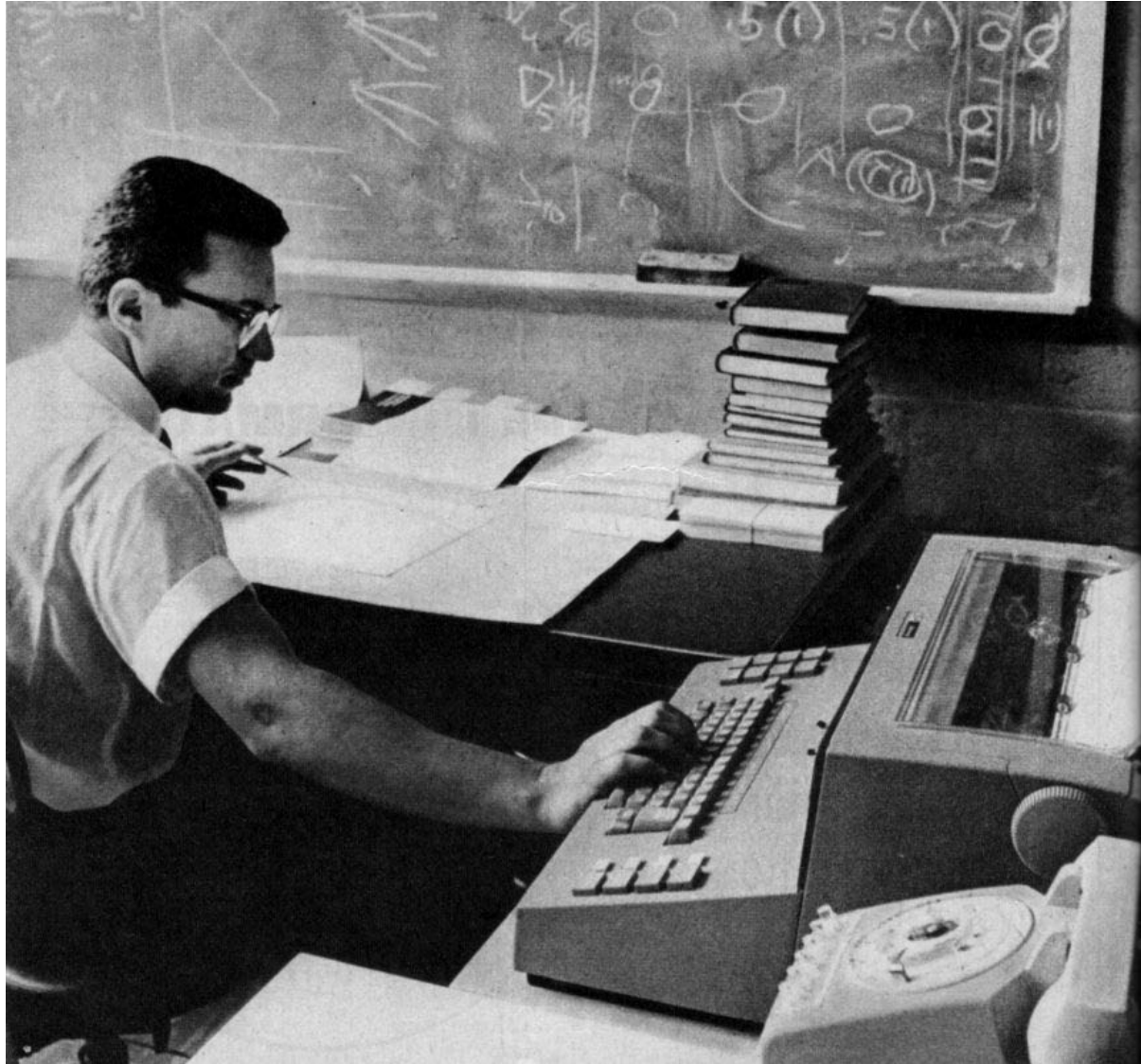




**J.C.R. Licklider (1960)**  
**“man-computer symbiosis”**



“The hope is that, in not too many years, human brains and computing machines will be coupled together very tightly and that the resulting partnership will think as no human brain has ever thought and process data in a way not approached by the information-handling machines we know today.”

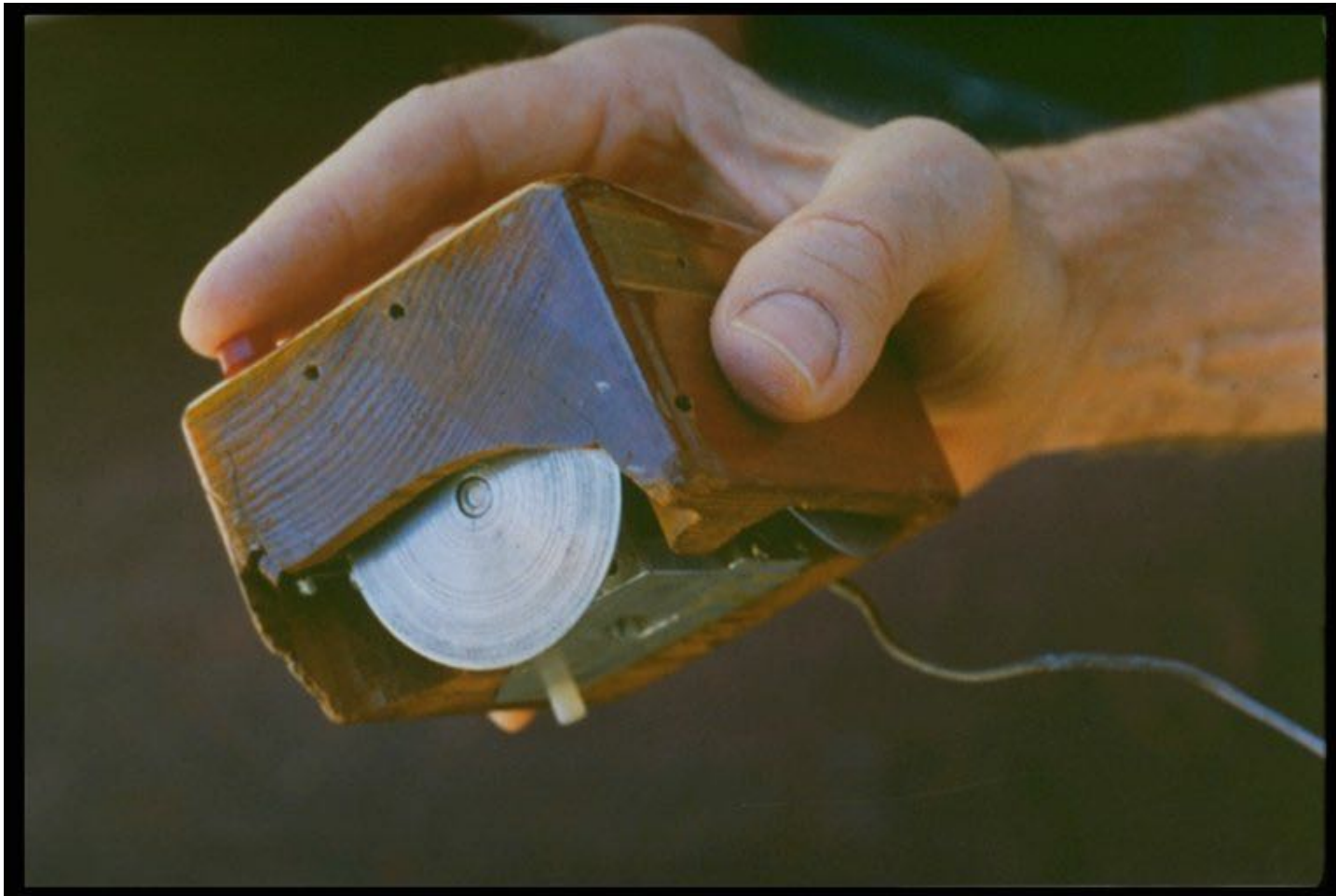


Le temps partagé (time sharing) :  
MIT, 1959-64



## **D. Engelbart : "augmenting human intellect" (SRI, 1963)**

"A Research Center for Augmenting Human Intellect," Douglas C. Engelbart, and William K. English, AFIPS Conference Proceedings of the 1968 Fall Joint Computer Conference, San Francisco, CA, December 1968, Vol. 33, pp. 395-410



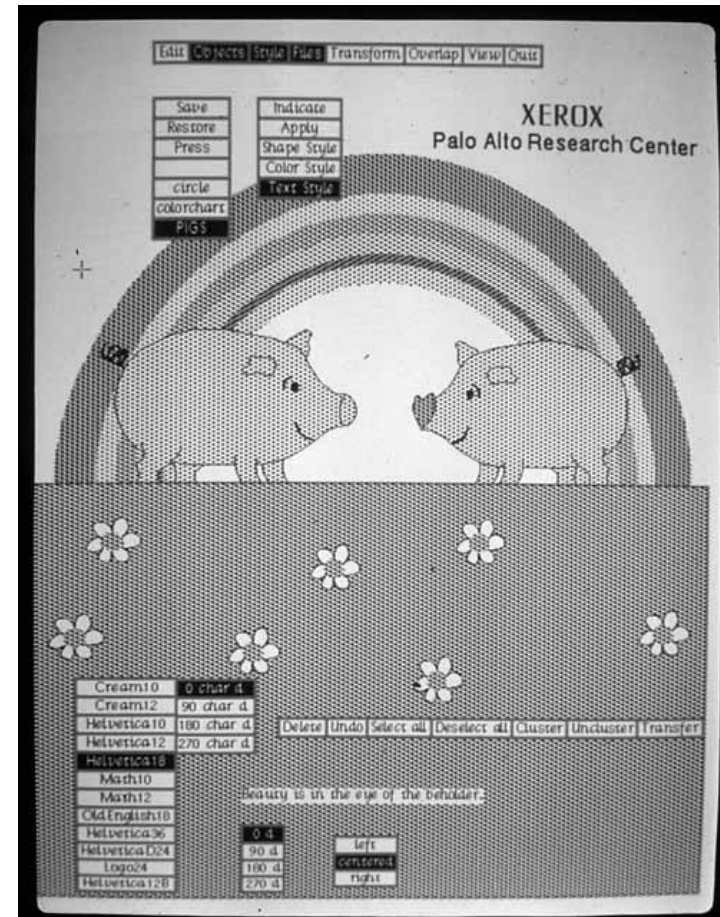
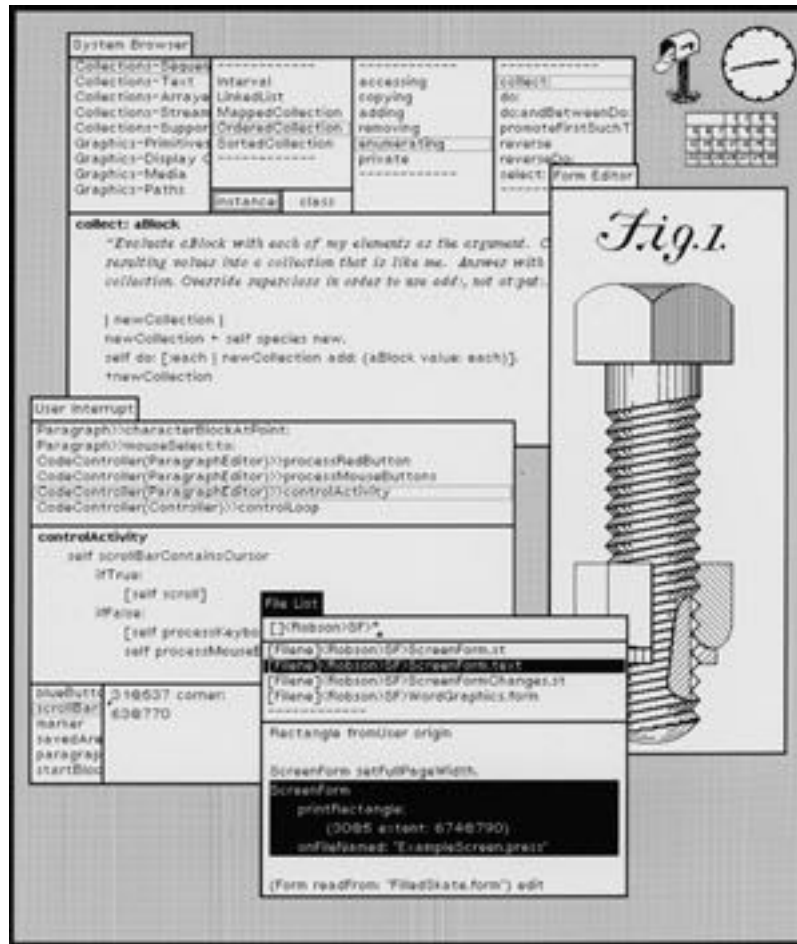
Douglas Engelbart et sa souris de 1963 (Stanford), 40 ans après

```
Processes: 66 total, 2 running, 64 sleeping, 260 threads          11:15:01
Load Avg: 0.39, 0.21, 0.15  CPU usage: 2.39% user, 3.82% sys, 93.77% idle
SharedLibs: 8060K resident, 8192K data, 0B linkedit.
MemRegions: 7904 total, 347M resident, 24M private, 249M shared.
PhysMem: 502M wired, 586M active, 232M inactive, 1320M used, 2774M free.
VM: 152G vsize, 1040M framework vsize, 66915(0) pageins, 0(0) pageouts.
Networks: packets: 64/14K in, 64/14K out.
Disks: 15221/864M read, 3985/72M written.

PID  COMMAND      %CPU  TIME    #TH  #WQ  #POR  #MRE  RPRVT  RSHRD  RSIZE  VPRVT
203  fontd        0.0   00:00.12 3    1    78    91    2408K  540K   3356K  31M
202- mdworker32   0.0   00:00.86 3    1    53    114   2256K  14M    6716K  41M
201  top          5.9   00:02.41 1/1  0    26    33    872K   264K   1452K  18M
198  bash         0.0   00:00.01 1    0    17    24    356K   244K   1032K  17M
197  login        0.0   00:00.02 1    0    22    53    488K   244K   1596K  19M
187  Terminal     1.8   00:03.62 5    1    111   155-  7300K- 28M    18M-   35M-
186  mdworker     0.0   00:00.08 3    1    50    60    1500K  13M    3288K  31M
180  mdworker     0.0   00:00.70 3    1    48    60    1748K  13M    3828K  31M
170* LaunchCFMApp 0.1   00:02.25 5    0    104   278   10M    15M    17M    278M
169- Microsoft AU 0.0   00:00.05 2    1    63    67    724K   1184K  2012K  30M
168* pptfc       0.0   00:16.39 4    0    116   392   51M    18M    80M    432M
166* LaunchCFMApp 1.1   00:44.11 5    0    163   467   70M    38M    100M   481M
160  Safari       0.0   00:07.55 8    2    132   292   19M    27M    40M    175M
157  Preview      0.0   00:14.87 2    1    110   208   14M    34M    39M    41M
```

ecran type VT100 24 lignes \* 80 colonnes  
ici la commande UNIX top

# 70's : XEROX PARC machine Alto : cut copy & paste



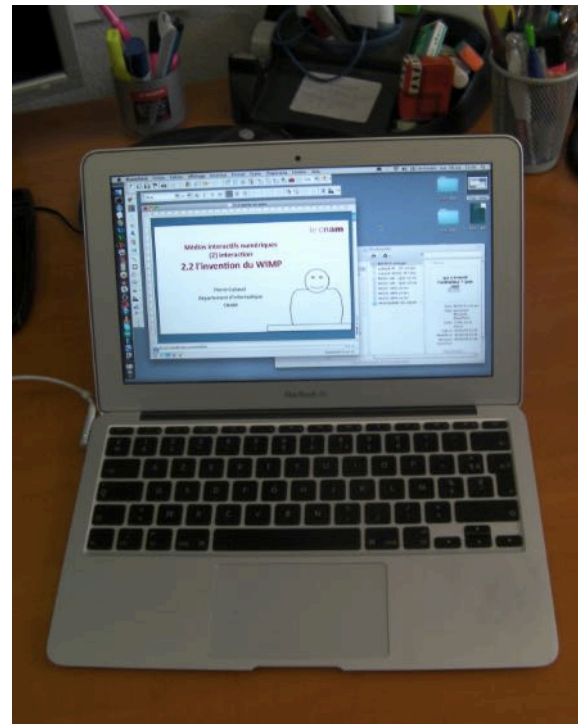
<http://news.squeak.org/2007/12/29/old-smalltalk-pics-from-parc-place/>

À voir aussi :

<http://www.nomodes.com/tesler-resume.htm>



- Ecran N&B 606 x 808 pixels (80 ppi)
- Clavier séparé, reconfigurable, mesure de force et durée
- Souris 3 boutons
- 2 disques durs de 3 Mo pour le stockage local
- Ethernet
- Imprimante laser



mon portable



- "métaphore" du bureau (  desktop)

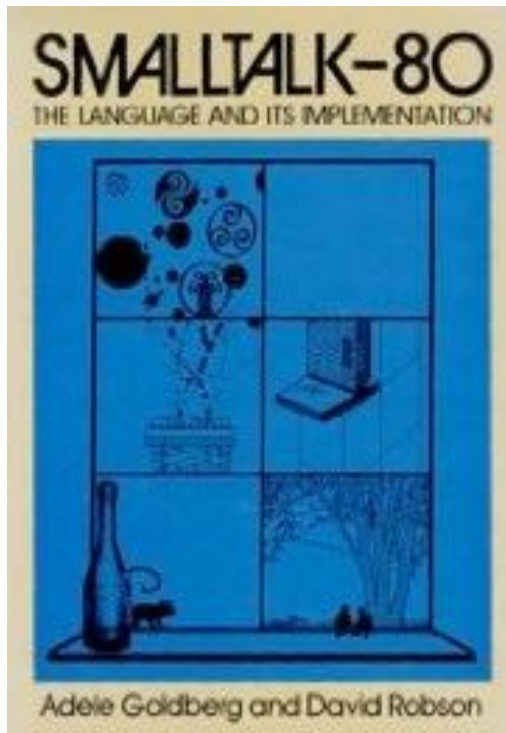
```
$  
$ rm -f toto.txt  
$ bauds
```



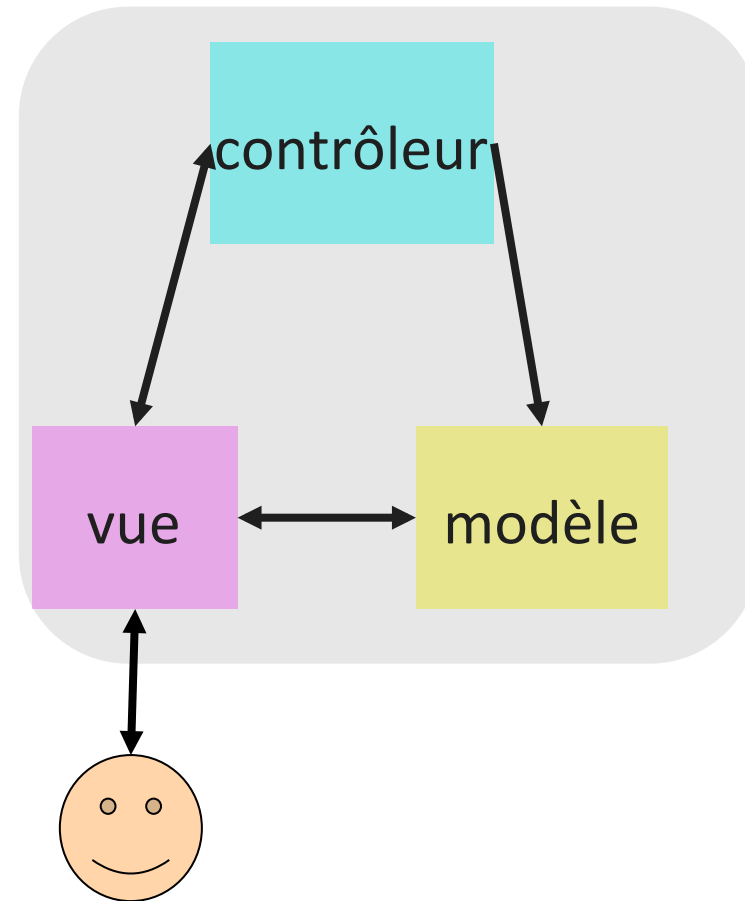
- le copier/coller (  copy/paste)
- l'annulation (  undo)

⇒ "manipulation directe" (Schneidermann, 1983) :  
des actions rapides, incrémentales, réversibles

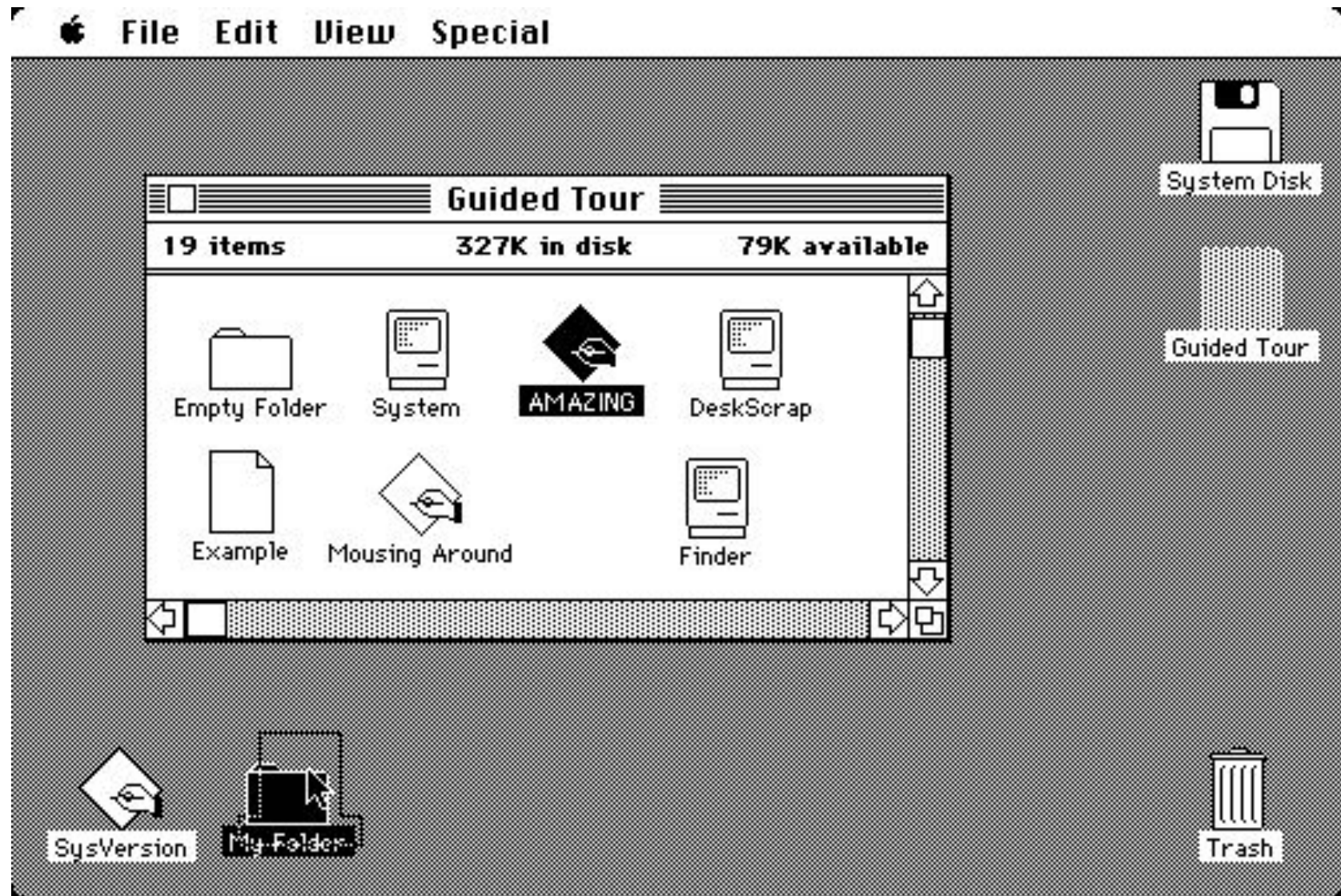
- langage de programmation "objet"
- modèle MVC



