M1 ENJMIN – USMU03
Bases de l'IHM
24 février 2021

Pierre Cubaud, CNAM
cubaud @ cnam.fr

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

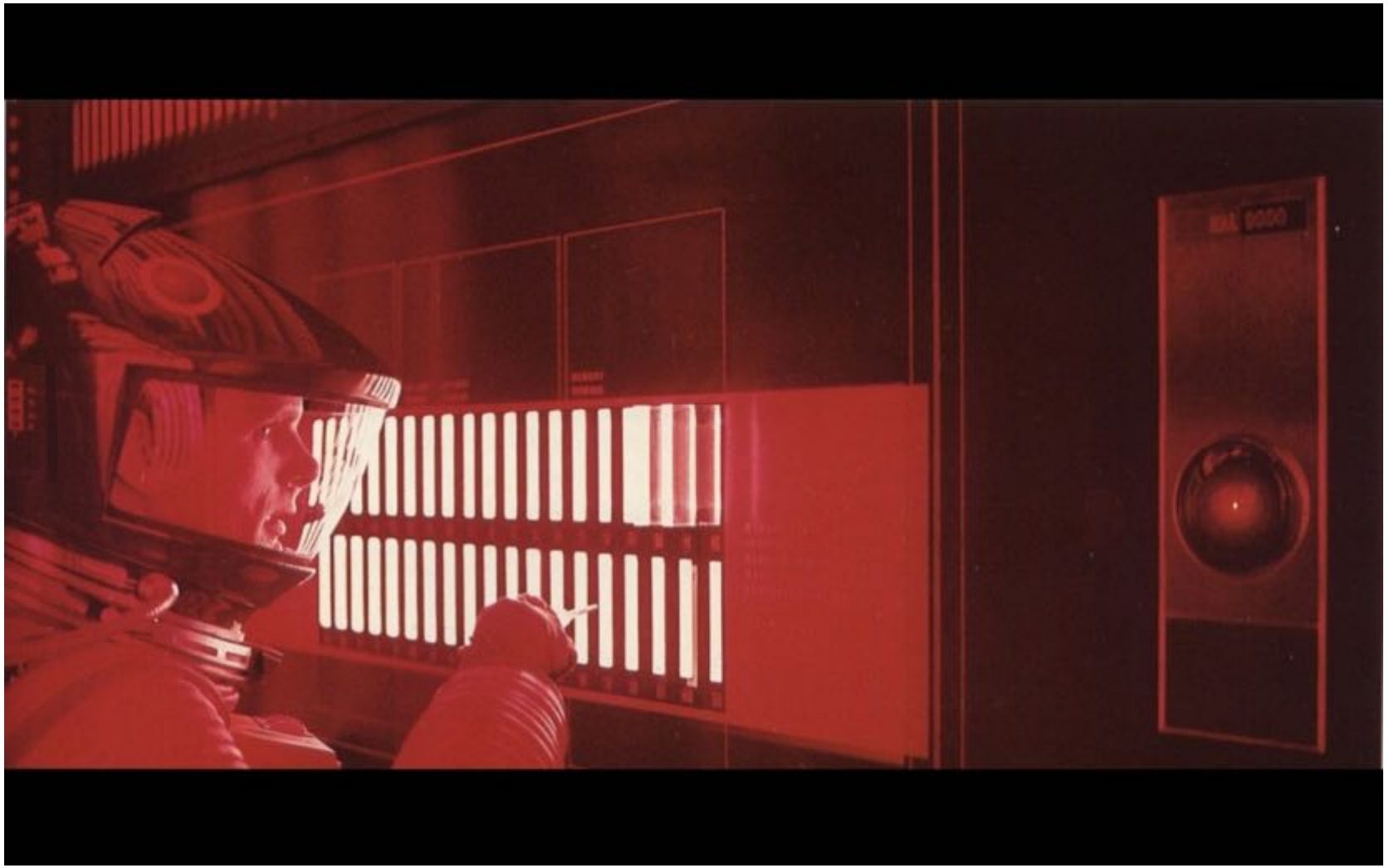
IHM = ?

Interface homme-machine

Interface humain-machine

Interaction humain-machine

Interaction humaine médiatisée



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

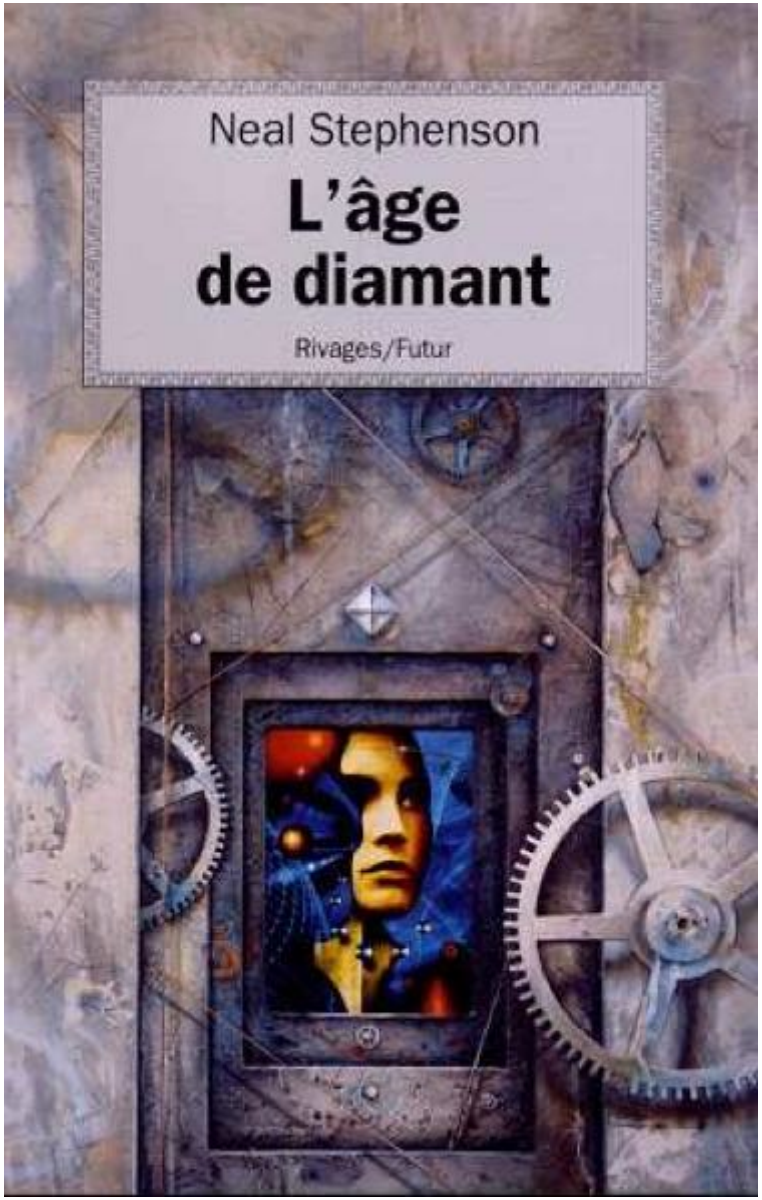
Exercice :
nommer un logiciel sans IHM

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

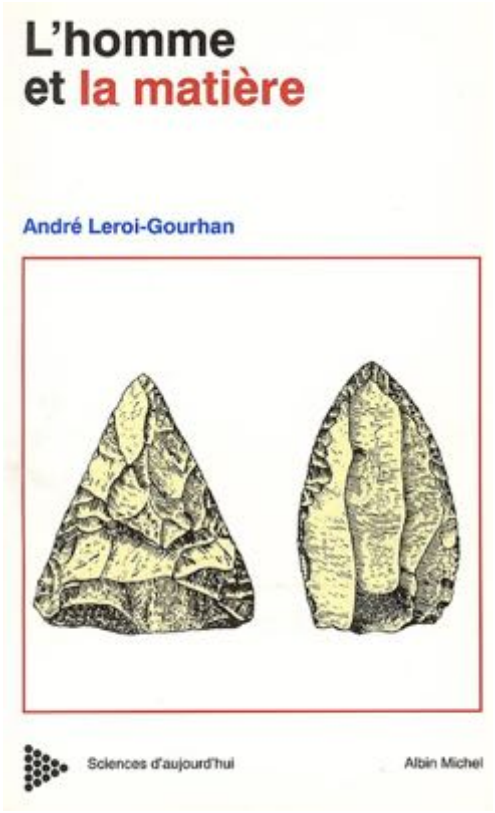
pub : association mondiale ACM SIGCHI

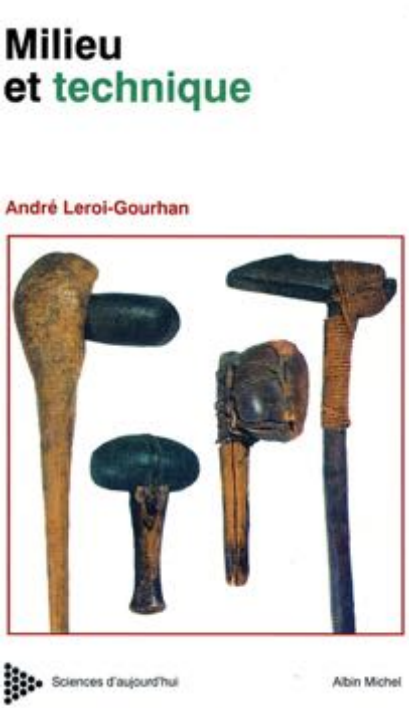
+ la revue

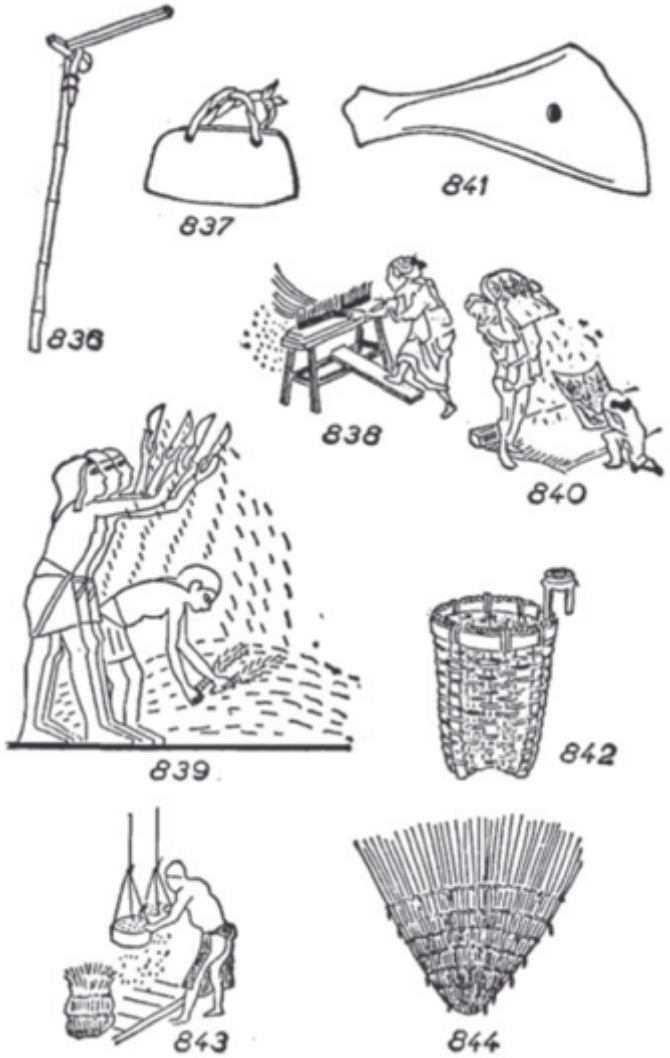
A (re)lire !



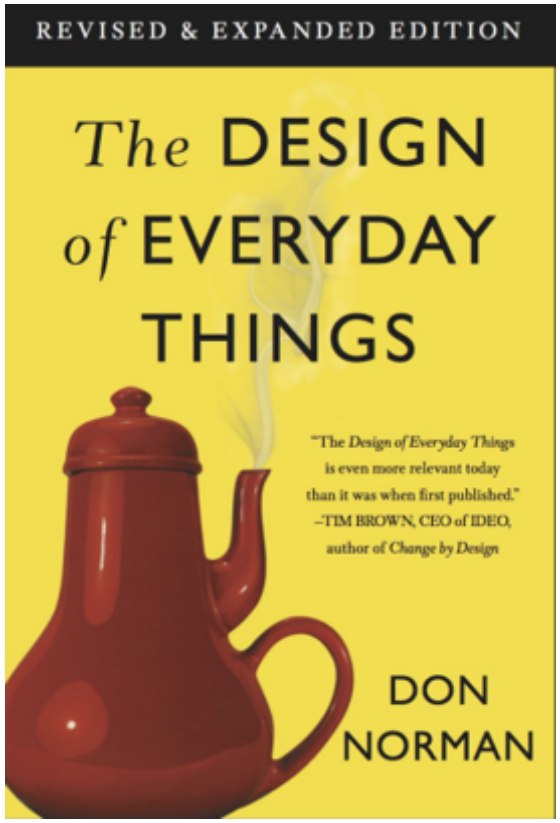
et aussi Leroi-Gourhan ?

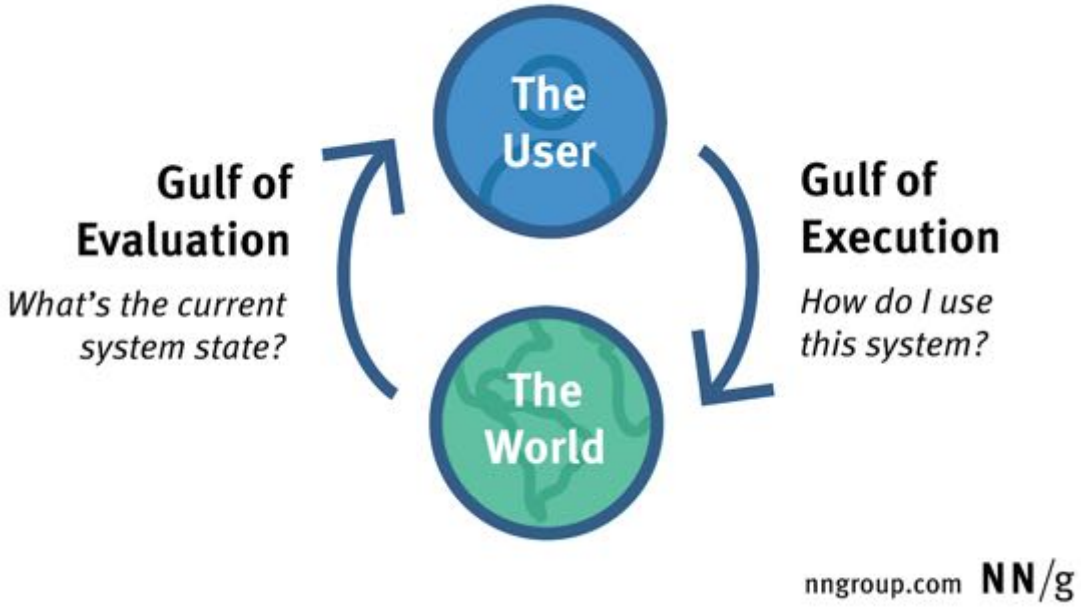






Don(ald) Norman (1988)



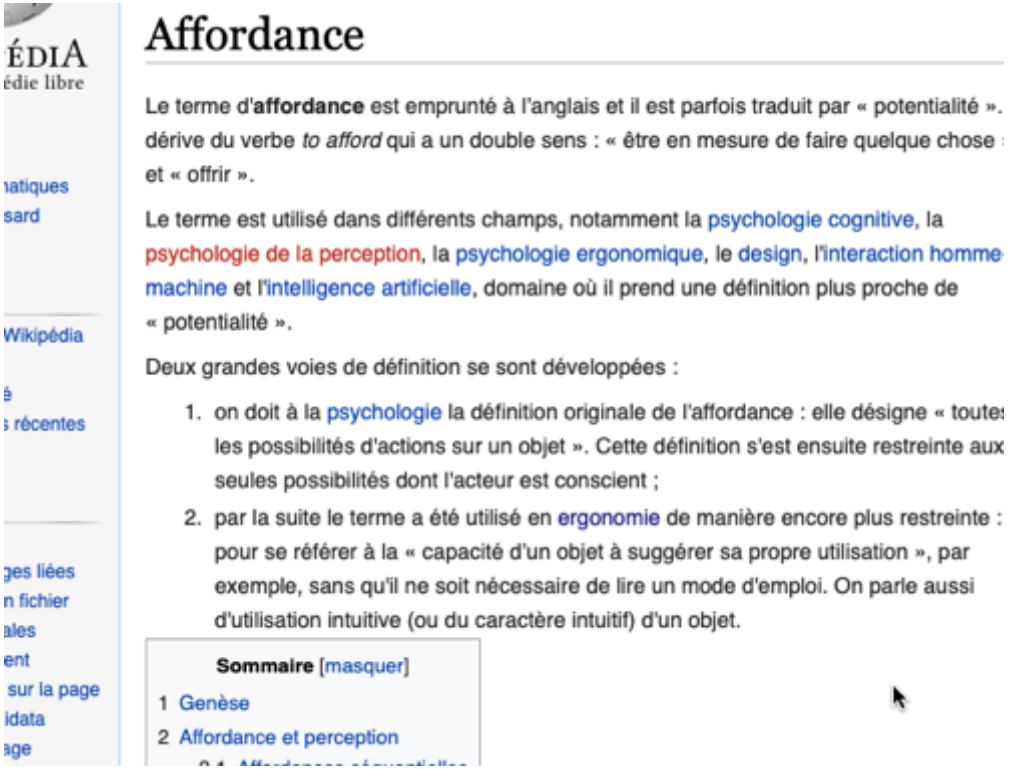


https://www.nngroup.com/articles/two-ux-gulfs-evaluation-execution/

http://jovermeulen.com/Research/FeedforwardCHI2013

Affordance

en design : capacité d'un objet à suggérer sa propre utilisation



Affordance

Le terme d'**affordance** est emprunté à l'anglais et il est parfois traduit par « potentialité ». dérive du verbe *to afford* qui a un double sens : « être en mesure de faire quelque chose et « offrir ».

Le terme est utilisé dans différents champs, notamment la psychologie cognitive, la psychologie de la perception, la psychologie ergonomique, le design, l'interaction homme machine et l'intelligence artificielle, domaine où il prend une définition plus proche de « potentialité ».

Deux grandes voies de définition se sont développées :

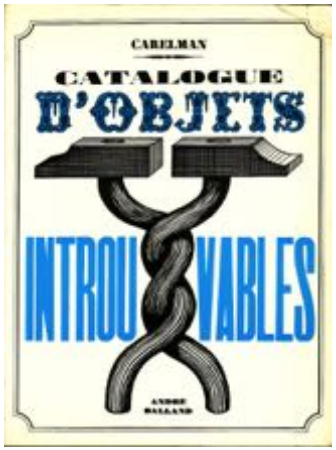
1. on doit à la psychologie la définition originale de l'affordance : elle désigne « toutes les possibilités d'actions sur un objet ». Cette définition s'est ensuite restreinte aux seules possibilités dont l'acteur est conscient ;
2. par la suite le terme a été utilisé en ergonomie de manière encore plus restreinte : pour se référer à la « capacité d'un objet à suggérer sa propre utilisation », par exemple, sans qu'il ne soit nécessaire de lire un mode d'emploi. On parle aussi d'utilisation intuitive (ou du caractère intuitif) d'un objet.

Sommaire [masquer]

1 Genèse
2 Affordance et perception

(lire l'article de Wikipedia)

E18 — Cafetière pour masochiste. Nous pensons que le dessin est suffisamment explicite pour ne pas s'appesantir sur des détails qui pourraient s'avérer pénibles.



repris dans D. Norman.
The design of every day thing

Rôle des conventions et du passé

Gros Horloge de Rouen (Wikipedia)

Fig. 63. Automatiquement, les opérateurs escomptent toujours le même effet lorsqu'ils agissent sur une commande. A gauche, un opérateur « s'attendrait » à voir l'aiguille de l'instrument à lire – vertical ou à plat – se déplacer dans le sens de la flèche, à la suite des mouvements indiqués sur les leviers ou cadrans circulaires. A droite, voici les mouvements de commande appropriés pour des instruments à lecture horizontale.

O.G. Edholm. La science du travail, l'ergonomie. Hachette, 1968 (p. 136)

Autre exemple : les pavés numériques

la touche 0 est en bas pour tous les dispositifs
mais touches 123 en bas pour calculatrices
en haut pour téléphones et télécommandes

photos : petit musée de P. Cubaud - d'après [Dix & Finlay]

Nouveaux dispositifs : conventions contradictoires ?

Ma jolie cuisinière mixte

d'après B. Jacomy. L'age du plip. Seuil, 2002

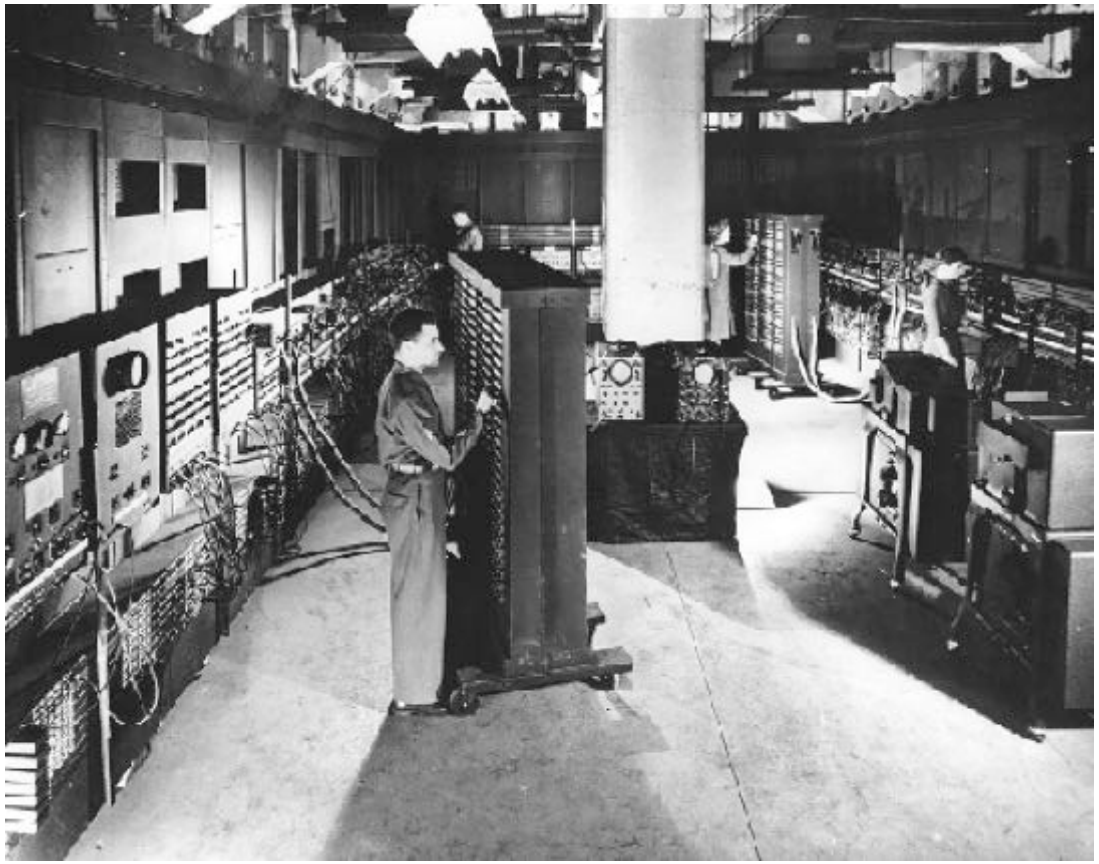
Sketch de la télévision norvégienne :
apparition du livre "volumen" comme remplaçant du rouleau

https://youtu.be/cgcSxQiS0RM

Suite de l'exposé :

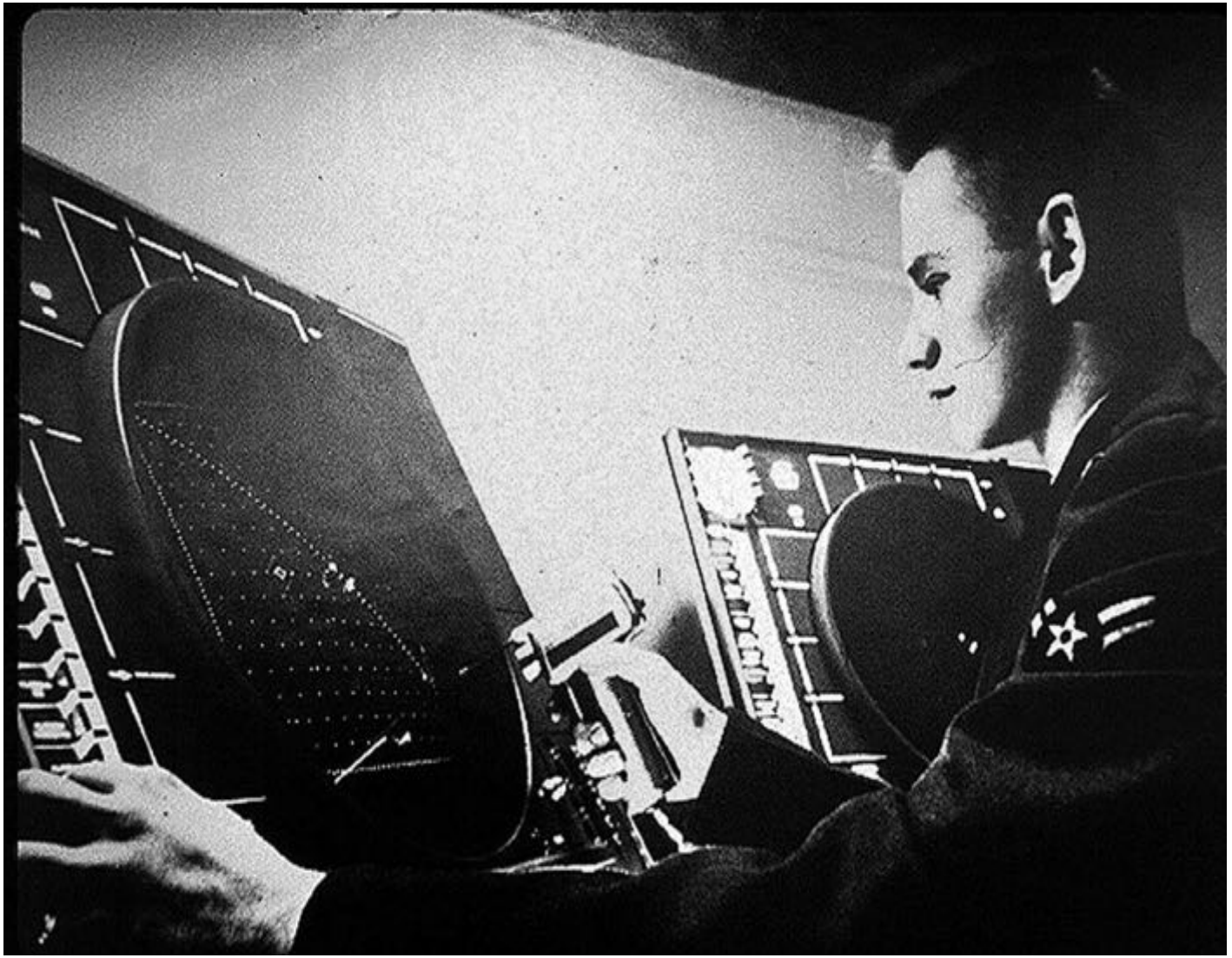
1. l'invention du WIMP
2. au-delà du WIMP
3. la captation
4. réalité étendue
5. objets malins

(1) l'invention du WIMP



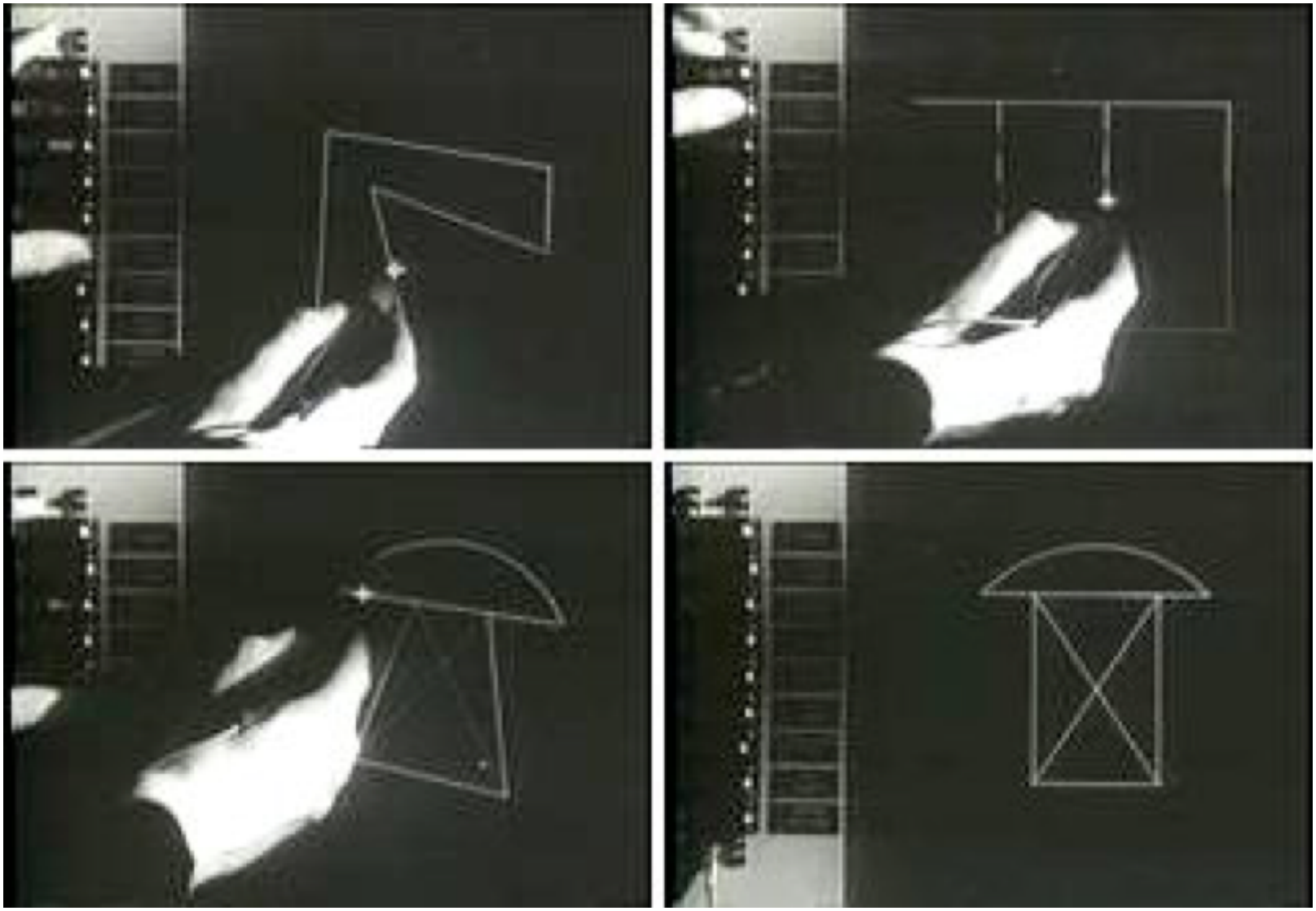
ENIAC - 1945

Le temps-réel : projet Whirlwind MIT, 1950



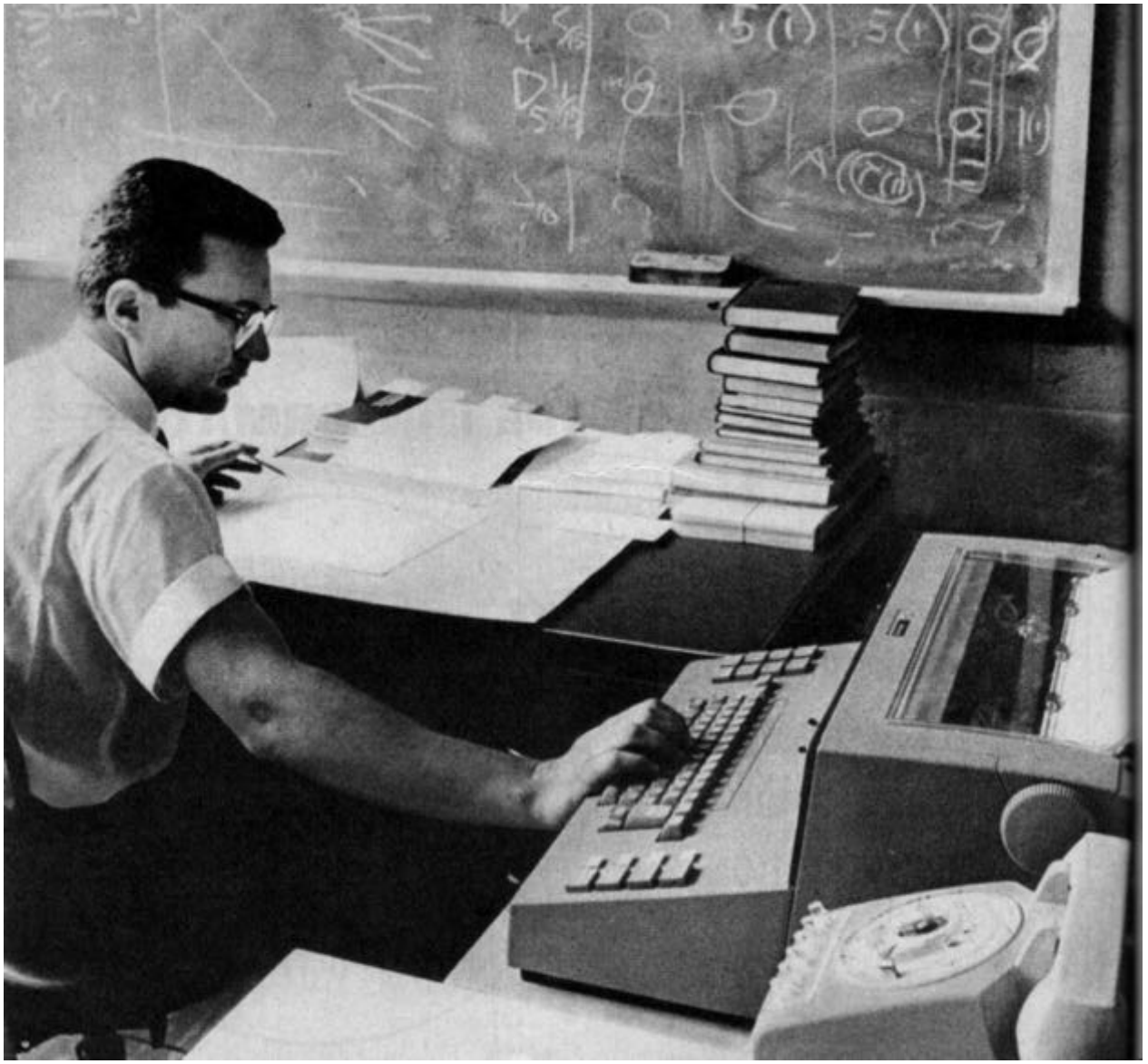
défense aérienne (SAGE)

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.”