(wikipedia)

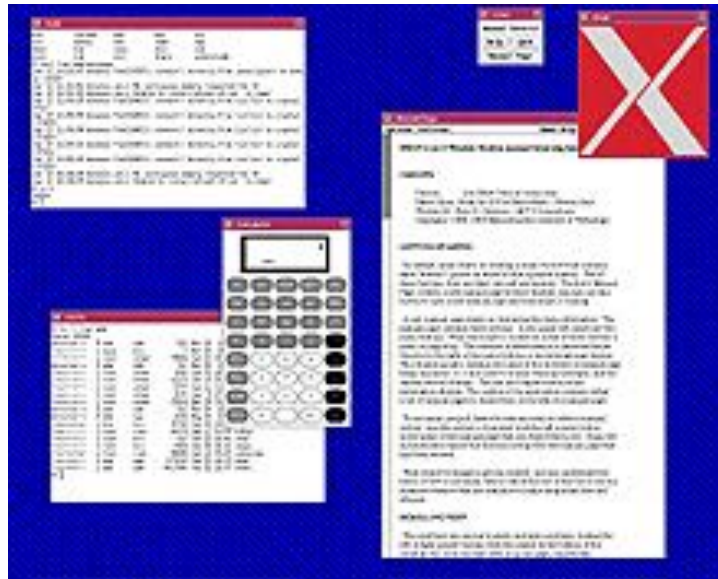


# Apple : Macintosh (1/1984)



<http://toastytech.com/guis/>

# X Window (X11.1 : 9/1987)

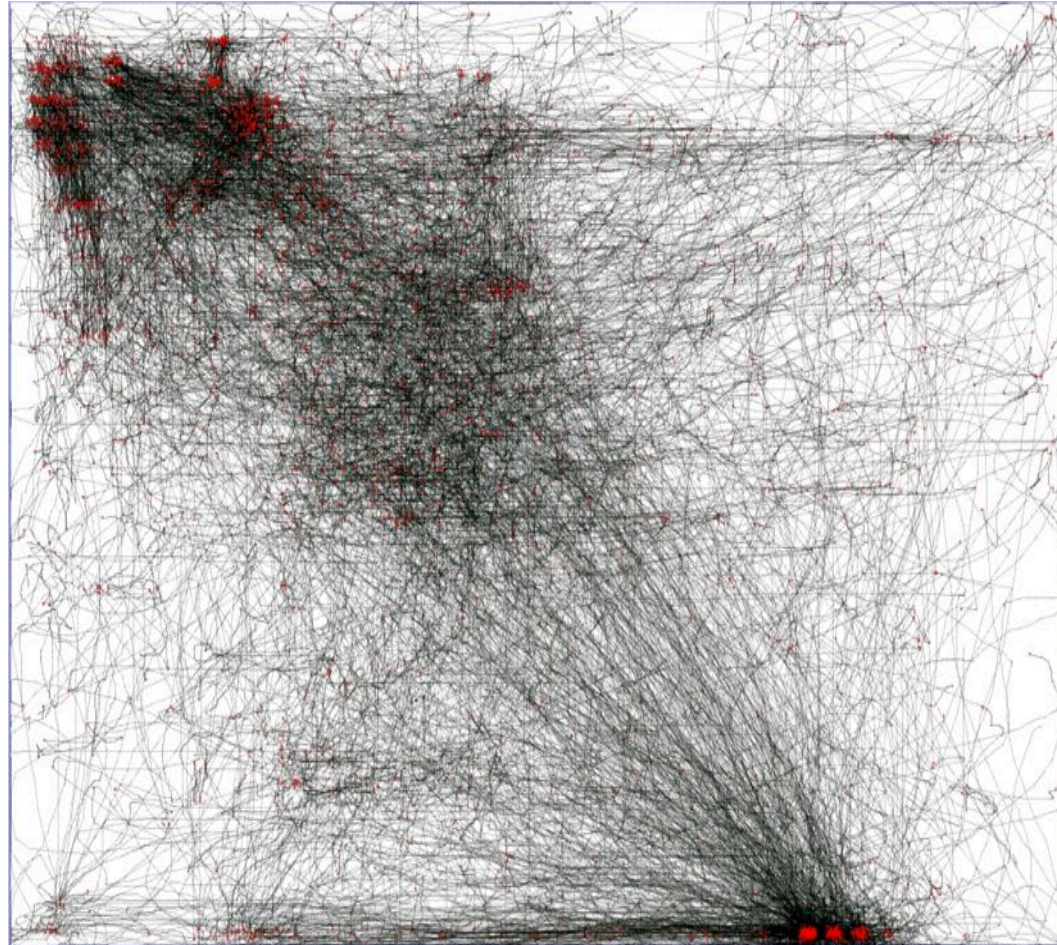


# NeXTSTEP (0.8 : 10/1988)



# Apple Aqua (1/2000)

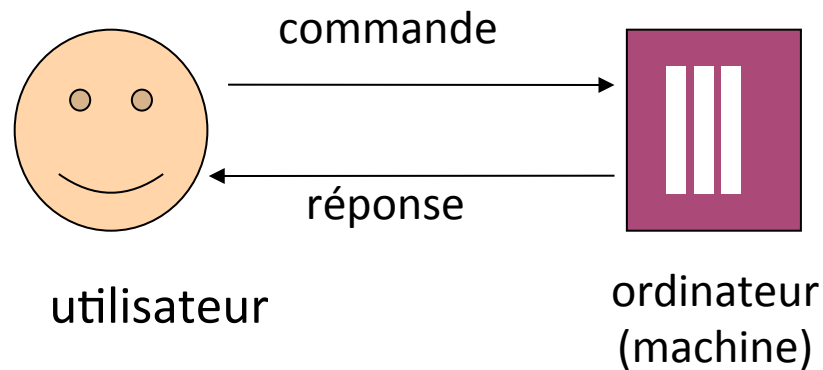
IHM vu du côté ordinateur...



O. Chapuis, R. Blanch, M. Beaudouin-Lafon  
Fitts' Law in the Wild: A Field Study of Aimed Movements  
LRI tech. report 1480, dec. 2007

## **(2) Au-delà du WIMP**

- les domaines d'applications de l'ordinateur ont considérablement changé en un demi-siècle, pour beaucoup grâce à la "loi" de Moore
- mais c'est toujours pénible de donner des ordres à un ordinateur : "gulf of execution" de D. Norman







# 1 : A coût égal, croissance exponentielle de puissance



ma TI-57 (1980) et mon téléphone (2010)

## 2: à puissance égale, décroissance exponentielle du coût



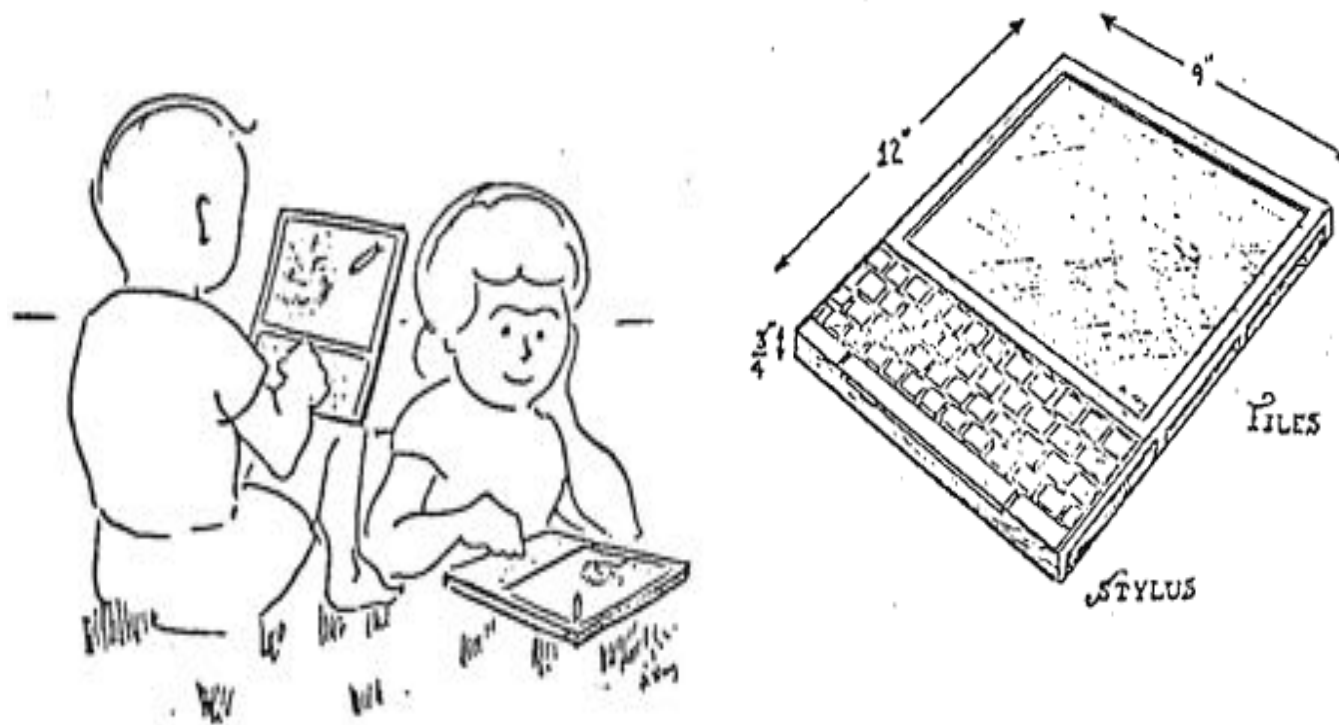


1er processeur dédié 3D pour PC (1995-97)



Etiquettes électroniques (e-ink)

## Etape 1 : l'ordinateur personnel (et pour tous ?)



[http://en.wikipedia.org/wiki/  
File:Dynabook.png](http://en.wikipedia.org/wiki/File:Dynabook.png)

**Le "dynabook" d'Alan Key (PARC, 1972)**

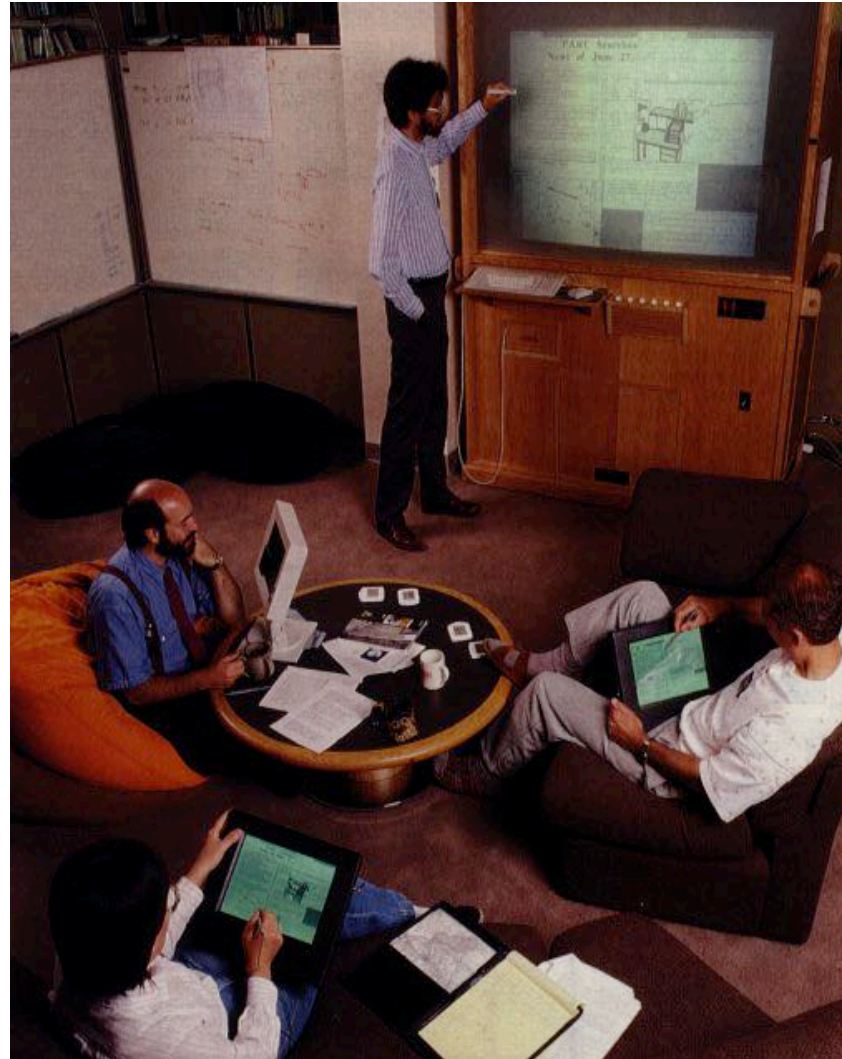


(2010)

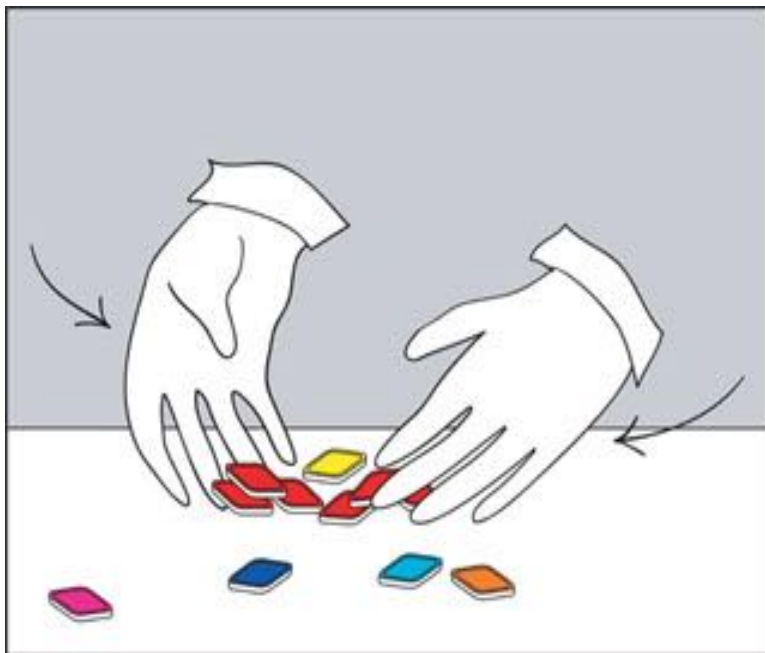
**Etape 2 :  
l'information  
tout le temps**

Ubiquitous  
computing  
M. Weiser  
PARC, ca. 1990

(wikipedia)



### Etape 3 : l'information dans tout



Siftables (Merill, MIT, 2009)



PhotoCubes (S.H. Hsu, CNAM, 2010)

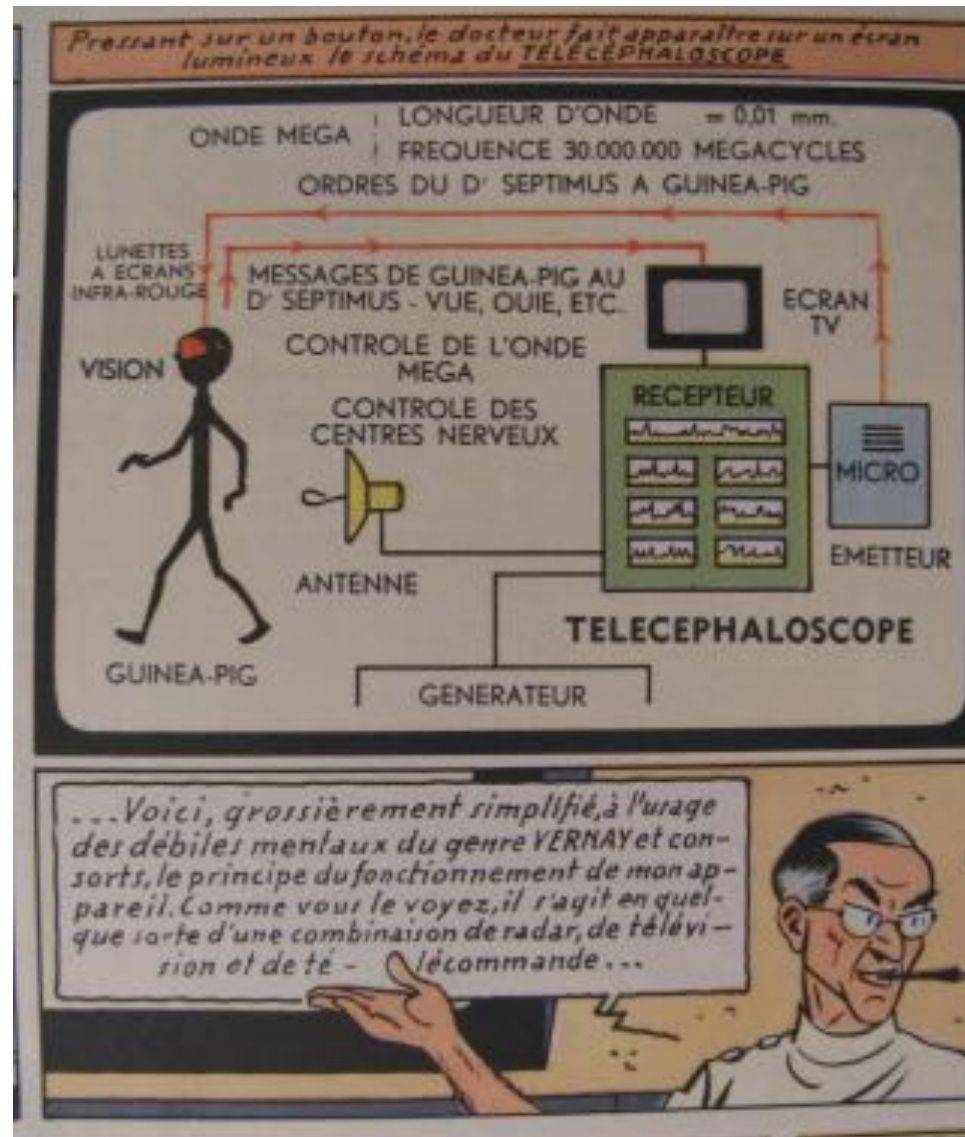


## **(3) La captation**

## **ce qu'on capte pour l'IHM :**

- position
- mouvement, déplacement
- geste
  
- voix : parole, chant
- attitude
- regard
  
- physiologie (température, rythme cardiaque, sudation ...)
- ondes cérébrales

## Capter pourquoi ? boucle de rétro-action (feedback)



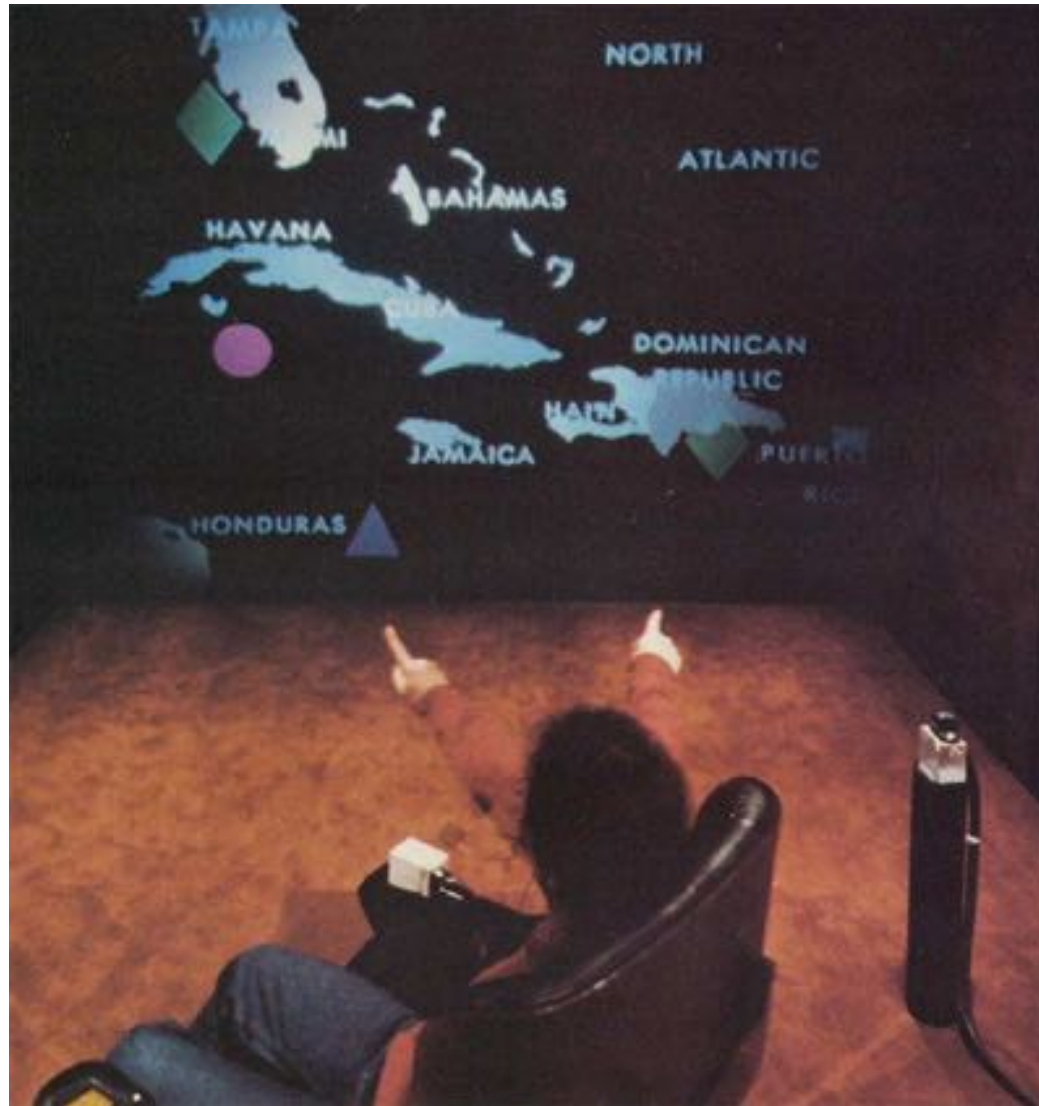


## IMU camera control / stabilisation

 **SebMadgwickResearch**  
 **S'abonner** 1 719

96 498

<https://www.youtube.com/watch?v=7GVXqNLLH7Q>



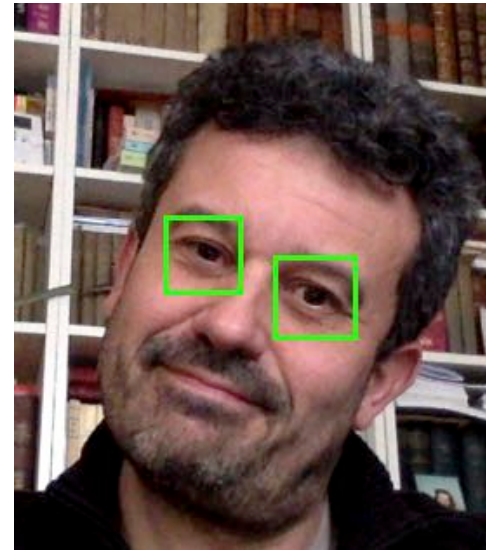
**R. Bolt - "put that there" (MIT, 1980)**