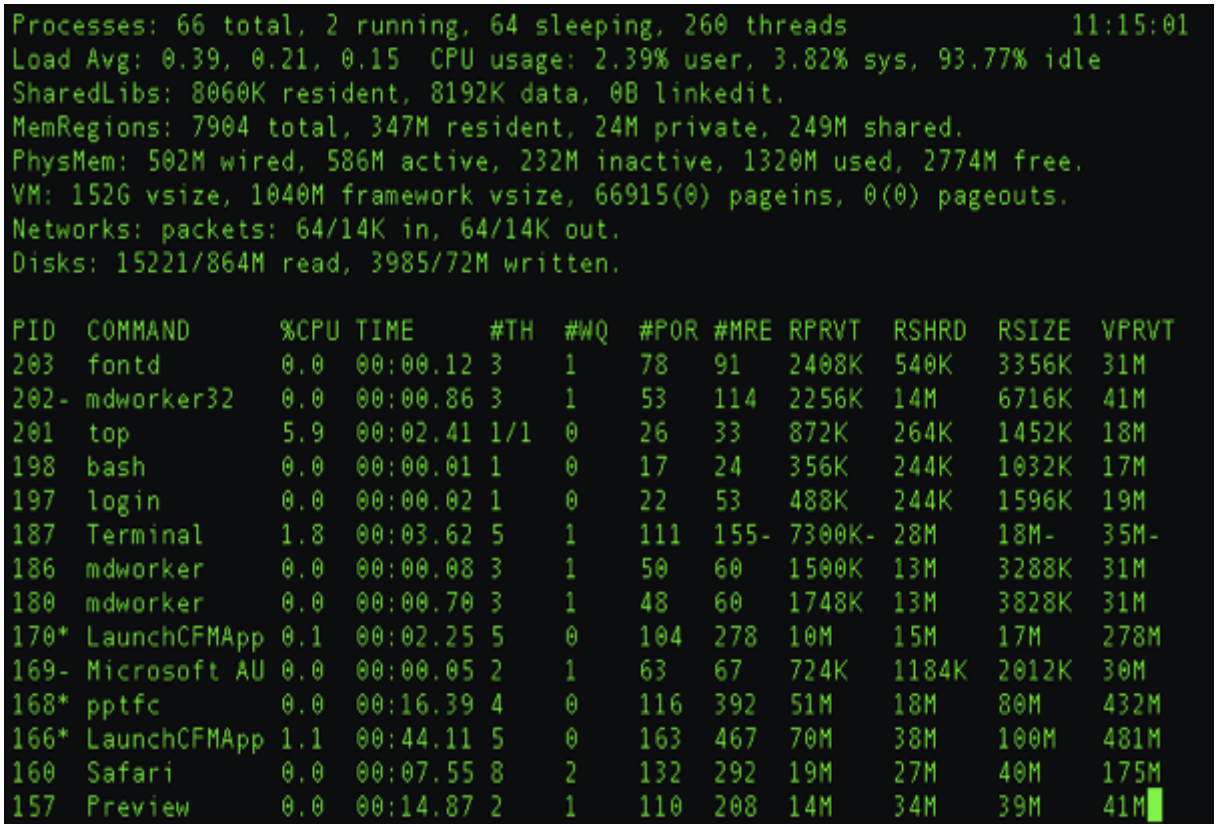


Le temps partagé (time sharing) :
MIT, 1959-64

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

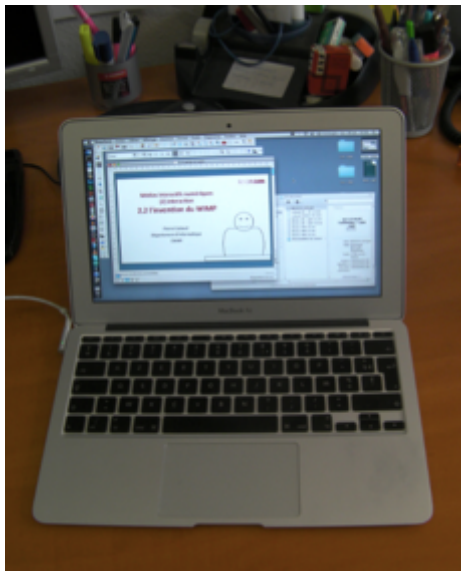
Douglas Engelbart et sa souris de 1963 (Stanford), 40 ans après



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

70’s : XEROX PARC machine Alto :

- 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

Larry Tesler

From Wikipedia, the free encyclopedia

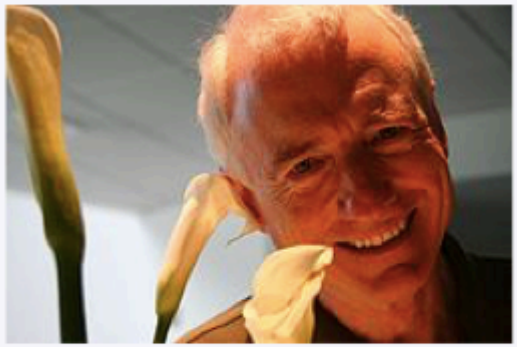
Lawrence Gordon Tesler (April 24, 1945 – February 16, 2020) was an American computer scientist who worked in the field of human–computer interaction. Tesler worked at Xerox PARC, Apple, Amazon, and Yahoo!

While at PARC, Tesler's work included Smalltalk, the first dynamic object-oriented programming language, and Gypsy, the first word processor with a graphical user interface (GUI) for the Xerox Alto. During this, along with colleague Tim Mott, Tesler developed the idea of copy and paste functionality and the idea of modeless software. While at Apple, Tesler worked on the Apple Lisa and the Apple Newton, and helped to develop Object Pascal and its use in application programming toolkits including MacApp.

Contents [hide]

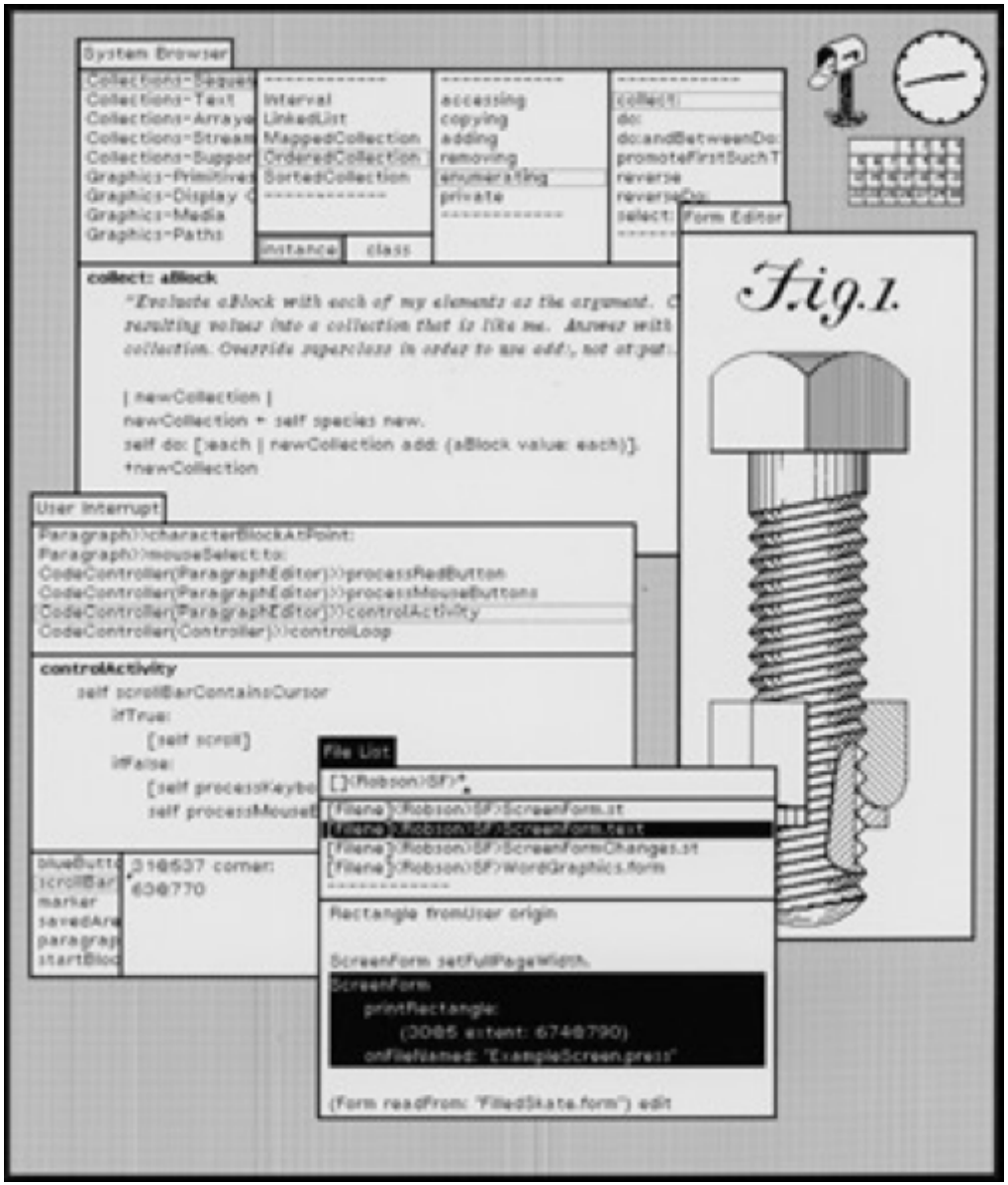
1 Biography
  1.1 Early career
  1.2 Xerox PARC

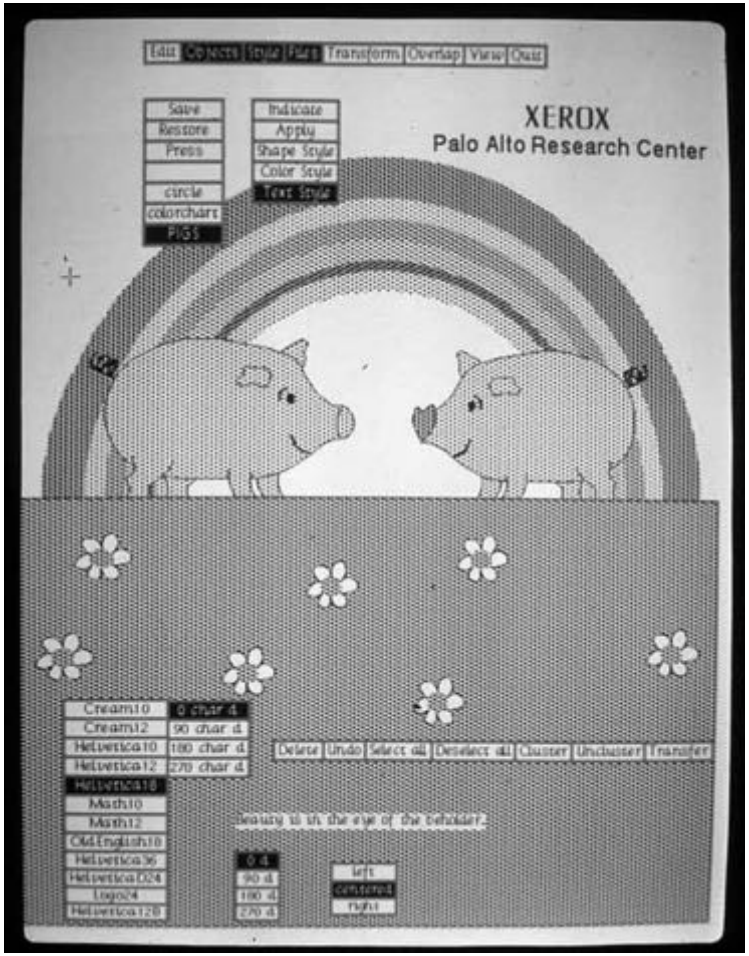
Larry Tesler



Tesler in 2007

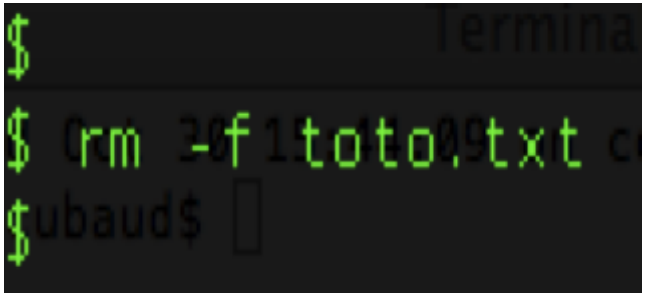
Born	Lawrence Gordon Tesler April 24, 1945 The Bronx, New York City, U.S.
Died	February 16, 2020 (aged 74) Portola Valley, California, U.S.
Citizenship	American
Alma mater	Stanford University
Known for	Copy and paste
Spouse(s)	unknown (div. 1969) Colleen Barton (m. 1970)





http://news.squeak.org/2007/12/29/old-smalltalk-pics-from-parc-place/
À voir aussi :
http://www.nomodes.com/tesler-resume.htm

- "métaphore" du bureau (desktop)

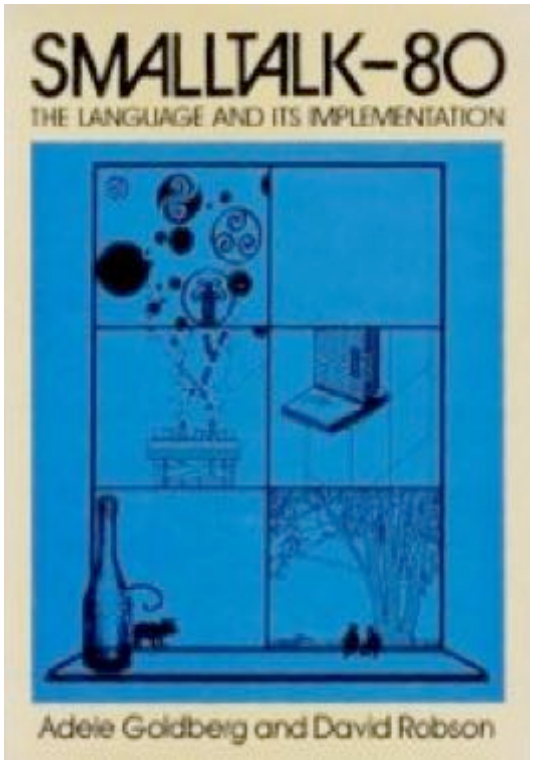


- le copier/coller (copy/paste)

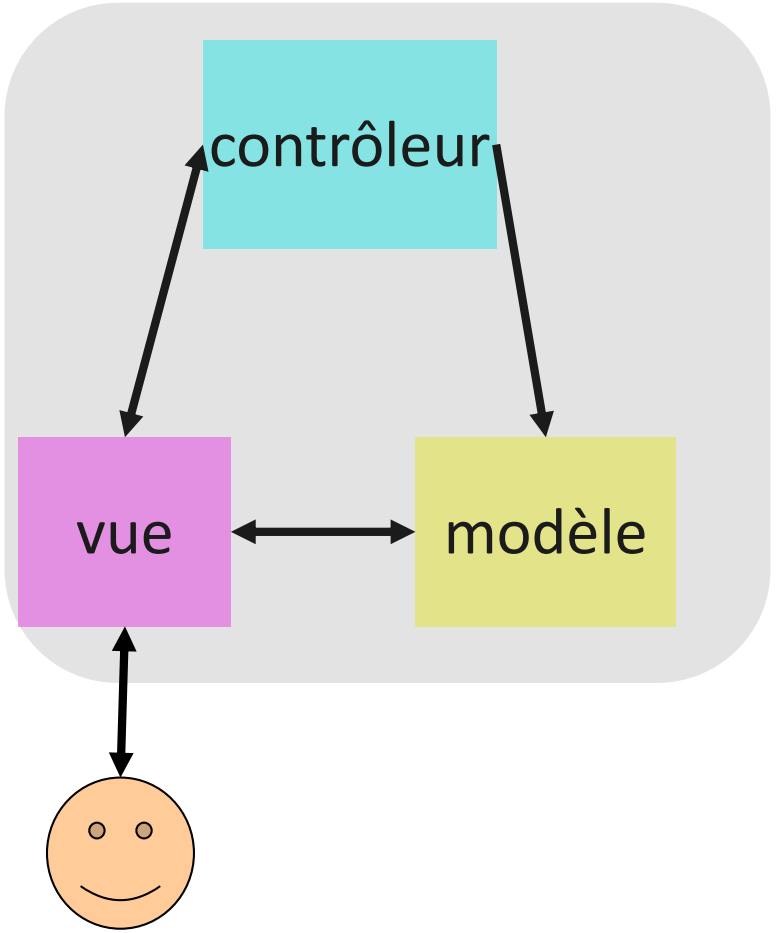
- l'annulation (undo)

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

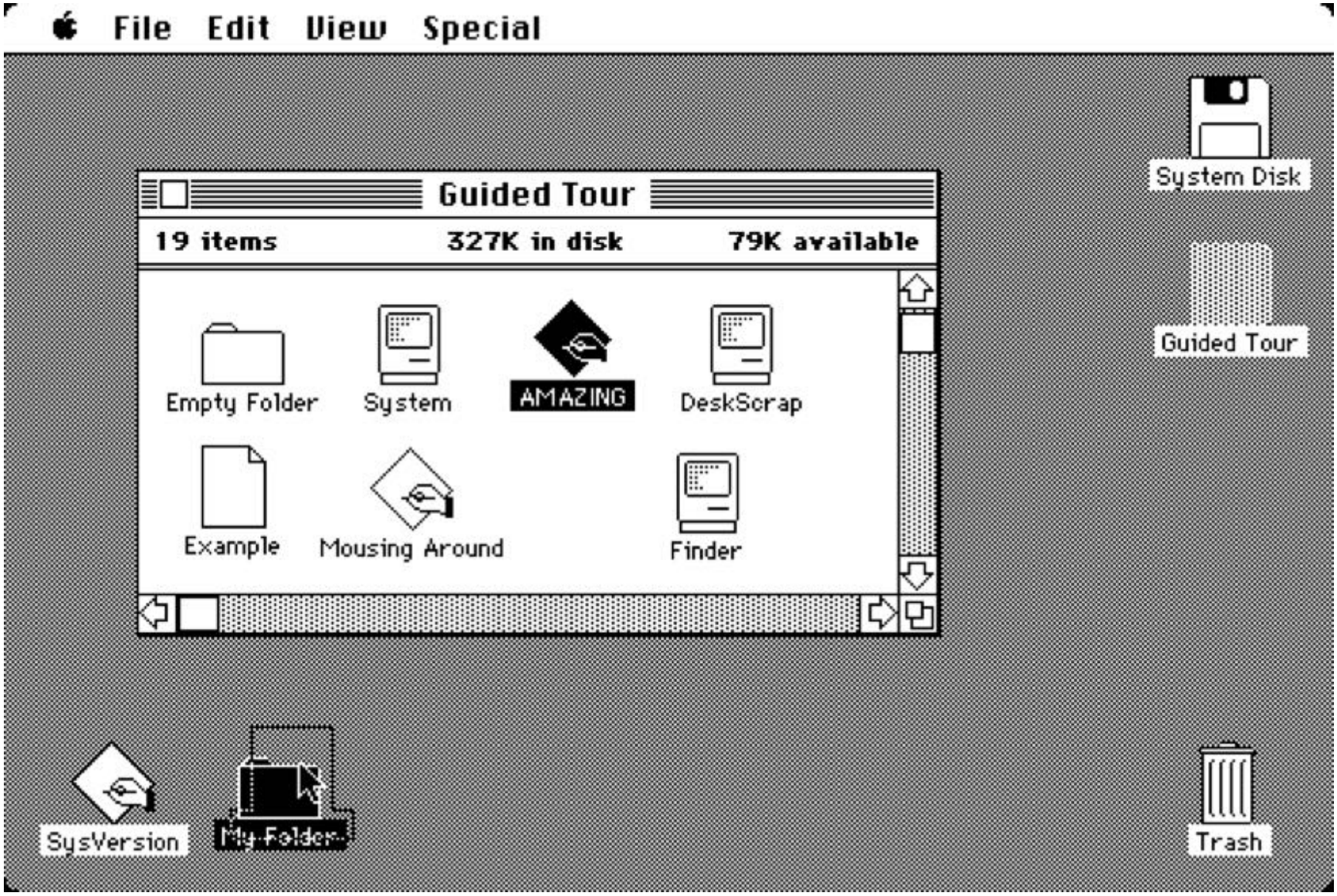
- langage de programmation "objet"
- modèle MVC



(wikipedia)



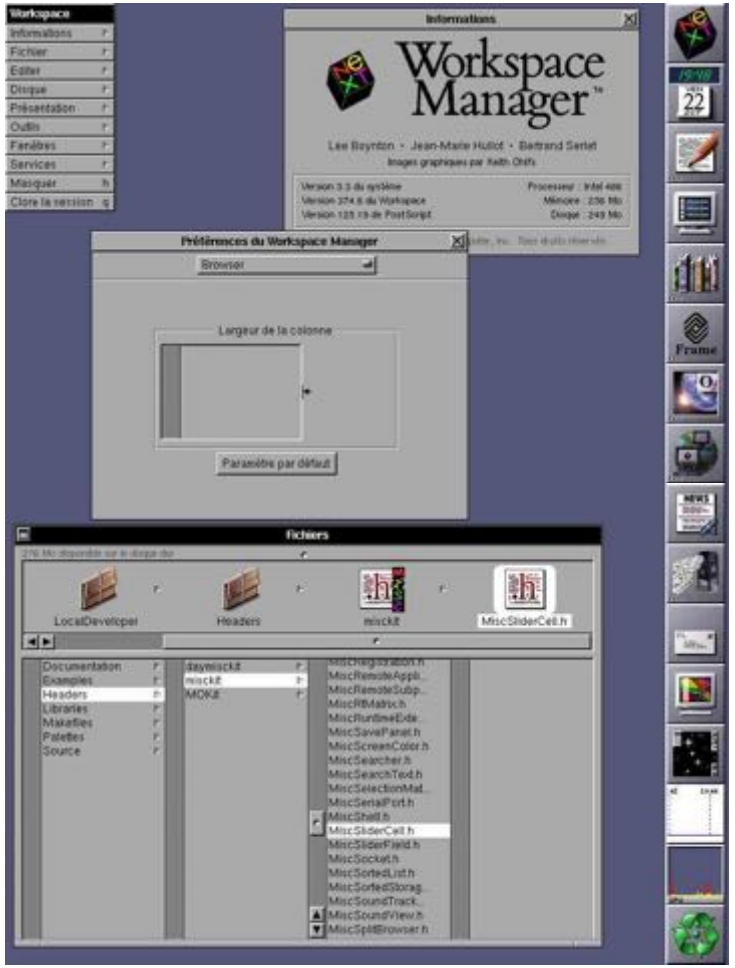
Apple : MacIntosh (1/1984)



http://toastytech.com/guis/

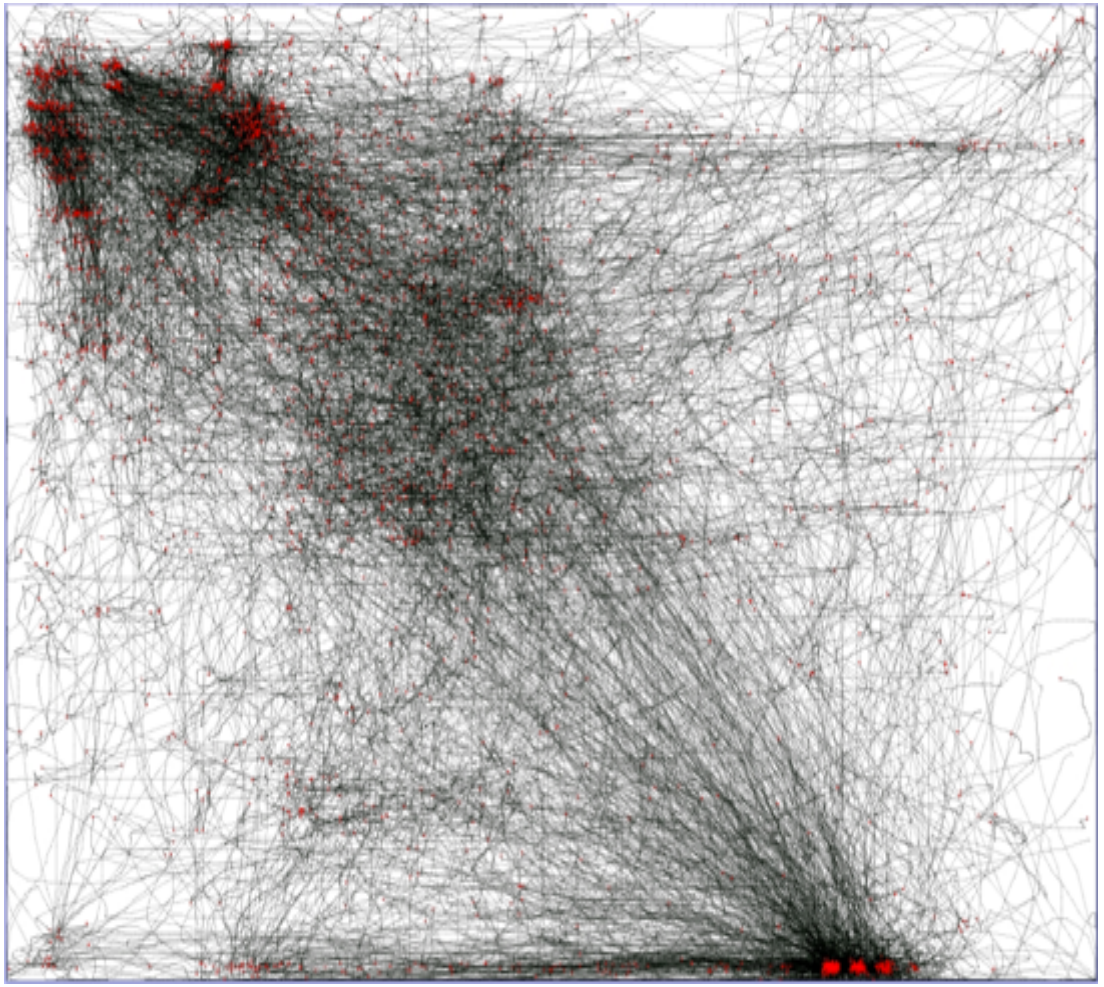
X Window (X11.1 : 9/1987)

NeXTSTEP (0.8 : 10/1988)



Apple Aqua (1/2000)

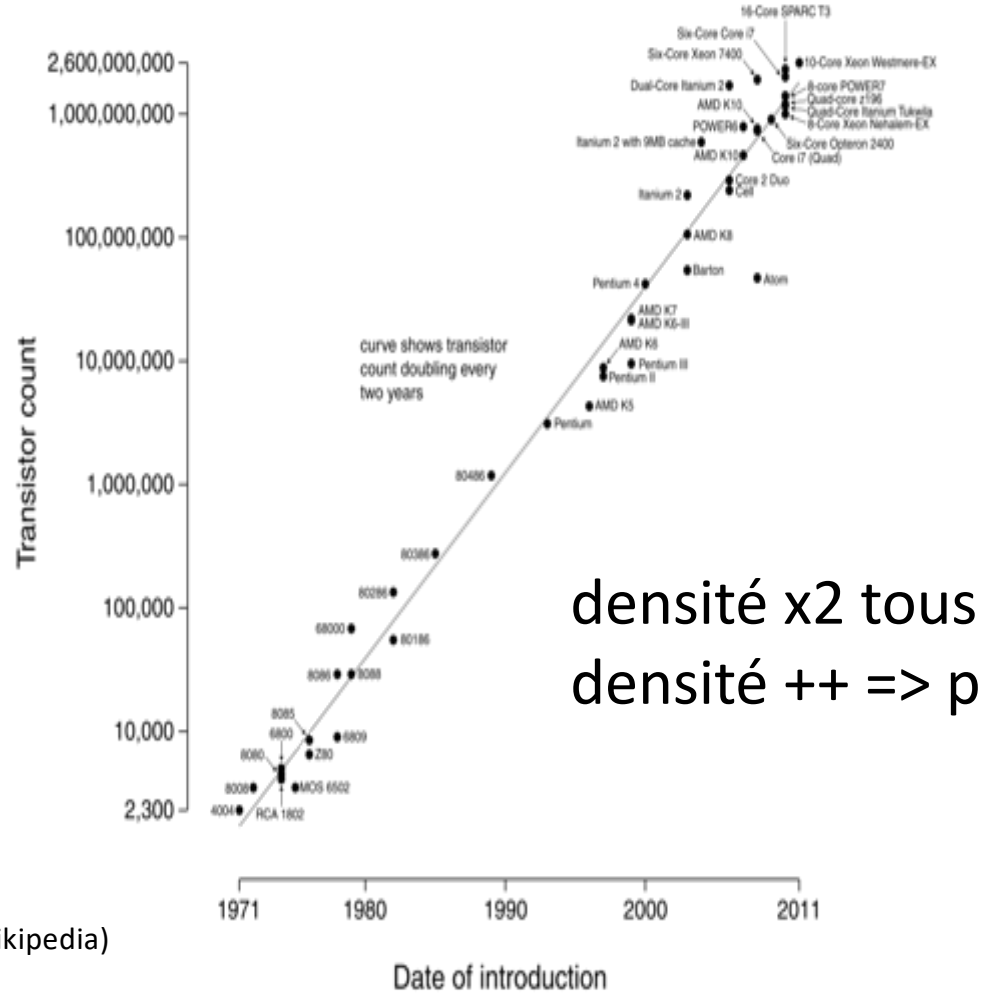
IHM vu du côté ordinateur…



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

La "loi" de Gordon Moore pour les circuits intégrés (1965)



(wikipedia)

densité x2 tous les 2 ans

densité ++ => prix vente --

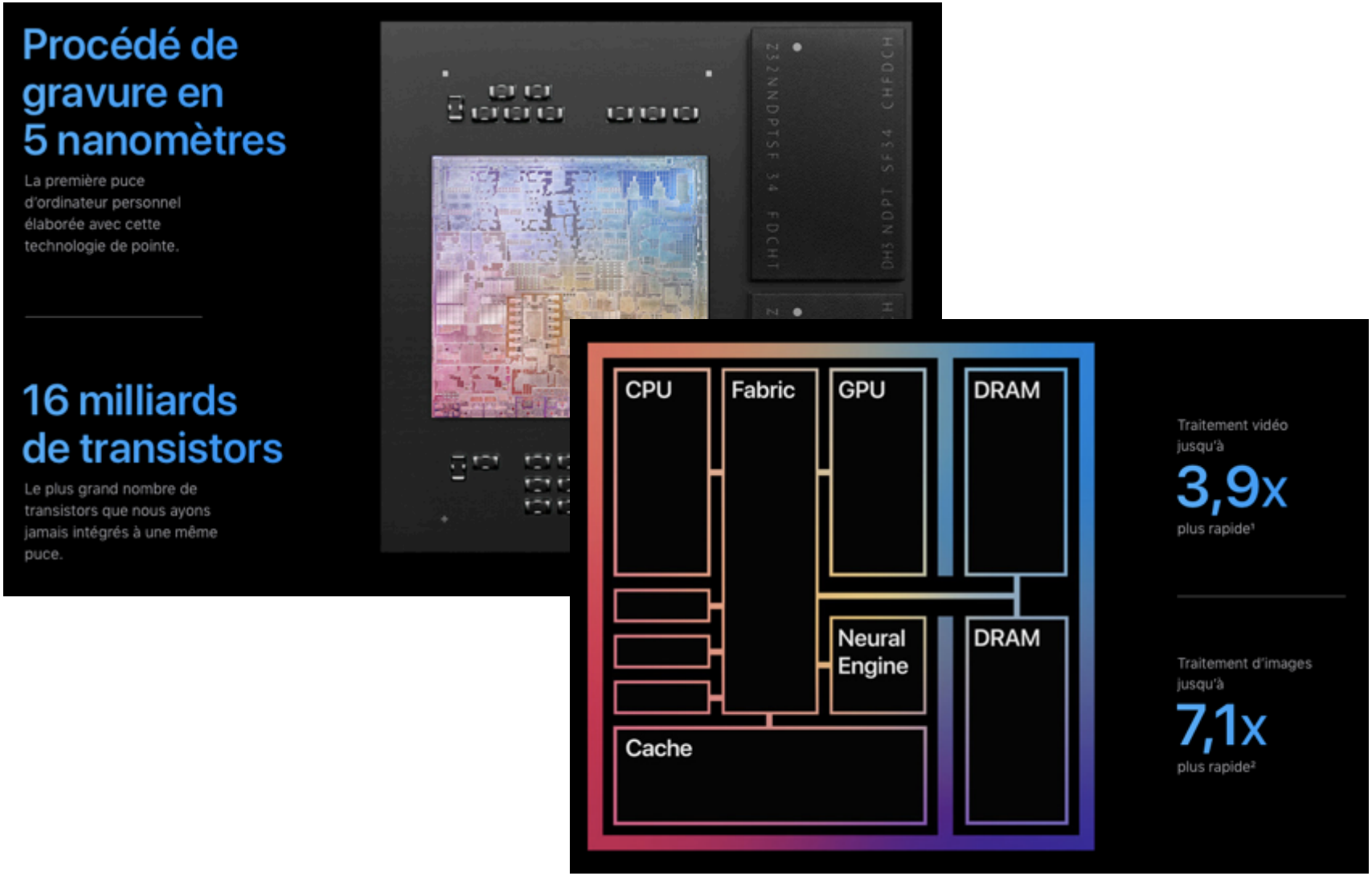
1 : A coût égal, croissance exponentielle de puissance

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

2: à puissance égale, décroissance exponentielle du coût

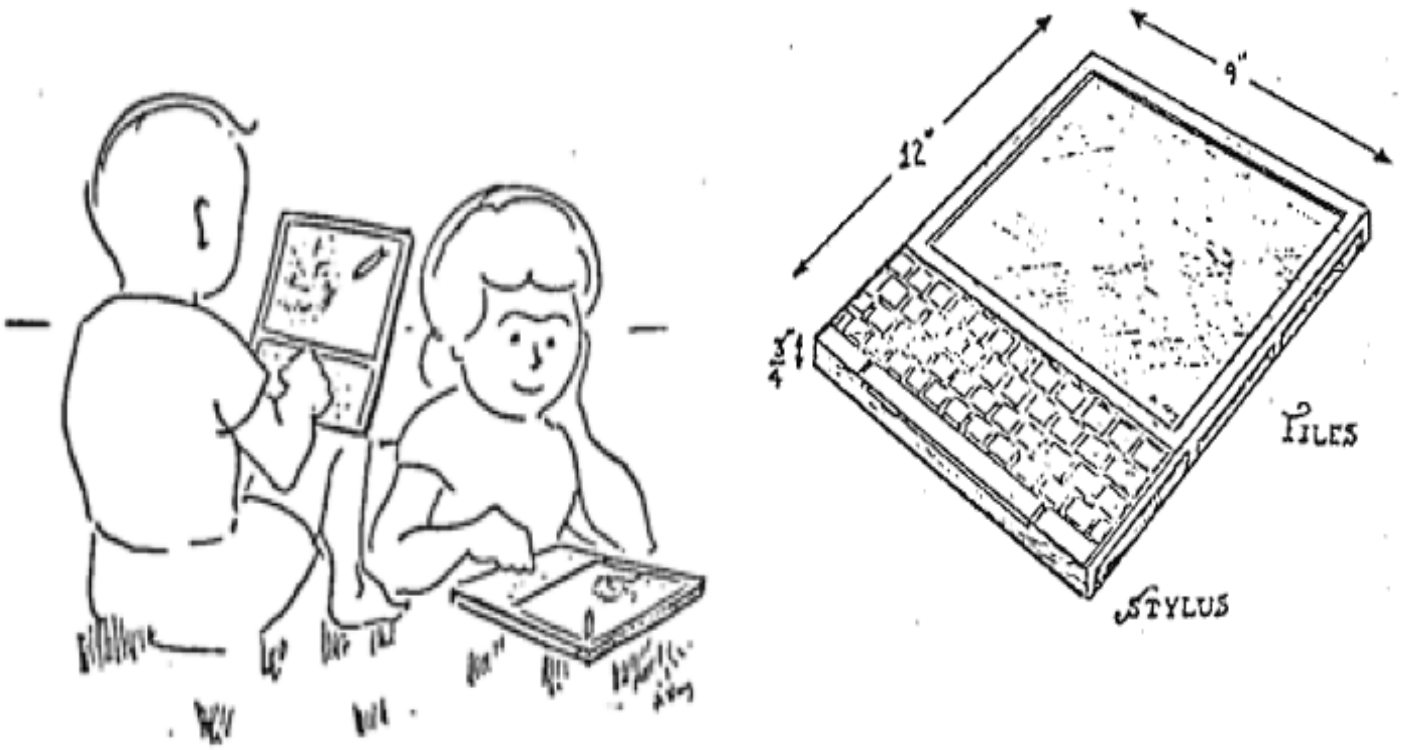
1er processeur dédié 3D pour PC (1995-97)

Exemple : puce Apple M1 (fin 2020)



Etiquettes électroniques (e-ink)

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



http://en.wikipedia.org/wiki/File:Dynabook.png

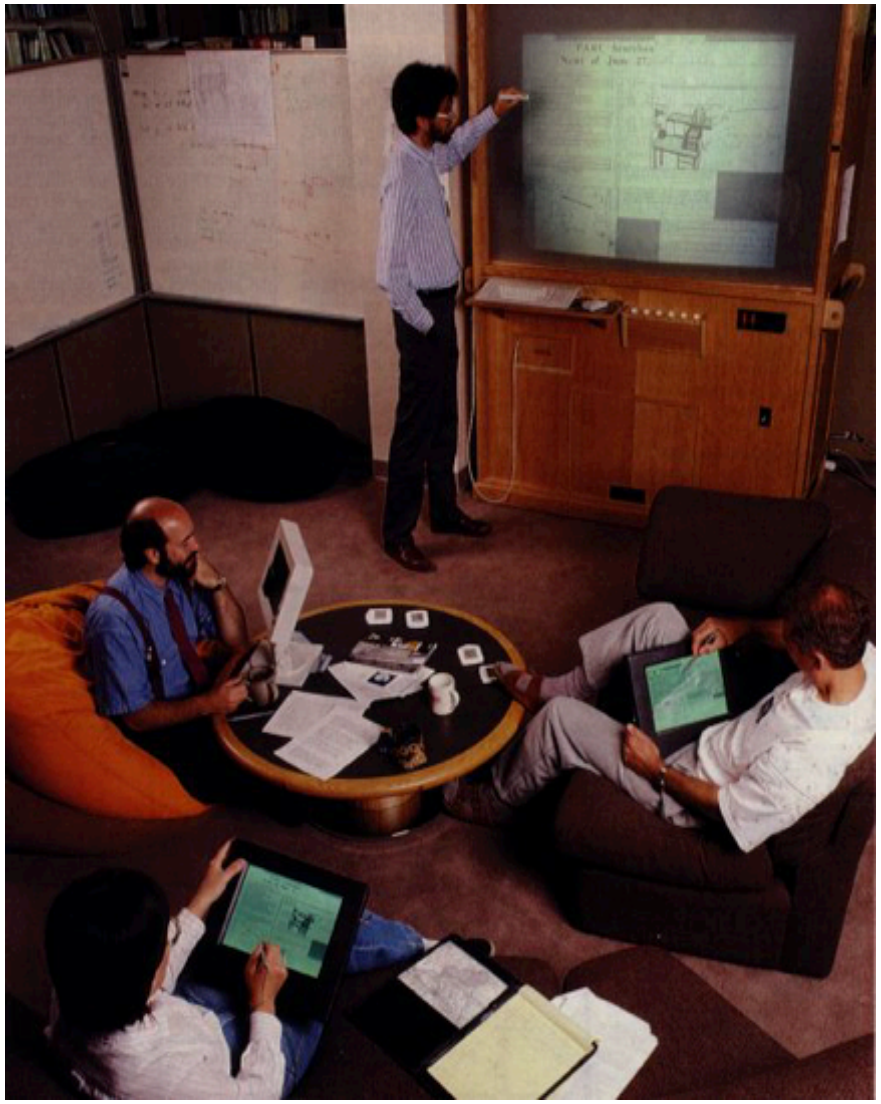
Le "dynabook" d'Alan Key (PARC, 1972)

tablette apple en 2010 (et ipod touch en 2007)

Etape 2 :
l'information
tout le temps

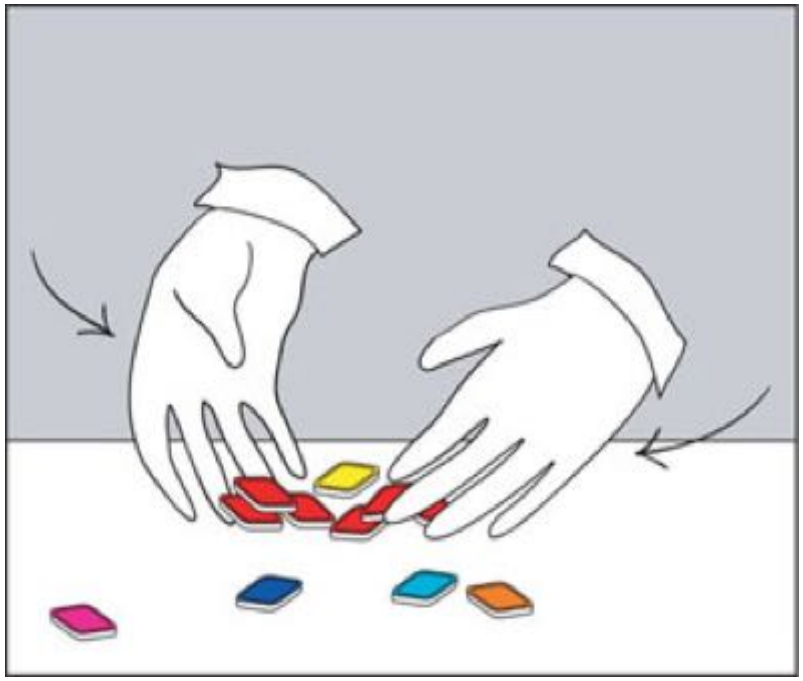
Ubiquitous
computing
M. Weiser
PARC, ca. 1990

(wikipedia)



pub circa 2012

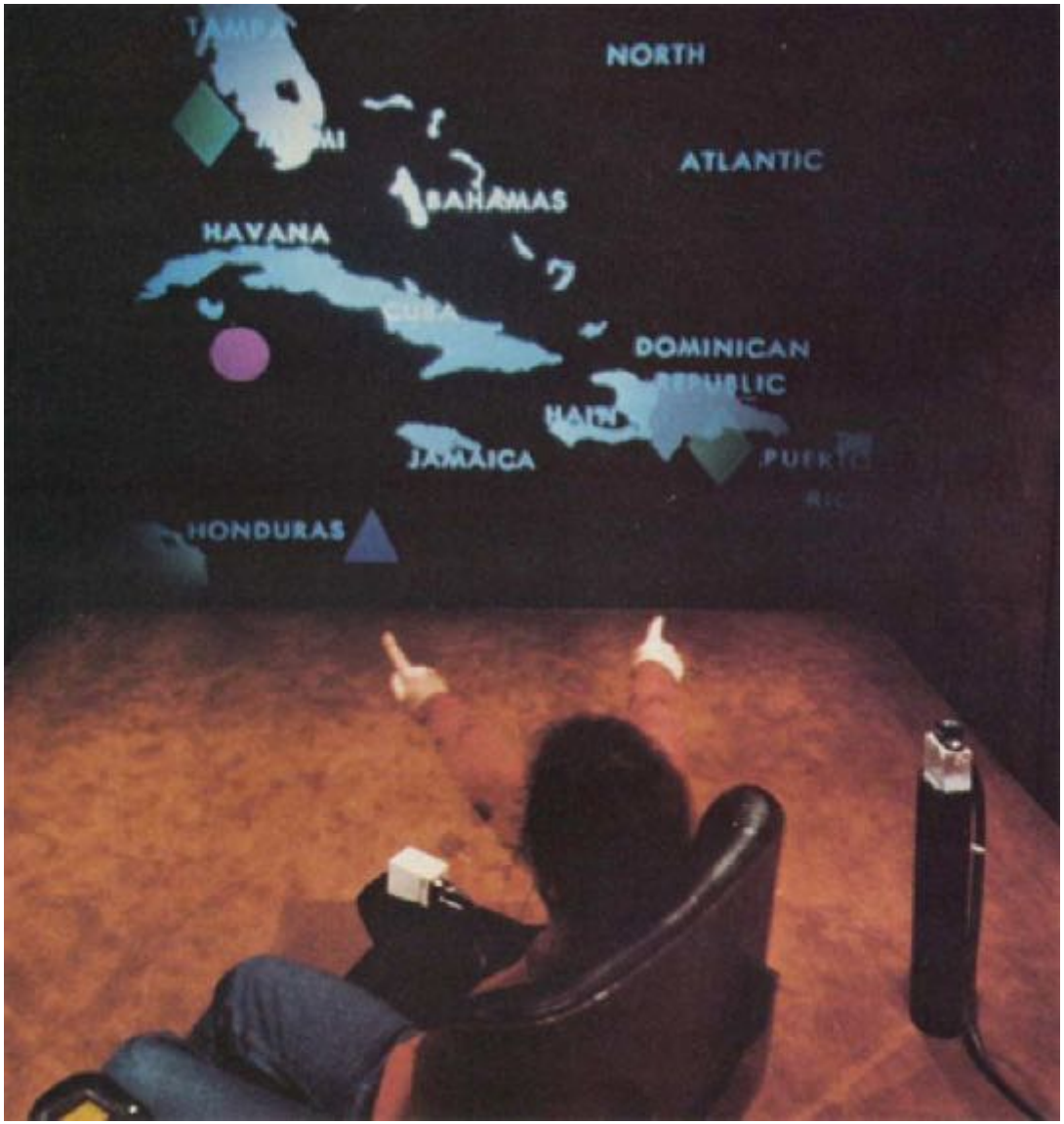
Etape 3 en cours : l'information dans tout



Siftables (Merill, MIT, 2009)

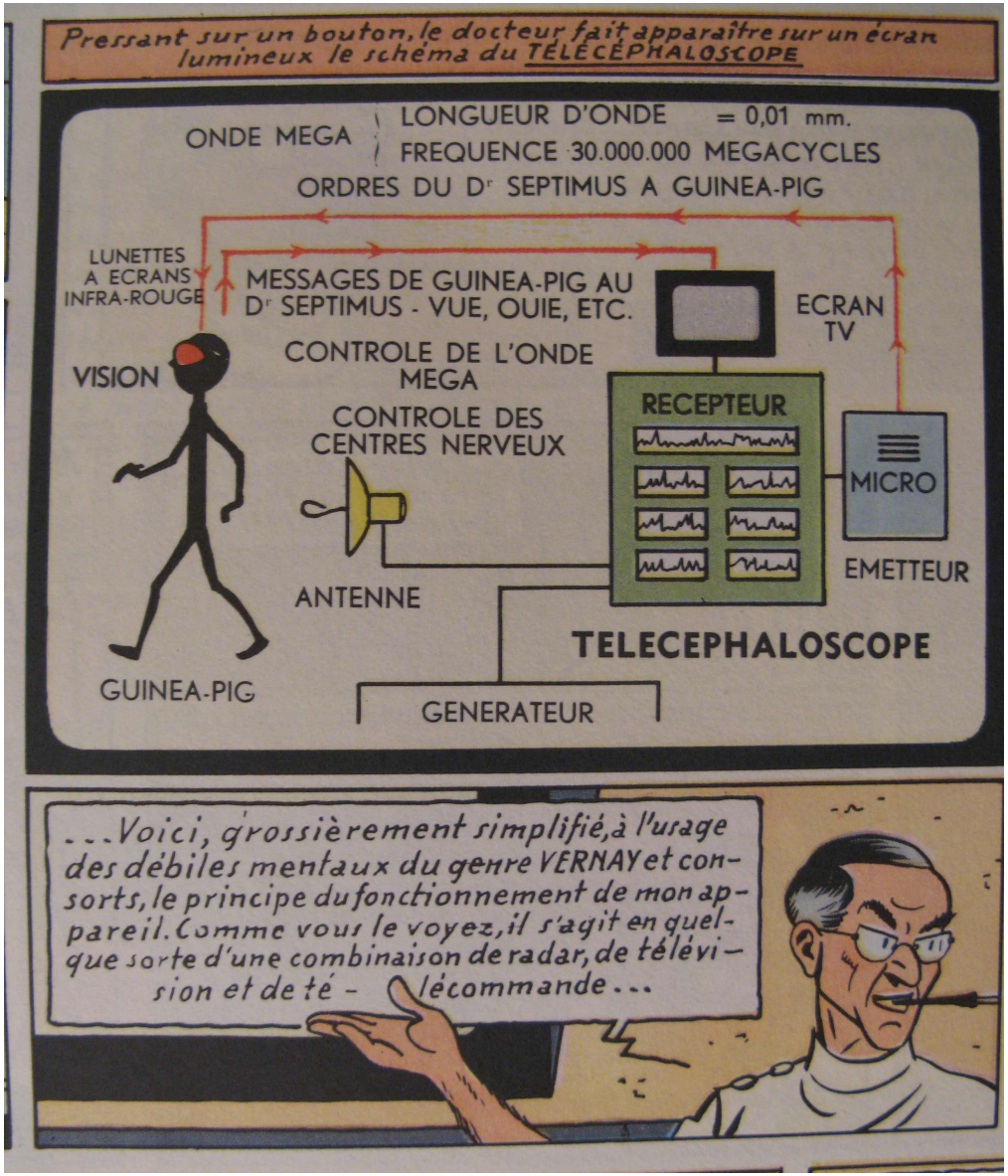
PhotoCubes (S.H. Hsu, CNAM, 2010)

(3) La captation



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

Capter pourquoi ? boucle de rétro-action (feedback)



Exemple de rétro action : la stabilisation de caméra

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

ce qu'on capte pour l'IHM :

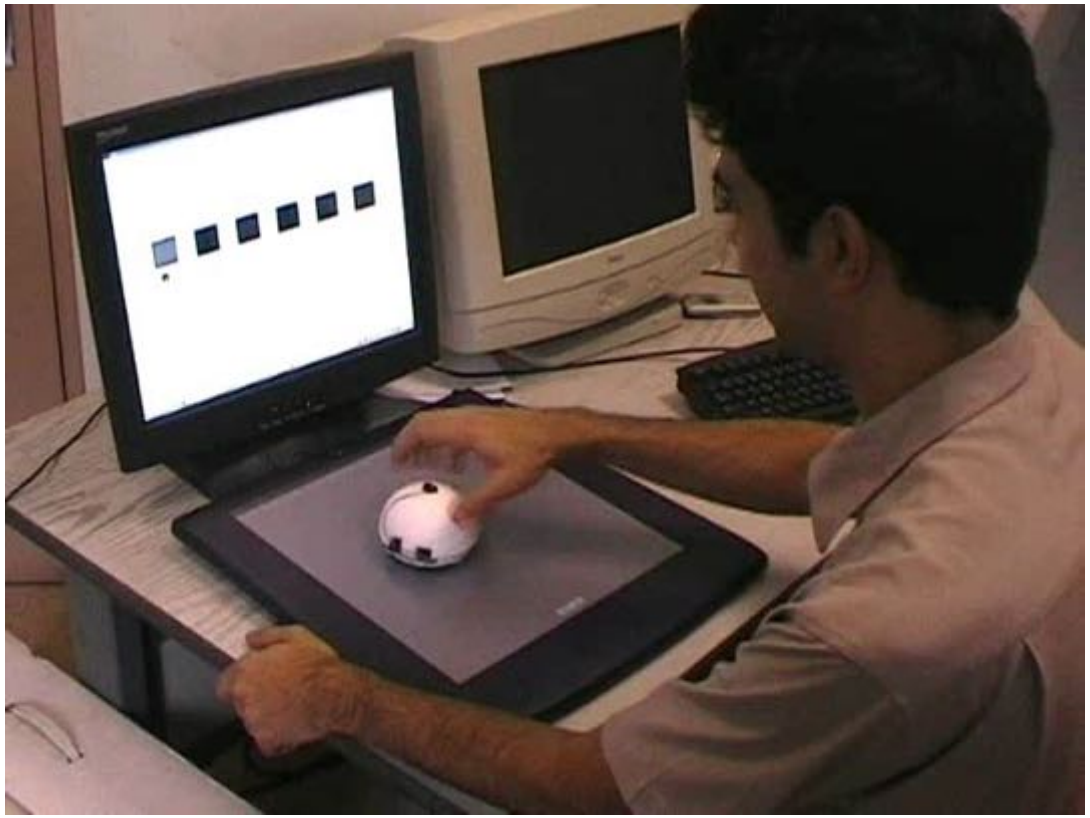
- position
- mouvement, déplacement
- geste
- voix : parole, chant
- attitude (attention)
- regard (direction)
- physiologie (temperature, rythme cardiaque, sudation ...)
- ondes cérébrales
- …

On ne traitera pas tout ici !

Deja vu en Octobre avec les ¬progs:

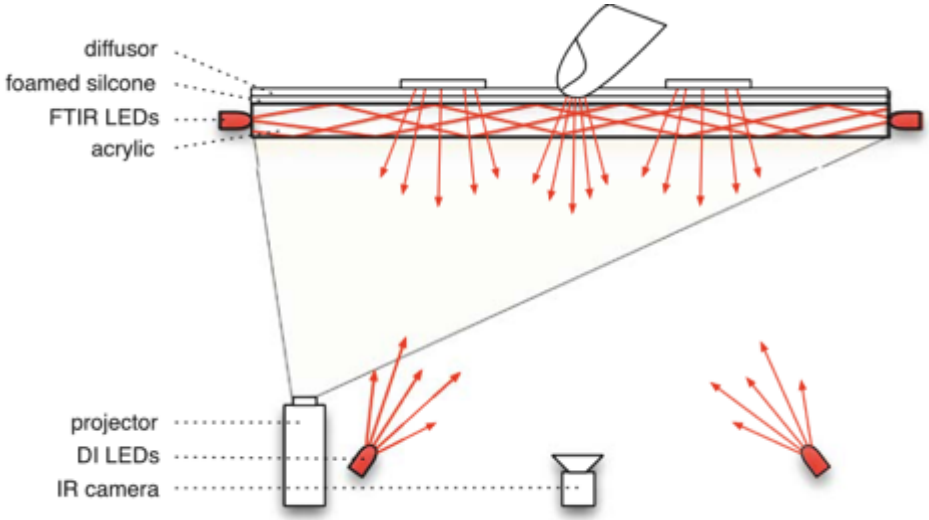
captation video, opencv

Souris à 3 DDL, Rodrigo Almeida, CNAM/CEDRIC



procontrol & promidi pour Processing, OSC, etc

Les tables d'affichages (tabletop displays)



Weiss, Malte & Hollan, James & Borchers, Jan & Müller-Tomfelde, Christian. (2010). Augmenting Interactive Tabletops with Translucent Tangible Controls.

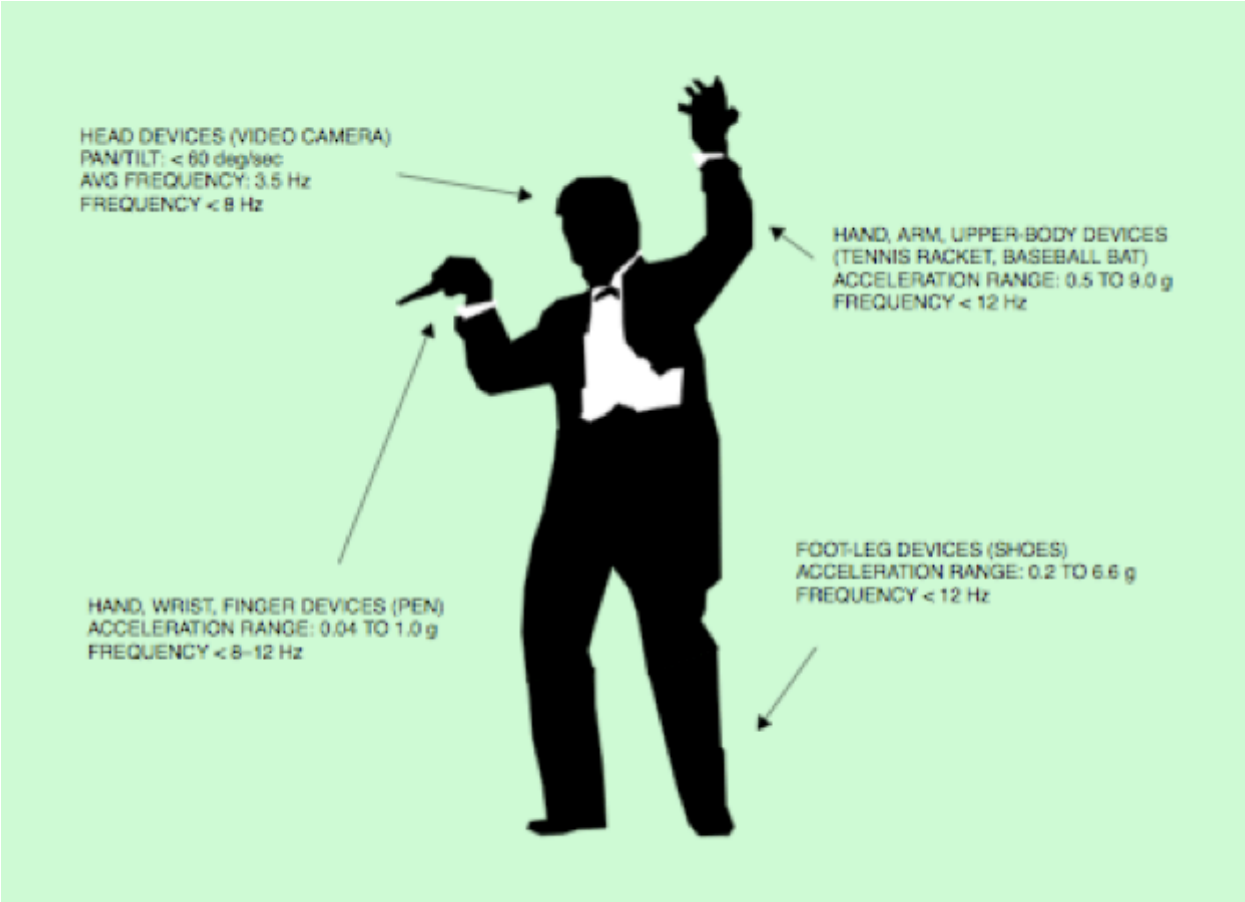
voir la vidéo de la conference
TED 2006 de Jeff Han`
+ son article UIST 2005

Microsoft Surface en 2007-8

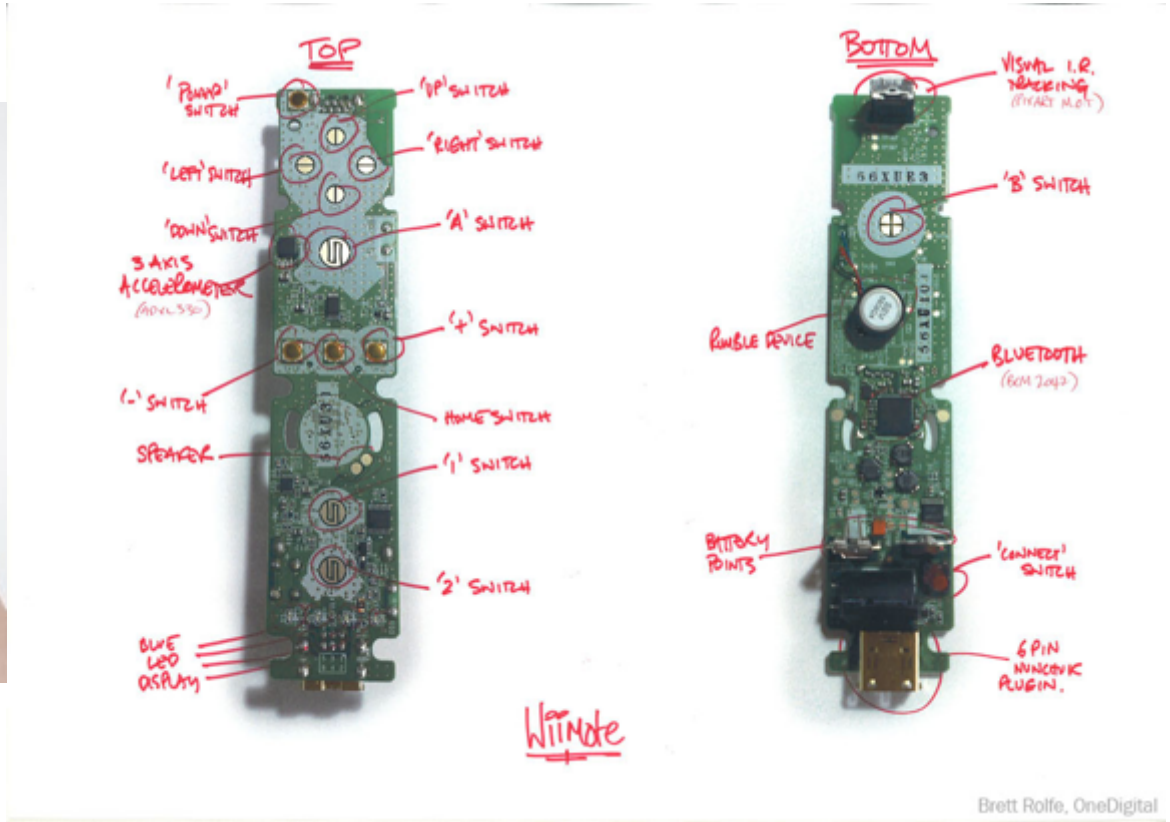
C. Verplaetse IBM Systems Journal 35(3-4) **1996** !!

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

by C. Verplaetse



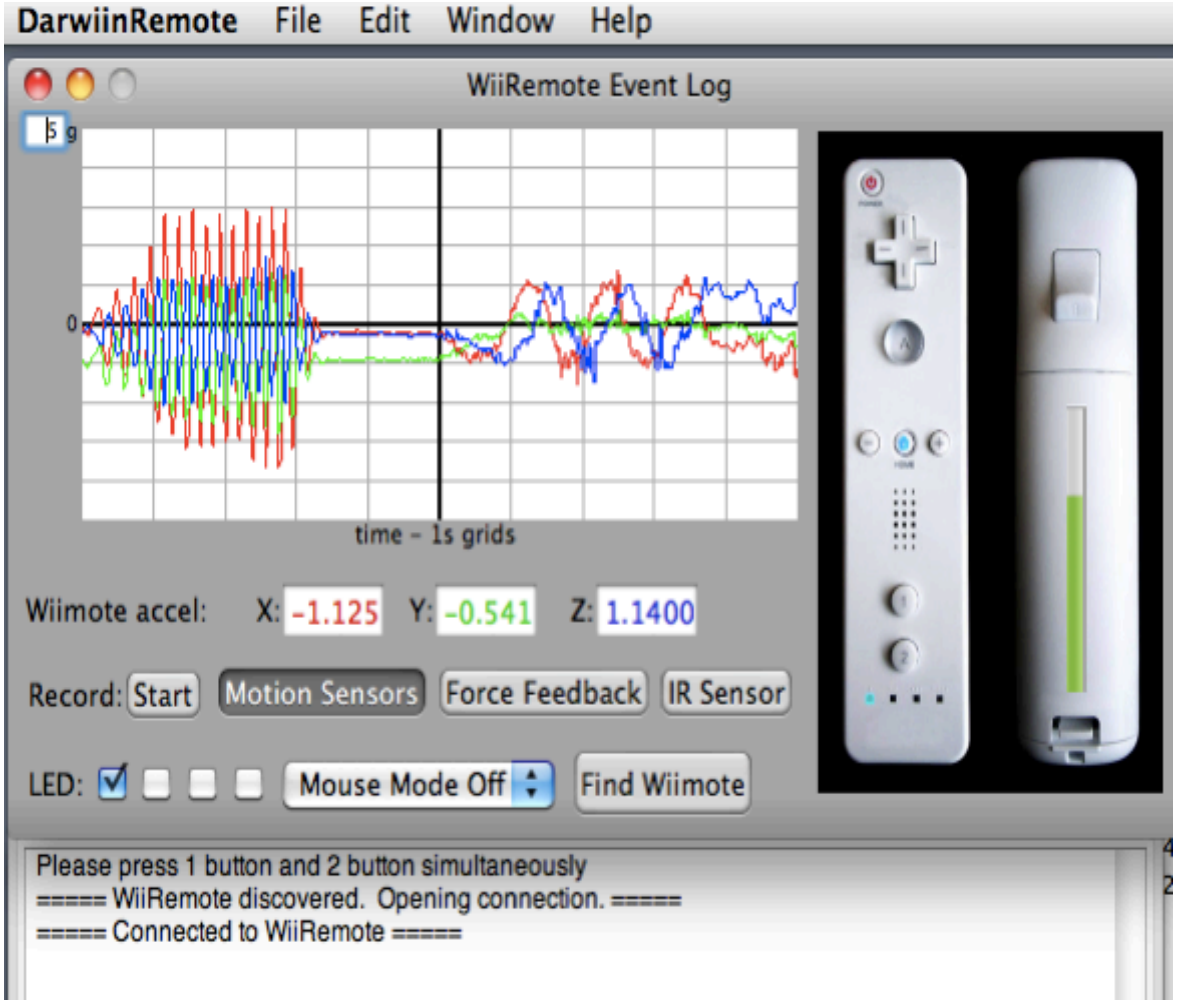
La Wiimote de Nintendo (2006)



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

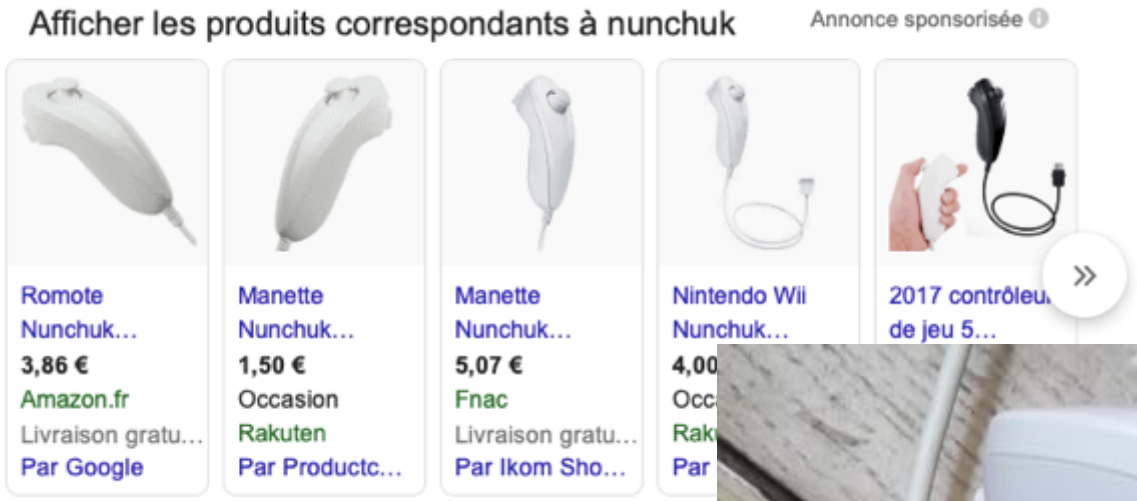
Totalement « hacké »
=> www.wiili.com

Utilisation de l'accéléromètre



plus de demo depuis 2017 ☹

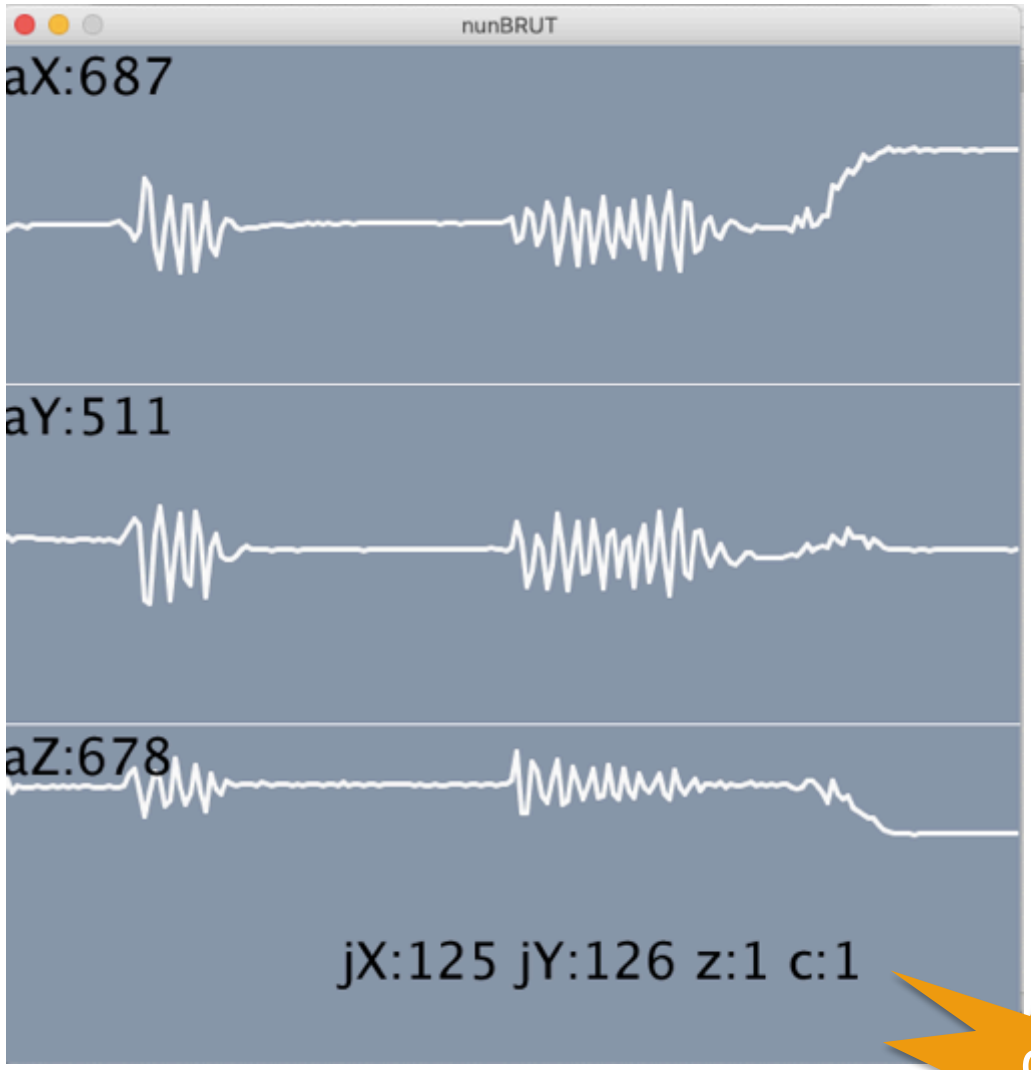
A la place : le nunchuk



Acceleromètre STmicro
(moins bon que wiimote ?)