## Souris à 3 DDL, Rodrigo Almeida, CNAM/CEDRIC



procontrol & promidi pour Processing, OSC, etc

## En octobre avec les `~progs`:



captation video, opencv

## C. Verplaetse IBM Systems Journal 35(3-4) 1996 !!

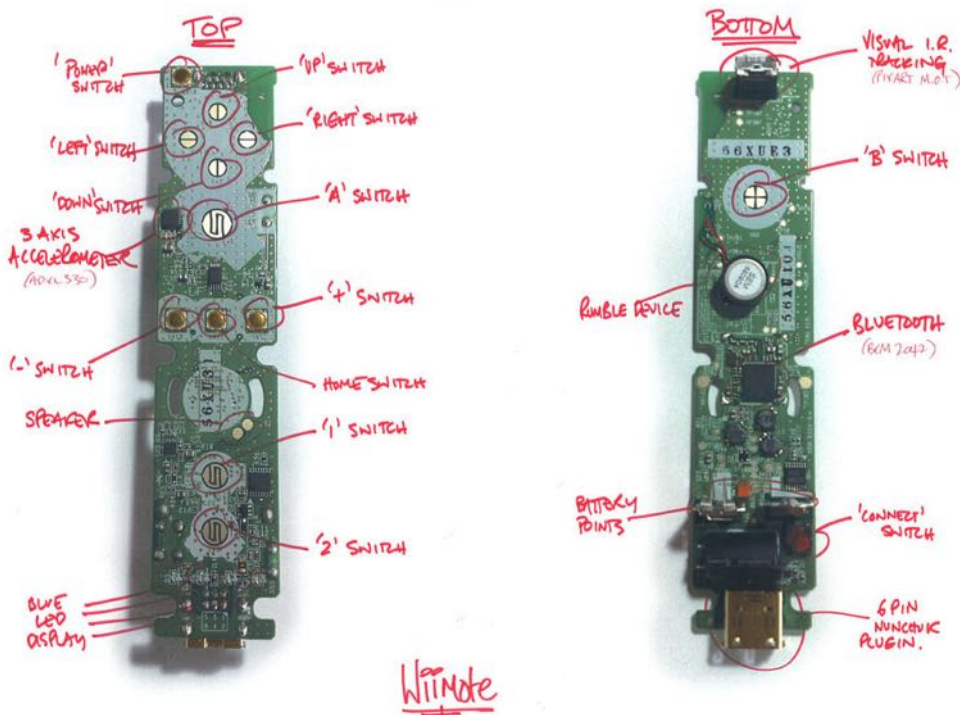
### Inertial proprioceptive devices: Self-motion-sensing toys and tools

by C. Verplaetse





# La Wiimote de Nintendo (2006)

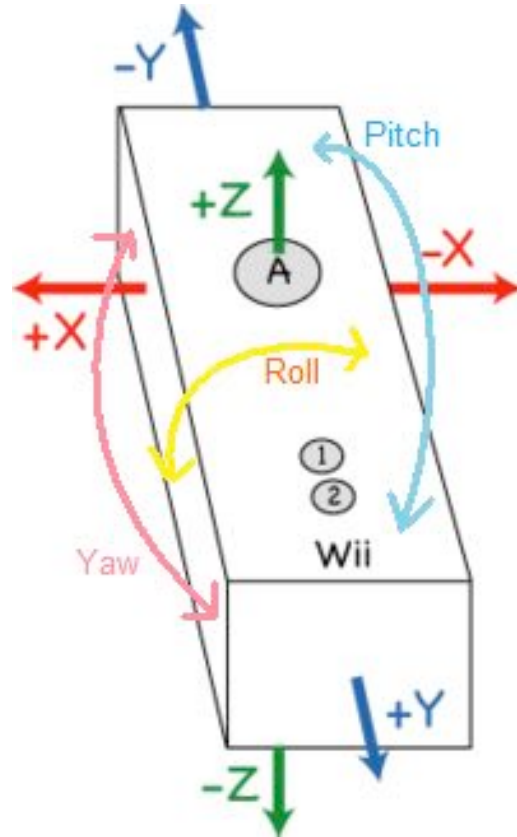


Brett Rolfe, OneDigital

- 40 € wiimote + 20 € nunchuck
- accelerometre 3axes
- Camera IR + rec. Blobs
- HP, vibreur
- Plein de boutons + joysticks
- Bluetooth (et i2c avec le nunchuck)

Totalement « hacké »  
=> [www.wiili.com](http://www.wiili.com)

# Utilisation de l'accéléromètre



On pose la wiimote de manière à avoir successivement les trois axes X Y Z à la verticale et on collecte les valeurs renvoyées.

+Z :  $x_1, y_1, z_1$

+Y :  $x_2, y_2, z_2$

+X :  $x_3, y_3, z_3$

d'où les coordonnées du point origine:

$$x_0 = (x_1 + x_2) / 2$$

$$y_0 = (y_1 + y_3) / 2$$

$$z_0 = (z_2 + z_3) / 2$$

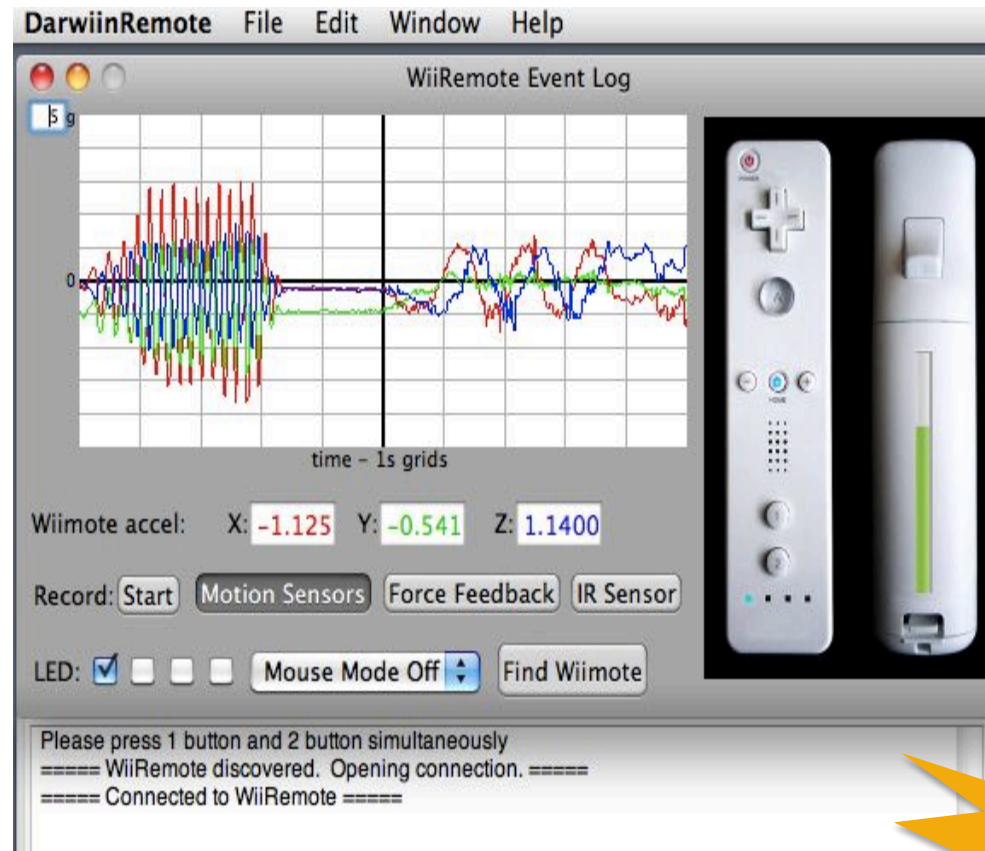
On obtient alors les coordonnées du vecteur force (exprimées en g) :

$$a_x = (x_{raw} - x_0) / (x_3 - x_0)$$

$$a_y = (y_{raw} - y_0) / (y_2 - y_0)$$

$$a_z = (z_{raw} - z_0) / (z_1 - z_0)$$

# Utilisation de l'accéléromètre

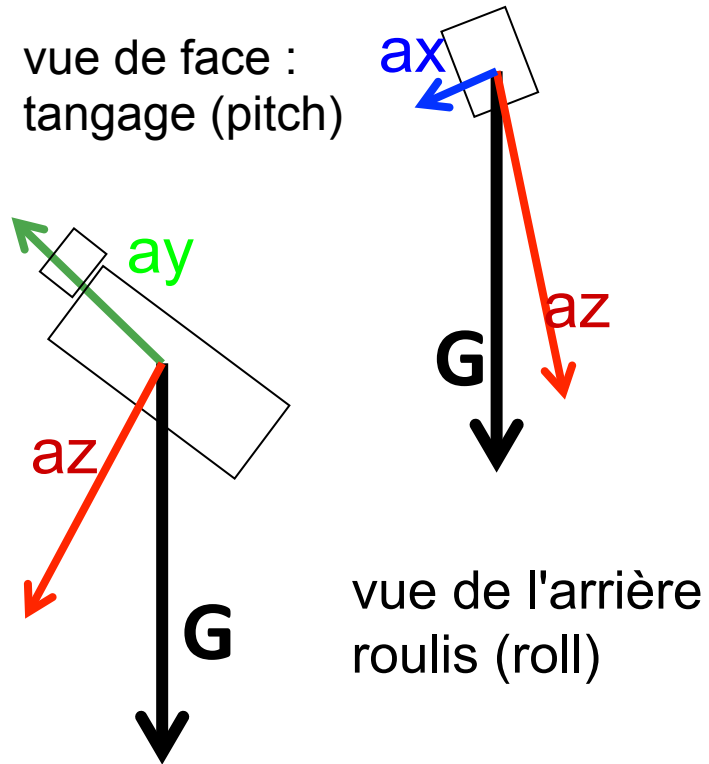


démo

# application à la mesure d'angles



ma (belle) lunette astronomique



$$\text{tg}(\text{pitch}) = \text{ay}/\text{az}$$

$$\text{tg}(\text{roll}) = \text{ax}/\text{az}$$

## Centrales inertiennes : les 3 angles d'Euler

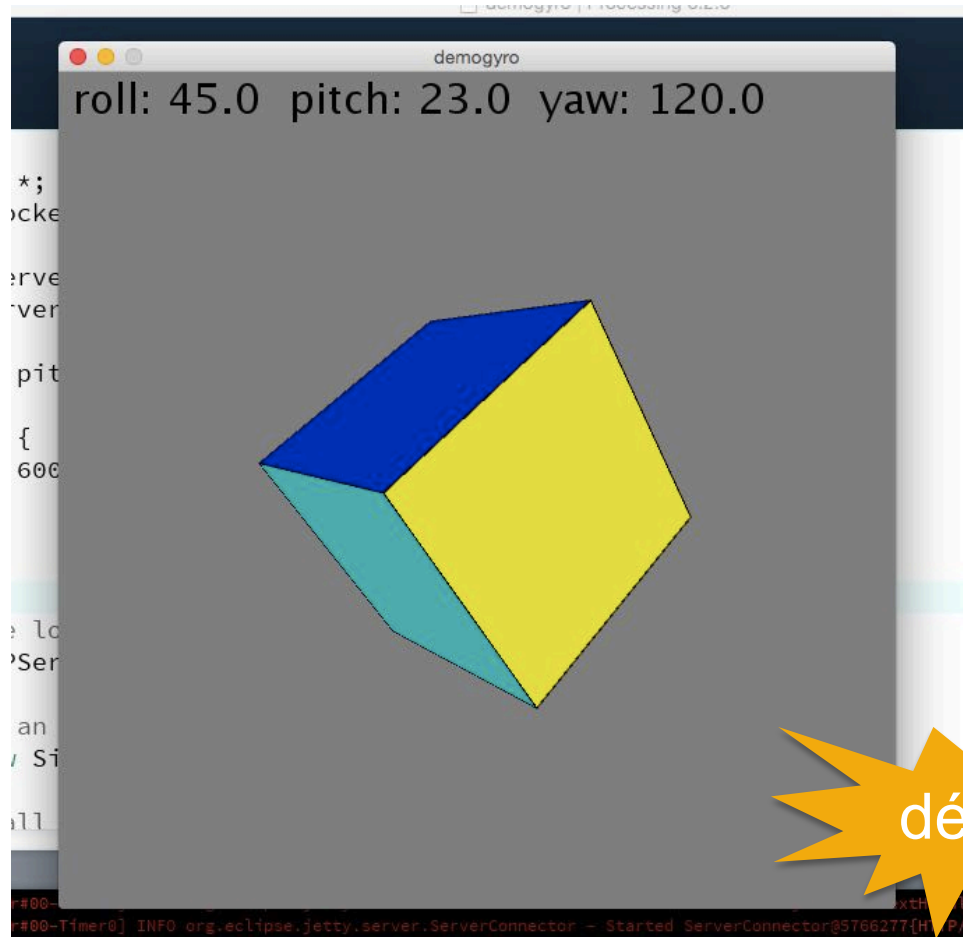


Xsense

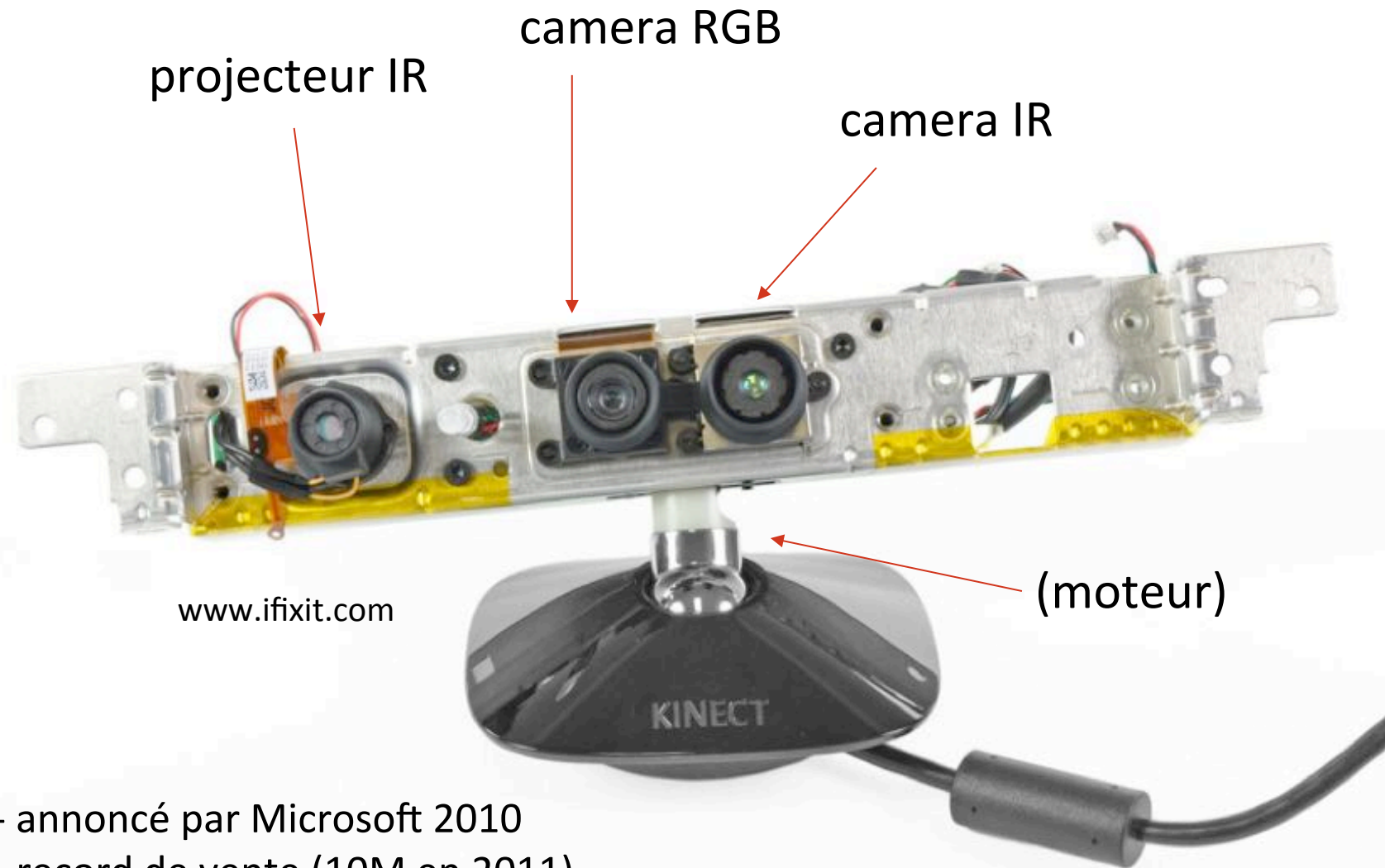


Sparkfun

# Centrale inertielle du smartphone



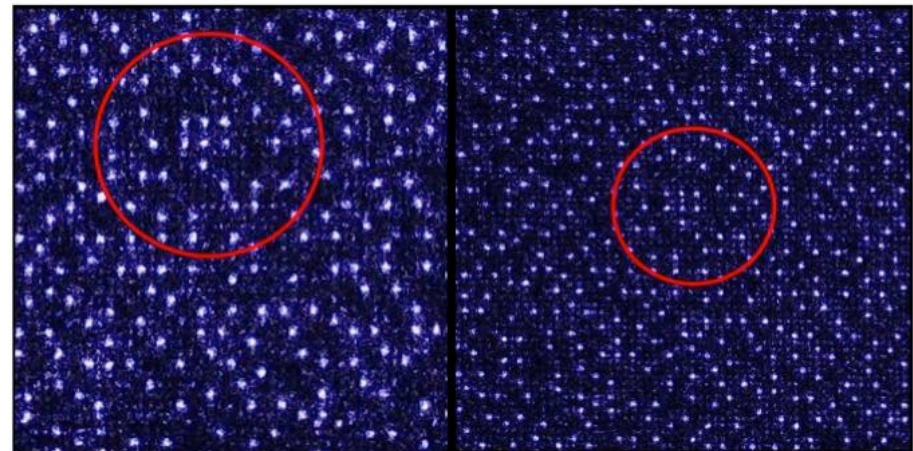
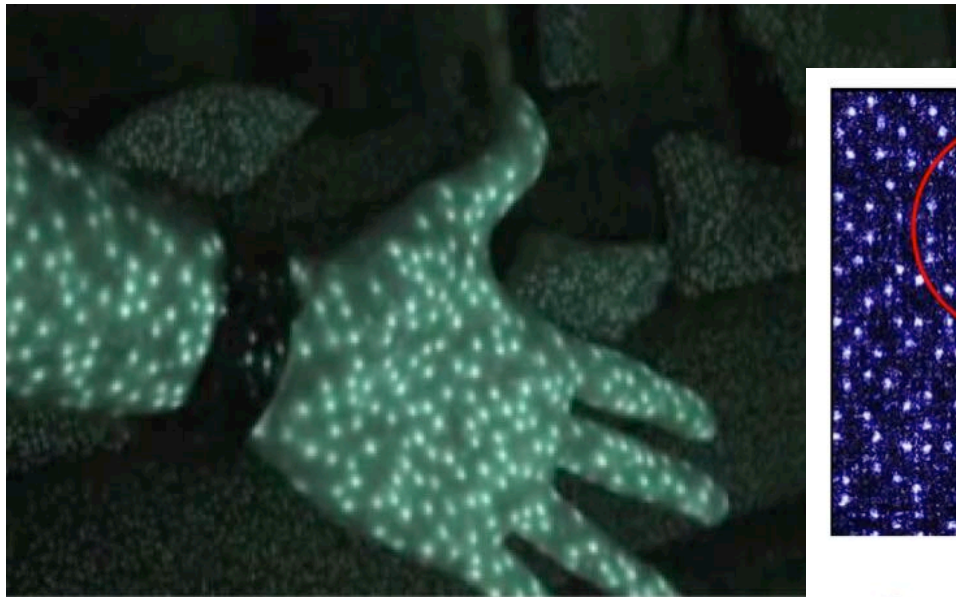
# Kinect



- annoncé par Microsoft 2010
- record de vente (10M en 2011)
- soft+puce de reconnaissance de forme : société PrimeSense (Israel)

## Principe de la reconstruction 3D :

- le projecteur IR diffuse un semis de point sur les surfaces à analyser
- la caméra IR récupère l'image
- la position 3D est déduite en mixant 2 méthodes  
(1) la dimension des points (2) la triangulation



**Pas tout à fait aléatoire !**

il y a 3 types de motifs, adaptés aux distances  
=> bon topo en ligne: H. Wannous, Telecom Lille



# Installation du wrapper Processing de OpenNI



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### Project Information

[Project feeds](#)

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[GNU GPL v2](#)

**Labels**  
Processing, Kinect, OpenNI, NITE

**Members**  
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**Groups**

## Introduction

This project is a simple [OpenNI](#) and [NITE](#) wrapper for [Processing](#). Therefore not all functions of OpenNI are available through this wrapper. It provides a simple access to the functionality of this library.