Protocole i2c
(deux fils E/S et deux fils alim)

Trame hackée aussi



démo

Calibration 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.

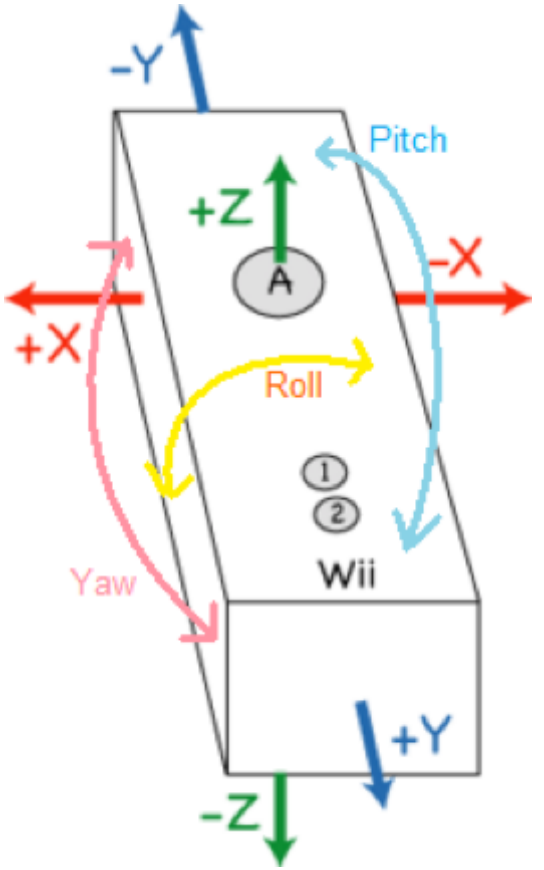
+Z : x1, y1, z1
+Y : x2, y2, z2
+X : x3, y3, z3

d'où les coordonnées du point origine:

x0 = (x1 +x2)/2
y0 = (y1 + y3)/2
z0 = (z2 + z3) /2

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

ax = (xraw -x0)/(x3-x0)
ay = (yraw - y0)/(y2-y0)
az = (zraw - z0)/(z1-z0)



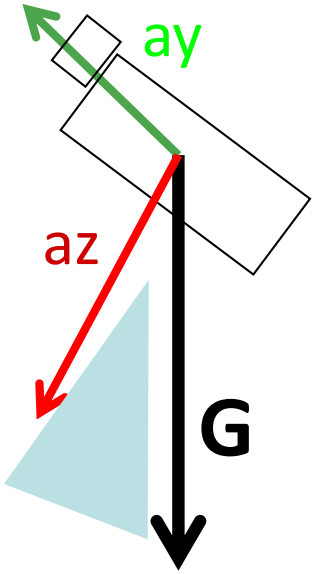
=> à faire pour chaque exemplaire (une fois)

http://www.wiili.org/index.php/Motion_analysis

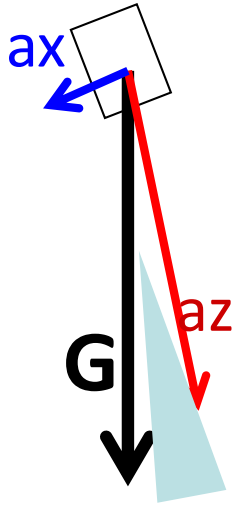
application à la mesure d'angles d'orientation

ma (belle) lunette astronomique

vue de face :
tangage (pitch)



vue de l'arrière :
roulis (roll)



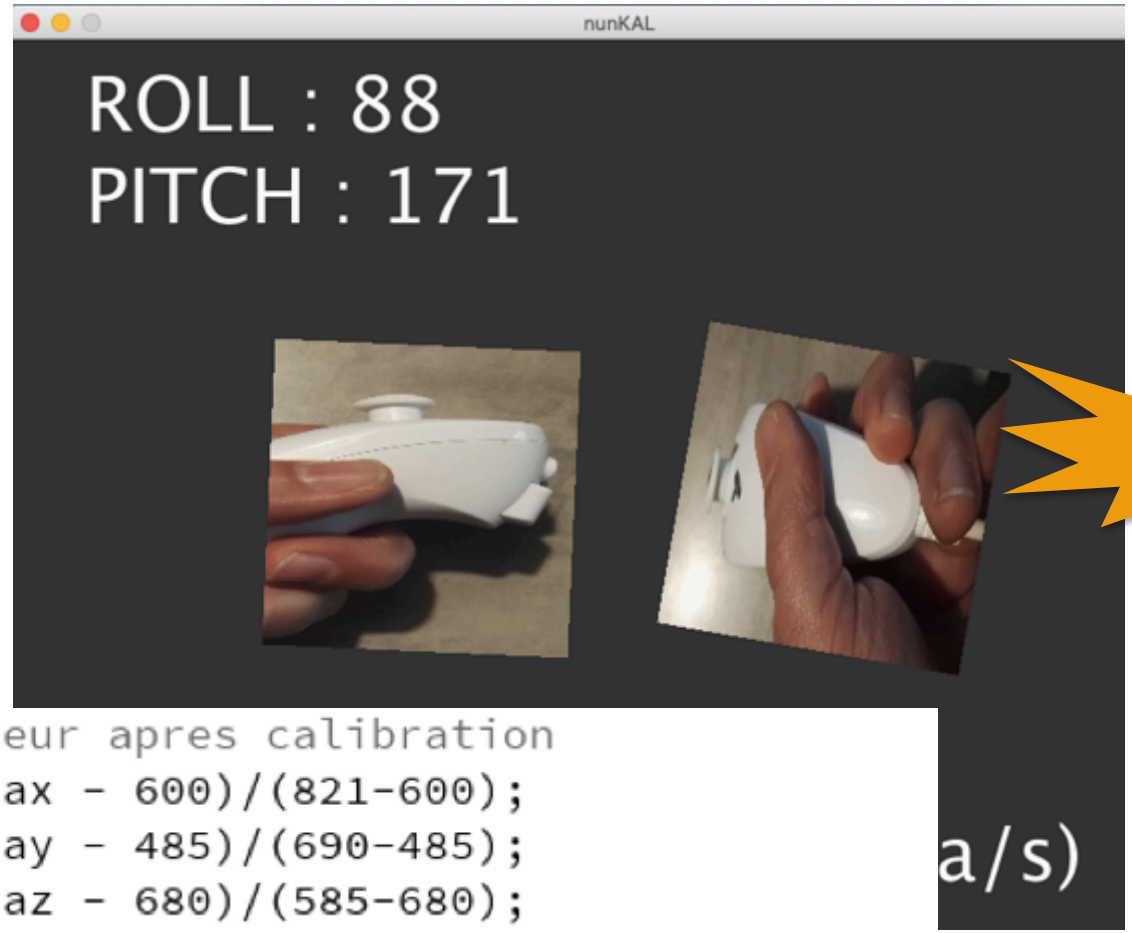
au repos : tg(pitch) = ay/az'

avec az' = √(ax^2+az^2)

tg(roll) = ax/az"

avec az" = √(ay^2+az^2)

+ filtrage alpha ou Kalman : cf cours captation d'Octobre



démo

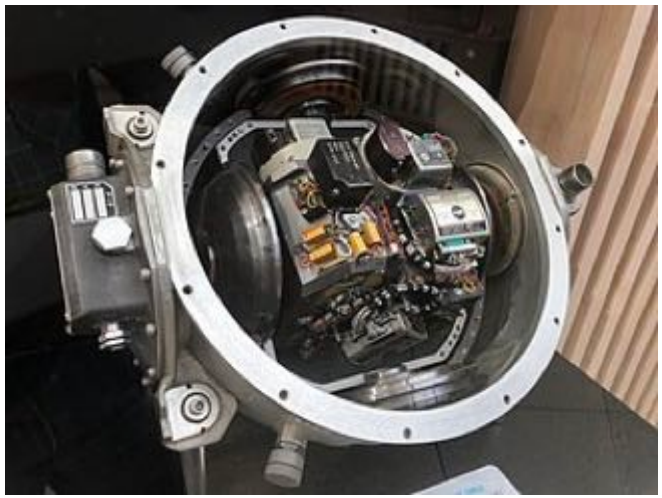
```
// valeur apres calibration
ax = (ax - 600)/(821-600);
ay = (ay - 485)/(690-485);
az = (az - 680)/(585-680);
// calcul des angles
roll = atan2(sqrt(ax*ax+az*az),ay);
pitch = atan2(sqrt(ay*ay+az*az),ax);
// avec filtrage ou sans
alpha = (filtrage)?0.99:0;
rollf = alpha*rollf + (1-alpha)*roll;
pitchf = alpha*pitchf + (1-alpha)*pitch;
// affiche les infos
```

il faut un filtrage fort
pour le nunchuk
≠ wiimote

moins précis aussi…

Centrales inertielles (IMU : inertial measurment unit)

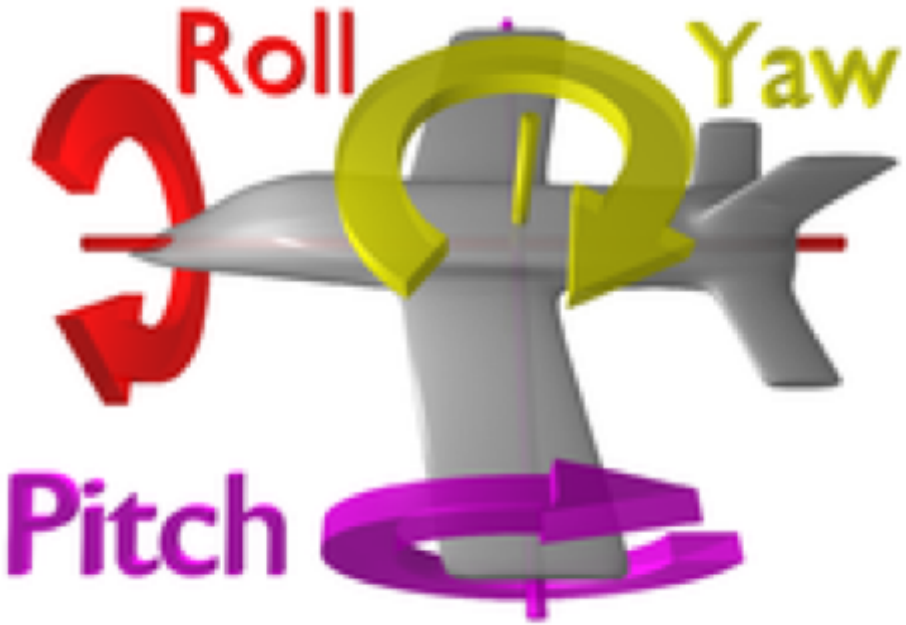
le missile V2



IMU appolo

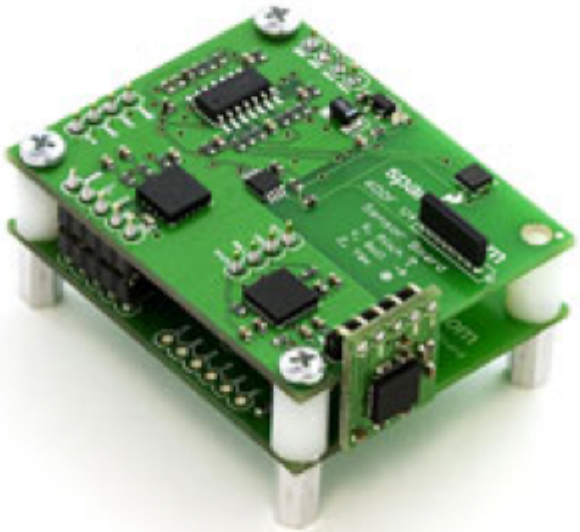
On ajoute l'angle manquant !

yaw = attitude = lacet



(images wikipedia FR et EN)

Enormes progrès en 10 ans (prix, stabilité, précision)



Sparkfun :

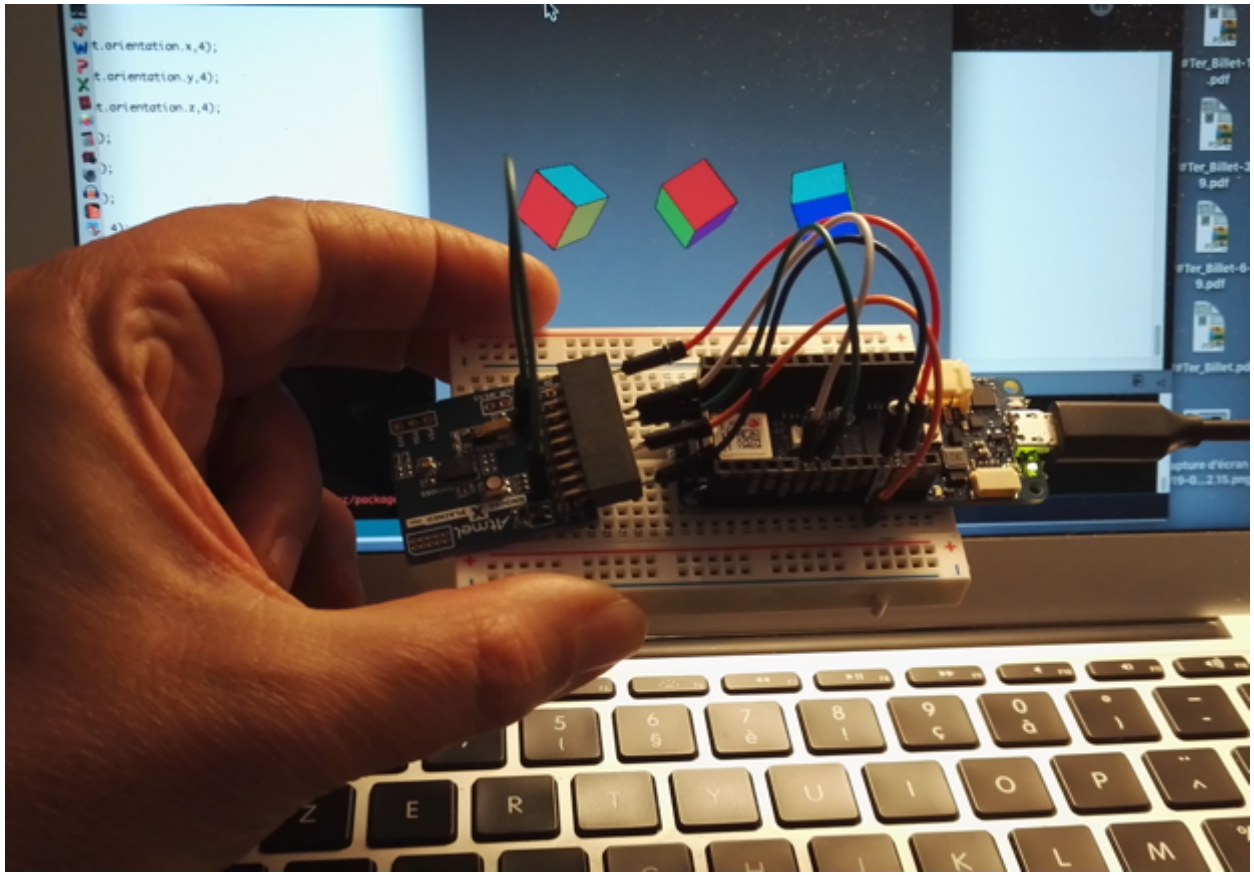
dizaine d'€
zero soft

Intersense : centaine d'€, bon soft

Xsense :

millier d'€
soft mocap

Centrale inertielle DIY



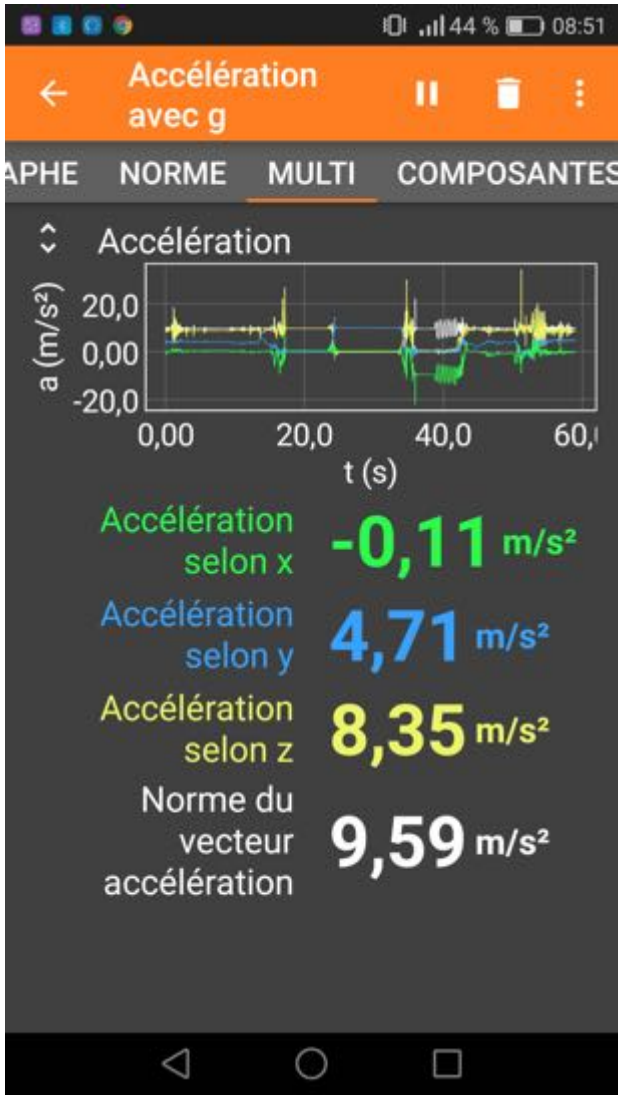
basé sur l'IMU Bosch BNO 055 (filtrage intégré)
carte ATMEL ATBNO055-XPRO (±25€)
en i2c surArduino MKR1010 (wifi)

démo

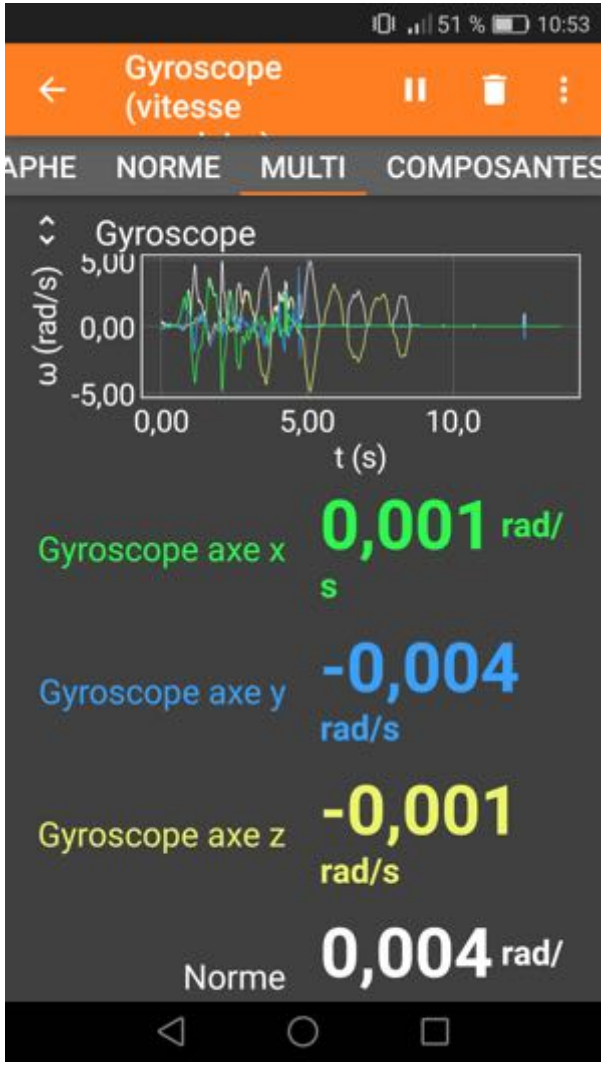
Plus simple pour explorer : un smartphone

Appli Phyphox

acceleromètres



gyroscopes



A lire !

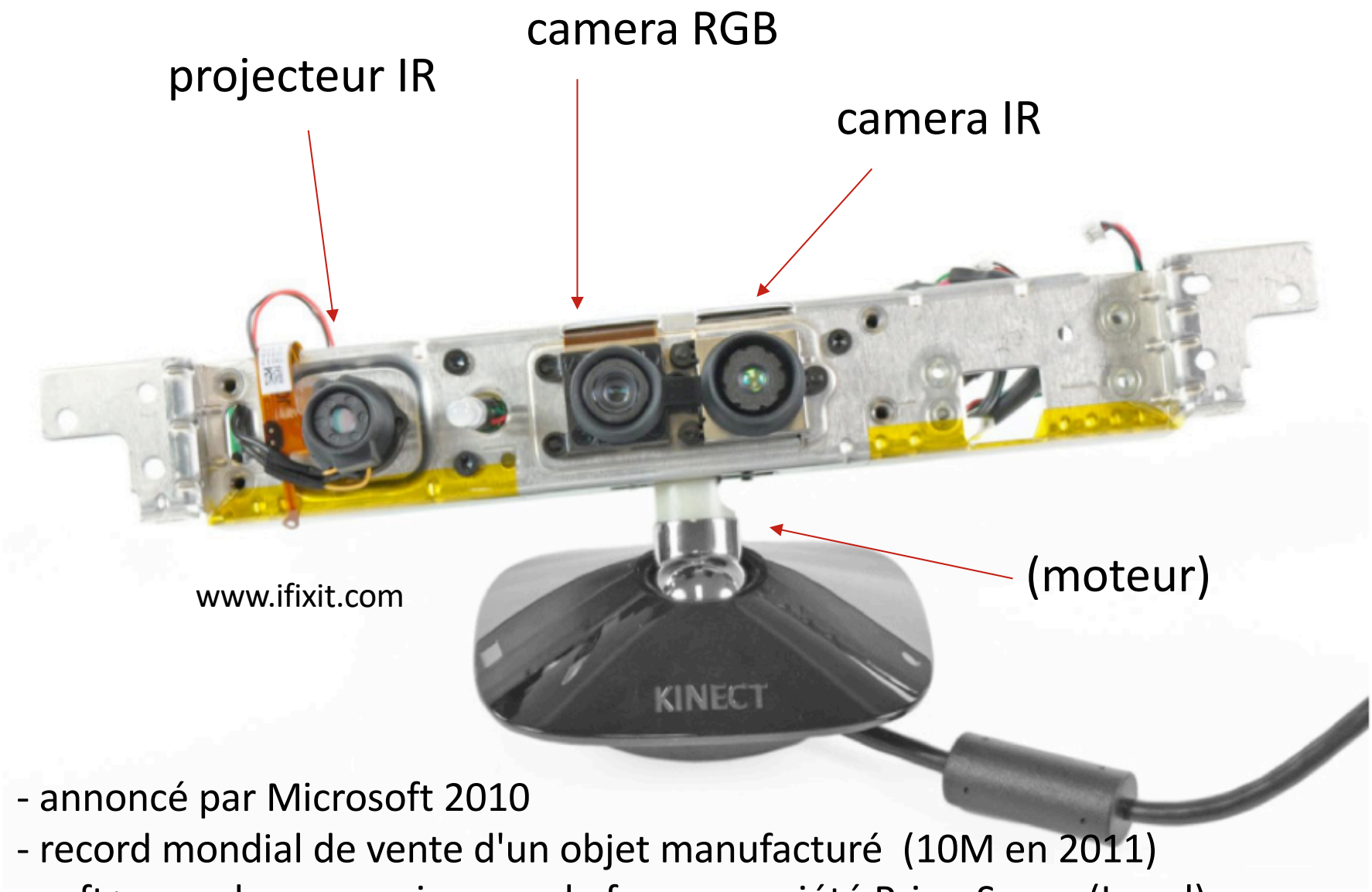
ULYSSE DELABRE
SMARTPHONIQUE
Expériences de physique
avec un smartphone
DUNOD

Un exemple : "collective loops"

video

"Designing Collaborative Co-Located Interaction for an Artistic Installation"
O. Mubarak, P. Cubaud, D. Bihanic, S. Bianchini, INTERACT'2017

Kinect



- annoncé par Microsoft 2010
- record mondial de vente d'un objet manufacturé (10M en 2011)
- soft+puce de reconnaissance de forme : société PrimeSense (Israel)

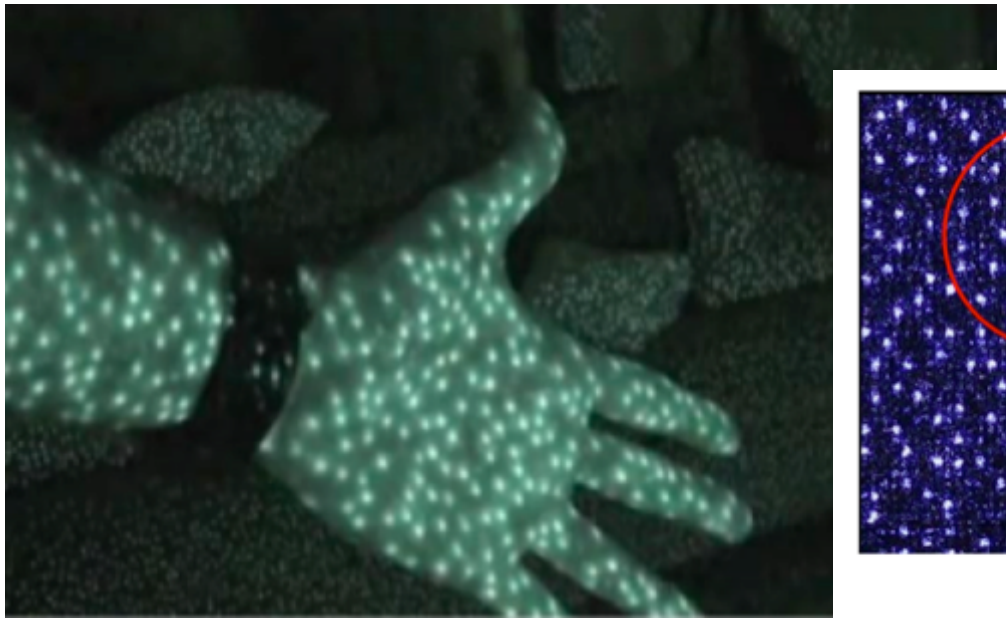
Principe de la reconstruction 3D :

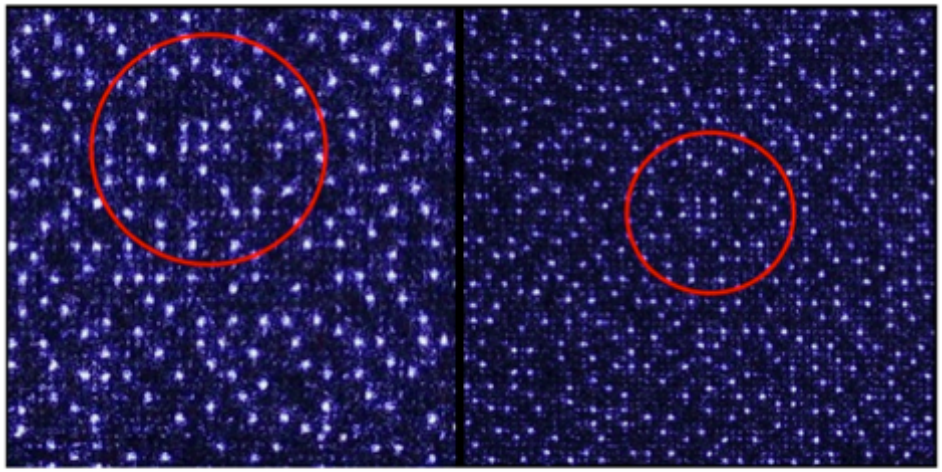
-le projecteur IR diffuse un semis de point sur les surfaces à analyser

-la caméra IR récupère l'image

-la position 3D est déduite en mixant 2 méthodes

(1) la dimension des points (2) la triangulation





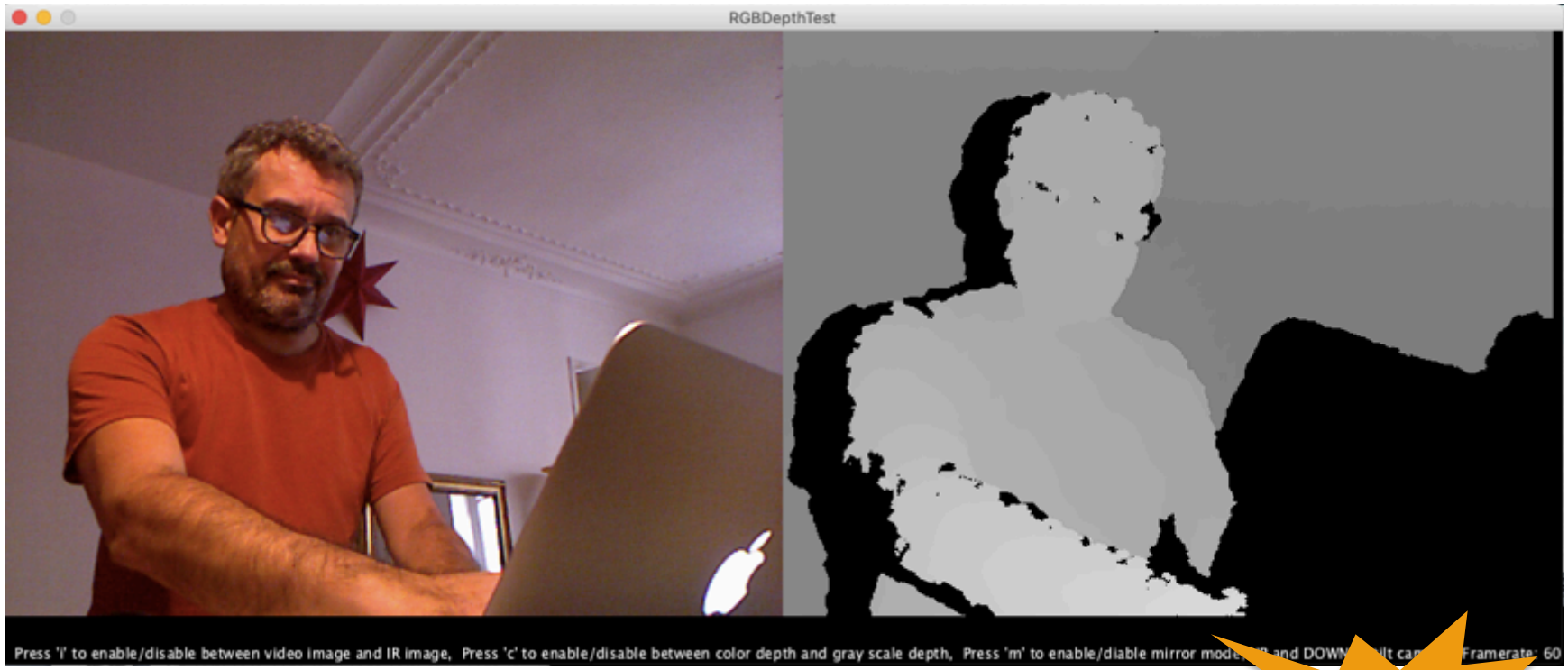
Pas tout à fait aléatoire !

il y a 3 types de motifs, adaptés aux distances

=> bon topo en ligne: H. Wannous, Telecom Lille

A lire sur la kinect :

Processing 3 : librarie Open Kinect de Shiffman
(alternative à SimpleNI - plus maintenue ?)



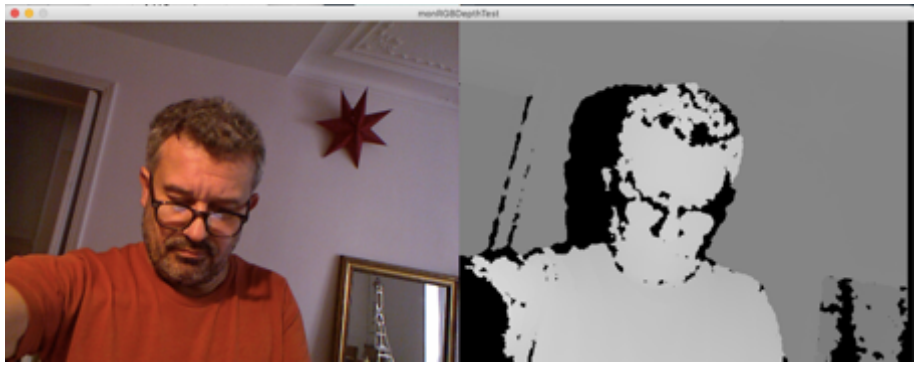
exemple de la librairie

démo

La carte de profondeur (depthimage)

monRGBDepthTest

```
import org.openkinect.freenect.*;
import org.openkinect.processing.*;

Kinect kinect;
void setup() {
  size(1280, 520);
  kinect = new Kinect(this);
  kinect.initDepth();
  kinect.initVideo();
}
void draw() {
  background(0);
  image(kinect.getDepthImage(), 640, 0);
  image(kinect.getVideoImage(), 0, 0);
}
```



Exemple d'utilisation : fabrication d'un pointeur

avec le point le plus proche dans la depthmap comme pointeur

G. Borensten "Making things see" O'Reilly

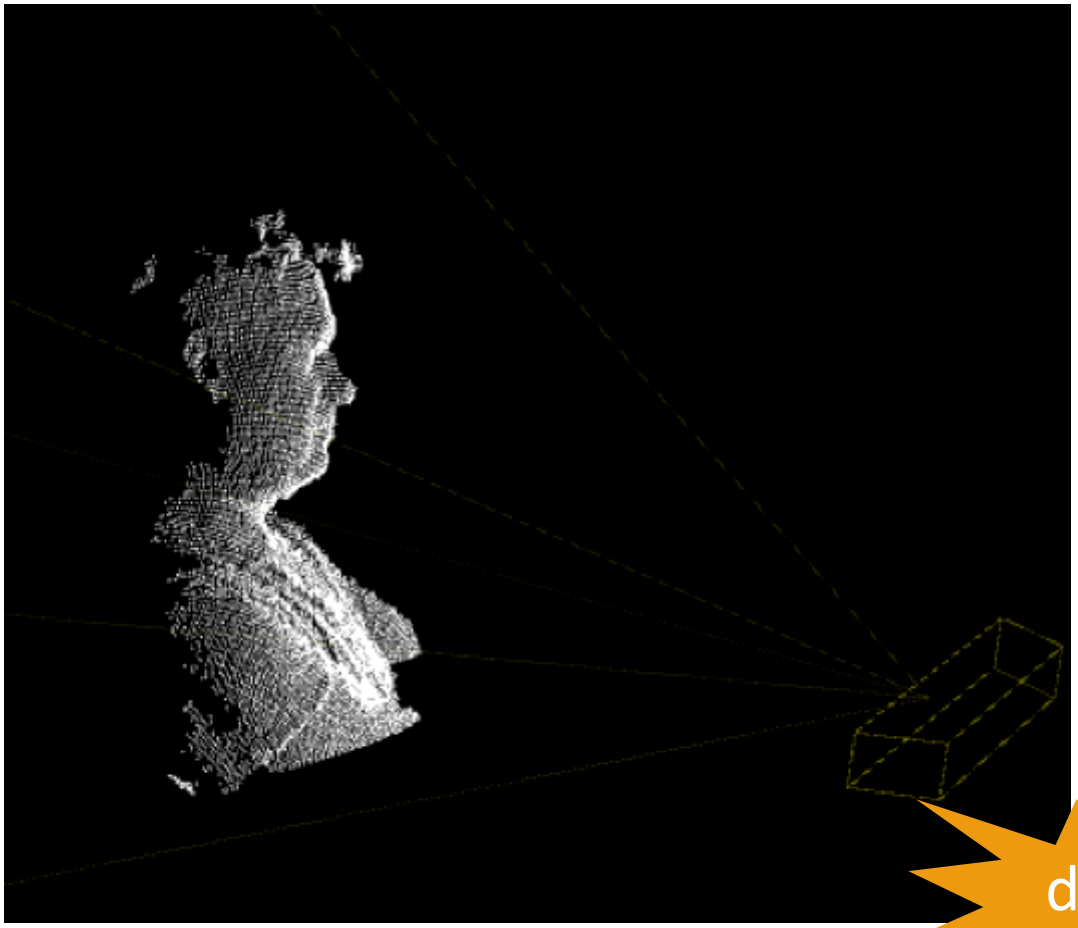
Code du livre

```
import SimpleOpenNI.*;
SimpleOpenNI kinect;

int closestValue;
int closestX;
int closestY;

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

```
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);
}
```

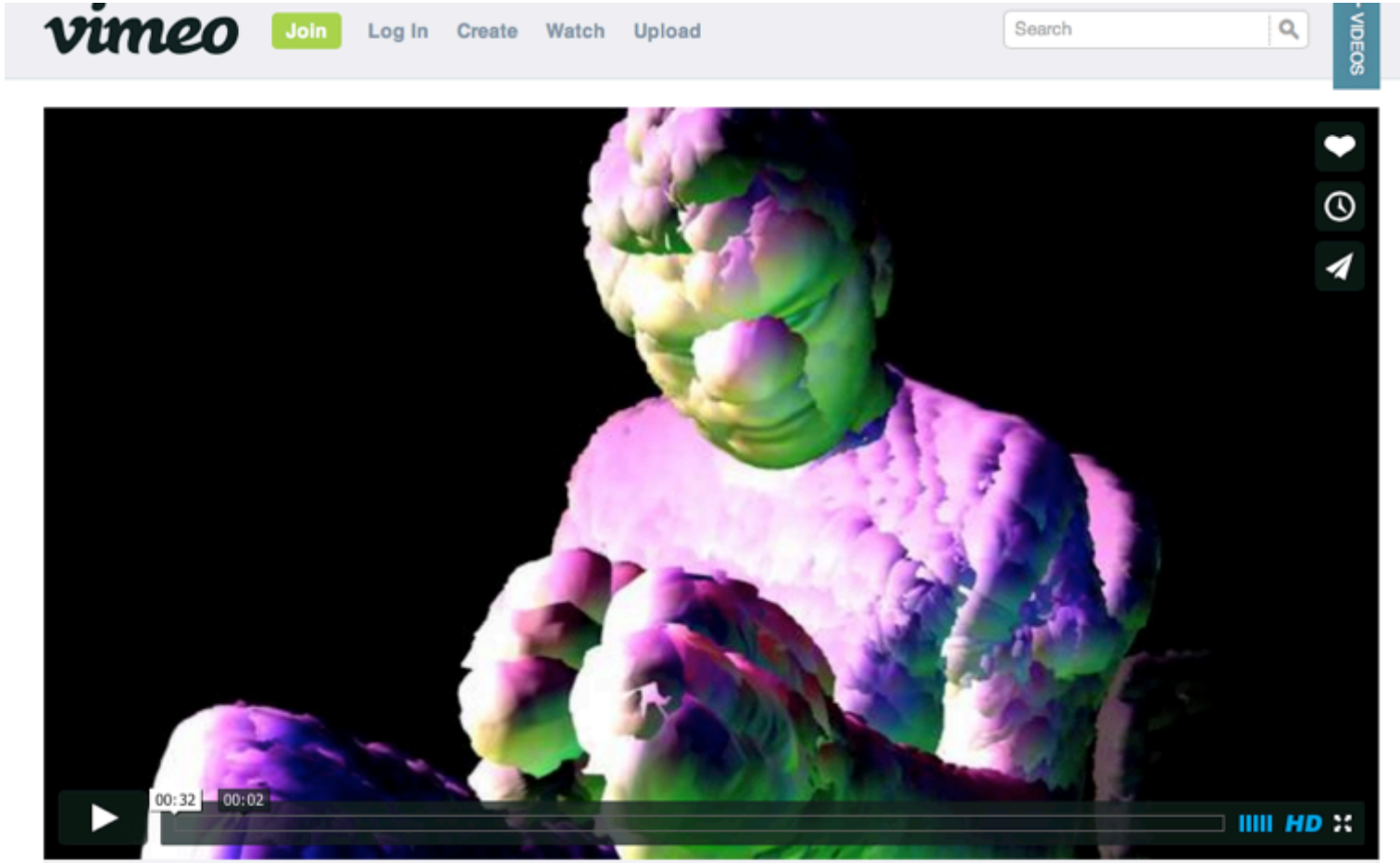
il faudra
filtrer le point

Reconstruction 3D basée sur la depthmap



demo "DepthMap3d" de SimpleOpenNI

reprise avec OpenKinect


vimeo
Join
Log In
Create
Watch
Upload
Search
VIDEOS
00:32
00:02
HD
Body Dysmorphic 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

video

A voir ...

Microsoft Translator | Choose language

Microsoft Research

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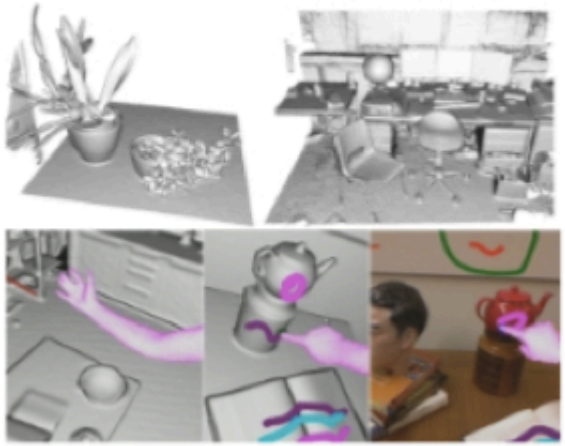
KinectFusion Project Page



This project investigates techniques to track the 6DOF position of handheld depth sensing cameras, such as Kinect, as they move through space and perform high quality 3D surface reconstructions for interaction. Other collaborators (missing from the list below): Richard Newcombe (Imperial College London); David Kim (Newcastle University & Microsoft Research); Andy Davison (Imperial College London)

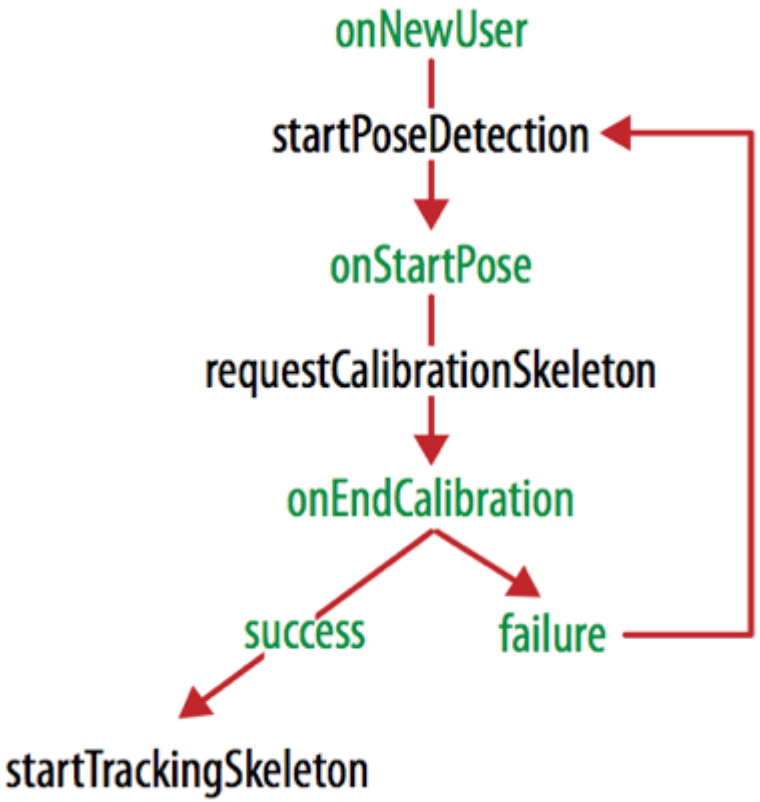
Publications

- Shahram Izadi, David Kim, Otmar Hilliges, David Molyneaux, Richard Newcombe, Pushmeet Kohli, Jamie Shotton, Steve Hodges, Dustin Freeman, Andrew Davison, and Andrew Fitzgibbon, KinectFusion: Real-time 3D Reconstruction and Interaction Using a Moving Depth Camera, ACM Symposium on User Interface Software and Technology, October 2011
- Richard A. Newcombe, Shahram Izadi, Otmar Hilliges, David Molyneaux, David Kim, Andrew J. Davison, Pushmeet Kohli, Jamie Shotton, Steve Hodges, and Andrew Fitzgibbon, KinectFusion: Real-Time Dense Surface Mapping and Tracking, in *IEEE ISMAR*, IEEE, October 2011

Videos

+ des centaines d'autres projets de recherche

Suivi du corps : demo "User" de simpleNI

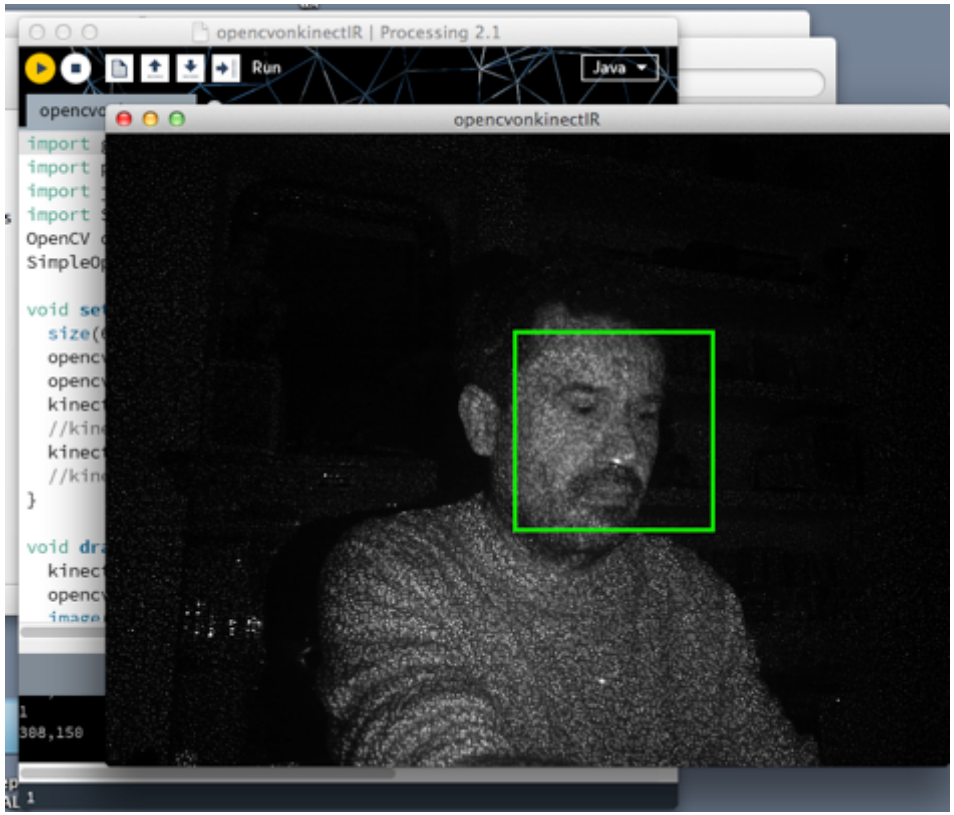


G. Borensten "Making things see" O'Reilly

- séparation fond/humains
- identifications des humains

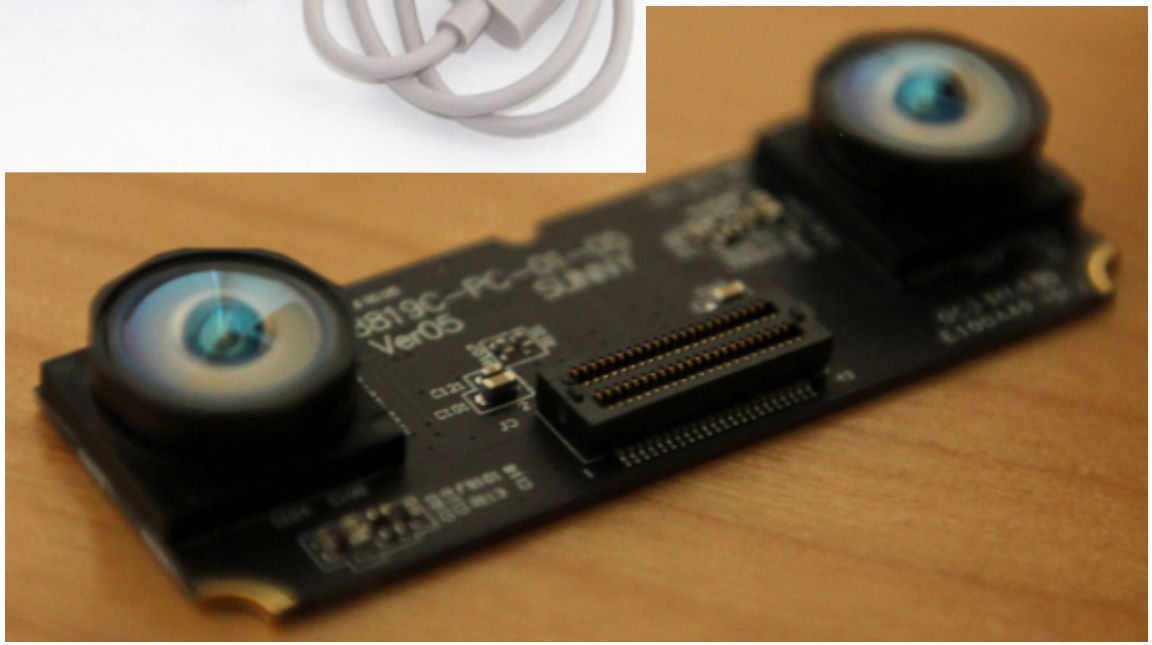
Couplage Kinect - openCV

avec la depthmap



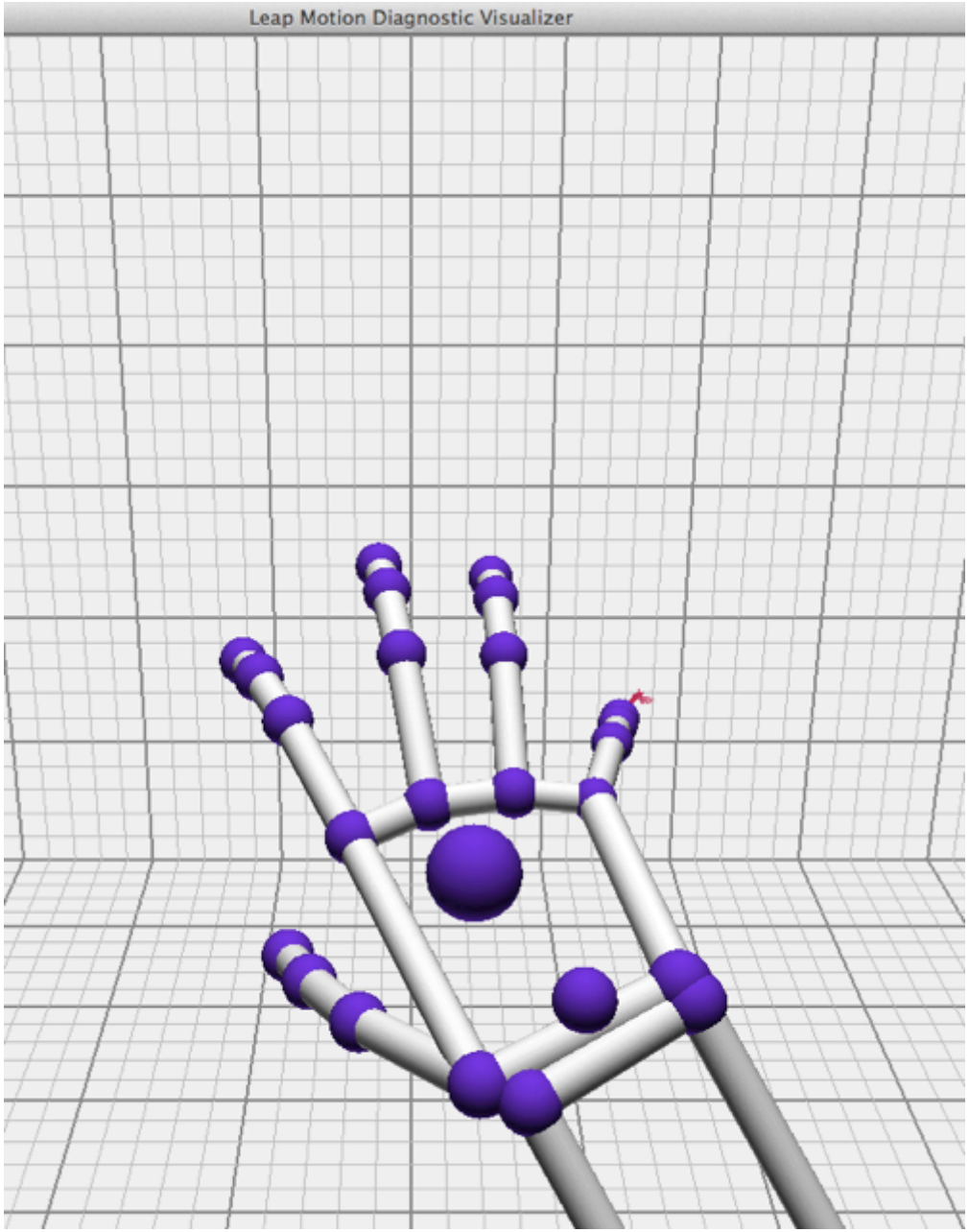
avec la camera IR

A voir aussi : Leap Motion



www.ifixit.com

Application
de test



demo "e1_basic" avec la lib pour Processing

e1_basic | Processing 2.1

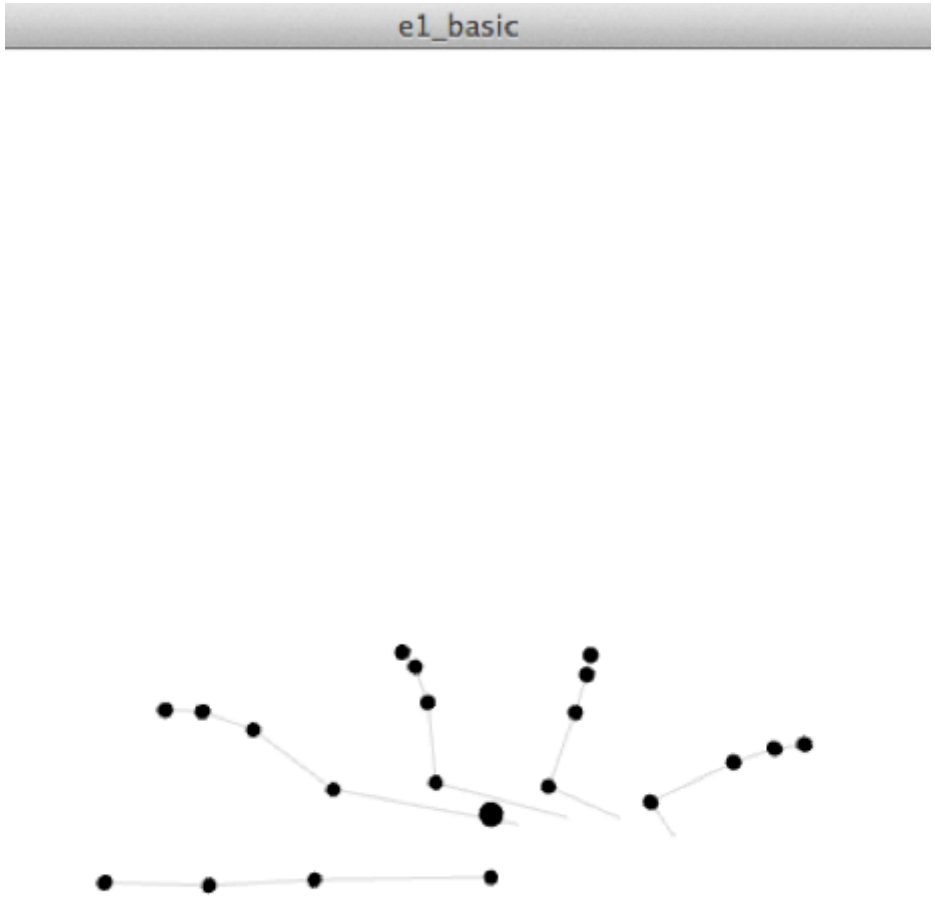
Run

e1_basic

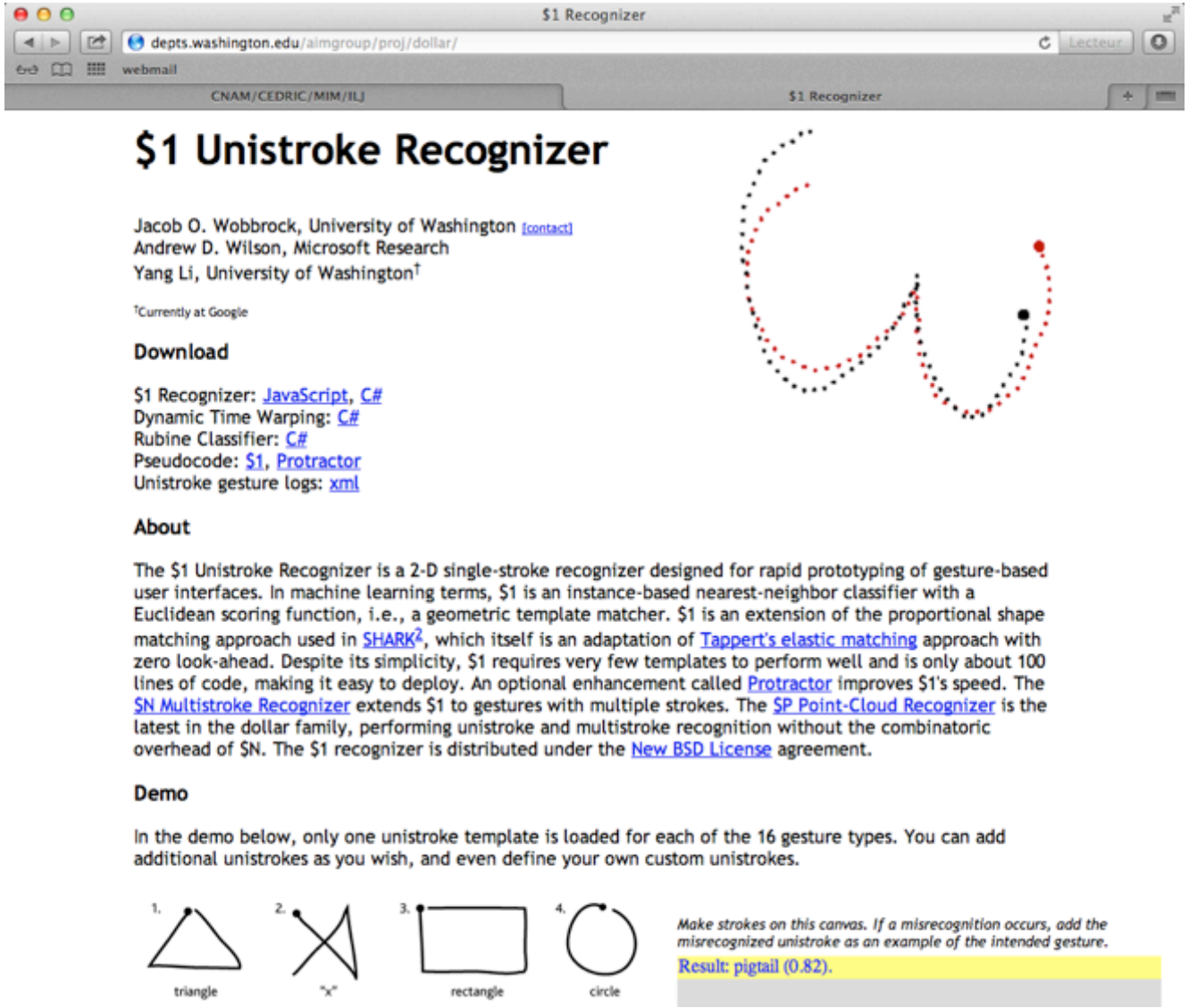
```
import de.voidplus.leapmotion.*;