## News

For a detailed list of changes see the [ChangeLog](#)

- Version 1.96
  - Support for Win32/64, OSX32/64, Linux64
  - [Installation is](#) now much simpler
- --- OpenNI2 ---
- Version 0.26
  - Added the autocalibration, now you can only enter the scene and get the skeleton data without further calibration
  - Updated the examples to enable auto-calibration (User, User3d)
  - Unified the SimpleOpenNI distribution library, from now there is only one library distribution for all architectures. This change is because of the Processing 2.0 autoinstaller.
  - SimpleOpenNI tries on windows/linux to find automatically the valid architecture(32bit/64bit). On OSX this works already through the universal libraries. SimpleOpenNI will print out which architecture it found.
  - Updated the wiki-install doc(thanks to Bradley Henke)

[Older logs](#)

<http://code.google.com/p/simple-openni/>

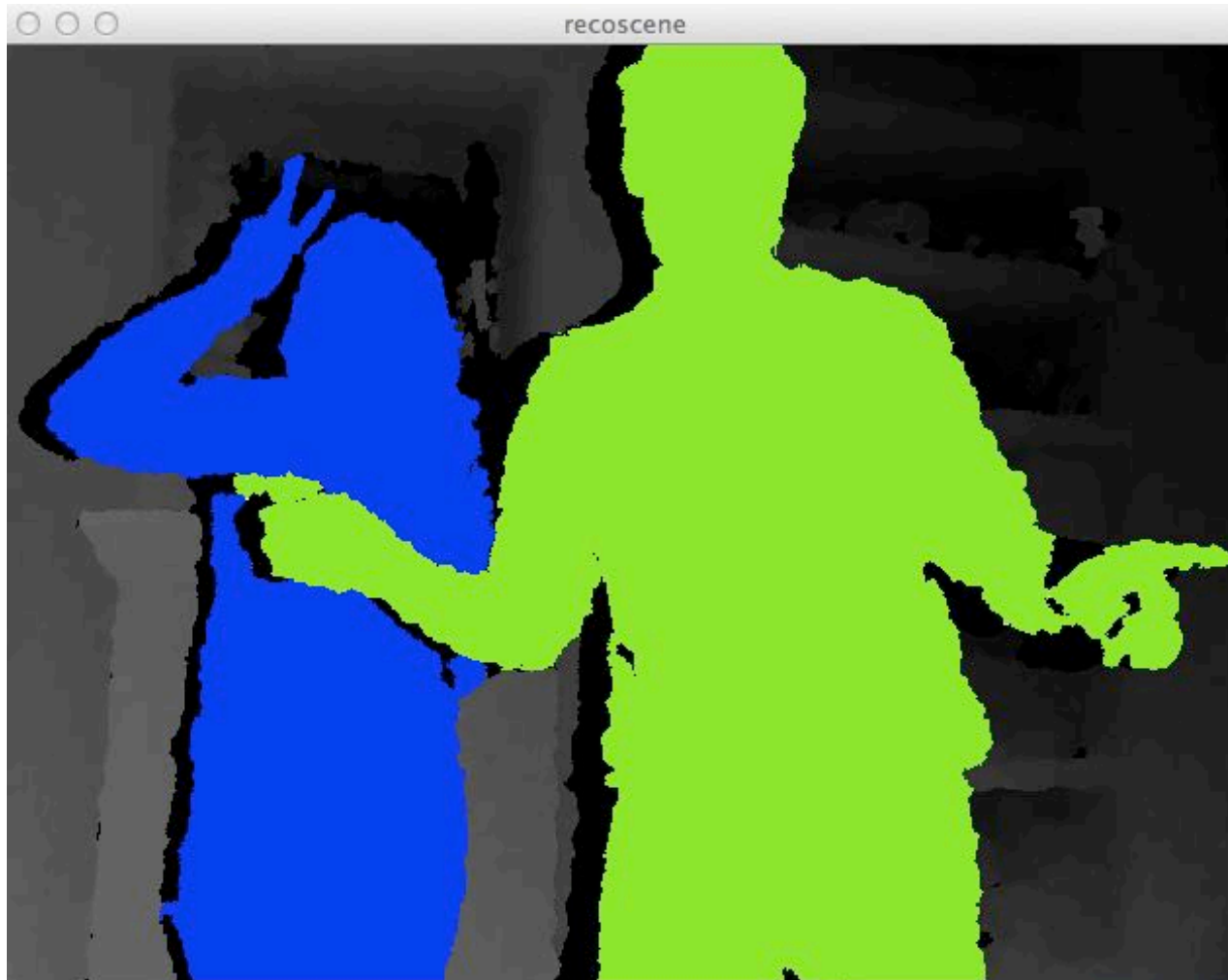
## La carte de profondeur (depthmap et depthimage)

essaiKinect1

```
import SimpleOpenNI.*;
SimpleOpenNI kinect;
void setup() {
  size(640*2, 480);
  kinect = new SimpleOpenNI(this);
  kinect.enableDepth();
  kinect.enableRGB();
  kinect.alternativeViewPointDepthToImage();
}
void draw() {
  background(0,255,0);
  kinect.update();
  image(kinect.depthImage(), 0, 0);
  image(kinect.rgbImage(), 640, 0);
}
```



- séparation fond/humains
- identifications des humains



## Favrication d'un pointeur

avec le point le plus proche dans la depthmap comme pointeur



G. Borensten "Making things see" O'Reilly



## Code du livre

```
import SimpleOpenNI.*;
SimpleOpenNI kinect;

int closestValue;
int closestX;
int closestY;

void setup() {
  size(640, 480);
  kinect = new SimpleOpenNI(this);
  kinect.enableDepth();
}
```

il faudra  
filtrer le point

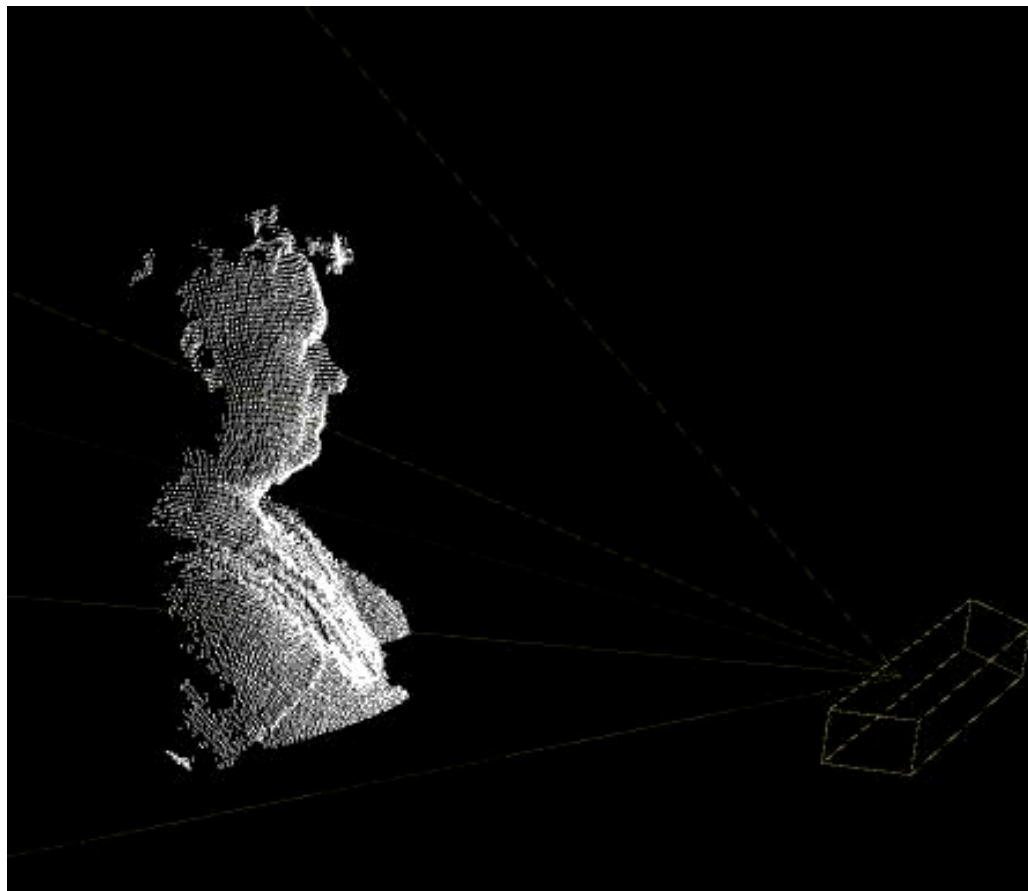
```
void draw() {
  closestValue = 8000;
  kinect.update();

  // get the depth array from the kinect
  int[] depthValues = kinect.depthMap();

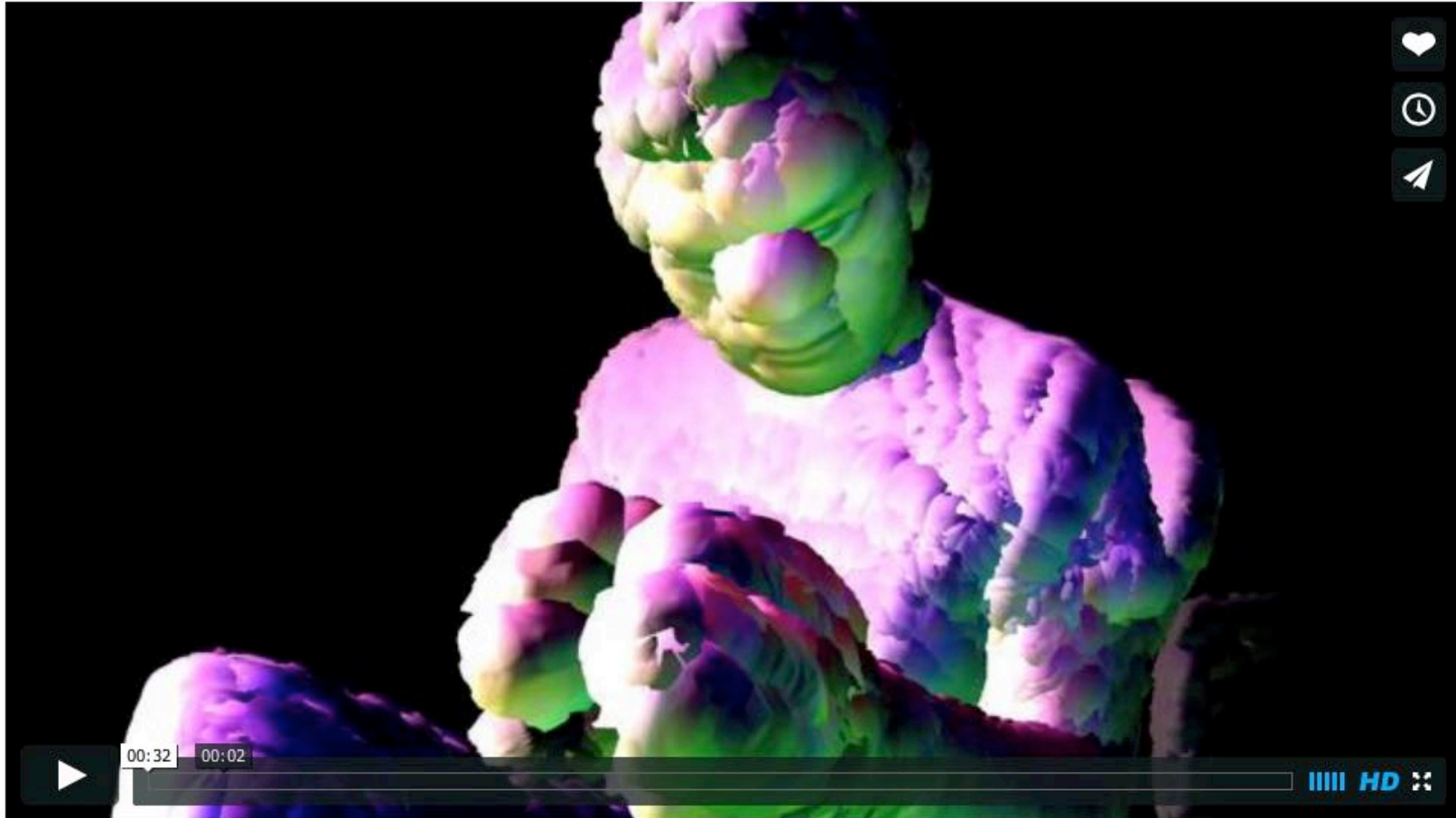
  for(int y = 0; y < 480; y++){
    for(int x = 0; x < 640; x++){
      int i = x + y * 640;
      int currentDepthValue = depthValues[i];
      if(currentDepthValue > 0 && currentDepthValue < closestValue){
        closestValue = currentDepthValue;
        closestX = x;
        closestY = y;
      }
    }
  }

  //draw the depth image on the screen + le point le plus proche
  image(kinect.depthImage(),0,0);
  fill(255,0,0);
  ellipse(closestX, closestY, 25, 25);
}
```

## Reconstruction 3D basée sur la depthmap



demo "DepthMap3d" de SimpleOpenNI

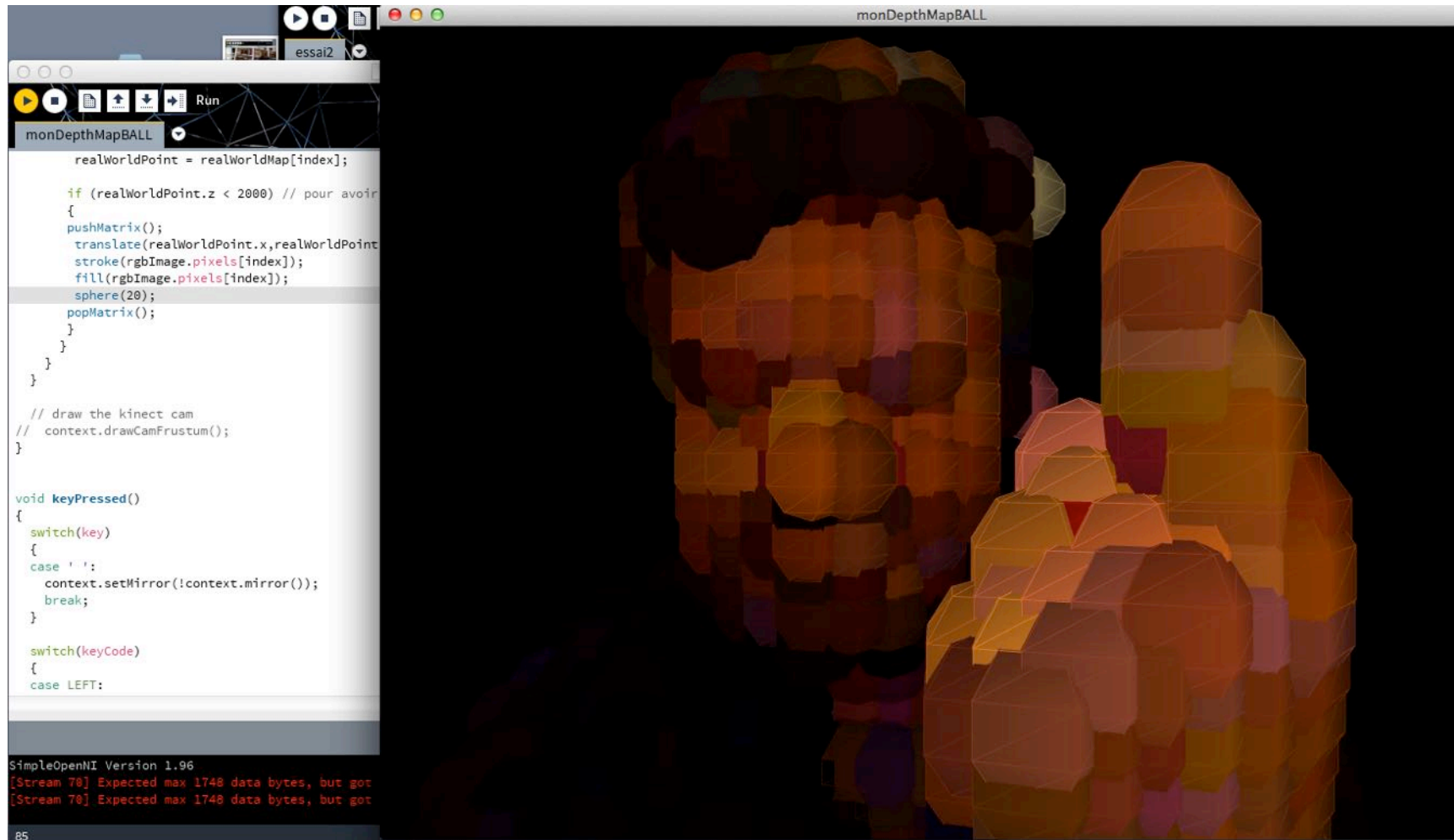


# Body Dystrophic Disorder

from **flight404** PLUS 3 years ago NOT YET RATED

Made with Cinder and the Kinect sensor. Runs in realtime.

[flight404.com/blog/?p=472](http://flight404.com/blog/?p=472)





```
// ici variables globales comme dans
// le code de "depthmap3d"

void setup(){
// ici debut comme dans code depthmap3d
  sphereDetail(5);
}
```


```
void draw() {
// debut comme dans code depthmap3d

PVector[] realWorldMap = context.depthMapRealWorld();

// draw pointcloud`
for(int y=0;y < context.depthHeight();y+=steps) {
  for(int x=0;x < context.depthWidth();x+=steps) {
    index = x + y * context.depthWidth();
    if((depthMap[index] > 0)) { // draw the projected point
      realWorldPoint = realWorldMap[index];

      if (realWorldPoint.z < 2000) { // pour avoir juste moi
        pushMatrix();
        translate(realWorldPoint.x,realWorldPoint.y,realWorldPoint.z);
        stroke(rgbaImage.pixels[index]);
        fill(rgbaImage.pixels[index]);
        sphere(20);
        popMatrix();
      }
    }
  }
}

// draw the kinect cam
// context.drawCamFrustum();
}
```



# Suivi du corps : demo "User" de simpleNI

The screenshot displays the Processing 2.1 IDE environment. On the left, a file explorer window titled "Java Examples" shows a directory structure with folders like "net", "pdf", "serial", "video", and "Contributed Libraries". Under "Contributed Libraries", the "SimpleOpenNI" folder is expanded, showing sub-folders "Extensions" and "OpenNI". The "OpenNI" folder contains several files, with "User" selected and highlighted in blue.

The main workspace shows a code editor for a sketch titled "User | Processing 2.1". The code is as follows:

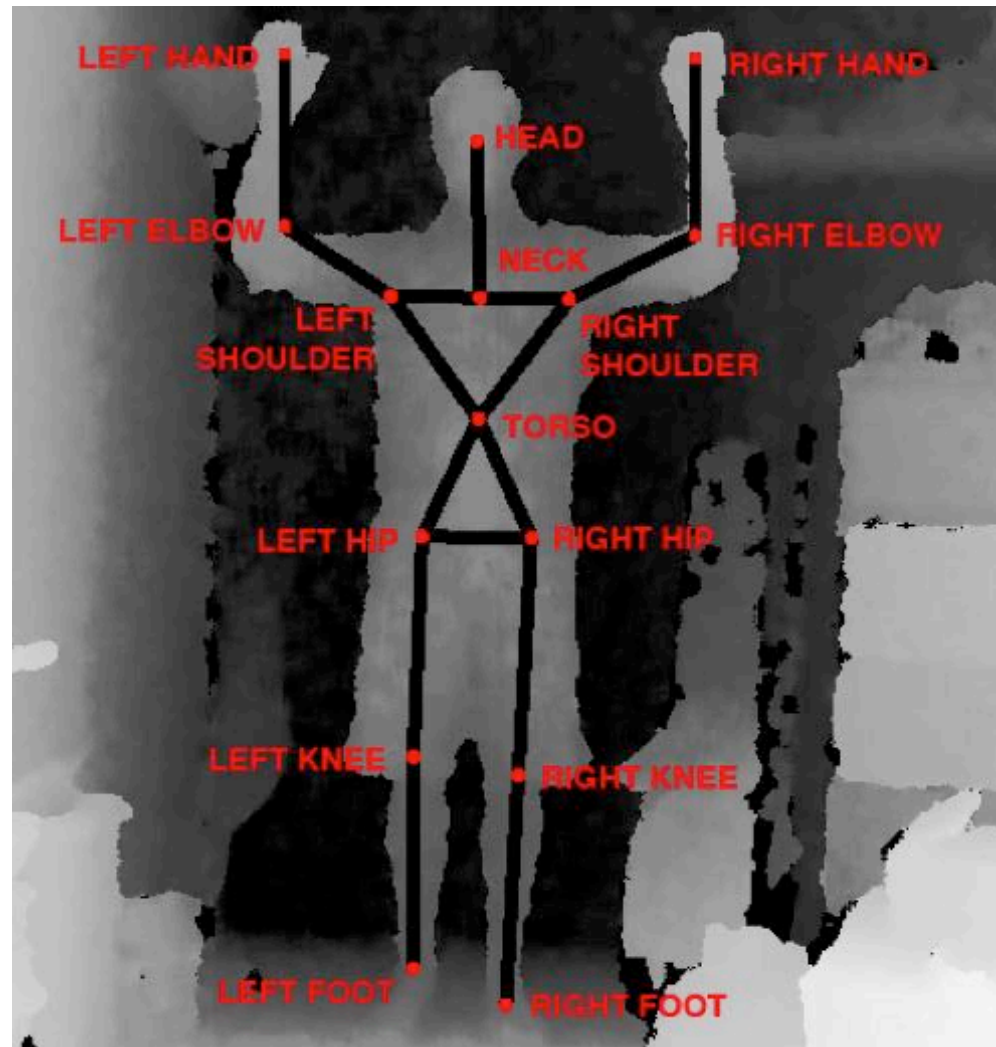
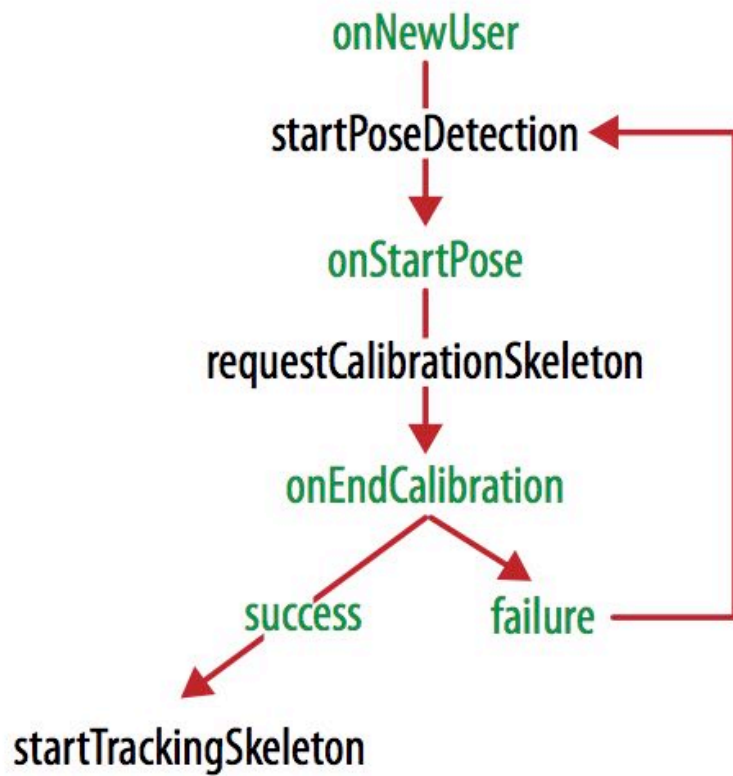
```
context
context

context
context
context
context
context
context
context
context
context
context
}
// -----
// Simple

void onLostUser
{
  println
}

void onNewUser
{
  println
}
```

The preview window, titled "User", shows a grayscale image of a person with red skeletal lines overlaid, representing body tracking. The person's arms are raised, and the skeletal lines connect the head, shoulders, elbows, wrists, hips, and knees. A green dot is visible at the center of the person's torso, likely representing the center of mass or a specific tracking point.



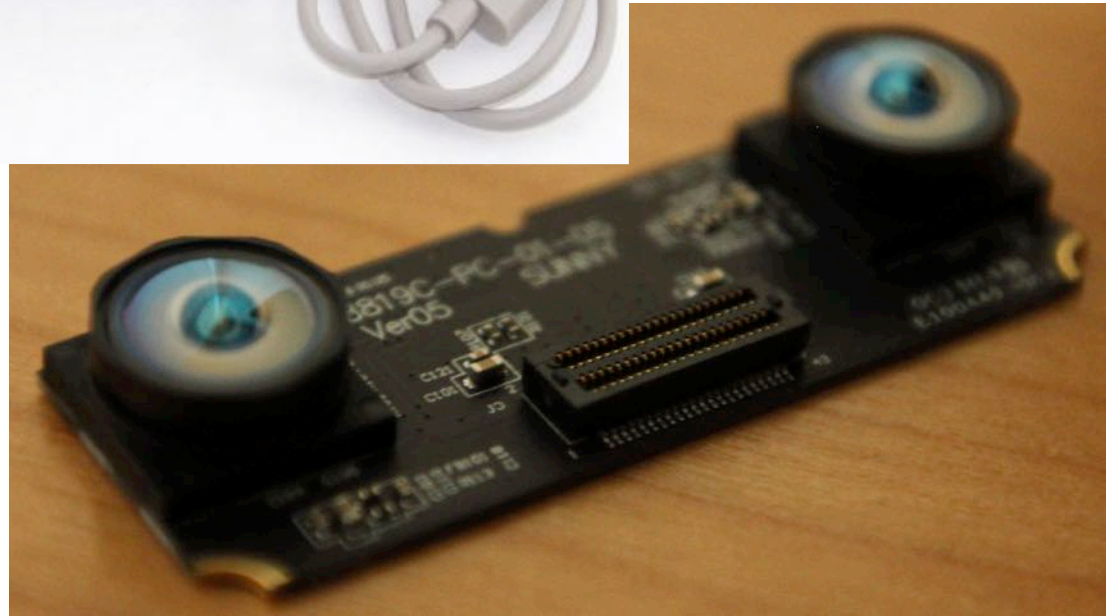
G. Borensten "Making things see" O'Reilly



sur la kinect :

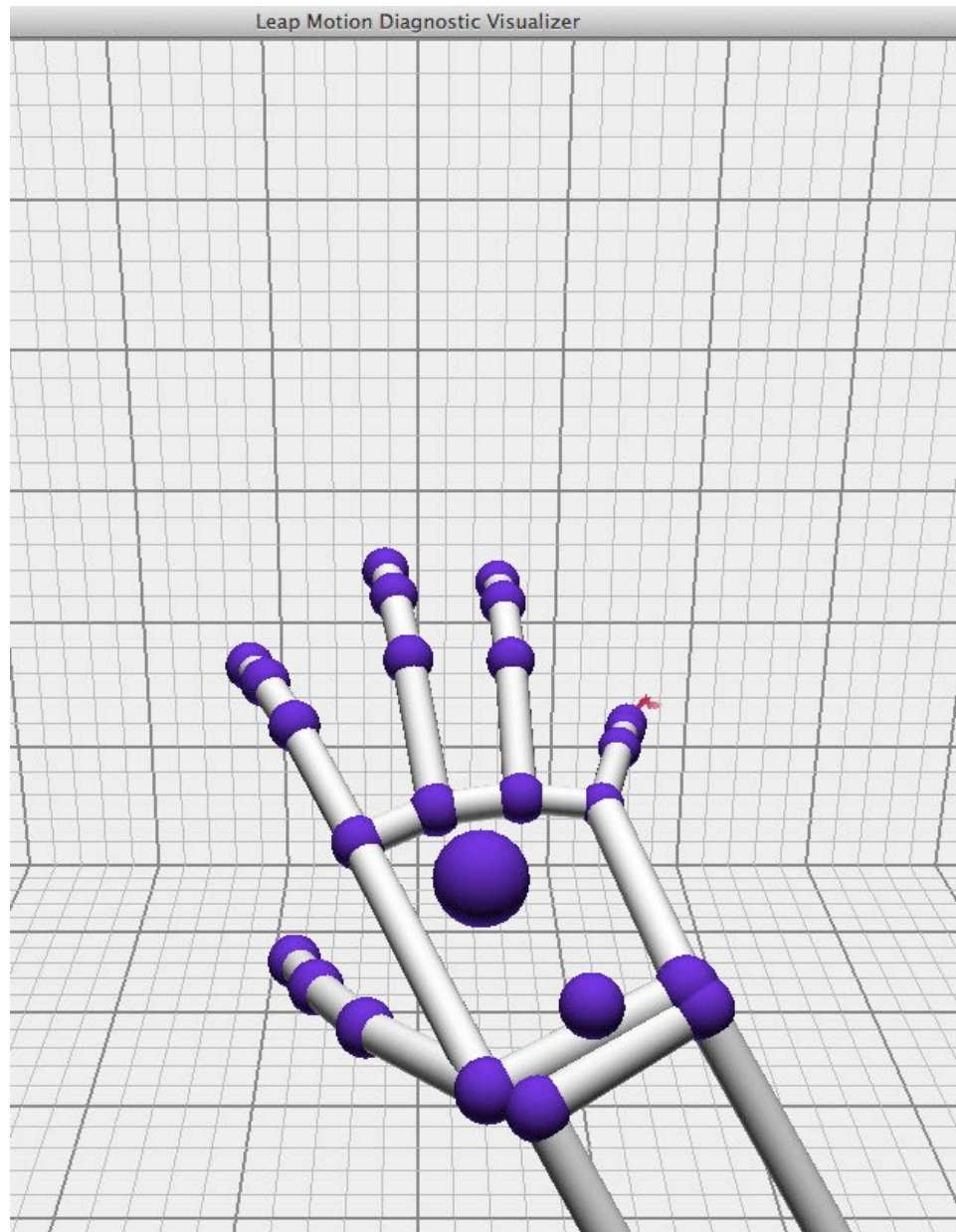


# Leap Motion



[www.ifixit.com](http://www.ifixit.com)

Application  
de test



# installer la librairie Processing

GitHub This repository Search Enterprise Blog Sign up

voidplus / leap-motion-processing ★ Star 129

Simple library to use the complete Leap Motion API in Processing.

72 commits 6 branches 8 releases 1 contributor

branch: master leap-motion-processing / +

fixed getType() bug of fingers in gestures

voidplus authored Nov 27, 2014 latest commit 486b9f3fee

download	fixed getType() bug of fingers in gestures	Nov 27, 2014
examples	added basic camera image api	Oct 24, 2014
library	fixed getType() bug of fingers in gestures	Nov 27, 2014
reference	fixed getType() bug of fingers in gestures	Nov 27, 2014
src/de/voidplus/leapmotion	fixed getType() bug of fingers in gestures	Nov 27, 2014
.gitignore	fixed generated jar bug	Jun 11, 2014
LICENSE.txt	fixed generated jar bug, ty @rbnVnzsz	Jun 10, 2014
README.md	fixed getType() bug of fingers in gestures	Nov 27, 2014

Code Pull Requests Pulse Graphs

HTTPS clone URL  
https://github.com

You can clone with HTTP Subversion.

Clone in D Download

<https://github.com/voidplus/leap-motion-processing>



# la demo "e1\_basic"

```
e1_basic | Processing 2.1
import de.voidplus.leapmotion.*;

LeapMotion leap;

void setup(){
  size(800, 500, P3D);
  background(255);
  noStroke(); fill(50);
  // ...

  leap = new LeapMotion(this);
}

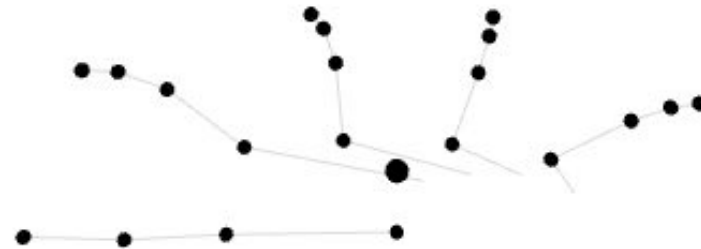
void draw(){
  background(255);
  // ...
  int fps = leap.getFrameRate();

  // HANDS
  for(Hand hand : leap.getHands()){

    hand.draw();
    int hand_id = hand.getId();
    PVector hand_position = hand.getPosition();

# LeapMotion-Library v1.1.2 - LeapMotion-SDK v0.8.1.6221 -
https://github.com/voidplus/leap-motion-processing
1
```

e1\_basic



# ET ENCORE : La reconnaissance de tracés simples

**\$1 Unistroke Recognizer**

Jacob O. Wobbrock, University of Washington [\[contact\]](#)  
Andrew D. Wilson, Microsoft Research  
Yang Li, University of Washington<sup>†</sup>

<sup>†</sup>Currently at Google

**Download**





\$1 Recognizer: [JavaScript](#), [C#](#)  
Dynamic Time Warping: [C#](#)  
Rubine Classifier: [C#](#)  
Pseudocode: [\\$1](#), [Protractor](#)  
Unistroke gesture logs: [xml](#)

**About**

The \$1 Unistroke Recognizer is a 2-D single-stroke recognizer designed for rapid prototyping of gesture-based user interfaces. In machine learning terms, \$1 is an instance-based nearest-neighbor classifier with a Euclidean scoring function, i.e., a geometric template matcher. \$1 is an extension of the proportional shape matching approach used in [SHARK<sup>2</sup>](#), which itself is an adaptation of [Tappert's elastic matching](#) approach with zero look-ahead. Despite its simplicity, \$1 requires very few templates to perform well and is only about 100 lines of code, making it easy to deploy. An optional enhancement called [Protractor](#) improves \$1's speed. The [\\$N Multistroke Recognizer](#) extends \$1 to gestures with multiple strokes. The [\\$P Point-Cloud Recognizer](#) is the latest in the dollar family, performing unistroke and multistroke recognition without the combinatoric overhead of \$N. The \$1 recognizer is distributed under the [New BSD License](#) agreement.

**Demo**

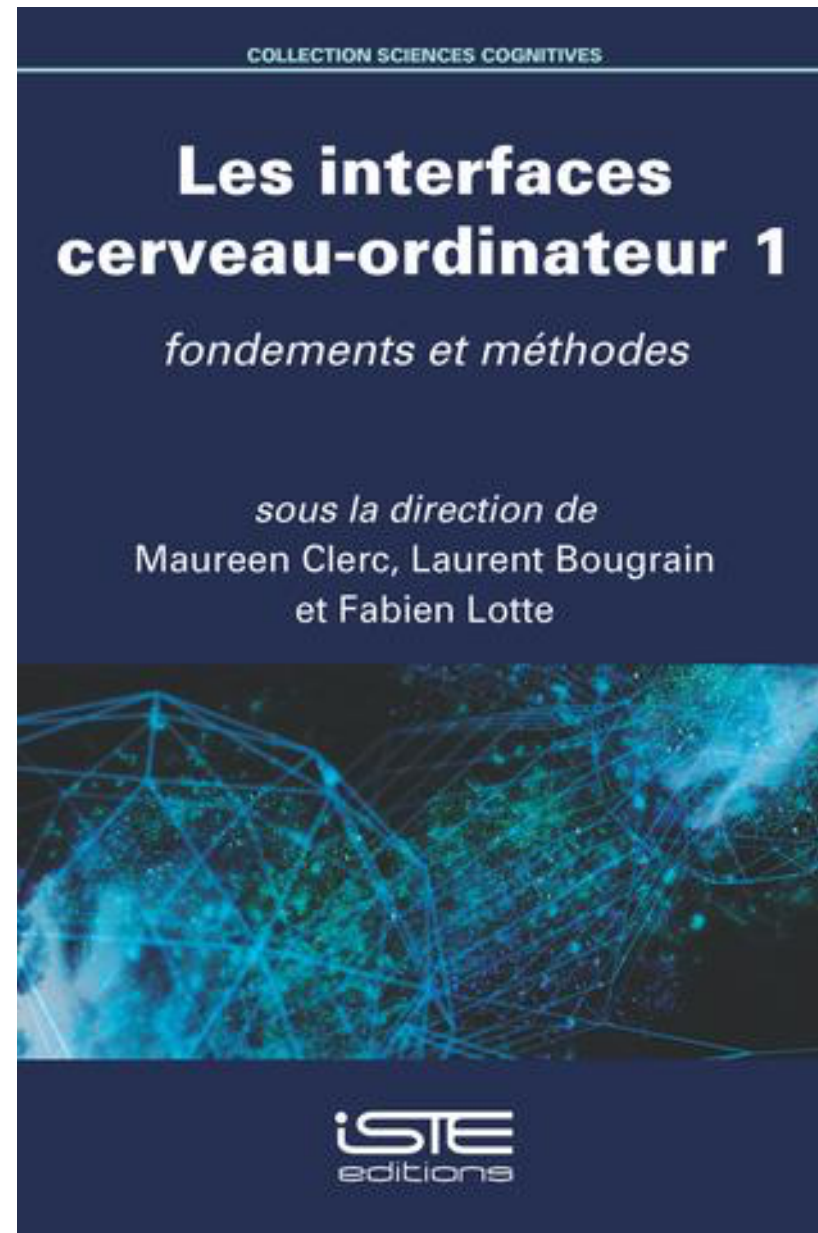
In the demo below, only one unistroke template is loaded for each of the 16 gesture types. You can add additional unistrokes as you wish, and even define your own custom unistrokes.

1.  triangle  
2.  "x"  
3.  rectangle  
4.  circle

Make strokes on this canvas. If a misrecognition occurs, add the misrecognized unistroke as an example of the intended gesture.  
Result: pigtail (0.82).



mais après ?



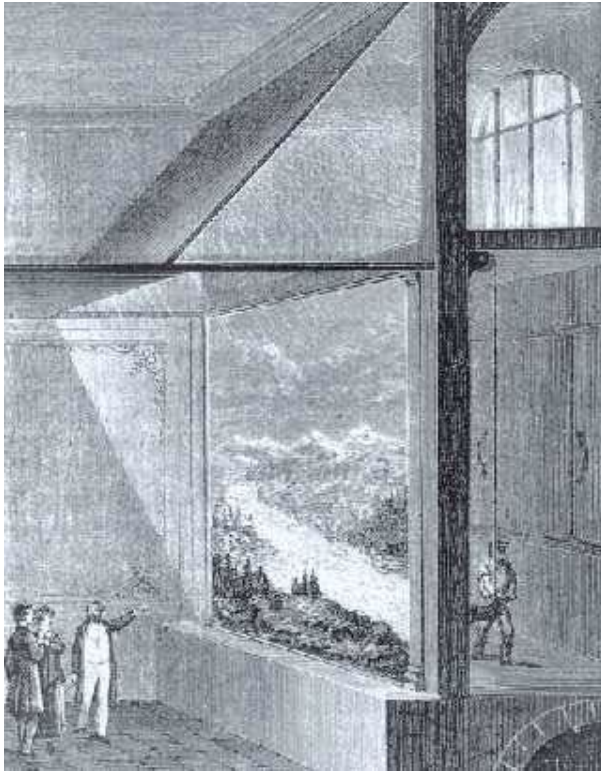
# **(3) L'immersion**



**Oculus rift**



**Lascaux -15000**



## Le diorama de Daguerre (1822)



<http://www.digischool.nl/ckv2/romantiek/romantiek/panorama/>



## Rue Léon Jouhaux (Xème)

## Multiplication des écrans



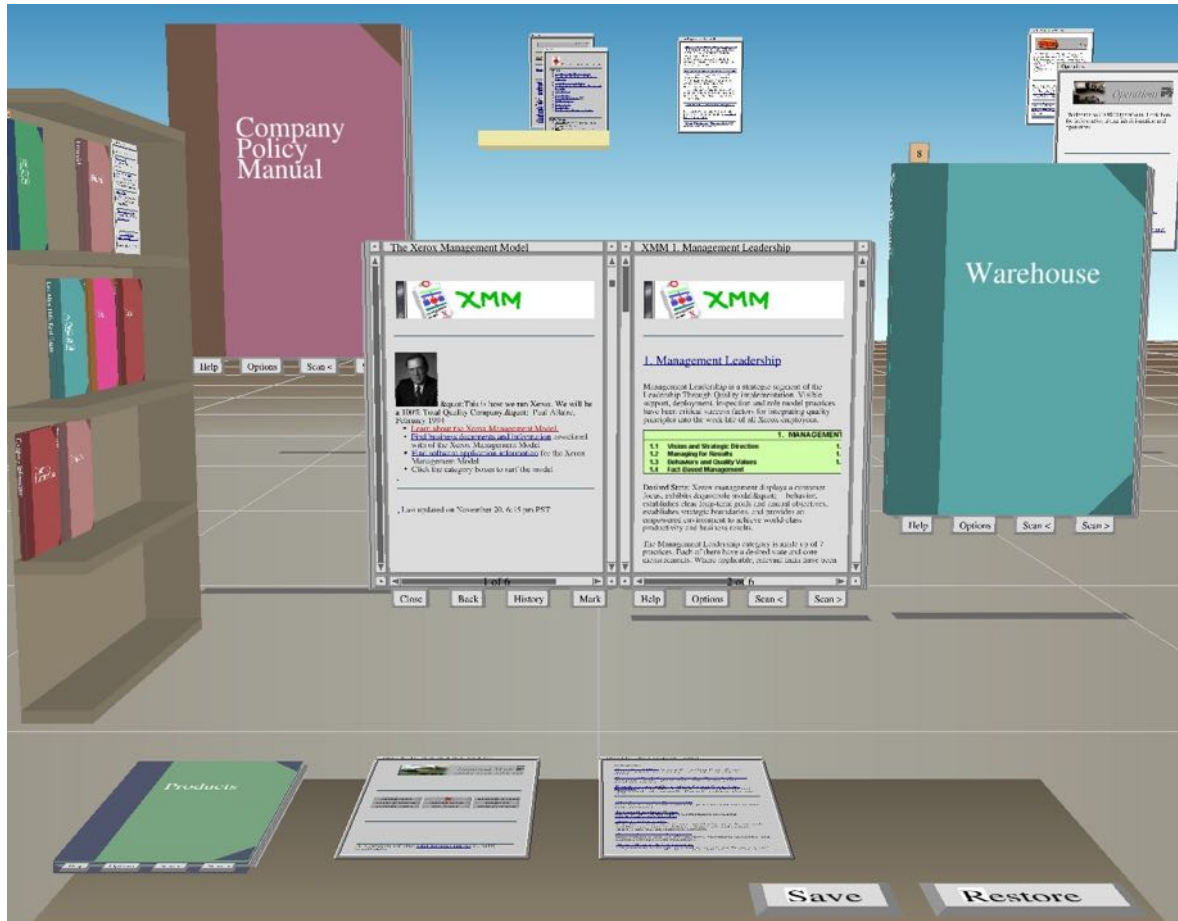
<http://www.stocktradingtogo.com/2007/09/25/are-20-monitors-enough-for-one-trader-you-decide/>



# Immersion dans les données

The image shows a screenshot of the Newsmap website interface. At the top, there are navigation links for REGISTER, LOGIN, CUSTOMIZE, and a language selector for U.S. A search bar is located on the right. The main content area is a grid of news articles, each represented by a colored tile with a headline and a small thumbnail image. The largest tile is a dark red one with the headline "Democrats begin effort to negatively define Chris Christie before 2016 campaign". Other prominent tiles include "US-Iran Thaw Grew From Years Of Behind-the-Scenes Talks" in a lighter red, "Philippines braces for Typhoon Haiyan" in a dark blue, and "Bieber allegedly filmed sleeping in Brazil" in a medium blue. The grid continues with various other news items in different colors. At the bottom, there is a navigation bar with categories like WORLD, NATIONAL, BUSINESS, TECHNOLOGY, SPORTS, ENTERTAINMENT, and HEALTH. The footer includes the Newsmap logo, the date "Thu November 7, 2013 14:56:25", and a copyright notice for 2004-2010.

<http://newsmap.jp>



Stuart K. Card, George G. Robertson, and William York . *The WebBook and the Web Forager: An Information Workspace for the World-Wide Web* proc. ACM CHI'96

Perception  
du relief :

Nombreux  
Indices

- Monoculaires
- Binoculaires



## Les expériences de J.C. Lee (HCII, Carnegie Mellon Univ., 2008)



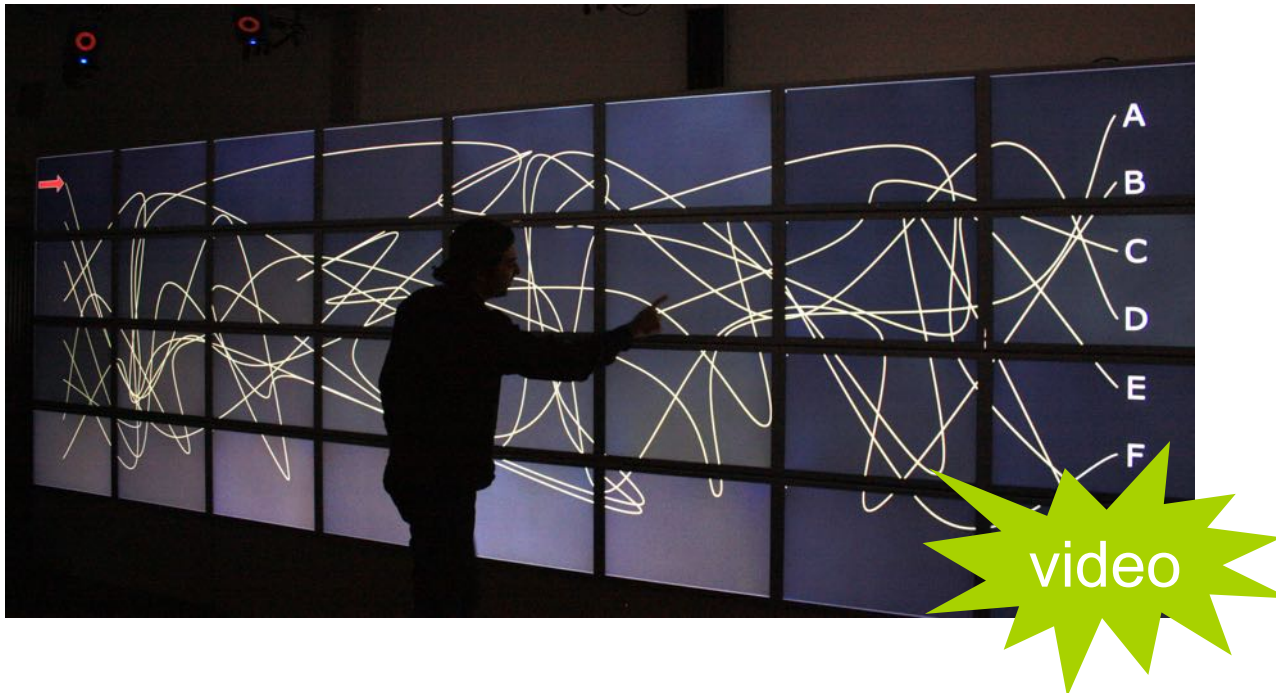
The image shows a screenshot of a YouTube video player. At the top left is the YouTube logo with the tagline "Broadcast Yourself™". Navigation tabs for "Home", "Videos", and "Channel" are visible. A search bar contains the word "Videos". The video title is "Head Tracking for Desktop VR Displays using the WiiRemote". The video frame shows a man with glasses sitting at a desk with a computer monitor displaying a VR interface with glowing red and white circles. The video player controls at the bottom show a play button, a progress bar at 0:06 / 4:46, and volume and full-screen icons. Below the player, the rating is "Rate: ★★★★★ 19,980 ratings" and the view count is "Views: 5,349,510".

**Rate:** ★★★★★ 19,980 ratings      **Views:** 5,349,510

video

<= 11M en 2015

## Reprise sur mur d'écrans (INRIA+CNAM, 2012)



- 8 x 4 = 32 écrans LCD 30" => 5.5m x 1.8m and 131 Mpix
- cluster de 16 macpro avec 16 x 2 nvidia 8800GT
- capture mouvements video IR VICON (e<1mm, 200 Hz)

# Le stéréoscope

Brewster (18xx)

Wheatstone (1830)



**Société des Établissements GAUMONT**      57-59, Rue Saint-Roch, Paris  
*Société anonyme - Capital : 4.000.000 de francs*

Paris 1900, Grand Prix    Saint-Louis 1904, Membre du Jury H.C.    Liège 1905, Grand Prix    Milan 1906, Grand Prix

STÉRÉODROME

Les **Stéréodromes** nouveaux Stéréoscopes classeurs pour la vision directe et les projections se font en  
**45×107, 6×13, 8 ½×17**

*Envoi de la Notice franco sur demande*

**Développement et Tirage**  
*Format 8×16*  
**(Positifs sur verre 8 ½×17)**

	unité	la douz.	
Développement.....	30	3	>
Tirage sur papier.....	40	4	>
Tir. s. verre non monté.	90	9	>
Tirage sur verre monté.	1 15	11 50	

Stéréoscope corollaire

Optique spéciale, la seule donnant la vue des images avec la perspective, le relief et la grandeur de la nature.