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();
```

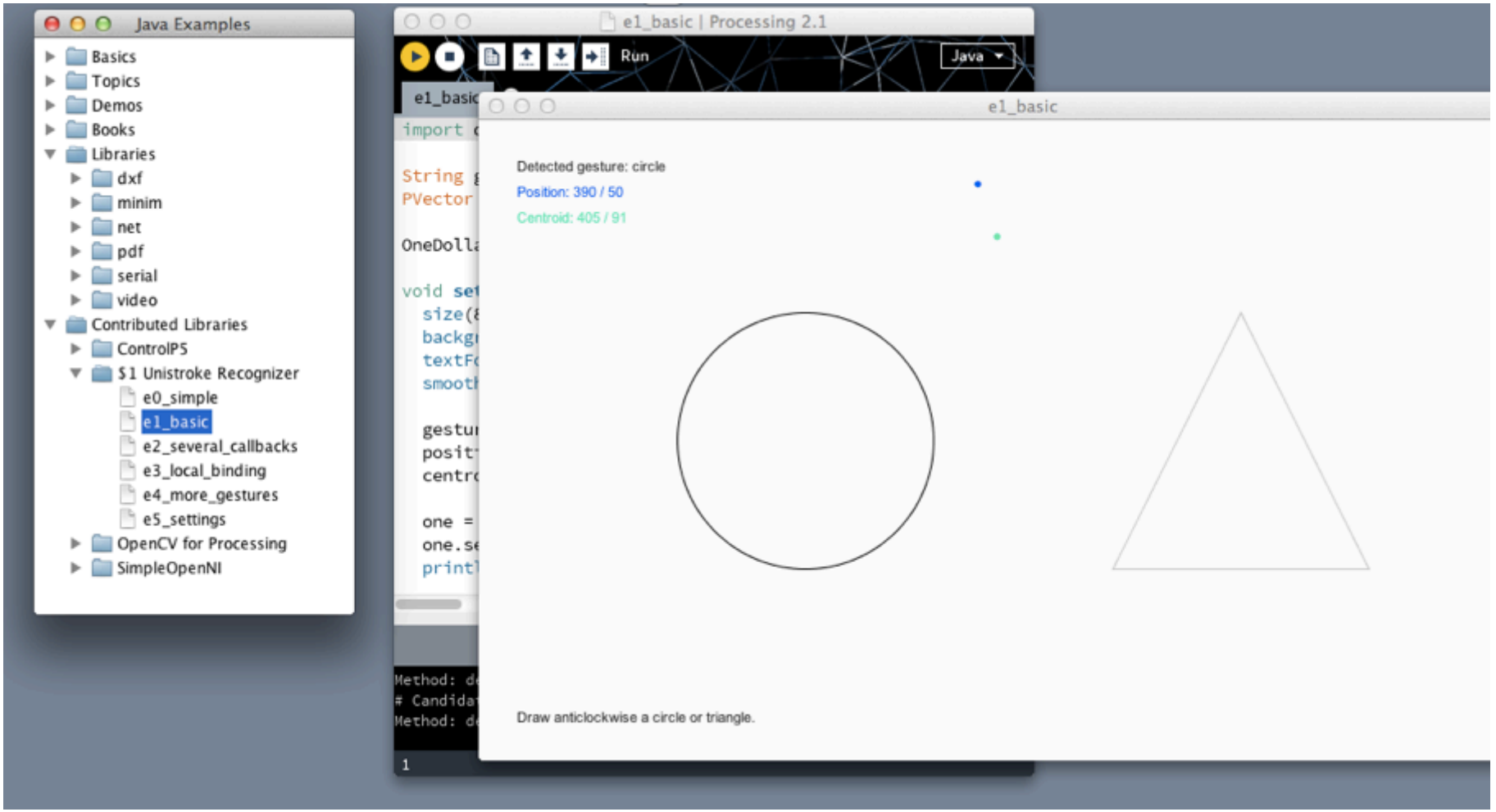
```
# LeapMotion-Library v1.1.2 - LeapMotion-SDK v0.8.1.6221 -
https://github.com/voidplus/leap-motion-processing
```

1



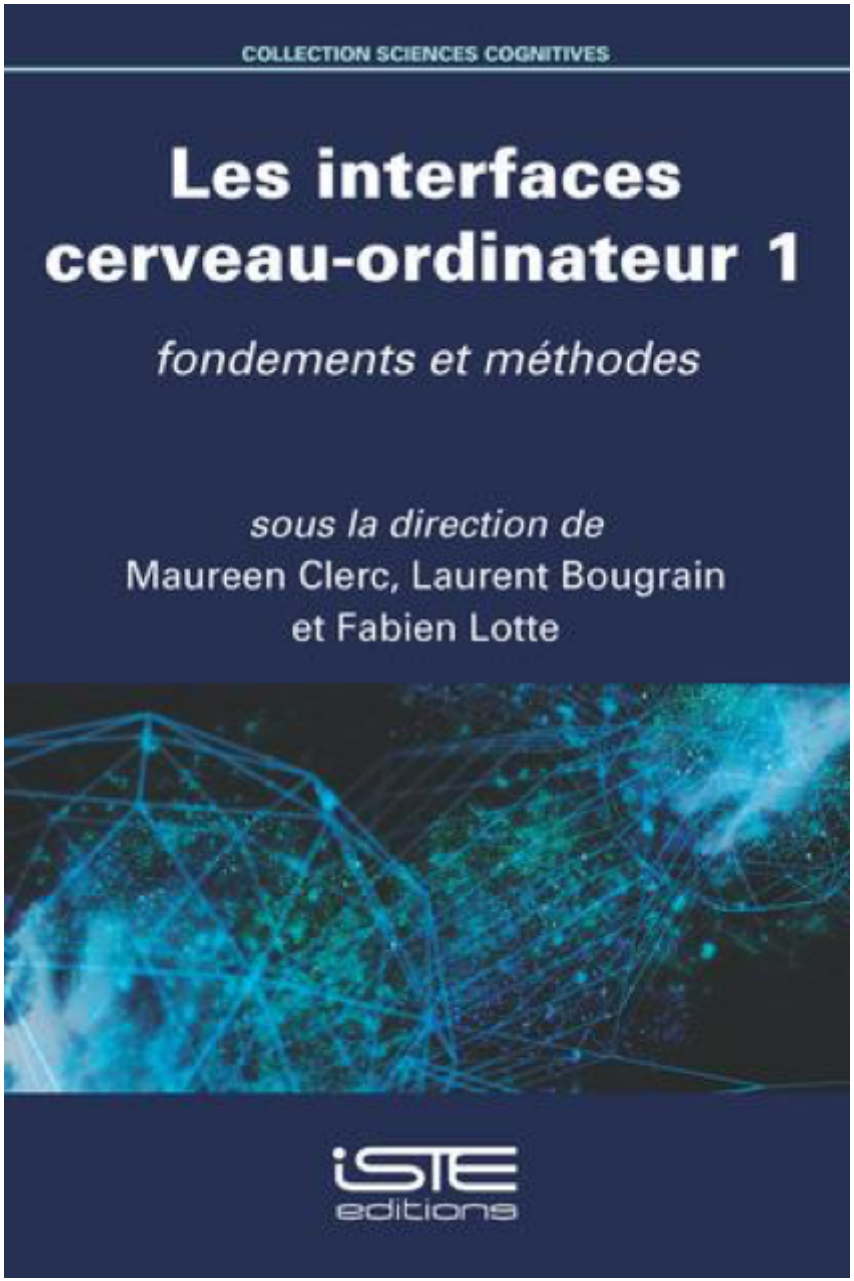
ET ENCORE : La reconnaissance de tracés simples

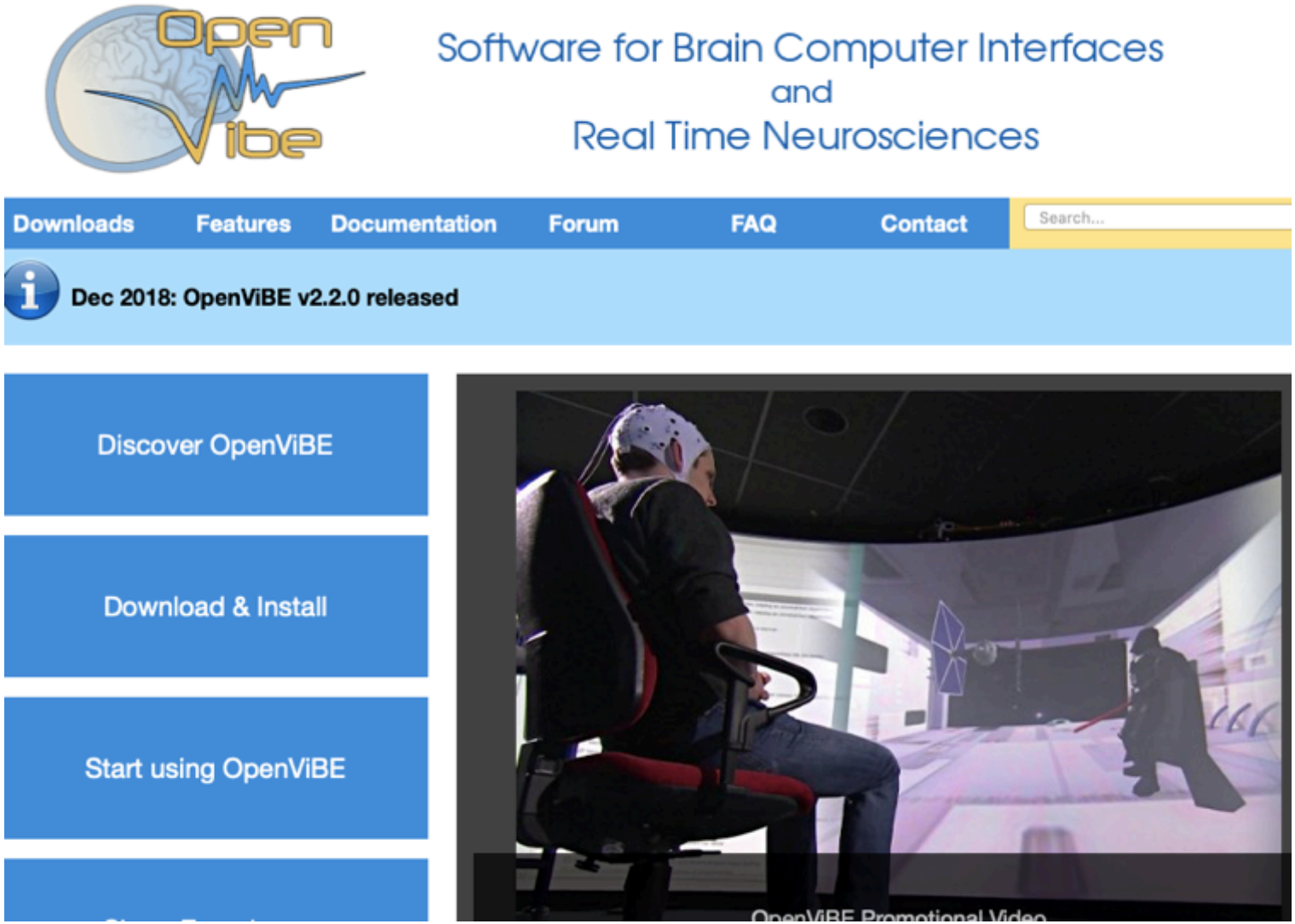




Prendre le temps de l'évaluer !

mais après ?


COLLECTION SCIENCES COGNITIVES
Les interfaces cerveau-ordinateur 1
fondements et méthodes
sous la direction de
Maureen Clerc, Laurent Bougrain
et Fabien Lotte
iSTE
editions

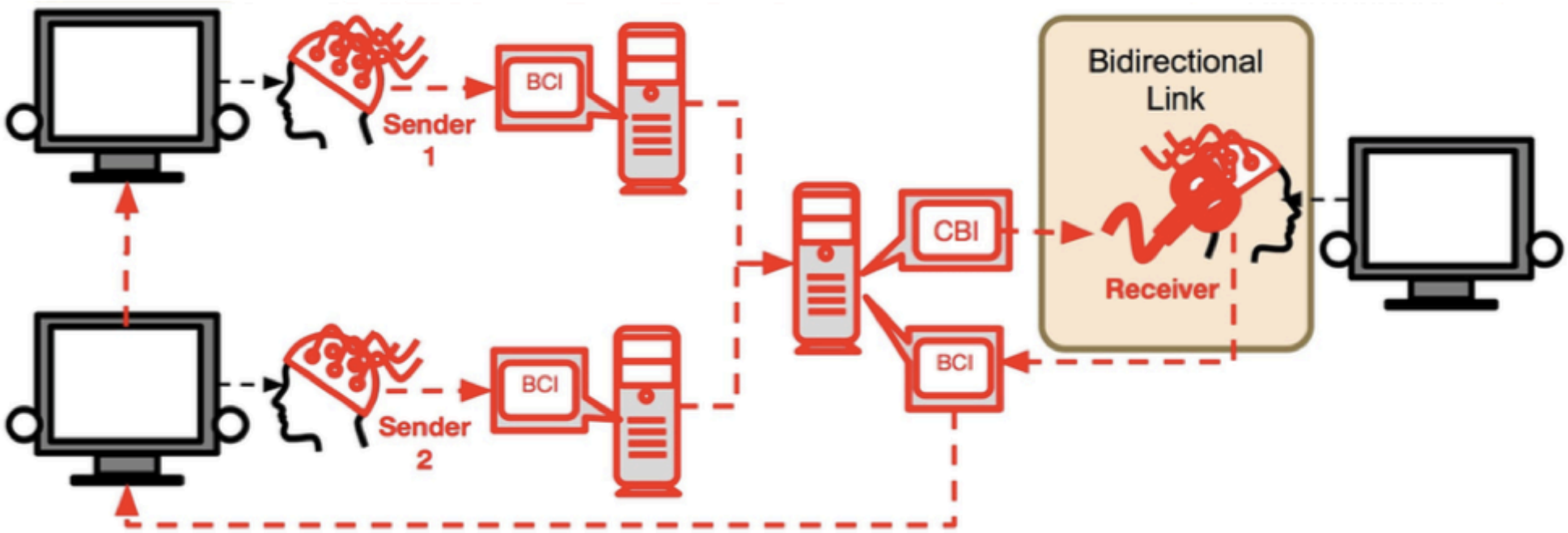


openVIBE de l'IRISA (Rennes)

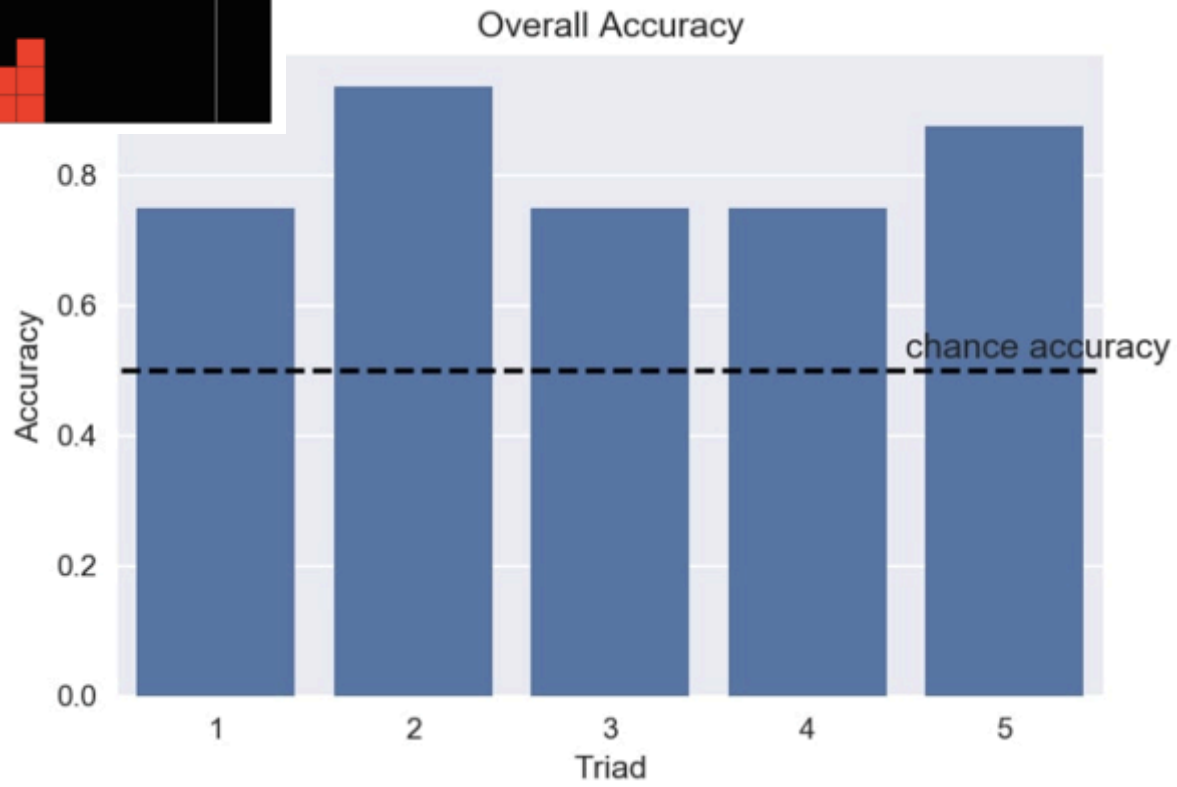
en 2018 :

BrainNet: A Multi-Person Brain-to-Brain Interface for Direct Collaboration Between Brains

Linxing Jiang[1,*], Andrea Stocco[2,3,4,5], Darby M. Losey[6,7,8], Justin A. Abernethy[2,3], Chantel S. Prat[2,3,4,5], and Rajesh P. N. Rao[1,4,5,+]



Waiting on Senders
0
0
1
You successfully cleared a line
1
You successfully cleared a line

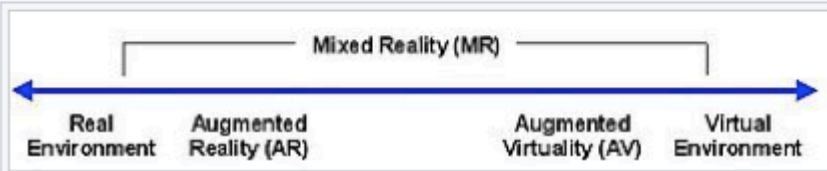

Overall Accuracy
0.8
0.6
0.4
0.2
0.0
Accuracy
chance accuracy
1
2
3
4
5
Triad

(3) Réalité étendue

Reality–virtuality continuum

From Wikipedia, the free encyclopedia

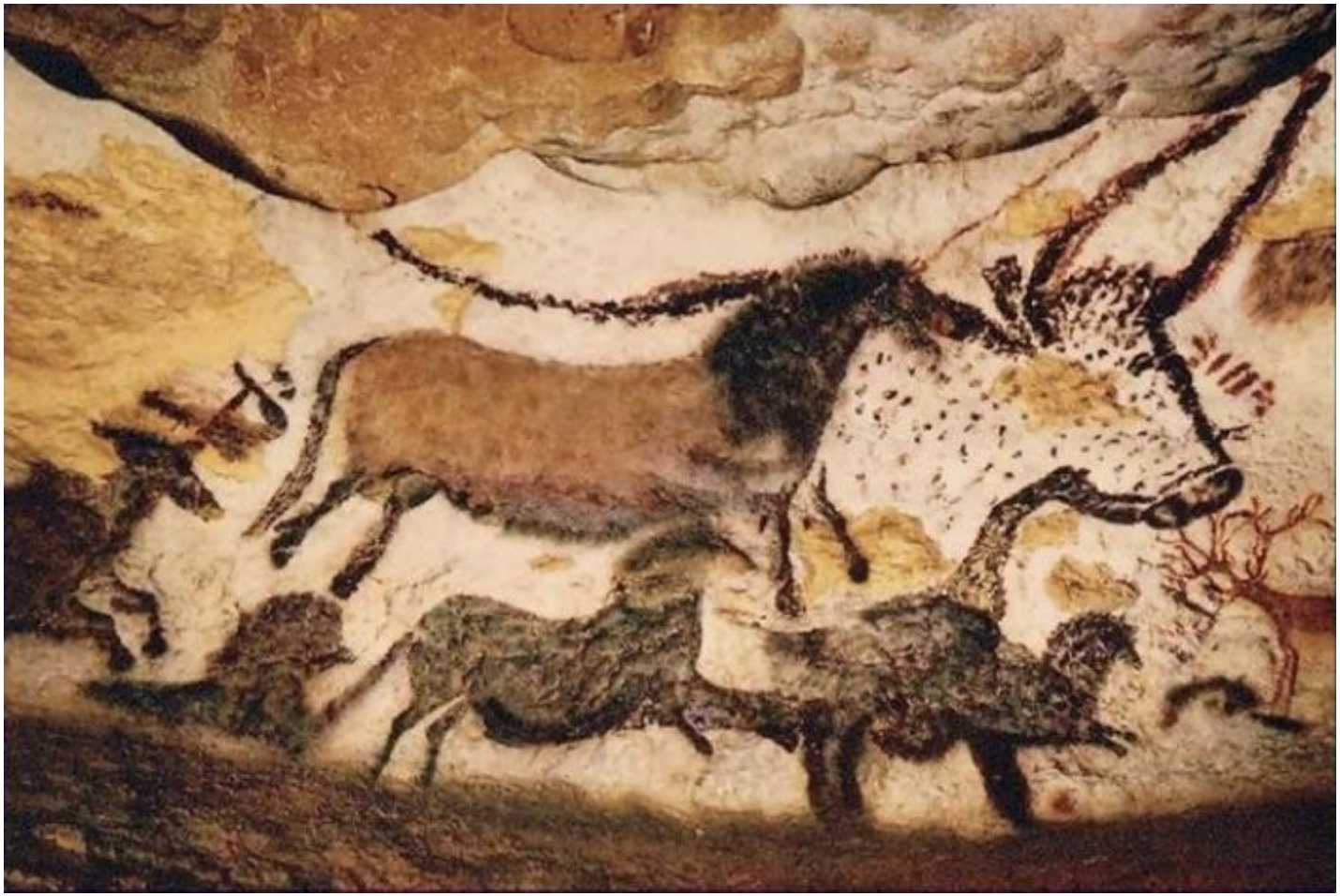
The **virtuality continuum** is a continuous scale ranging between the completely virtual, a virtuality, and the completely real, reality. The **reality–virtuality continuum** therefore encompasses all possible variations and compositions of real and virtual objects. It has been described as a concept in new media and computer science, but in fact it could be considered a matter of anthropology.[*clarification needed*][*citation needed*] The concept was first introduced by Paul Milgram.[1]



Reality–virtuality continuum

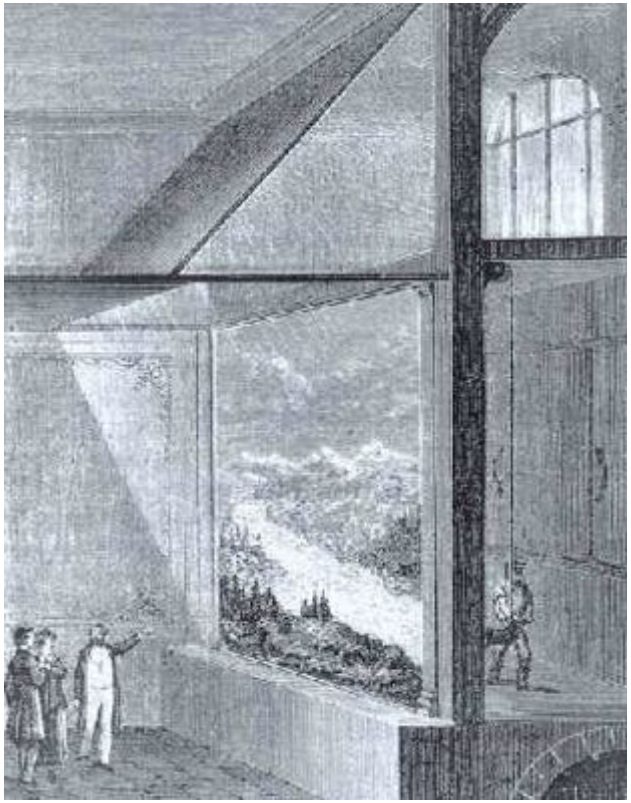
The area between the two extremes, where both the real and the virtual are mixed, is called mixed reality. This in turn is said to consist of both augmented reality, where the virtual augments the real, and augmented virtuality, where the real augments the virtual.

réalité ?



Lascaux -15000
réalité virtuelle ?

mon salon
réalité augmentée ?



Le diorama de Daguerre (1822)

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

Rue Léon Jouhaux (Xème)

Perception
du relief :

Nombreux
Indices
- Monoculaires
- Binoculaires

Ex. de système binoculaire : le "mexicain"

http://www.berezin.com/3d/holmes.htm

(en kit 45€)

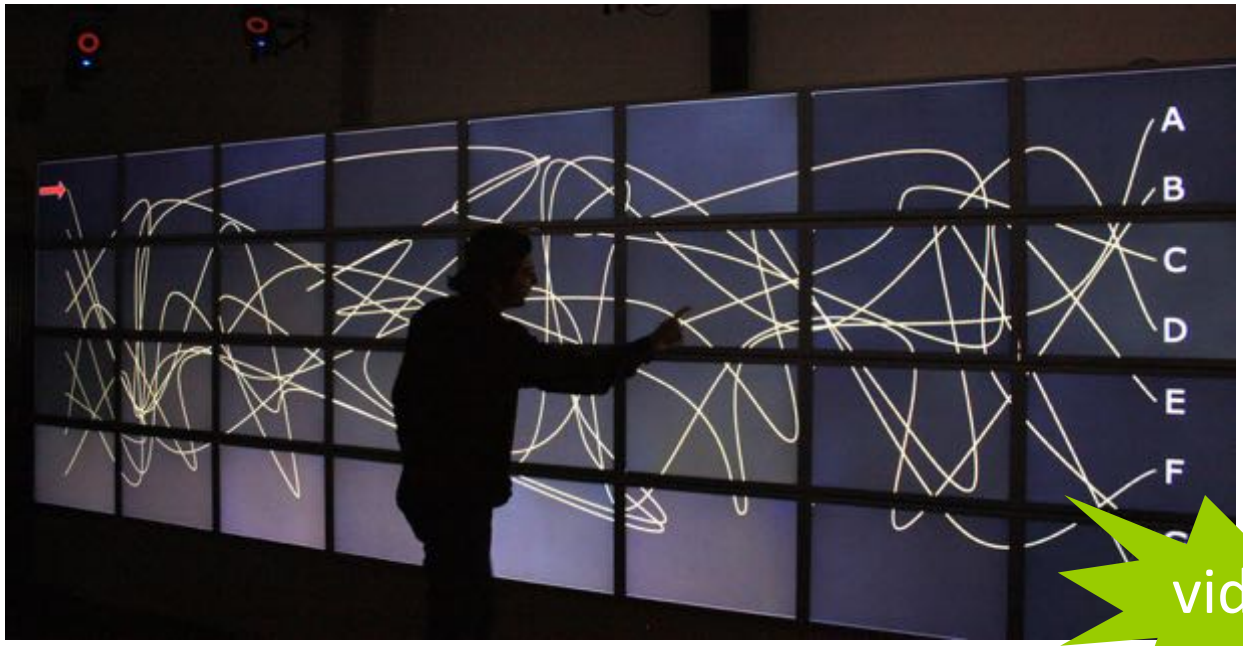
En monoculaire ?

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

video

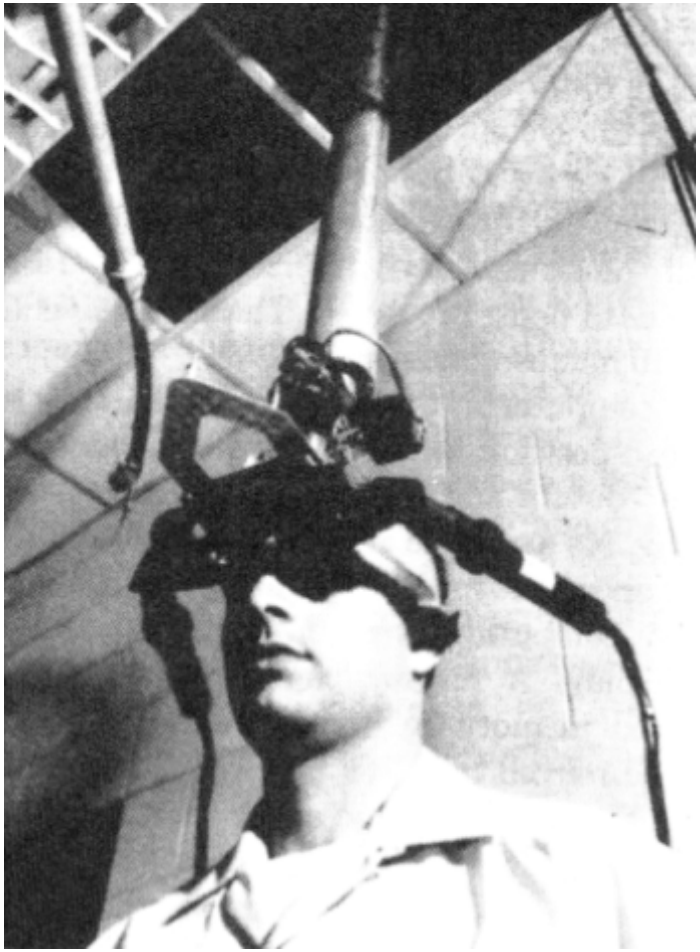
<= 11M en 2015

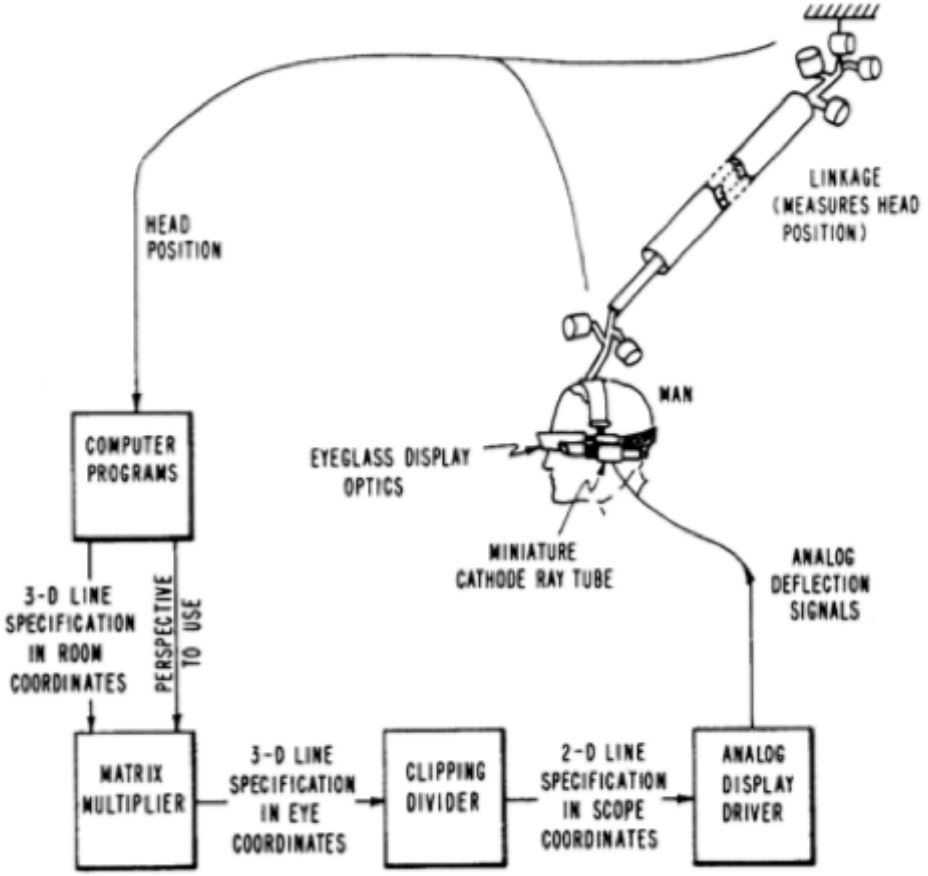
Reprise sur mur d'écrans (INRIA+CNAM, 2012)



video

- 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)





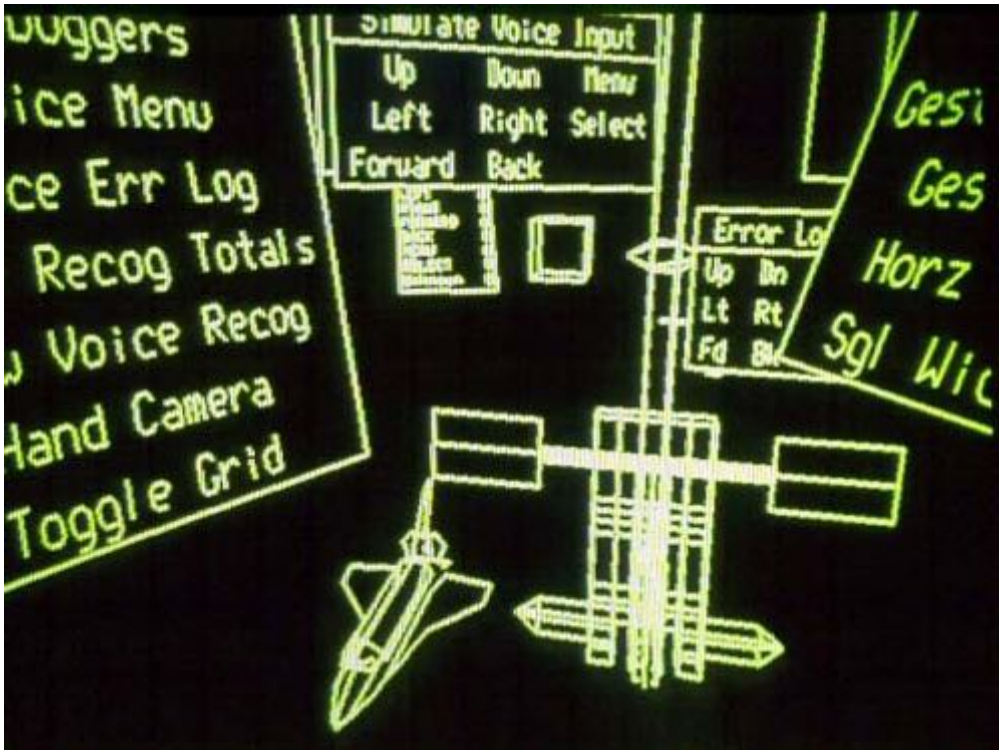
I. Sutherland (1968)

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

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



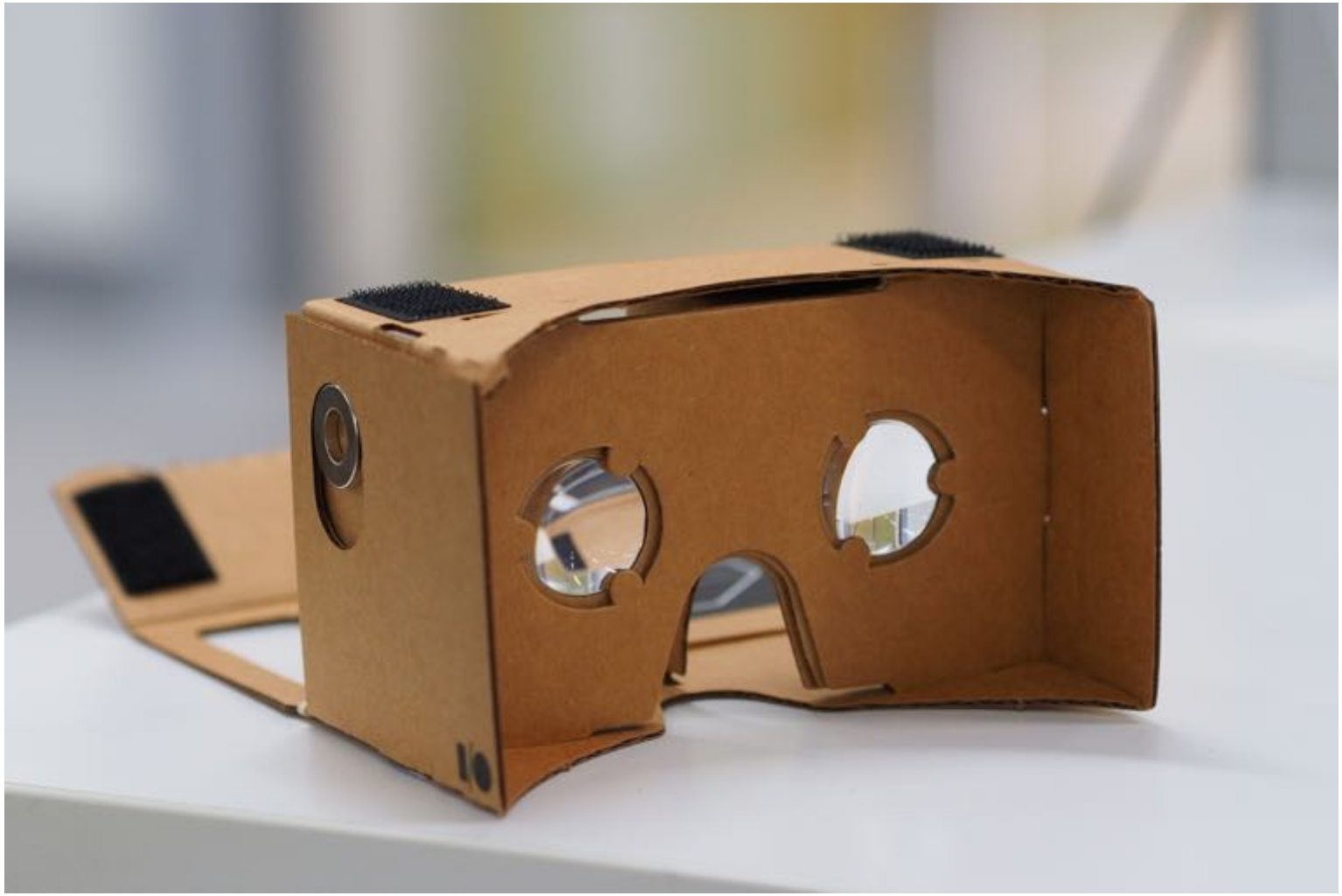
http://itofisher.com/sfisher/

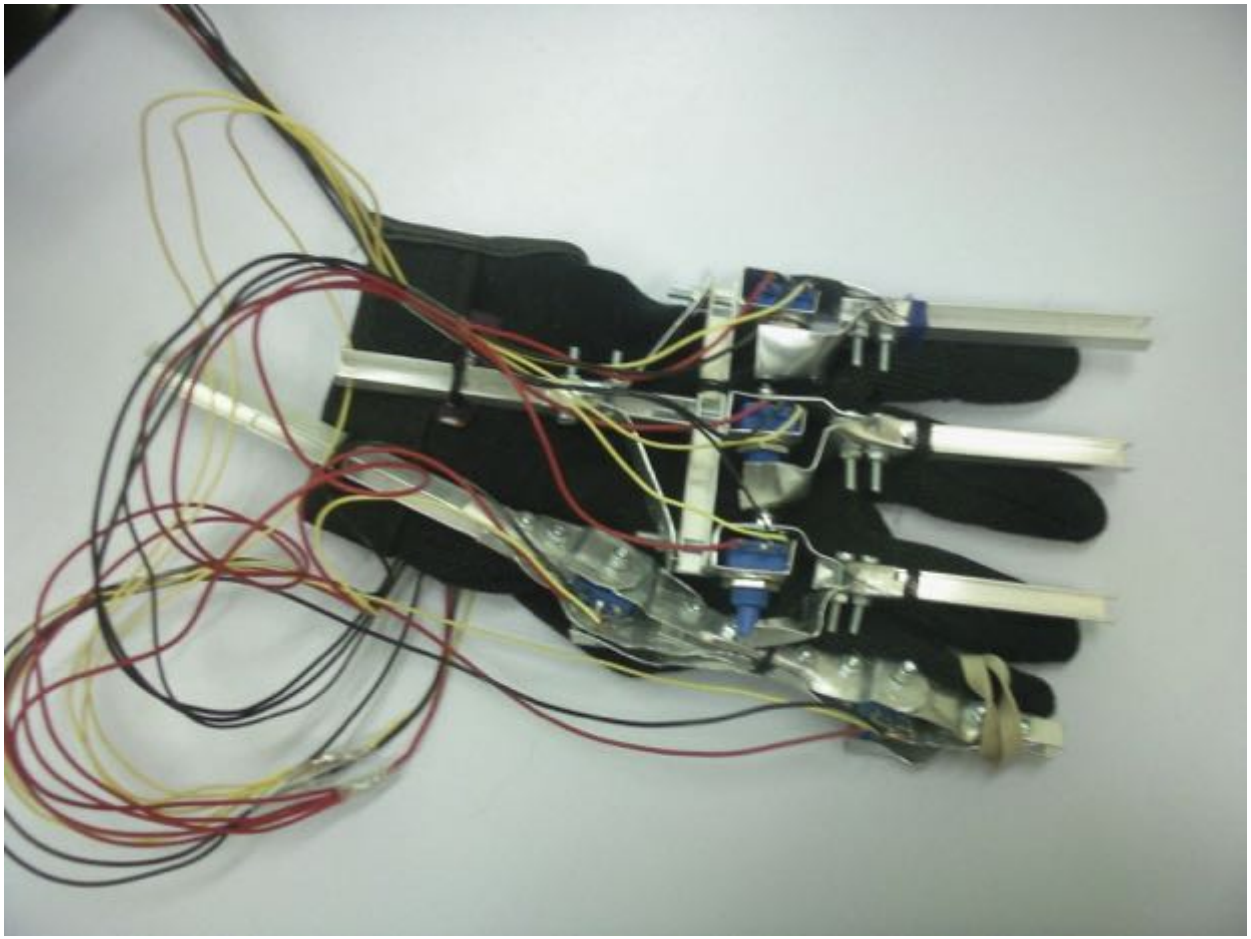
http://itofisher.com/sfisher/portfolio/files/viewlab.html

http://www.jaronlanier.com/

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

Google cardboard

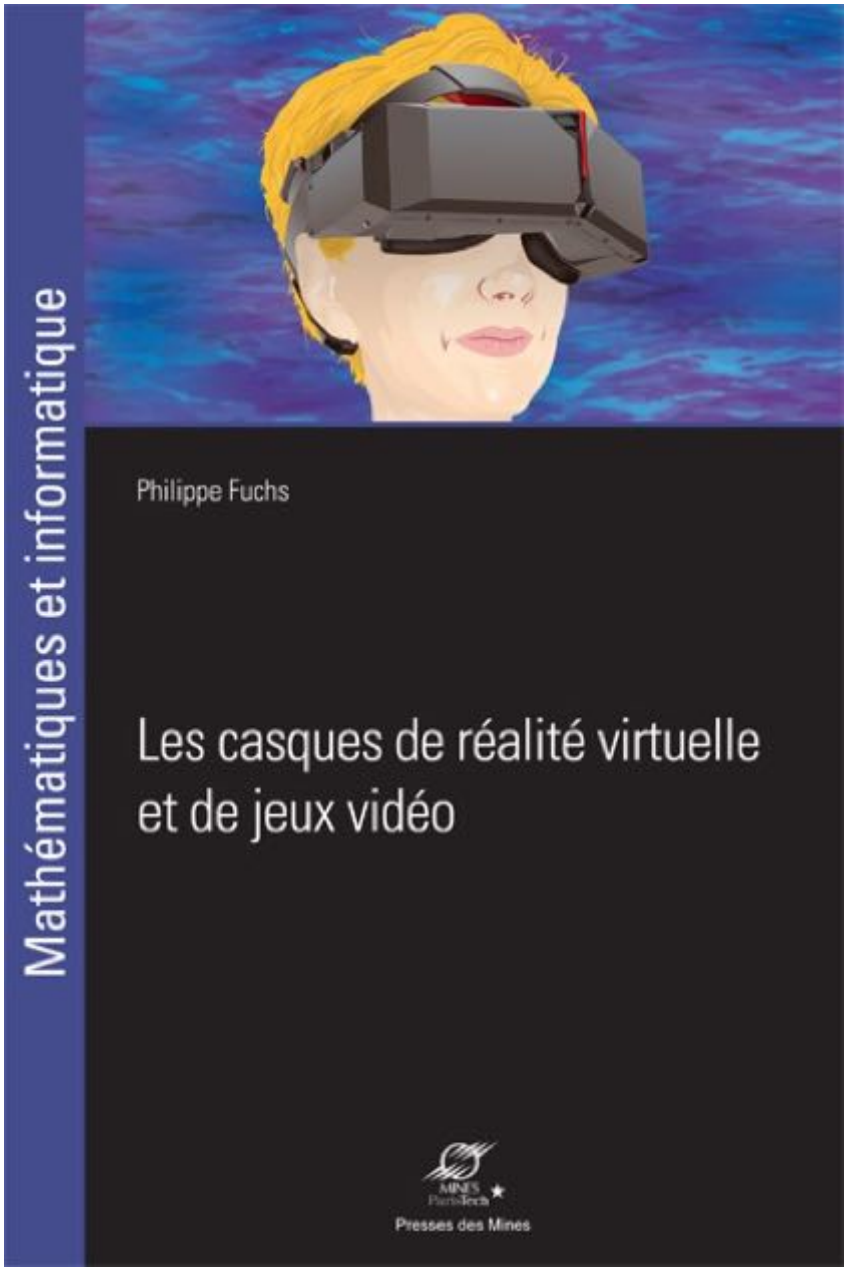




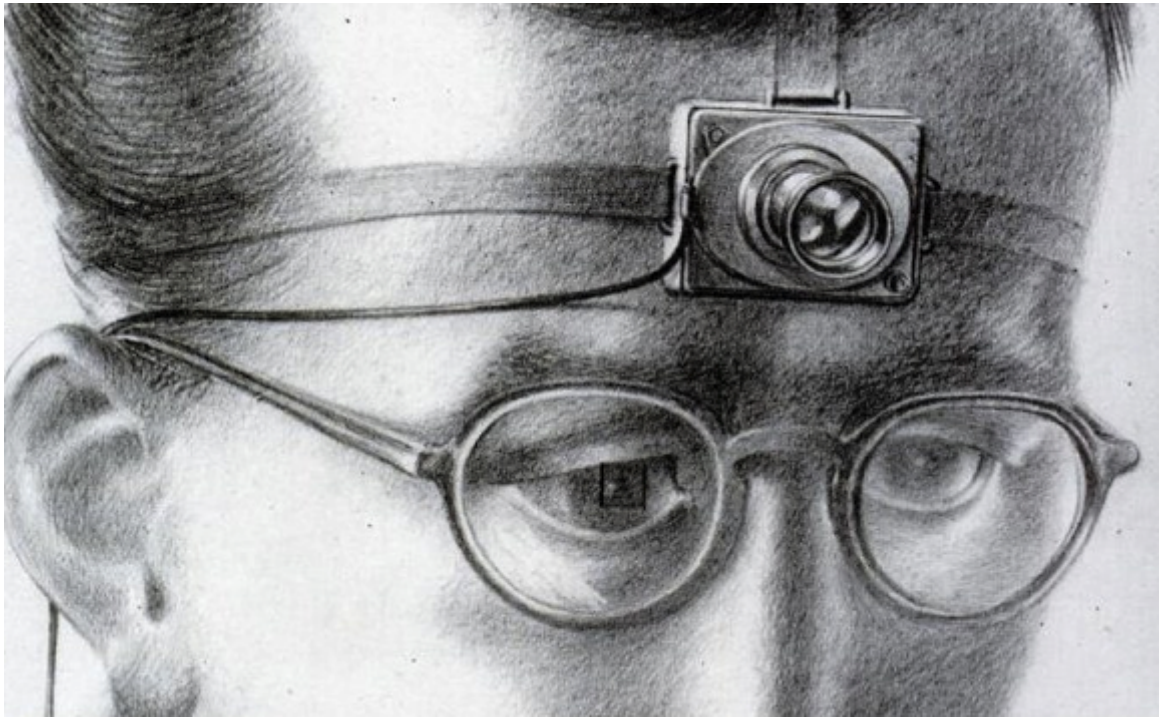
gant de captation (élève ingénieur cnam paris, 2010)

paru en 2016

+ le traité de la RV
Fuchs et al.



Sortie nov. 2020
30 €



V. Bush. "As we may think" 1945

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.

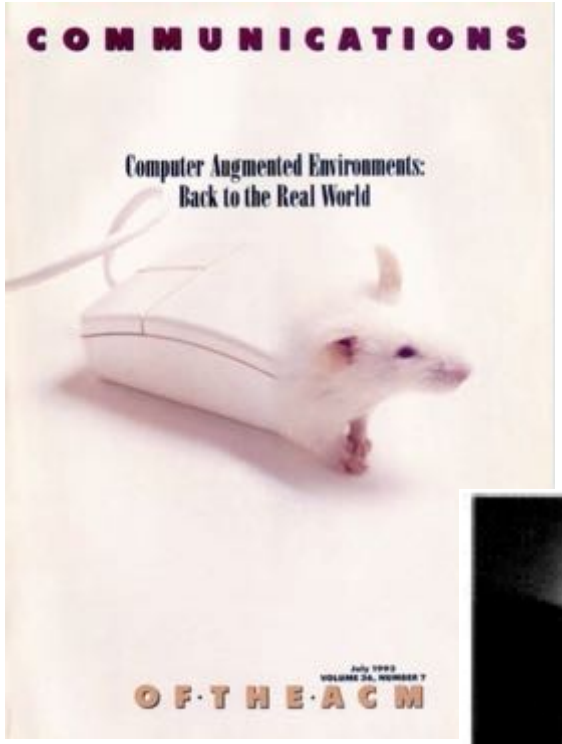
Augment:	Approach	Technology	Applications
Users	Wear devices on the body	VR helmets Goggles Data gloves	Medicine Field service Presentations
Physical objects	Imbed devices within objects	Intelligent bricks Sensors, receptors GPS, electronic paper	Education Office facilities Positioning
Environment surrounding 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

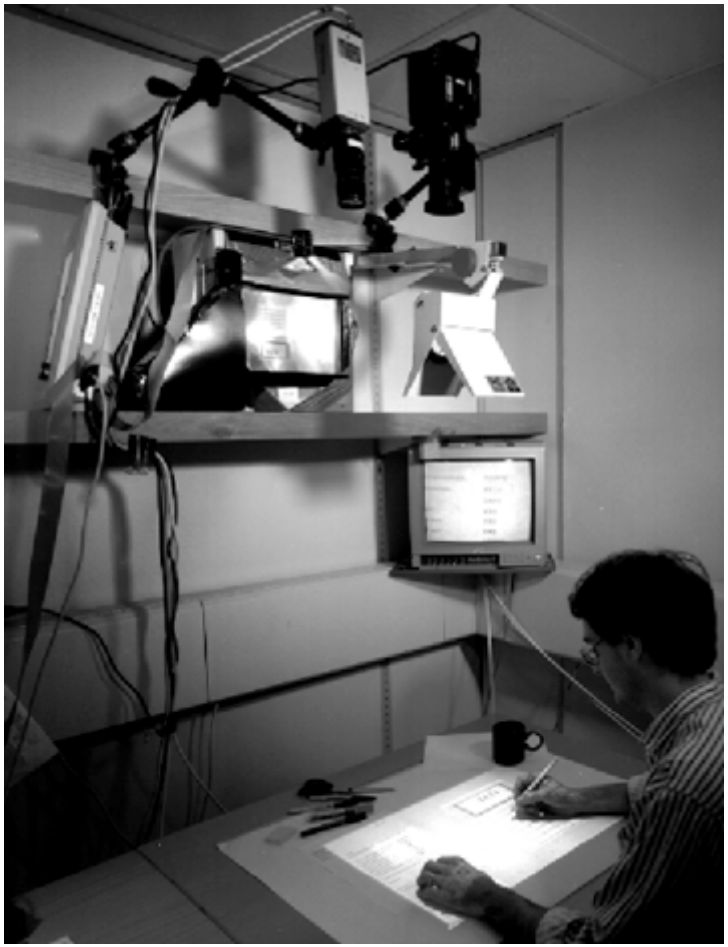
Head-up display (HUD) = affichage tête haute

https://fr.wikipedia.org/wiki/Affichage_tête_haute



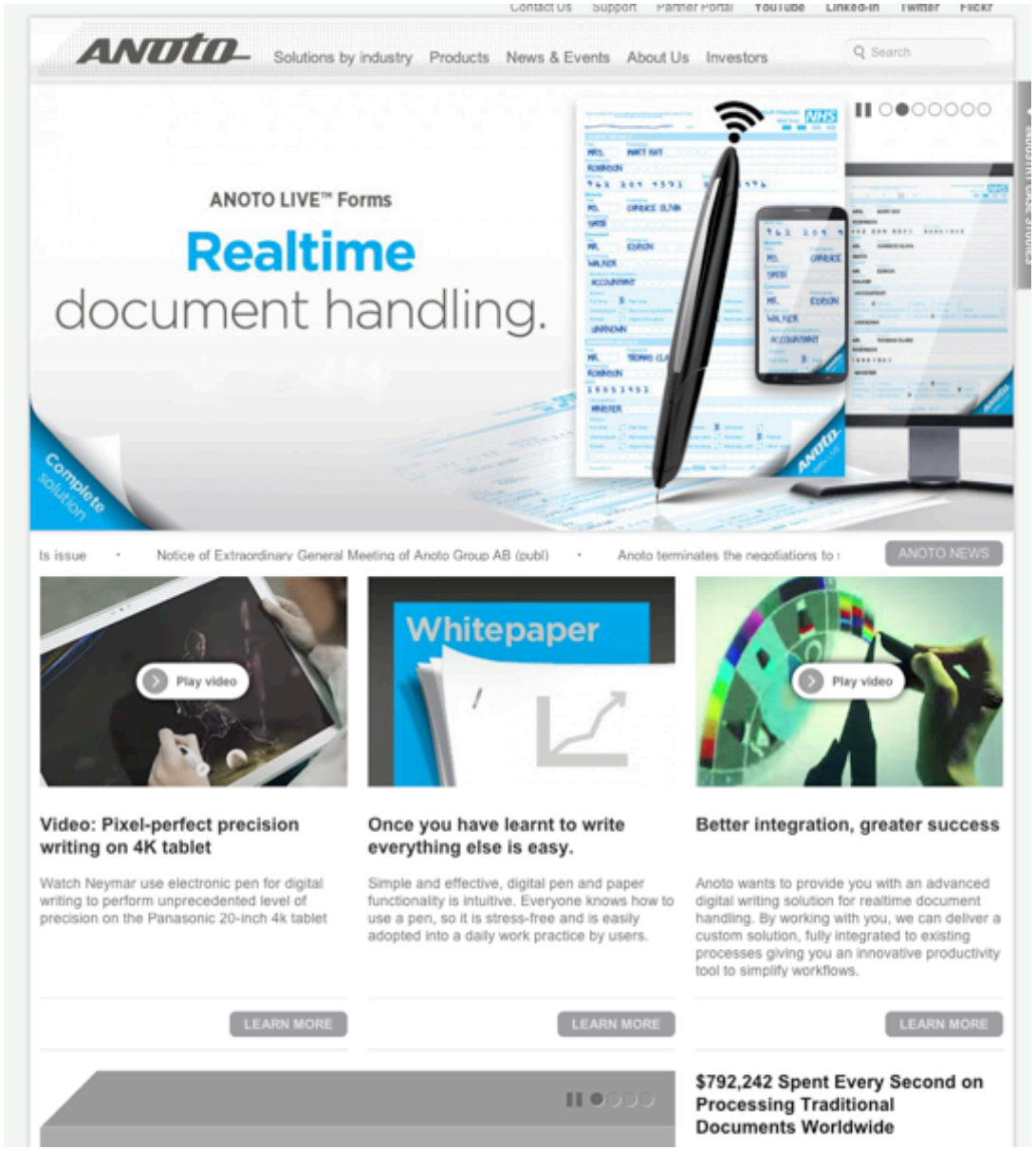
CACM July 1993

W. Mackay
et al.



P. Wellner

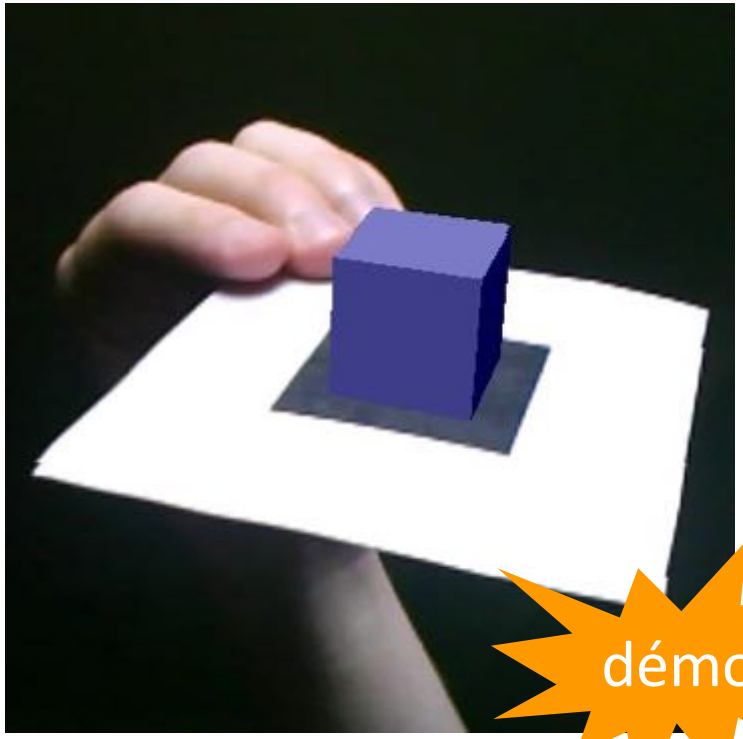
Le stylo Anoto et les cahiers augmentés



(a)

(b)

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



ARToolkit

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

Thèse d'Areti Damala (FT R&D, 2006-8) : RA visuelle

The evaluation of the mobile AR guide had many inherent difficulties. The first one is related with a major issue observed in the field of AR, where user studies are still clearly underutilized. Gabbard and Swan report that in a total of 1,104 articles on AR recessed, only 2% included a user based study [11]. This creates

Thèse de Fatima Kaghat (2011-14) : RA sonore

machines ≠ sculptures ?

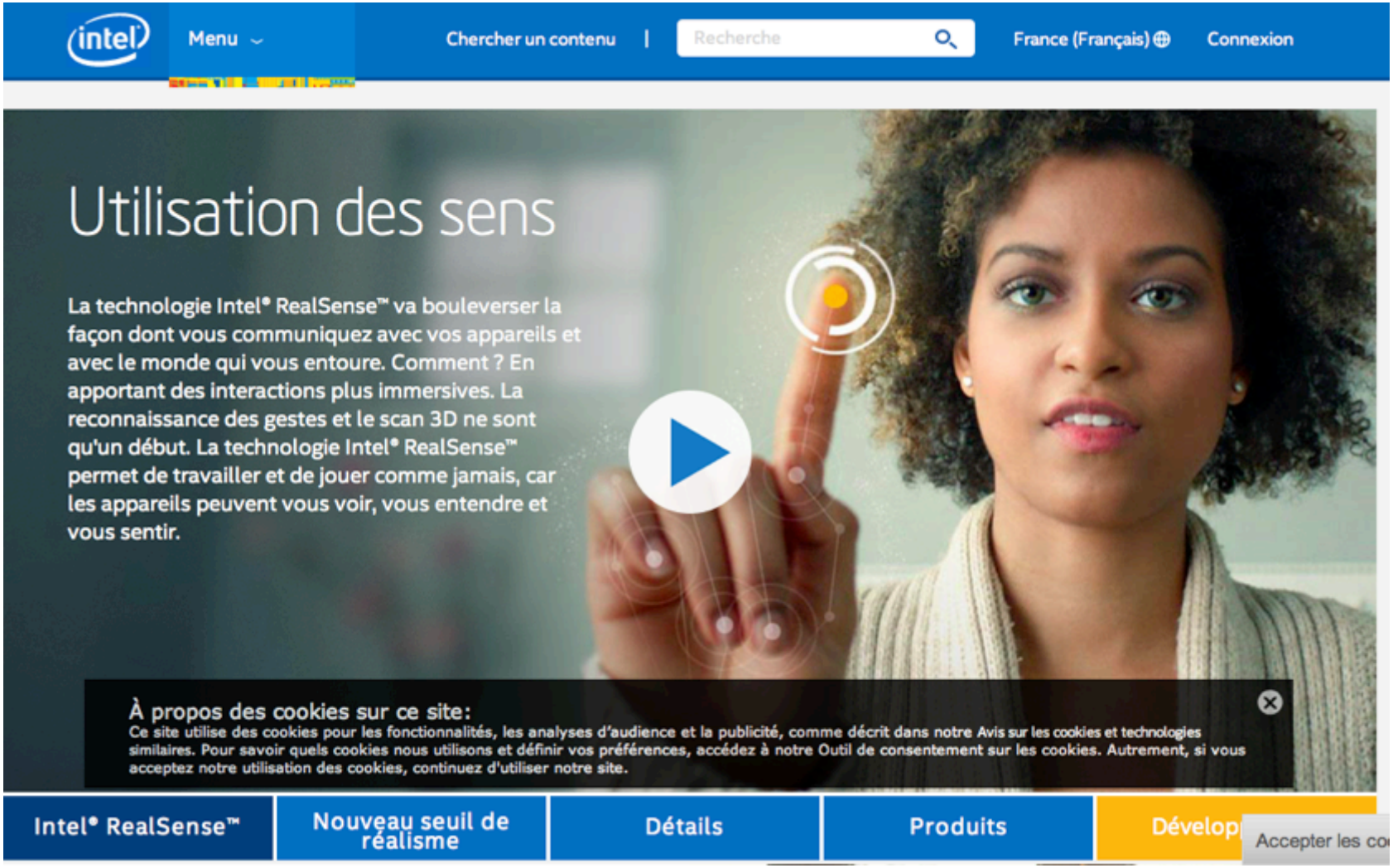
couplage restitution stéreo et captation des mouvements

utilisation d'AR toolkit pour la captation

2014 : Google Glass

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

Intel "RealSense » en 2014



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

en 2016 : les premiers produits

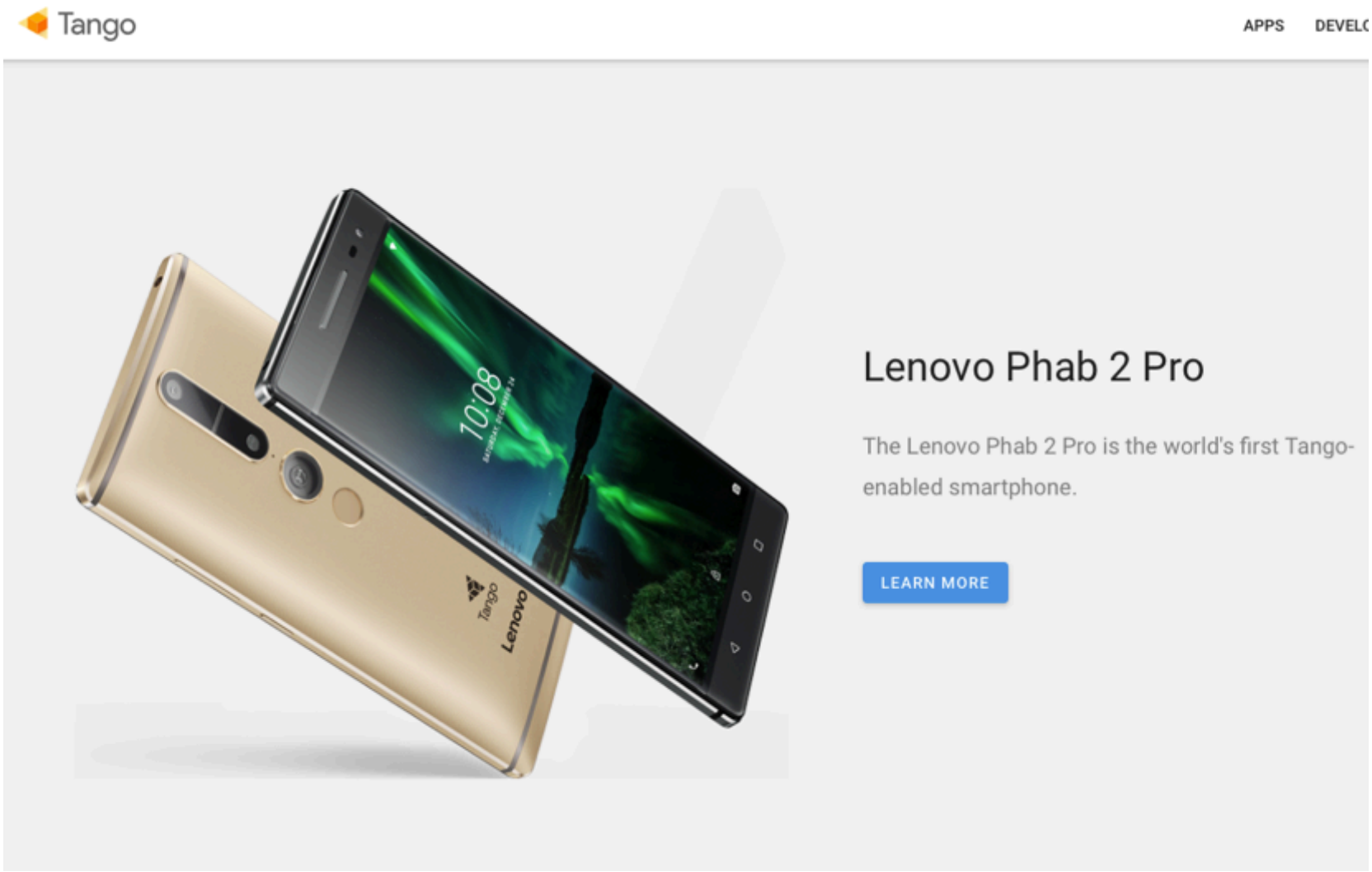