PRIX Format	6×13...	70	>
—	45×107..	75	>
—	8 ½×17...	90	>

## Le "mexicain"



<http://www.berezin.com/3d/holmes.htm> (en kit 45€)

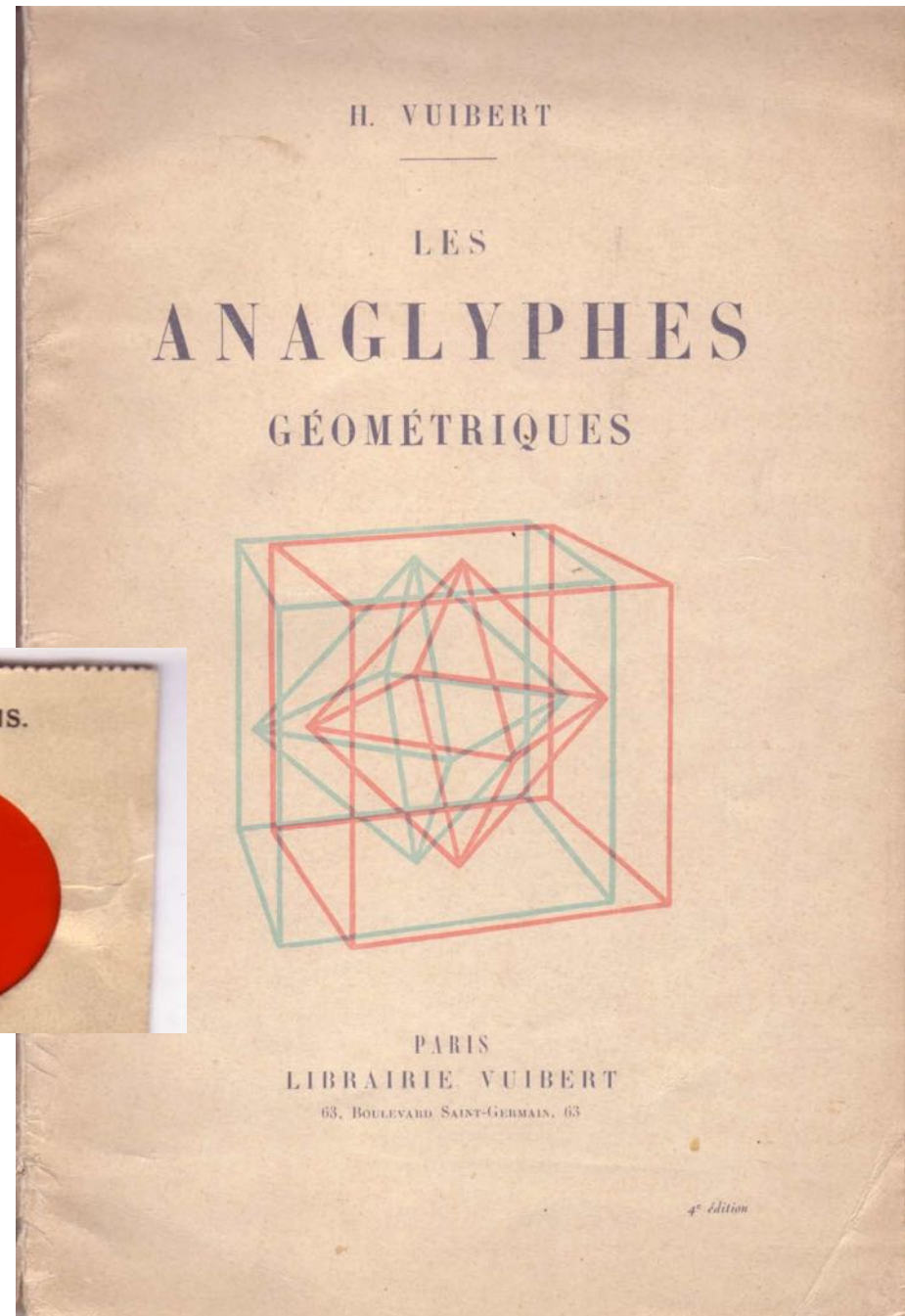
# Google cardboard

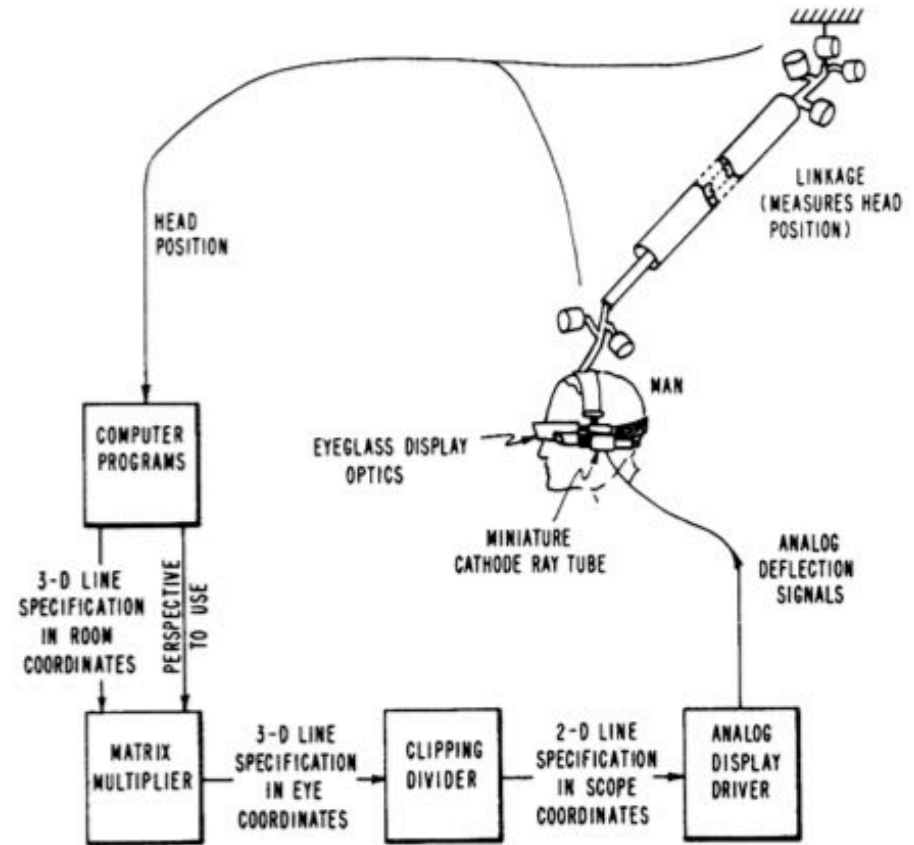
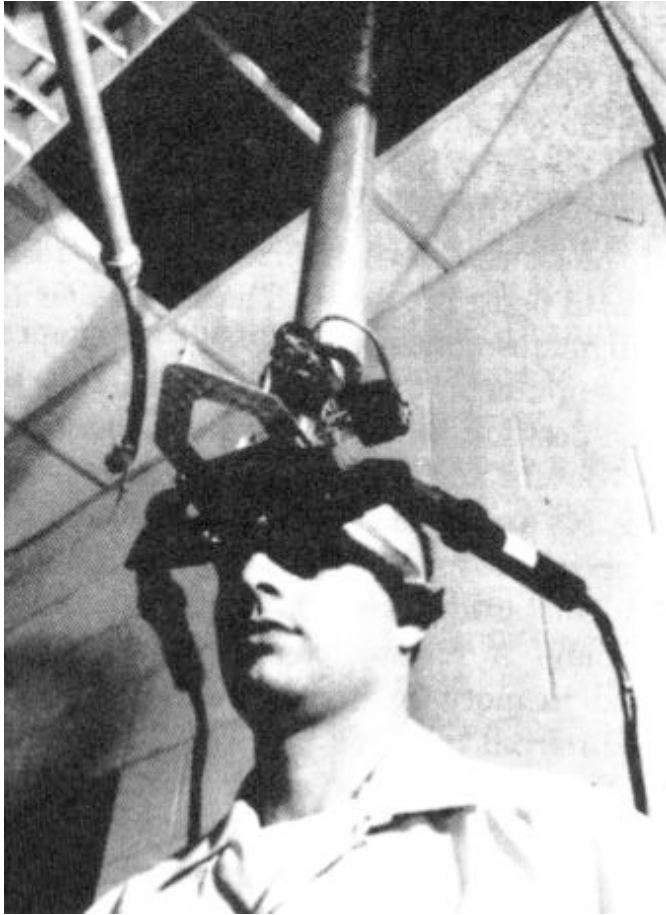




## Les anaglyphes

d'Almeida (1858)  
Ducos du Hauron (1891)





## I. Sutherland (1968)

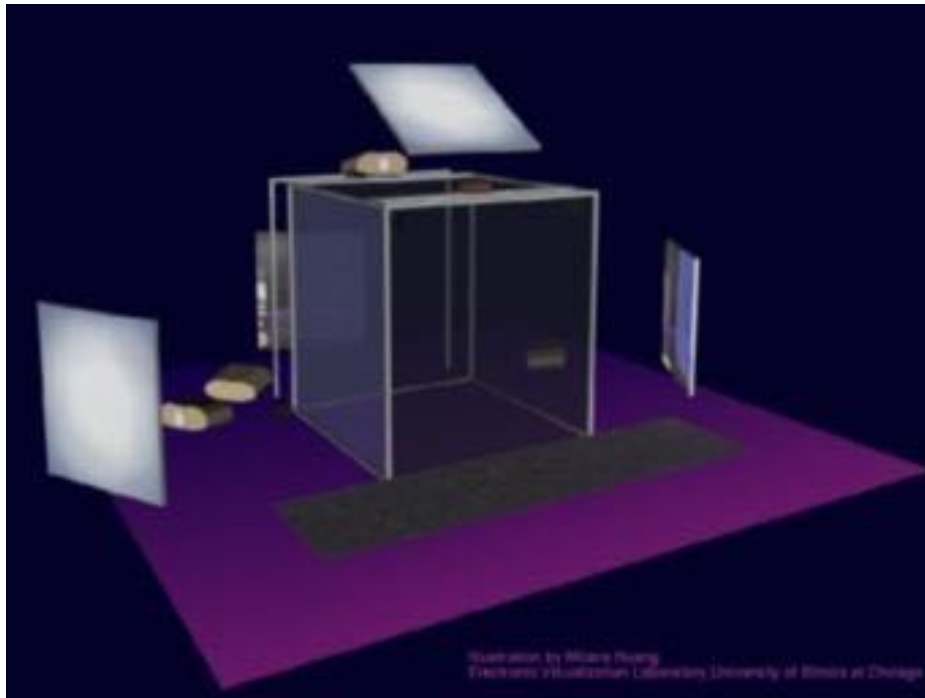
## **Ivan Sutherland - The ultimate display, 1965**

The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal. With appropriate programming such a display could literally be the Wonderland into which Alice walked.

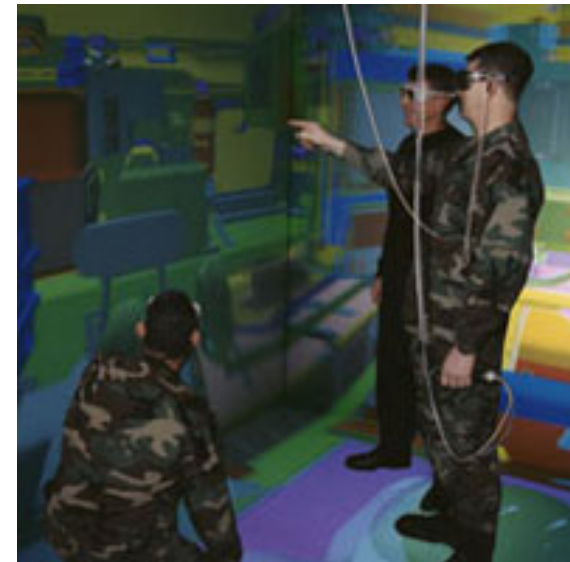
<http://www.eng.utah.edu/~cs6360/Readings/UltimateDisplay.pdf>

## CAVE : Univ. Illinois Chicago (1992)

Cruz-Neira, C., Sandin, D.J., DeFanti, T.A., Kenyon, R.V., and Hart, J.C.  
"The CAVE: Audio Visual Experience Automatic Virtual Environment,"  
Communications of the ACM, Vol. 35, No. 6, June 1992, pp. 65-72.

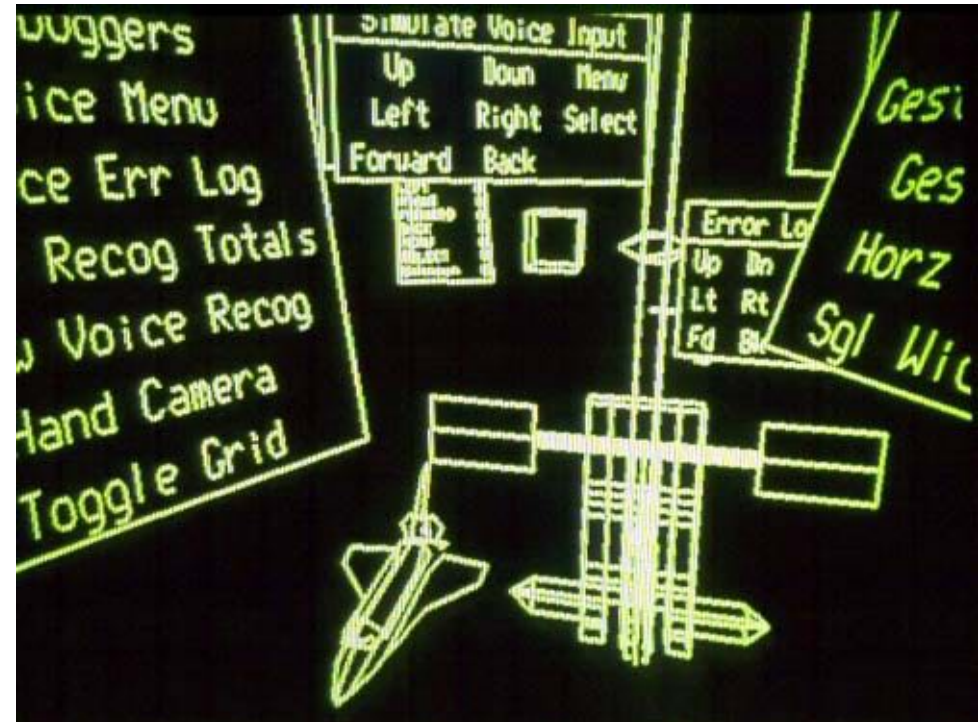


<http://www.ev1.uic.edu/pape/CAVE/>



<http://www.mechdyne.com/>  
16 Mpix / mur !

La réalité virtuelle : Scott Fisher et al., Jaron Lanier (1985-7)



<http://itofisher.com/sfisher/>

<http://itofisher.com/sfisher/portfolio/files/viewlab.html>

# SCIENTIFIC AMERICAN

OCTOBER 1987  
\$2.50

*The next revolution in computers, the subject of this issue, will see power increase tenfold in 10 years while networks and advanced interfaces transform computing into a universal intellectual utility.*

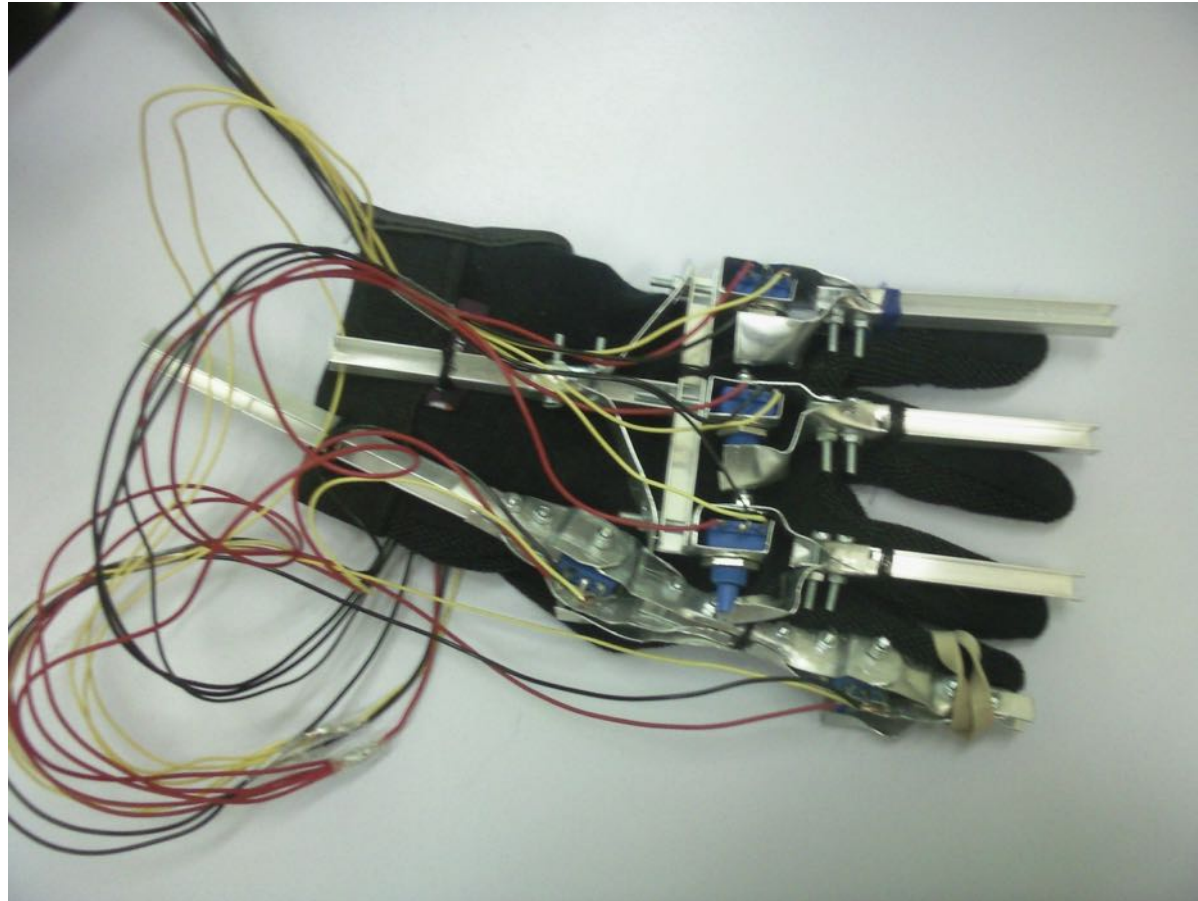


*Wired Glove gives a computer user the sensation of handling objects on the screen; the image of the hand mimics the user's movements.*



<http://www.jaronlanier.com/>

A LIRE : <http://www.jaronlanier.com/topeleven.html>

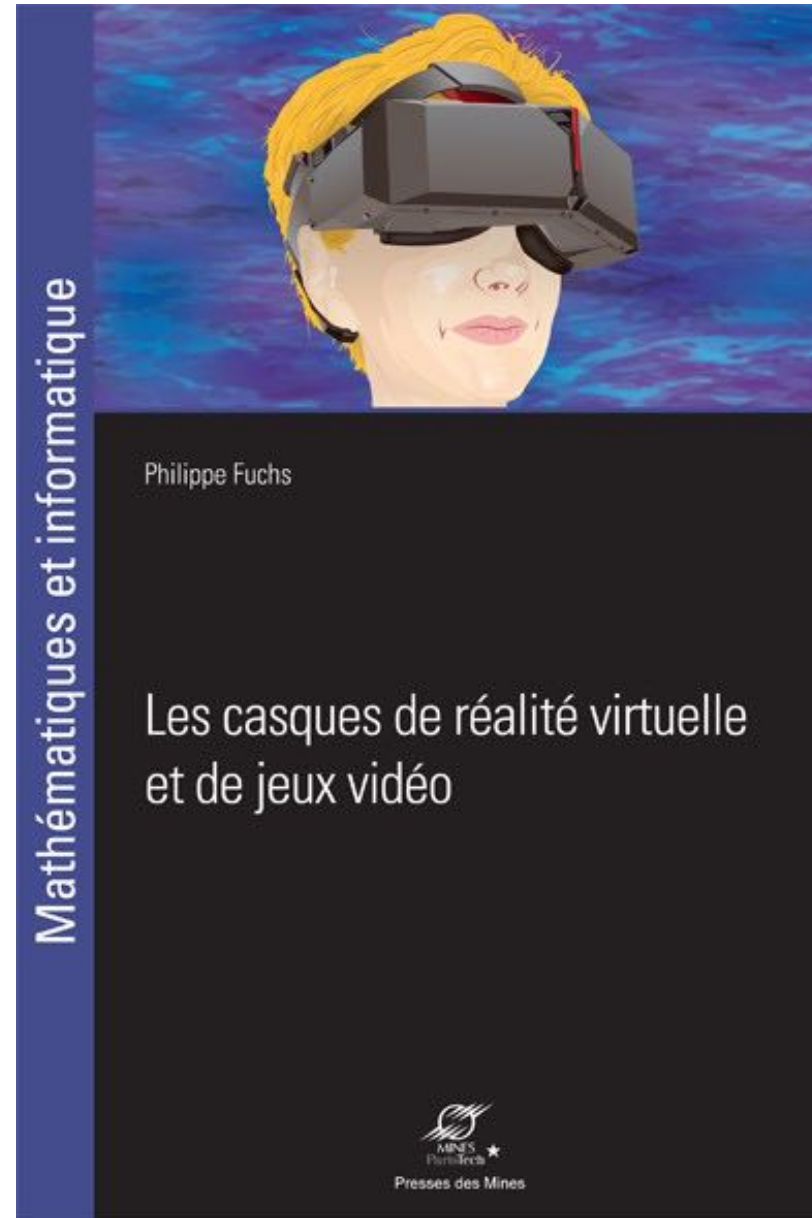


**gant de captation (élève ingénieur cnam paris, 2010)**

**... à suivre (cours de J. Dupire)**

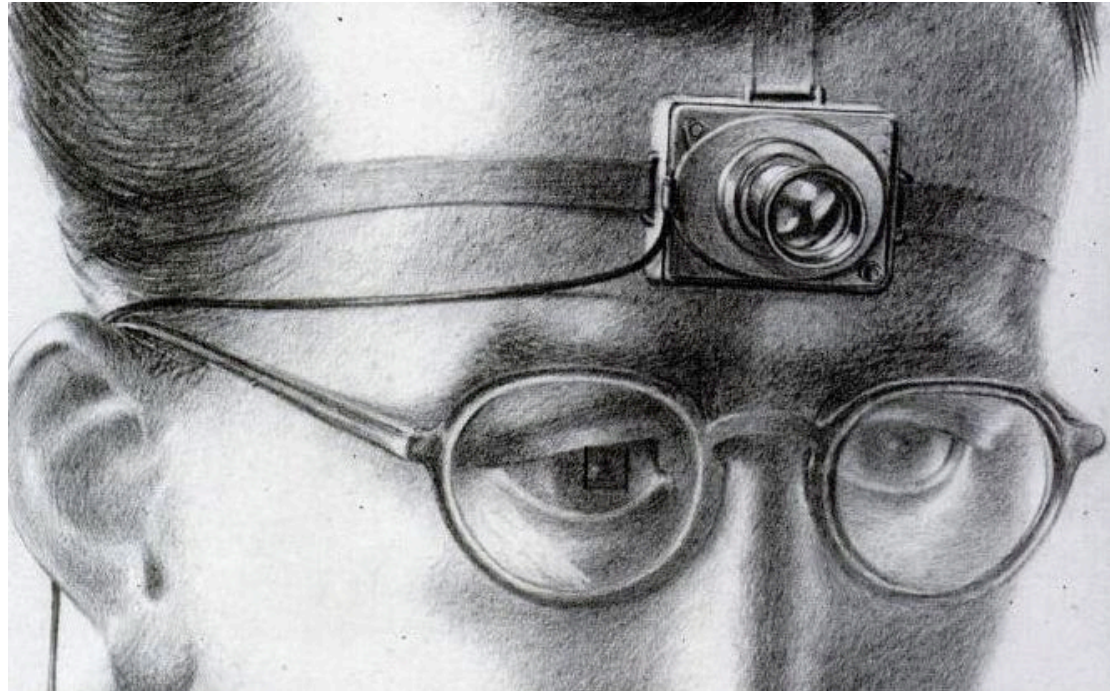
paru en 2016

+ le traité de la RV  
Fuchs et al.





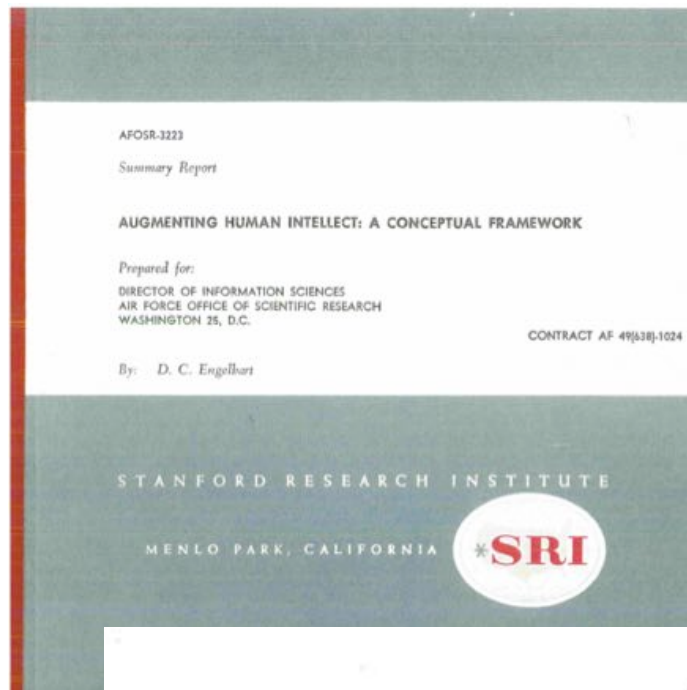
# (4) L'augmentation



V. Bush. "As we may think" 1945



**réalité augmentée ?**



**D. Engelbart (1962)**

**Augmenting human  
intellect (...)**

**ABSTRACT**

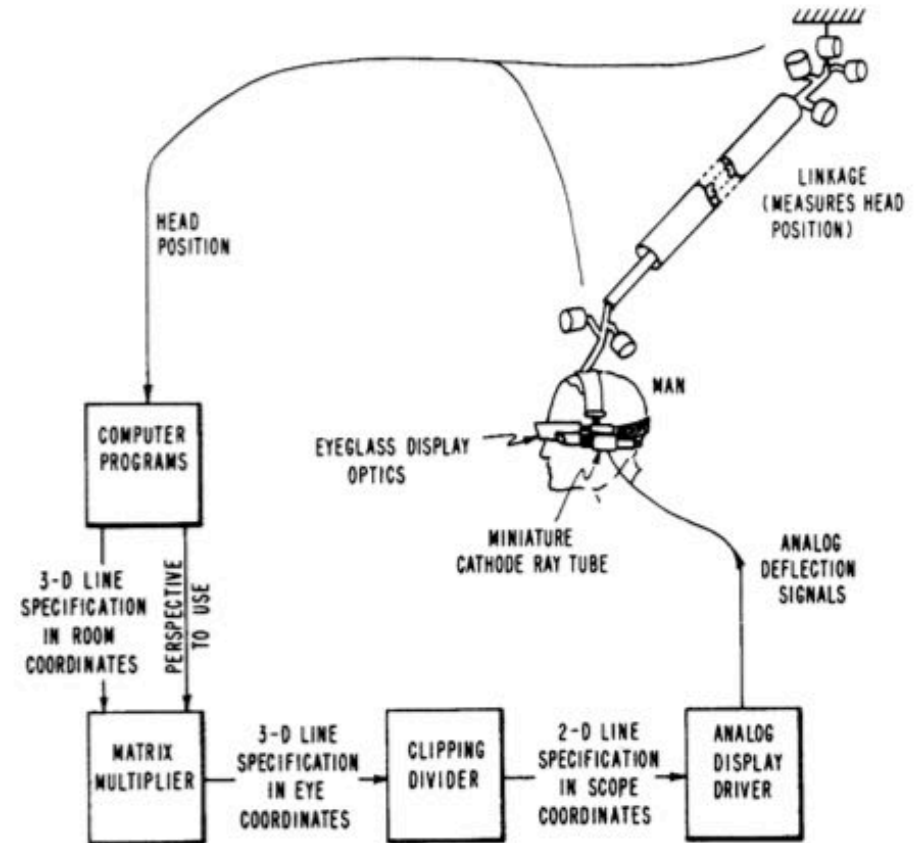
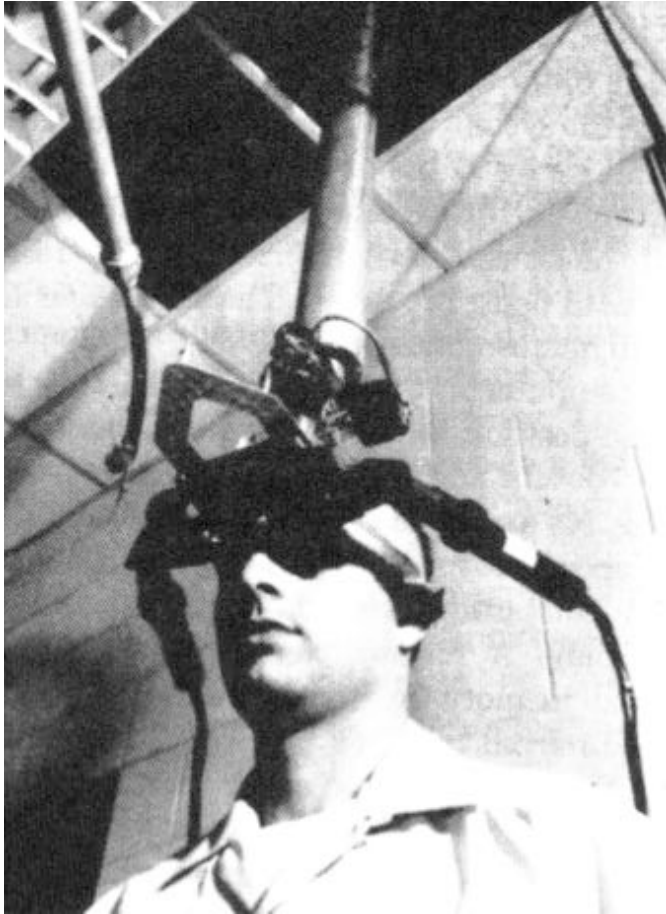
---

This is an initial summary report of a project taking a new and systematic approach to improving the intellectual effectiveness of the individual human being. A detailed conceptual framework explores the nature of the system composed of the individual and the tools, concepts, and methods that match his basic capabilities to his problems. One of the tools that shows the greatest immediate promise is the computer, when it can be harnessed for direct on-line assistance, integrated with new concepts and methods.

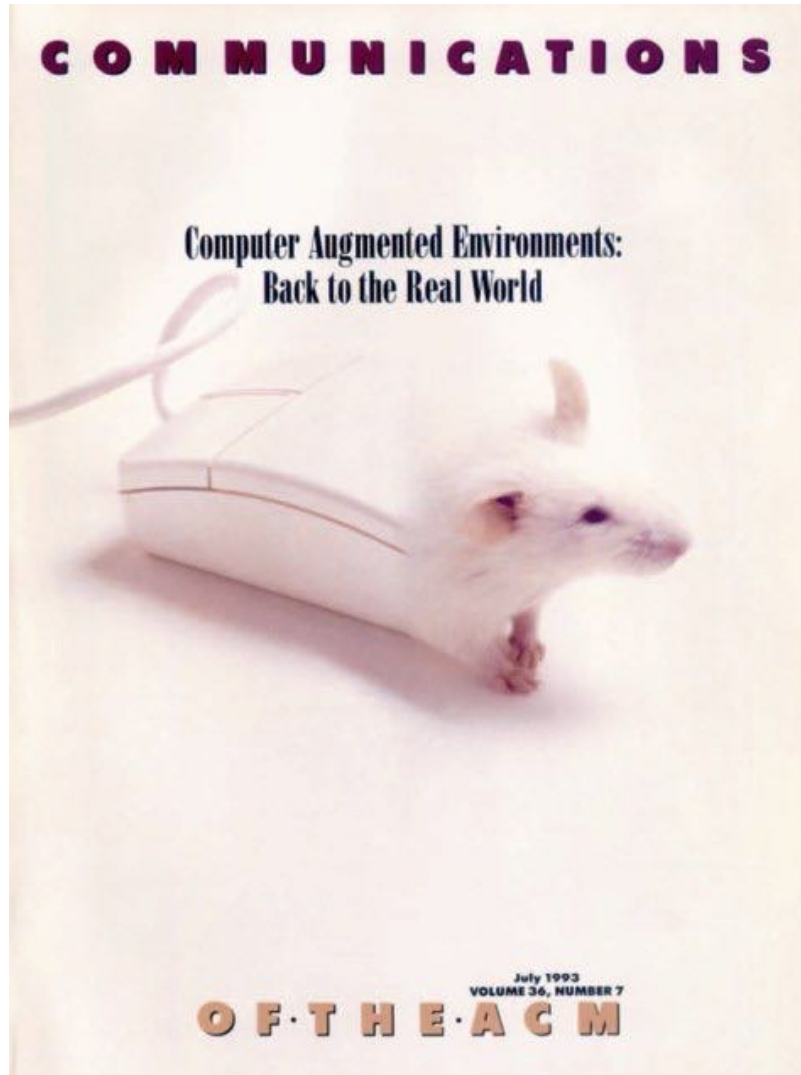
<b>Augment:</b>	<b>Approach</b>	<b>Technology</b>	<b>Applications</b>
Users	Wear devices on the body	VR helmets Goggles Data gloves	Medicine Field service Presentations
Physical objects	Imbed devices within objects	Intelligent bricks Sensors, receptors GPS, electronic paper	Education Office facilities Positioning
Environment surrounding objects and users	Project images and record remotely	Video cameras, Scanners Graphics tablets Bar code readers Video Projectors	Office work Film-making Construction Architecture

**Figure 1: Examples of augmented reality approaches, with relevant technologies and applications**

W.E. Mackay. Augmented reality : Linking real and virtual worlds. A new paradigm for interacting with computers. Proc. ACM AVI'1998



... bis repetita



CACM July 1993



P. Wellner



W. Mackay  
et al.

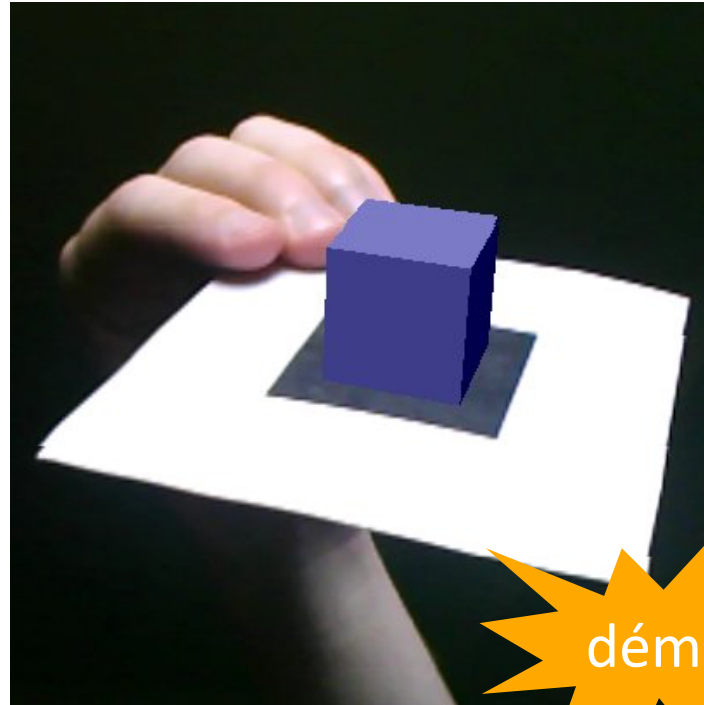


(a)



(b)

**1997 : S. Feiner et al. : Columbia touring machine**



**ARToolkit**

**H. Kato + U. Washington + U. Canterbury, >1999**



couplage restitution stéréo et captation des mouvements

utilisation d'AR toolkit pour la captation



# Le stylo Anoto et les cahiers augmentés

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**\$792,242 Spent Every Second on Processing Traditional Documents Worldwide**

## 2014 : Google Glass



- + Aura (Optivent)
- + SpaceGlasses (Meta)
- + ReconJet (ReconInstrument)
- + Wrap 1200 DXAR (Vuzix)



nov. 2013

# Intel "RealSense" » en 2014

**Utilisation des sens**

La technologie Intel® RealSense™ va bouleverser la façon dont vous communiquez avec vos appareils et avec le monde qui vous entoure. Comment ? En apportant des interactions plus immersives. La reconnaissance des gestes et le scan 3D ne sont qu'un début. La technologie Intel® RealSense™ permet de travailler et de jouer comme jamais, car les appareils peuvent vous voir, vous entendre et vous sentir.

**À propos des cookies sur ce site:**  
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Intel® RealSense™ | Nouveau seuil de réalisme | Détails | Produits | Développement | Accepter les cookies

<http://www.intel.fr/content/www/fr/fr/architecture-and-technology/realsense-overview.html>

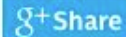
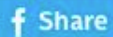
en 2016 : les premiers produits



## Introducing Intel® RealSense™ Smartphone Developer Kit

By Miao W. (Intel), Added February 22, 2016

Translate



Forum

Intel® F  
SDK

During [CES 2016](#) in Las Vegas in January, Intel announced the Intel RealSense Smartphone Developer Kit (SDK), an Android device with embedded Intel® RealSense™ Camera ZR300 and supports Google\* Project Tango\* developer ecosystem. Currently the developer kit is open for [reservation](#).

The Intel® RealSense™ Smartphone Developer Kit is powered by the Intel® Atom™ x7-Z8700 SoC (formerly Cherry Trail), which features the 14nm Intel Architecture technology with 4 Cores / 4 Threads and Gen 8 Intel® HD Graphics, and the industry-leading Intel® RealSense™ Camera ZR300. The Developer Kit includes a 6" QHD (2560x1440) display. The device comes with 2GB of memory and 64GB of internal storage. It includes an 8MP rear camera and a 2MP front-facing camera. Figure 1 and Figure 2 show the front and back views of the Developer Kit, respectively.



## Lenovo Phab 2 Pro

The Lenovo Phab 2 Pro is the world's first Tango-enabled smartphone.

[LEARN MORE](#)

[http:// get.google.com/tango/](http://get.google.com/tango/)

# [Réalité augmentée] En réponse à Apple, Google annonce ARCore et arrête Tango

JULIEN BERGOUNHOUX | RÉALITÉ AUGMENTÉE, GOOGLE, SMARTPHONE |  
PUBLIÉ LE 30 AOÛT 2017 À 11H12

TWITTER

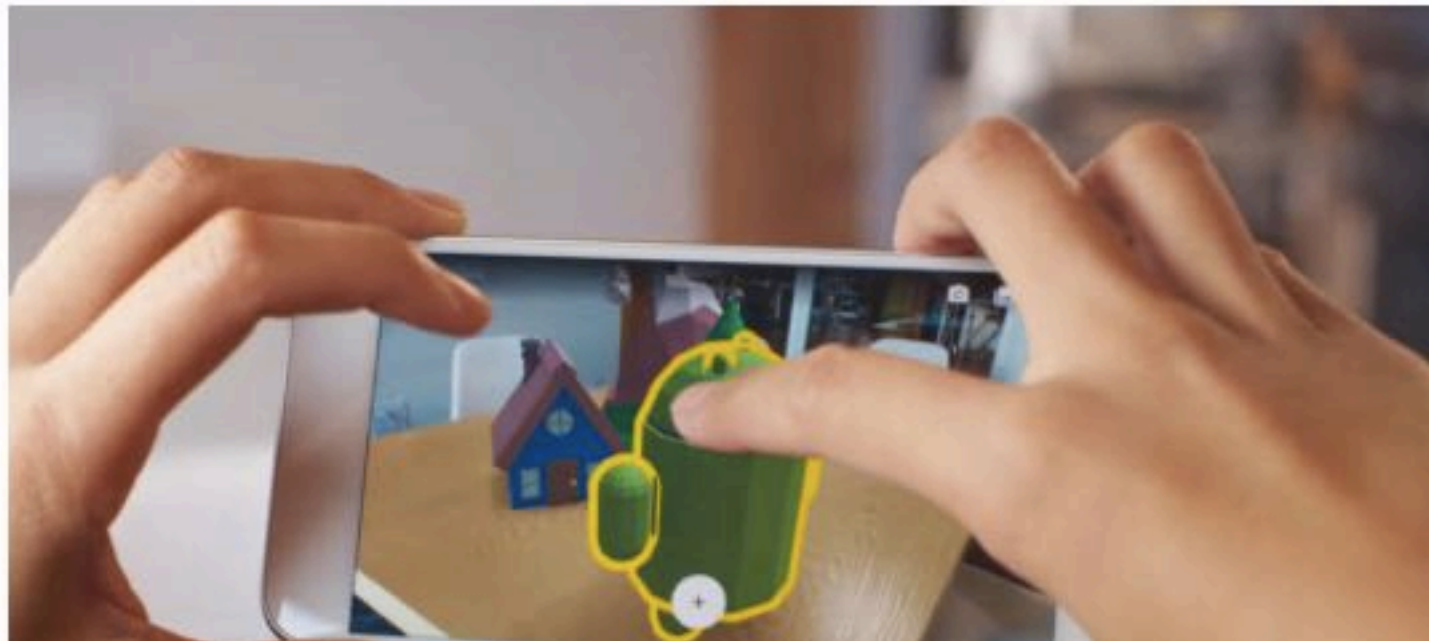
FACEBOOK

LINKEDIN

GOOGLE +

EMAIL

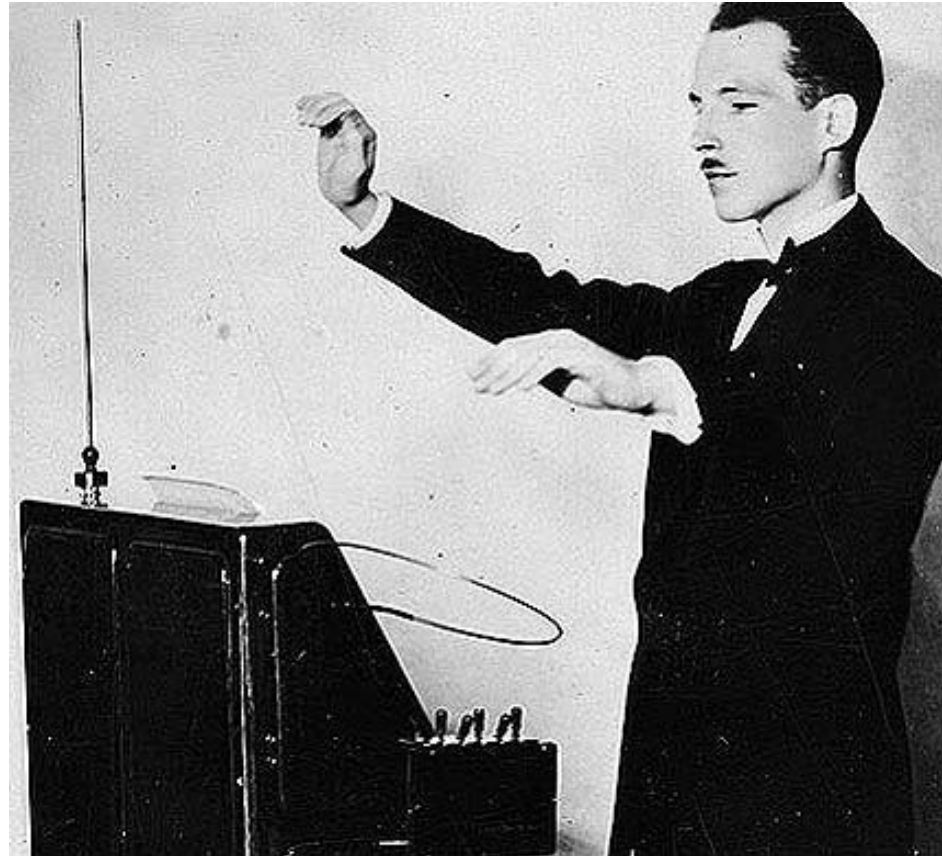
**VIDÉO** **ANALYSE** A deux semaines de la sortie des premières applications en réalité augmentée sur iPhone, Google annonce ARCore, un kit de développement logiciel pour démocratiser la réalité augmentée sur Android. La plate-forme Tango, sur laquelle il travaillait depuis 3 ans, est abandonnée au profit de cette nouvelle approche. Un changement de stratégie brutal forcé par la perspective de millions d'iPhone compatibles avec ARKit, alors que les ventes smartphones embarquant Tango ne se comptaient qu'en milliers.







# (5) Les objets malins



Theremine (1917)

**(existe encore : ex. de Moog)**



# "Physical computing" ?

Physical computing

From Wikipedia, the free encyclopedia

• *Have questions?*

[Find out how to ask questions and get answers.](#) • Jump to: [navigation](#), [search](#)

**Physical computing**, in the broadest sense, means building interactive [physical systems](#) by the use of [software](#) and [hardware](#) that can sense and respond to the [analog](#) world. While this definition is broad enough to encompass things such as smart automotive traffic [control systems](#) or factory [automation processes](#), it is not commonly used to describe them. In the broad sense, physical computing is a creative framework for understanding [human beings'](#) relationship to the [digital](#) world. In practical use, the term most often describes handmade [art](#), design or [DIY](#) hobby projects that use [sensors](#) and [microcontrollers](#) to translate analog input to a [software system](#), and/or control [electro-mechanical](#) devices such as [motors](#), [servos](#), [lighting](#) or other hardware.

(Greenberg, UIST'01)

## INTRODUCTION

In the last decade, various movements embraced human-computer interface designs that include physical user interfaces augmented by computing power. These include *ubiquitous computing* and *calm technology* [15], *pervasive computing* [1], *tangible user interfaces* [7], *information appliances* [12] and *context-aware computing* [3].

Researchers in these areas have demonstrated many simple but exciting examples of physical user interfaces. Ishii and

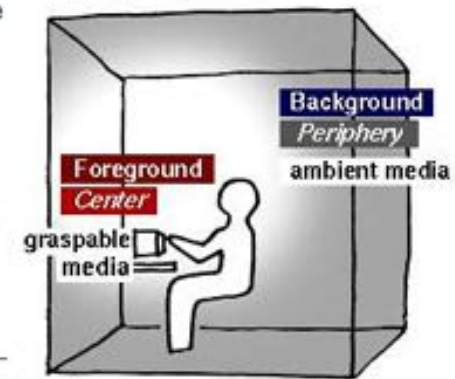
Physical Computing is an approach to learning how humans communicate through computers that starts by considering how humans express themselves physically. In this course, we take the human body as a given, and attempt to design computing applications within the limits of its expression.

(Interactive Telecom. Program ITP NYU)

## Les interfaces tangibles

**Tangible Bits** is our vision of Human Computer Interaction (HCI) which guides our research in the Tangible Media Group. People have developed sophisticated skills for sensing and manipulating our physical environments. However, most of these skills are not employed by traditional GUI (Graphical User Interface). Tangible Bits seeks to build upon these skills by giving physical form to digital information, seamlessly coupling the dual worlds of bits and atoms.

Guided by the Tangible Bits vision, we are designing "tangible user interfaces" which employ physical objects, surfaces, and spaces as tangible embodiments of digital information. These include foreground interactions with graspable objects and augmented surfaces, exploiting the human senses of touch and kinesthesia. We are also exploring background information displays which use "ambient media" – ambient light, sound, airflow, and water movement. Here, we seek to communicate digitally-mediated senses of activity and presence at the periphery of human awareness. The goal is to change the "painted bits" of GUIs (Graphical User Interfaces) to "tangible bits," taking advantage of the richness of multimodal human senses and skills developed through our lifetime of interaction with the physical world.



drawing: Hiroshi Ishii

[Tangible Bits full paper presented at CHI 97](#)

Prof. Hiroshi ISHII <http://web.media.mit.edu/~ishii/>

Ex. de projet de l'équipe : super cilia skin



# Les « phidgets » (S. Greenberg, C. Fitchett, U. Calgary, 2001)

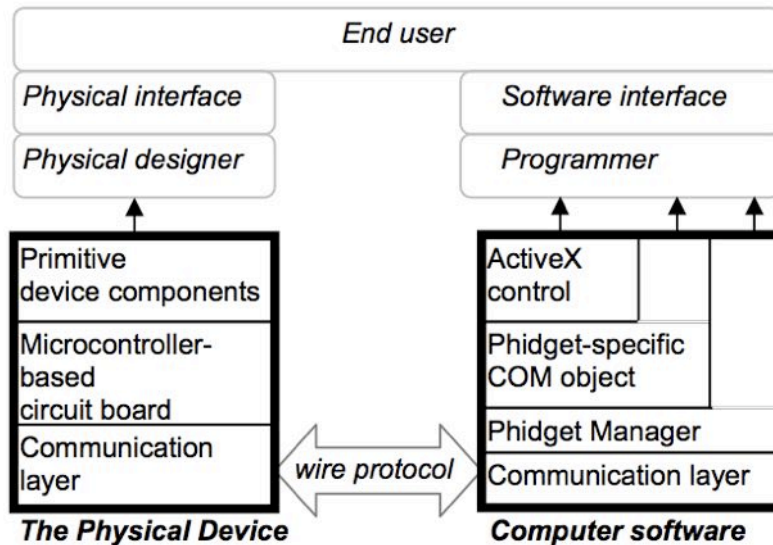


Figure 5. Phidget Architecture

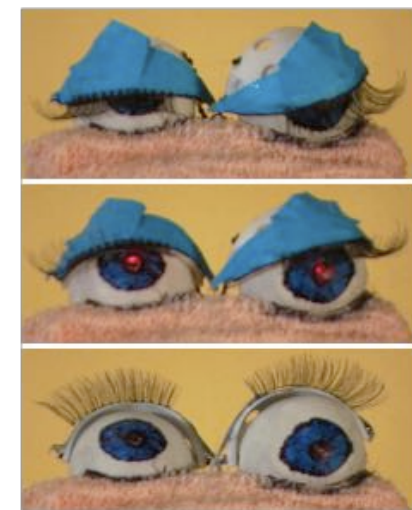
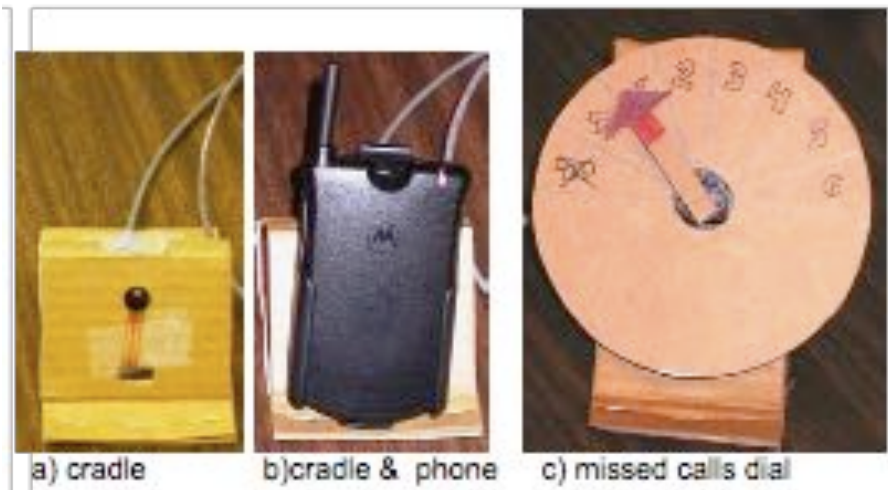
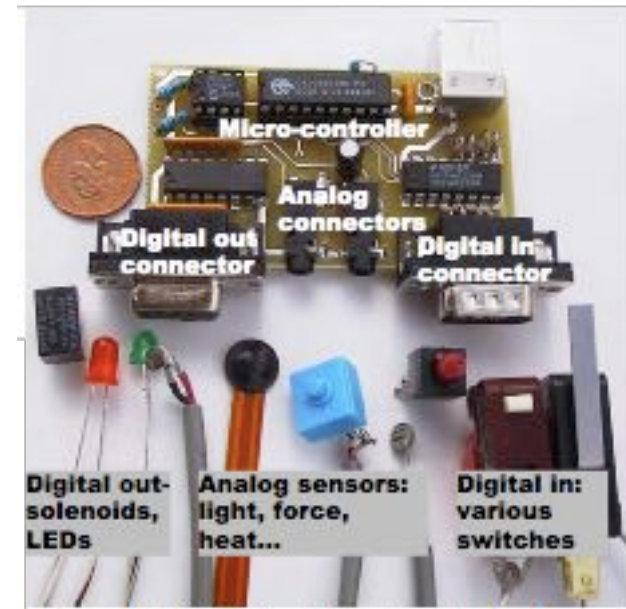


Figure 11: Phidget Eyes: closed, open & lit, fully open

# Deja une industrie

- Choose your robot type:
- Vacuum Cleaning
  - Floor Washing
  - Shop Sweeping
  - Pool Cleaning
  - Gutter Cleaning
  - Virtual Visiting**



Sign up here to receive regular updates on iRobot ConnectR.

## iRobot® ConnectR™ Virtual Visiting Robot

Stay close to those you love – no matter where you are!

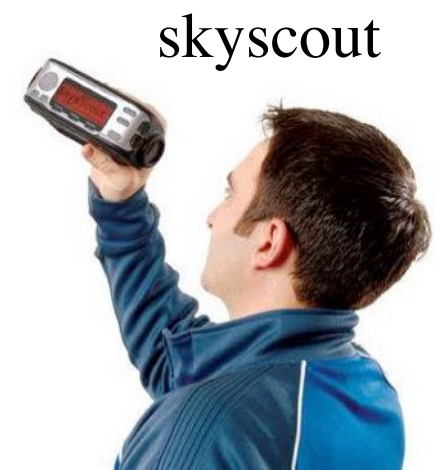
Don't miss out on special moments at home even when you are away. The iRobot ConnectR is a fun new way to see, talk to and interact with your loved ones, friends and pets – when you can't be there in person. Combining the latest in Internet communications and robot technology, ConnectR lets you virtually visit with loved ones, relatives and pets anytime you wish – seeing, hearing and interacting with them in their home as if you were there in person.



- Participate in family moments even though you're working late
- On a business trip? Read your kids a story and see their faces light up
- Join the fun from near or far
- Throw a party from a thousand miles away
- Tell Fido he's a "good boy" even while you're on vacation

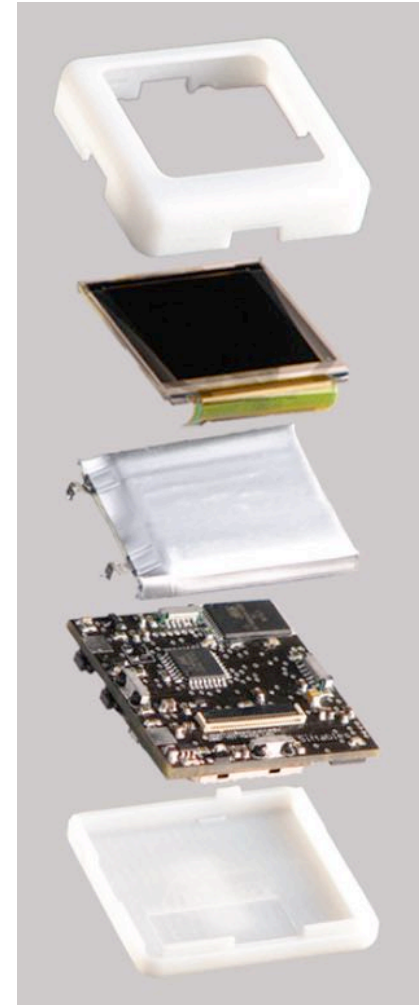
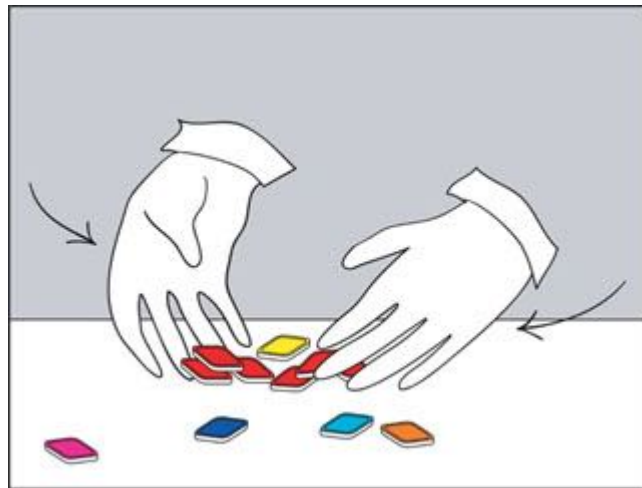
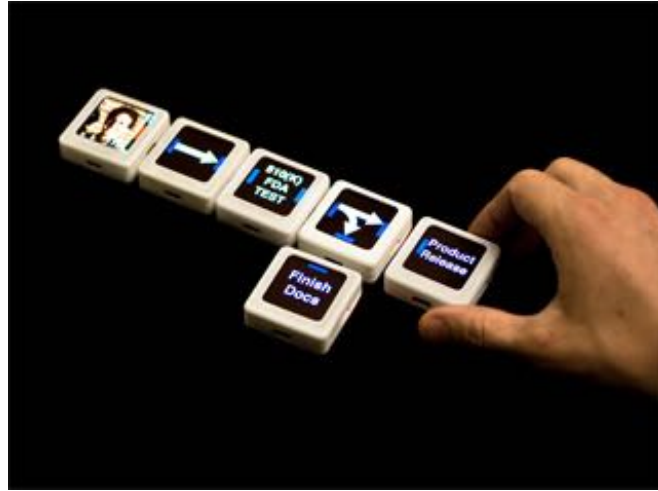
About ConnectR

- [How it Works](#)
- [ConnectR FAQs](#)
- [ConnectR Sign-up](#)





## Le projet « siftables » (David Merrill, MIT, 2007)



<http://web.media.mit.edu/~dmerrill/siftables.html>



LOGIN CART

Sifteo Cubes Intelligent Play Games About Us Press Shop

# Sifteo Cubes

award-winning interactive game system



< thought possible. >>

San Francisco Chronicle

<< a clever new way for children >



projet "fat and furious" Master ENJMIN 2013



## So long, thank you, we're still here

We'll cut to the chase: Sifteo has been acquired by [3D Robotics](#)! We're really excited about it; we will continue to support Sifteo Cubes and Sifteo users; and we are so grateful to our customers and supporters around the world. *Thank you.*



*handbuilt prototypes from our MIT days*

When we (Dave and Jeevan) started Sifteo in 2009, we knew we could deliver magical versions of everyday objects - that we could use the latest in computing and sensors to create new interactions that were more natural, more human, and just better than what currently existed.

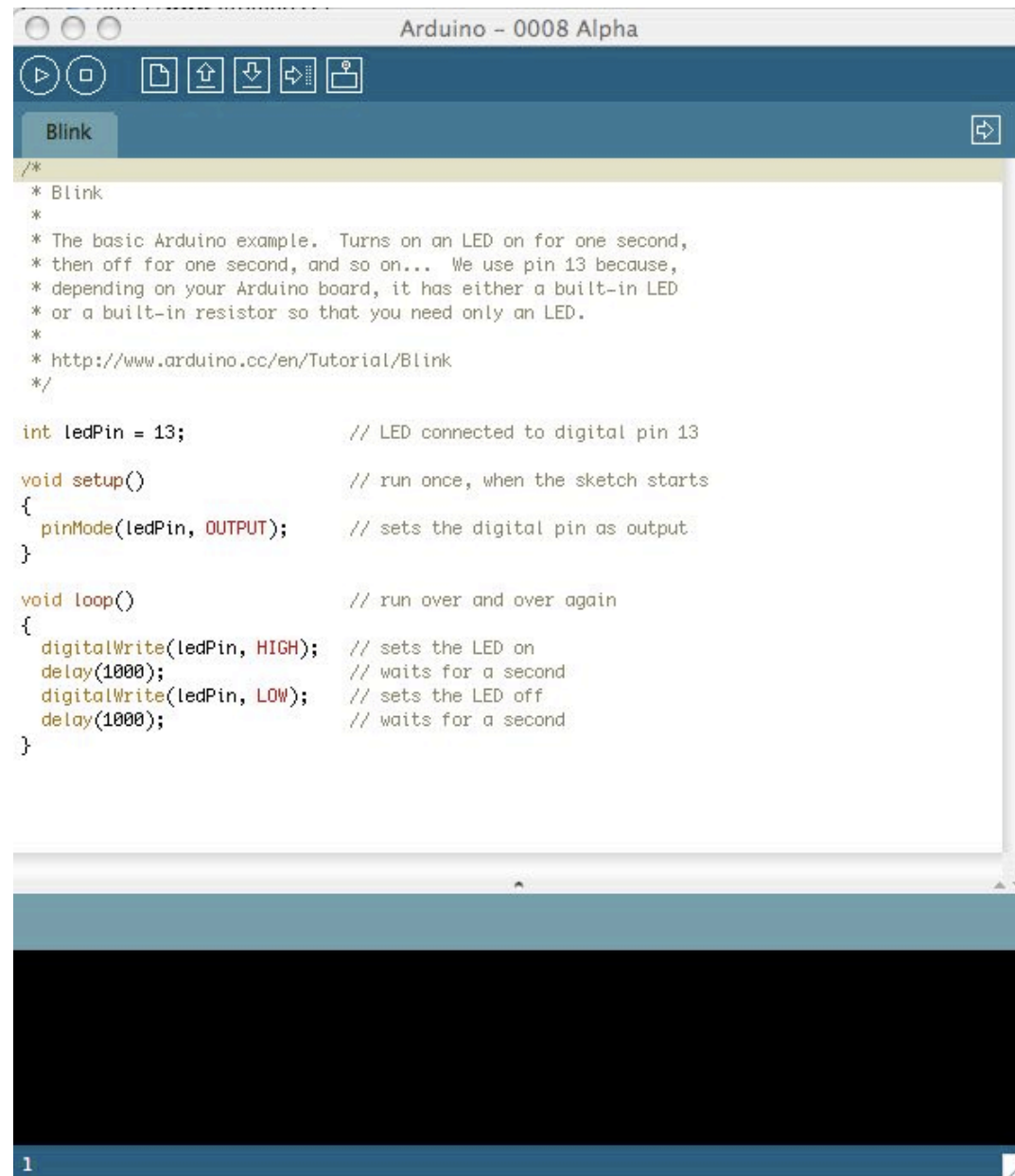
### zooids

## La carte ARDUINO



(Science et vie junior - février 2012)

# « blink » : le Hello world de l'Arduino



The image shows a screenshot of the Arduino IDE interface. The window title is "Arduino - 0008 Alpha". The top toolbar contains icons for running, stopping, saving, uploading, and downloading. The "Blink" sketch is selected in the top bar. The main text area contains the following code:

```
/*
 * Blink
 *
 * The basic Arduino example. Turns on an LED on for one second,
 * then off for one second, and so on... We use pin 13 because,
 * depending on your Arduino board, it has either a built-in LED
 * or a built-in resistor so that you need only an LED.
 *
 * http://www.arduino.cc/en/Tutorial/Blink
 */

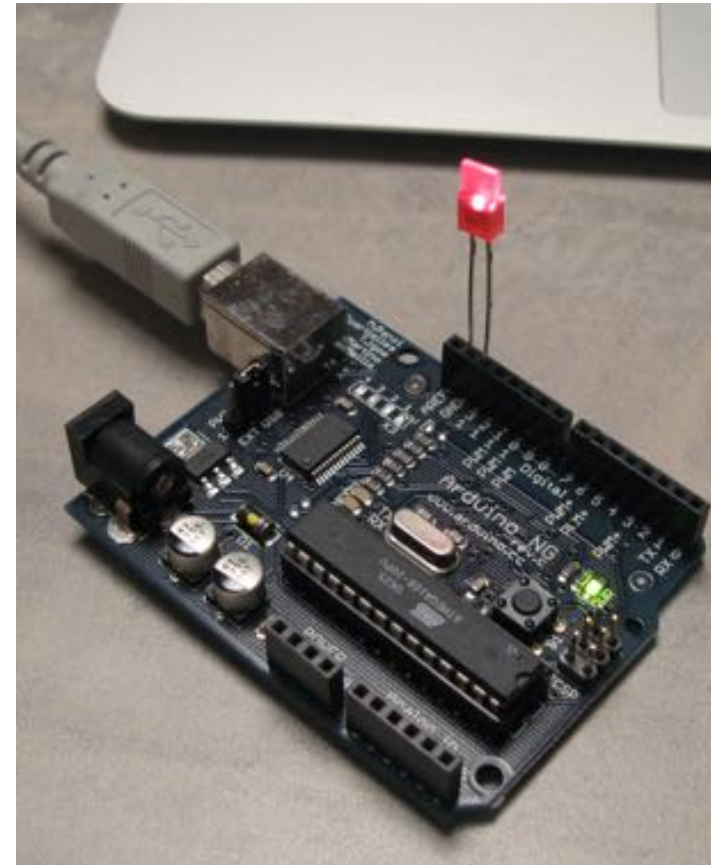
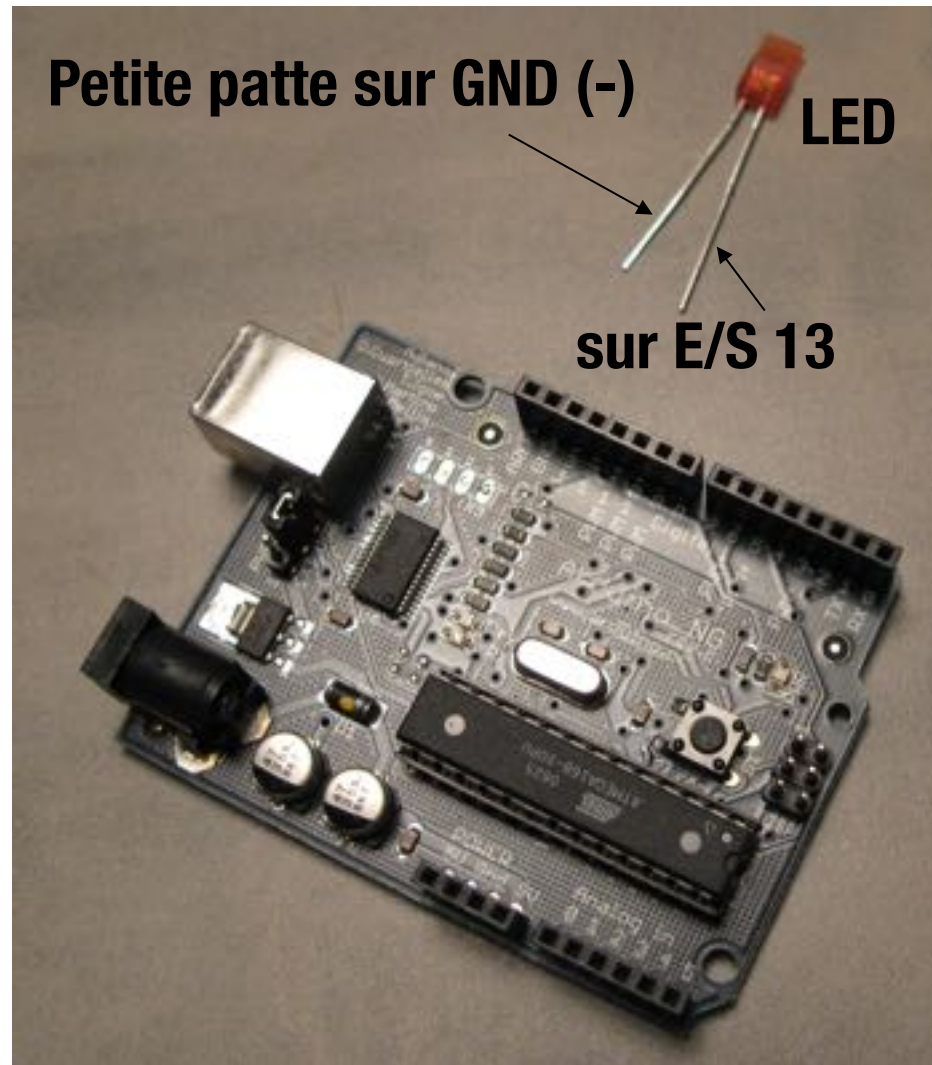
int ledPin = 13;           // LED connected to digital pin 13

void setup()              // run once, when the sketch starts
{
  pinMode(ledPin, OUTPUT); // sets the digital pin as output
}

void loop()               // run over and over again
{
  digitalWrite(ledPin, HIGH); // sets the LED on
  delay(1000);                // waits for a second
  digitalWrite(ledPin, LOW);  // sets the LED off
  delay(1000);                // waits for a second
}
```

The bottom status bar shows the number "1".

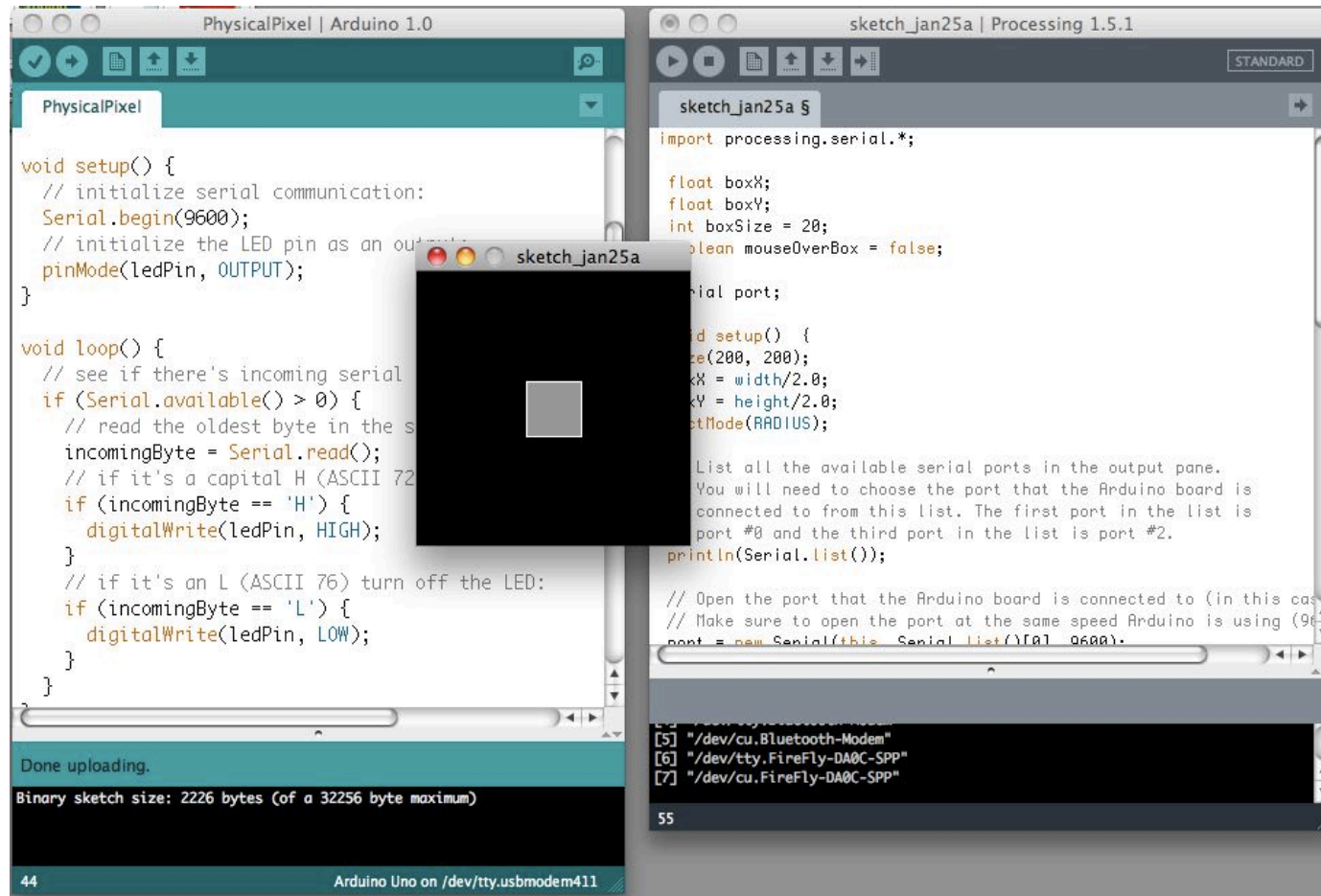
## Blink : le montage



Fiat lux ...



# Dialogue avec une application processing (liaison série) : La demo "physical pixel" de exemples->communication



=> à suivre cours de J. Dupire