Introducing Intel® RealSense™ Smartphone Developer Kit

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

Share Tweet Share

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.



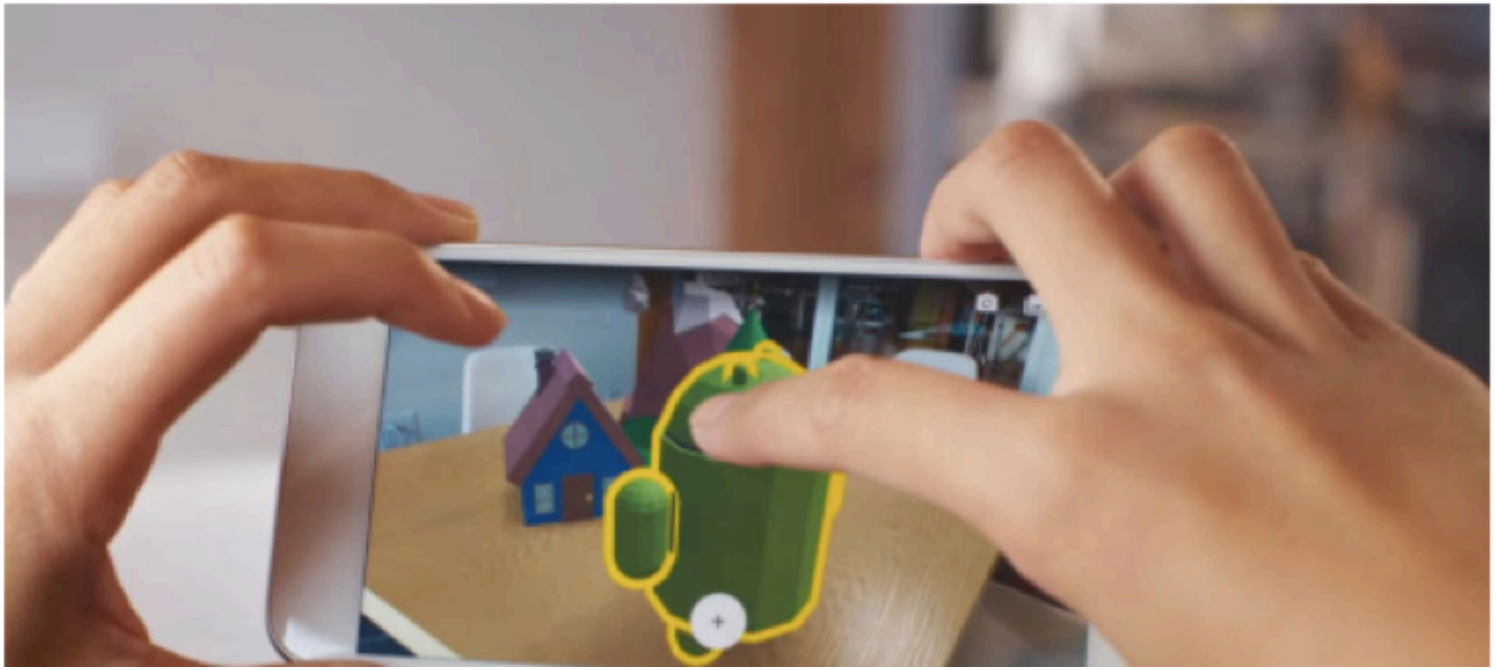
http:// get.google.com/tango/

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

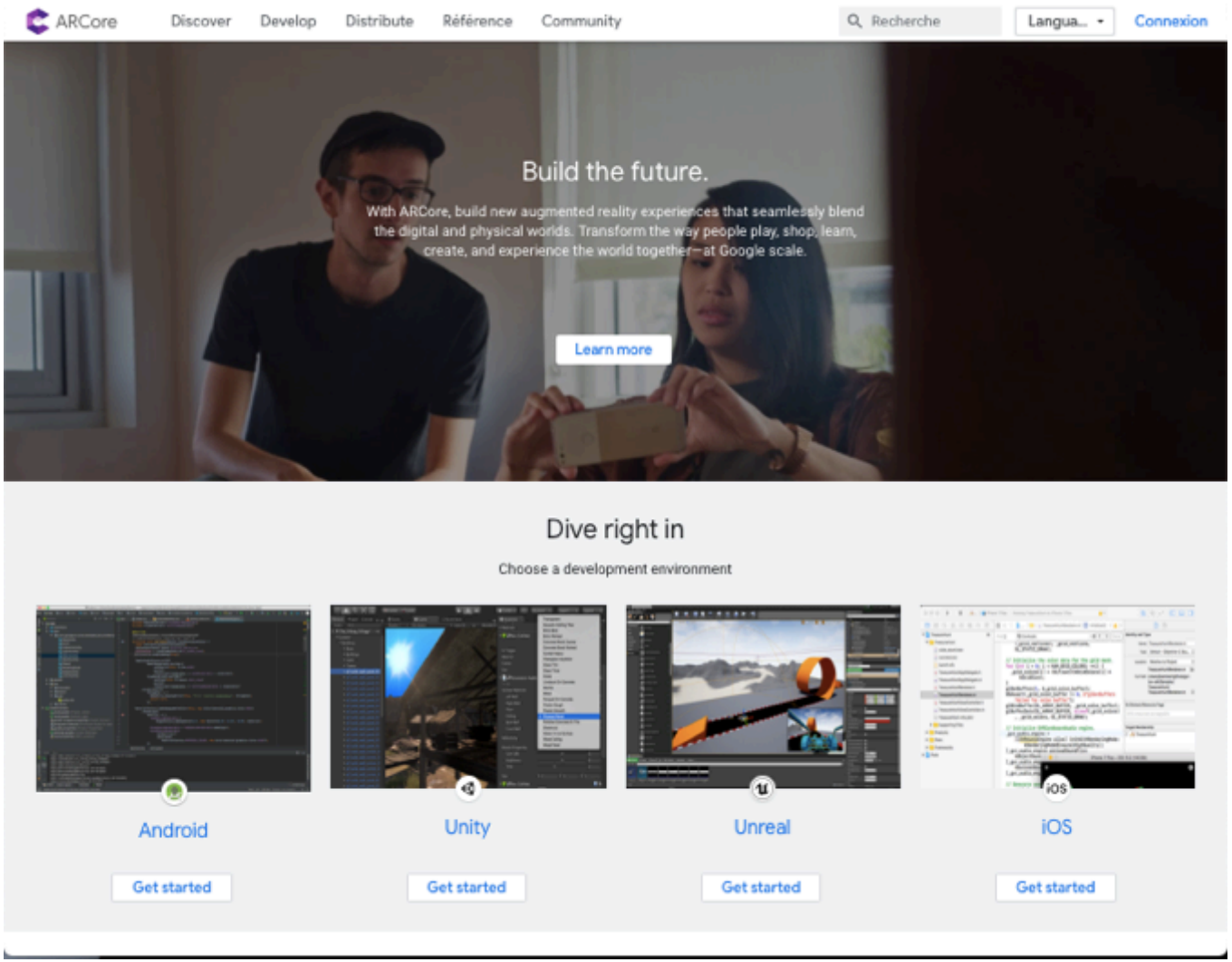
JULIEN BERGOUNHOUX | RÉALITÉ AUGMENTÉE, GOOGLE, SMARTPHONE |
PUBLIÉ LE 30 AOÛT 2017 À 11H12

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.

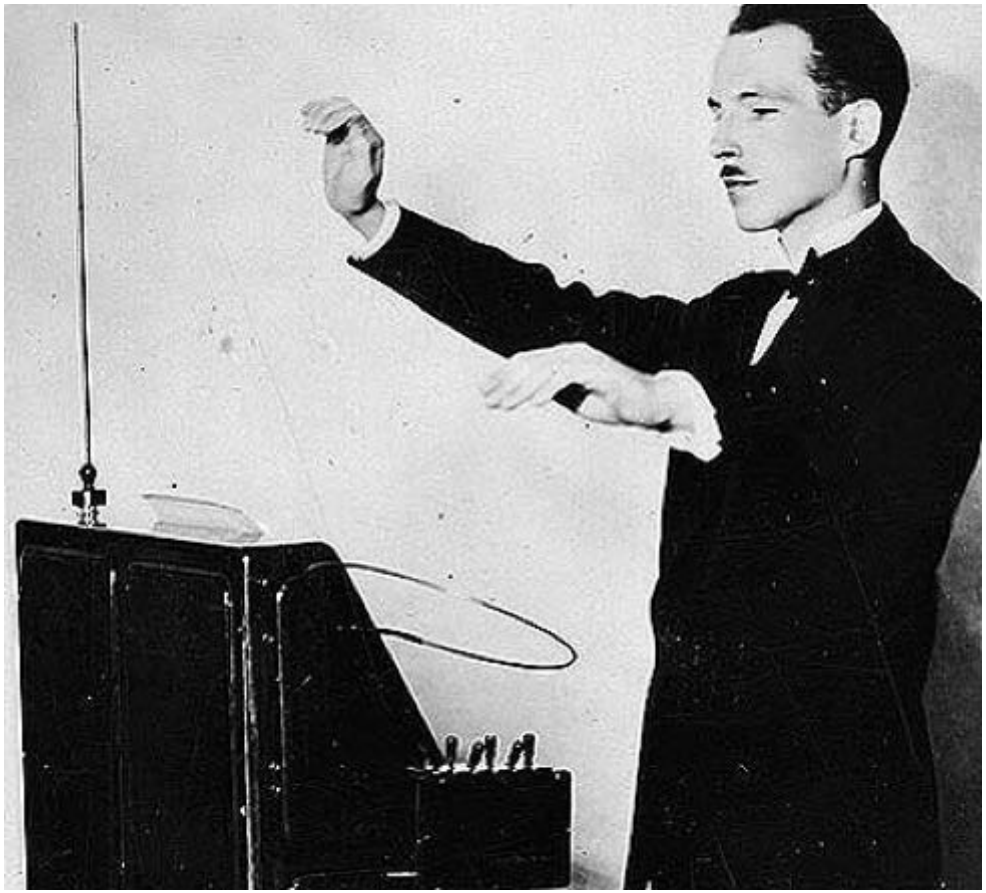


Et en 2019 : ARCore opérationnel ☺



=> voir la rubrique "discover" du site

(5) Les objets malins



Theremine (1917)

Deja une industrie

skyscout

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

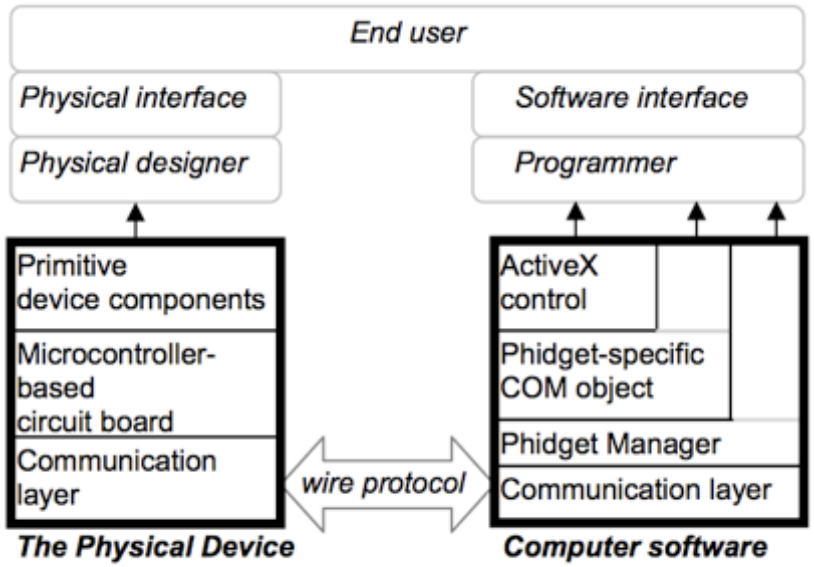
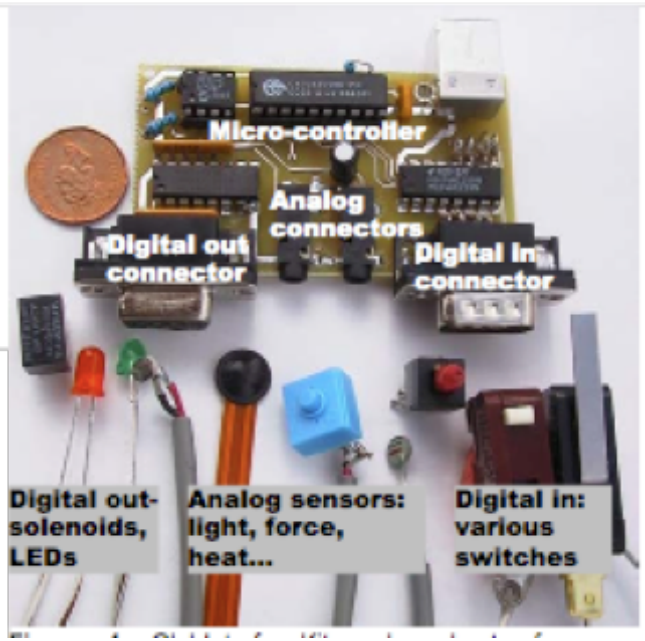


Figure 5. Phidget Architecture



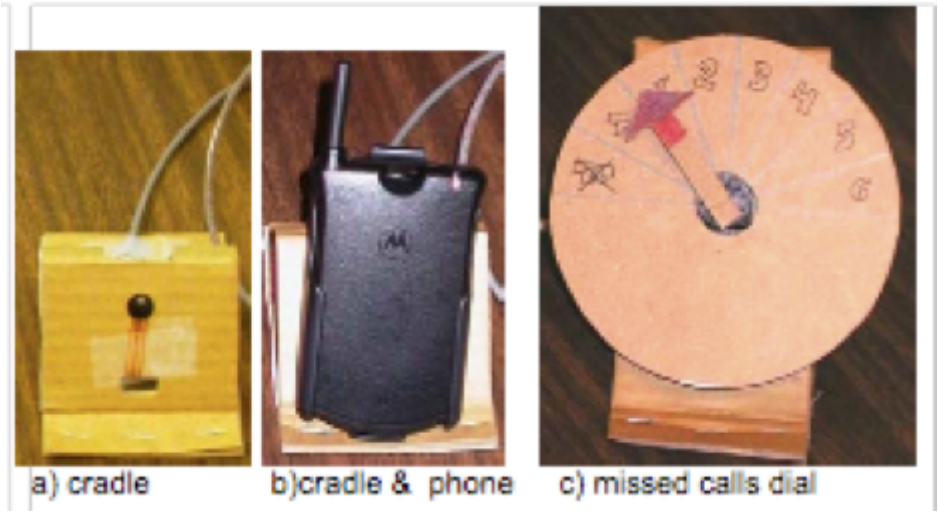


Figure 11: Phidget Eyes: closed, open & lit, fully open

"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

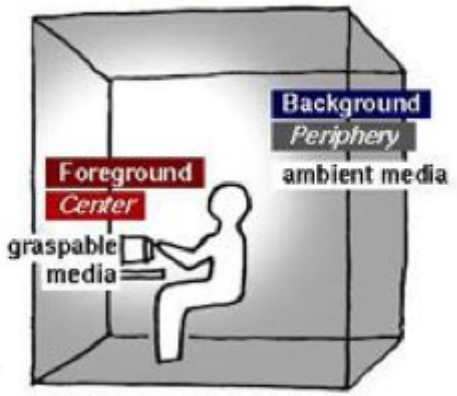
Physical Computing is an approach to learning how humans communicate through computers that starts by considering how humans express themselves physically. In this course, we take the human body as a given, and attempt to design computing applications within the limits of its expression.

(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.

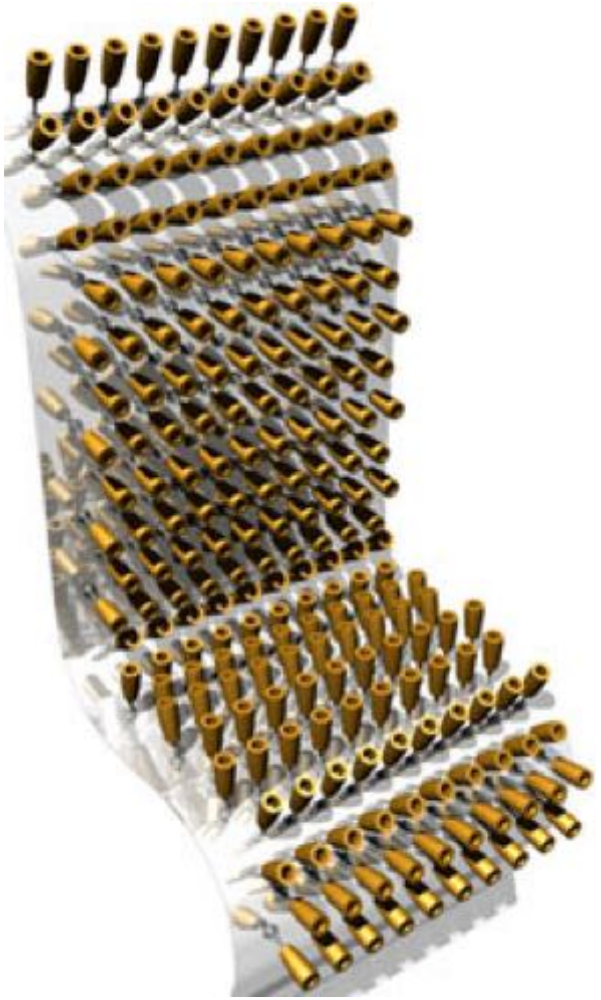


drawing: Hiroshi Ishii

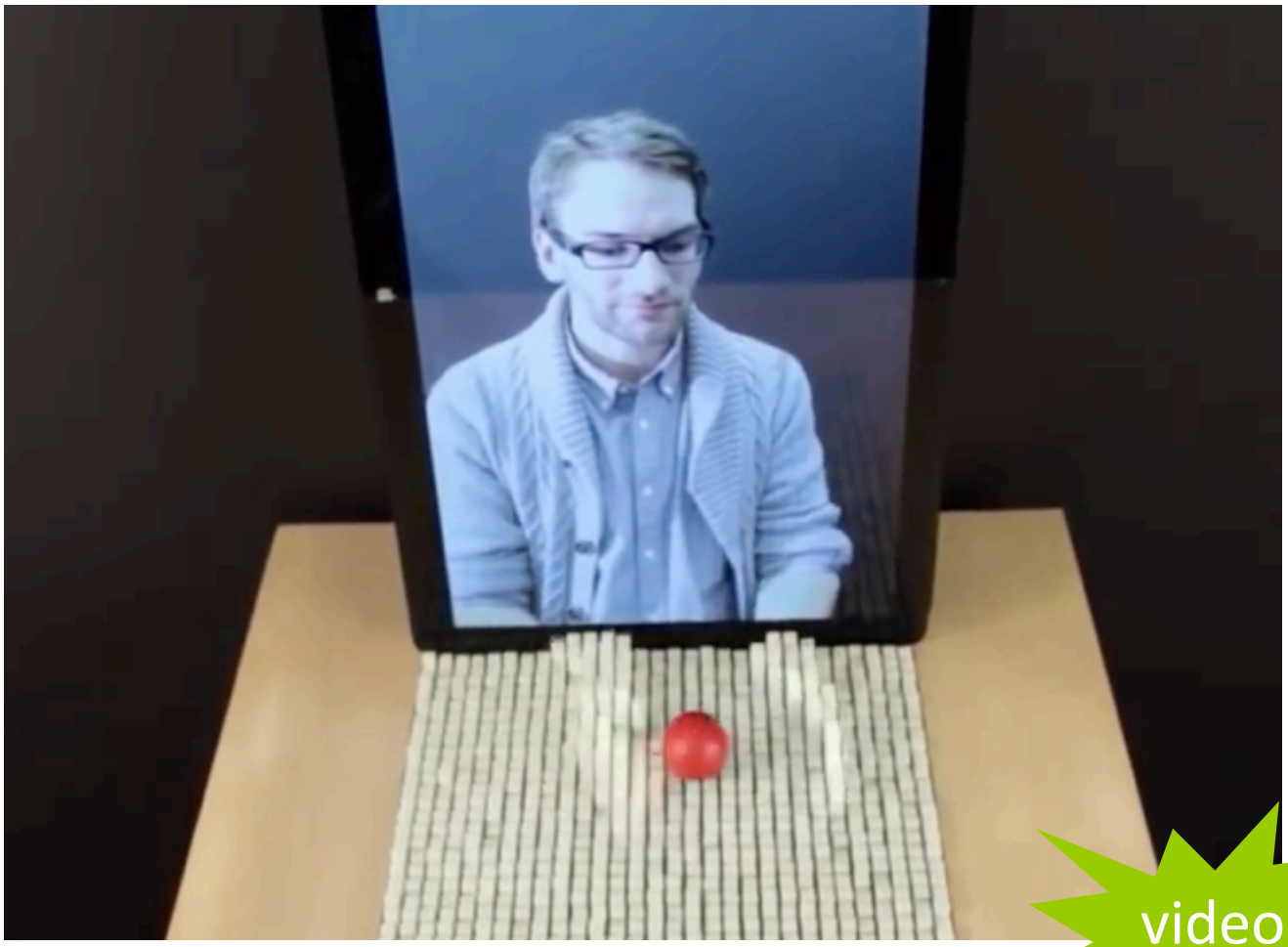
Tangible Bits full paper presented at CHI 97

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

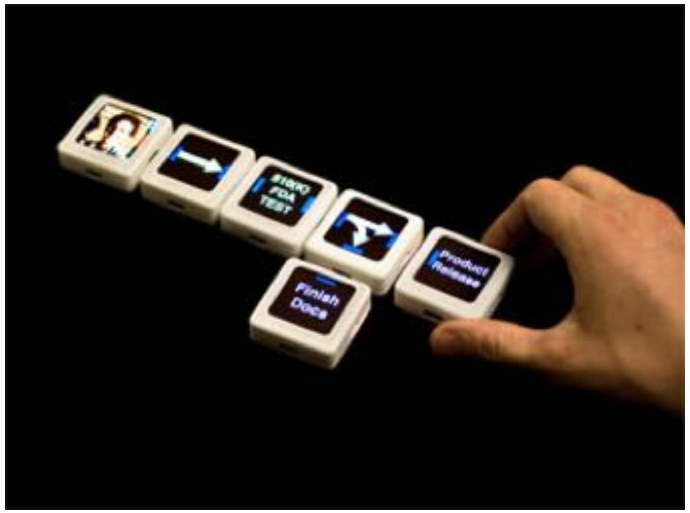
Ex. de projet de l'équipe : super cilia skin

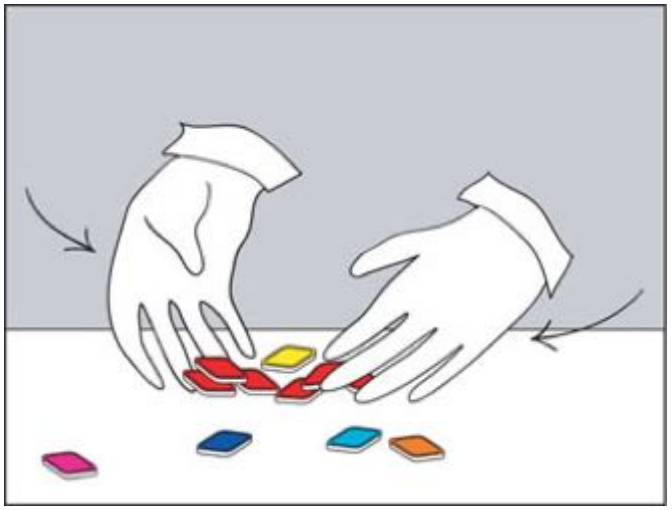


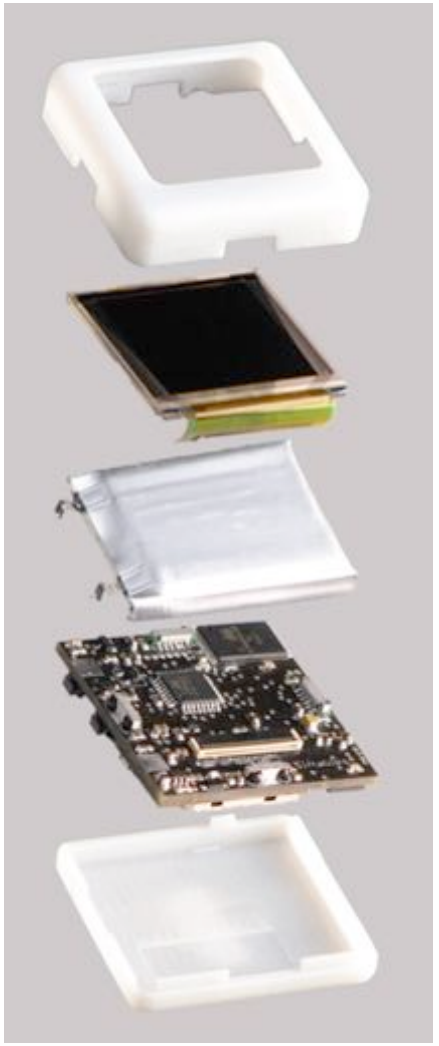
Ex : projet inFORM (Leithinger, Follmer, Ishii)



Le projet « siftables » (David Merril, MIT, 2007)







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

LOGIN CART

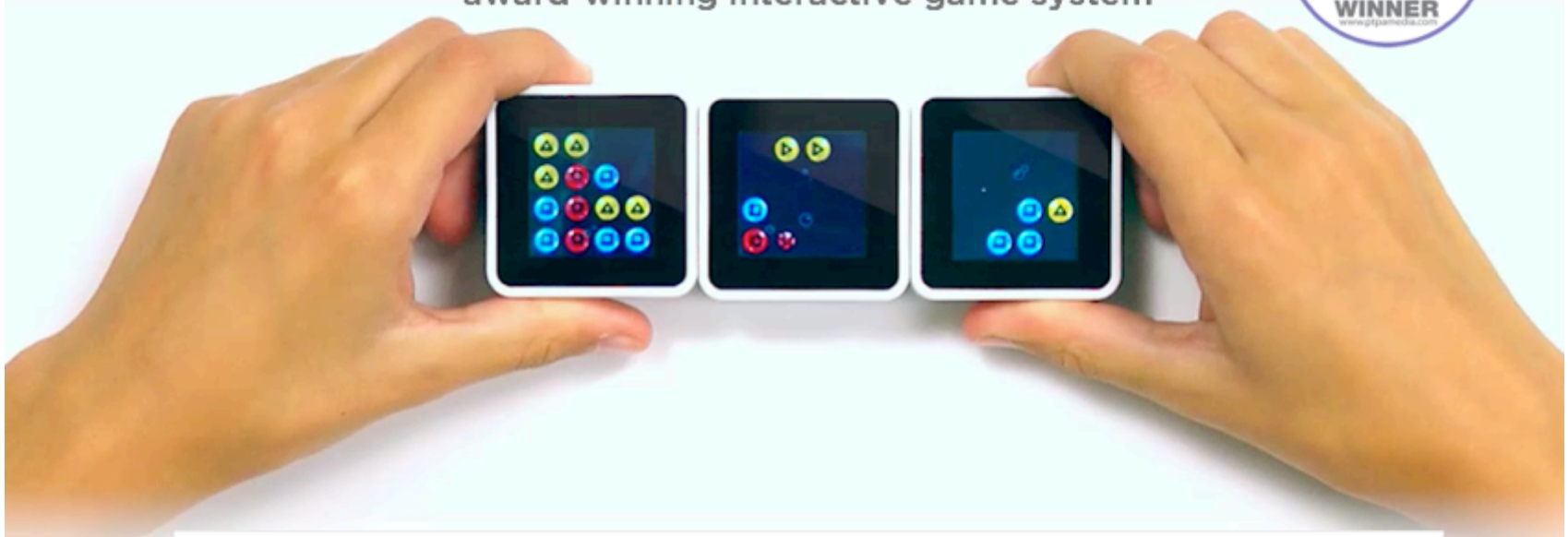
sifteo

Sifteo Cubes | Intelligent Play | Games | About Us | Press | Shop

Sifteo Cubes

award-winning interactive game system

parent tested parent approved WINNER



‹ thought possible." San Francisco Chronicle " a clever new way for childre ›

projet "fat and furious" Master ENJMIN 2013

sifteo ♥ 3D Robotics

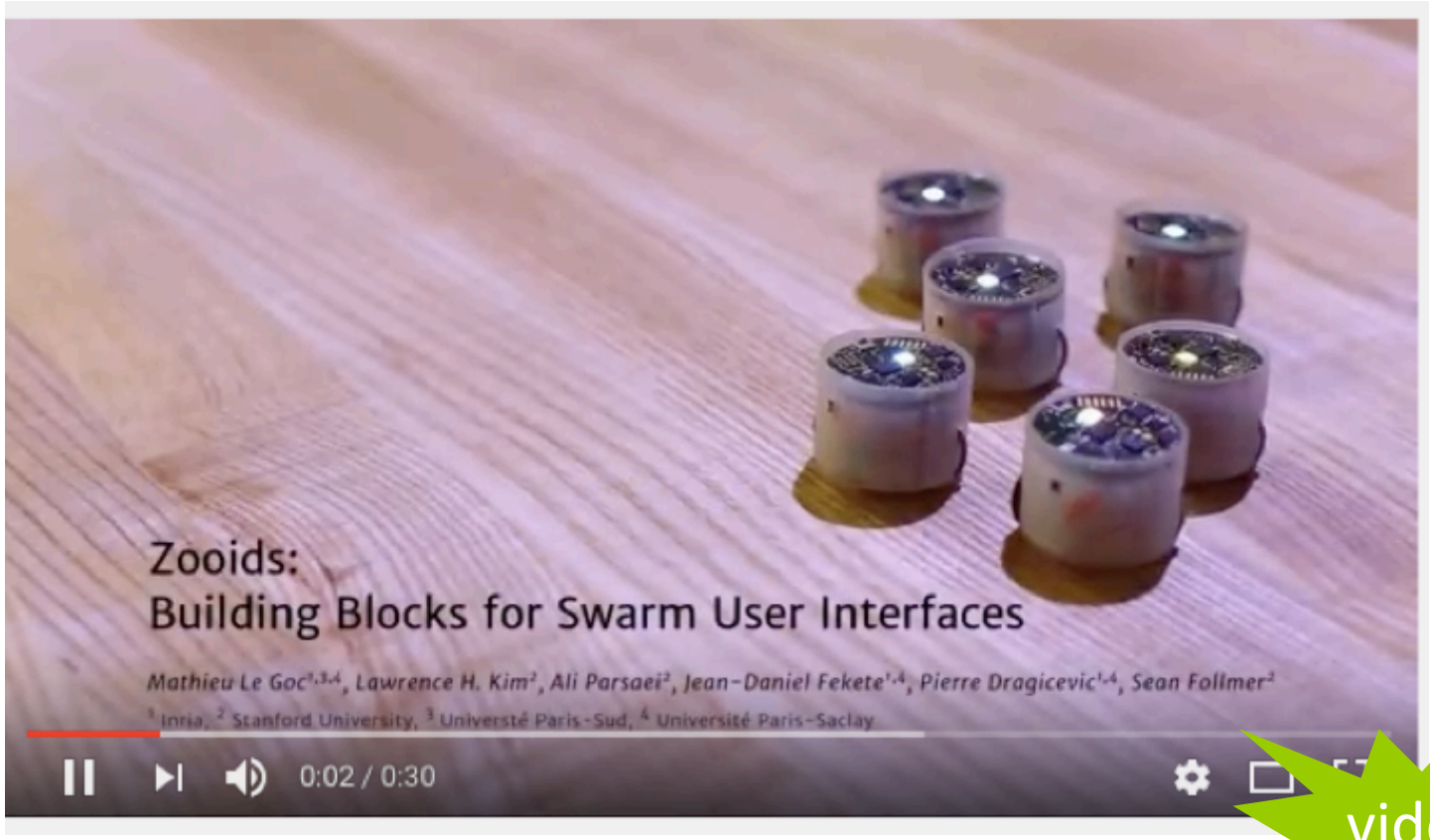
So long, thank you, we're still here

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.

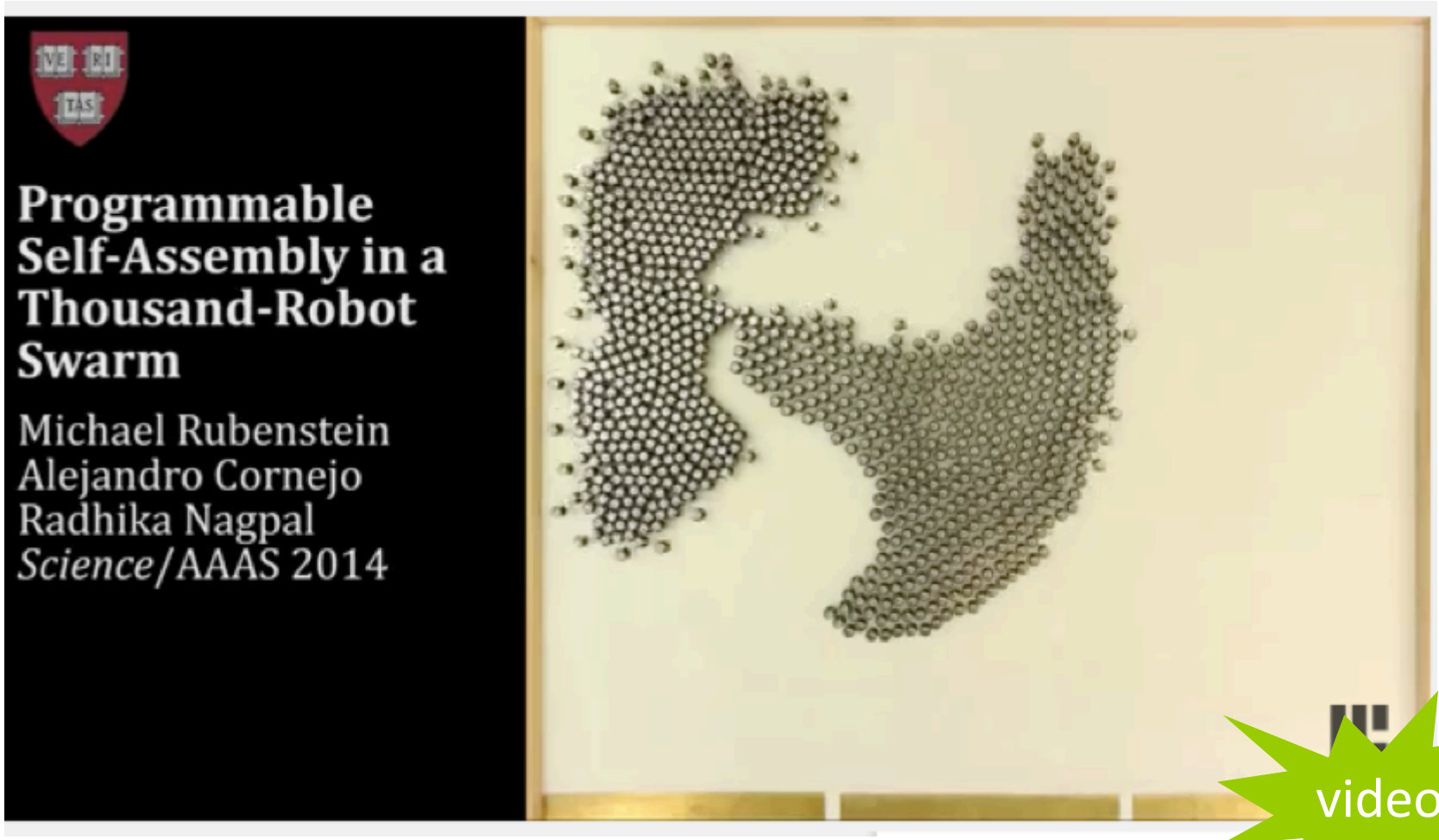
zoids



video

https://aviz.fr/swarmui

à étudier ?

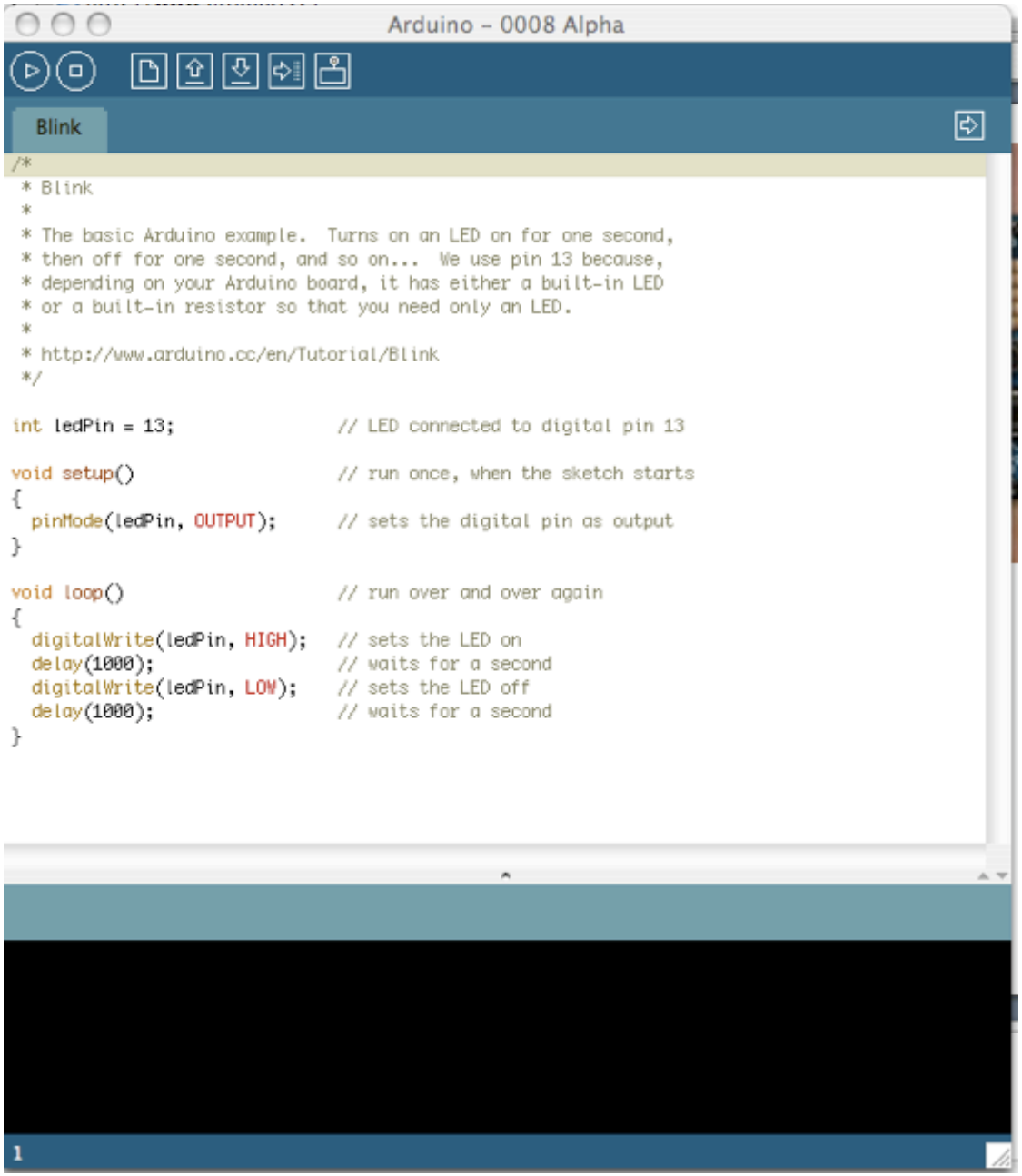


https://www.youtube.com/watch?v=G1t4M2XnIhI

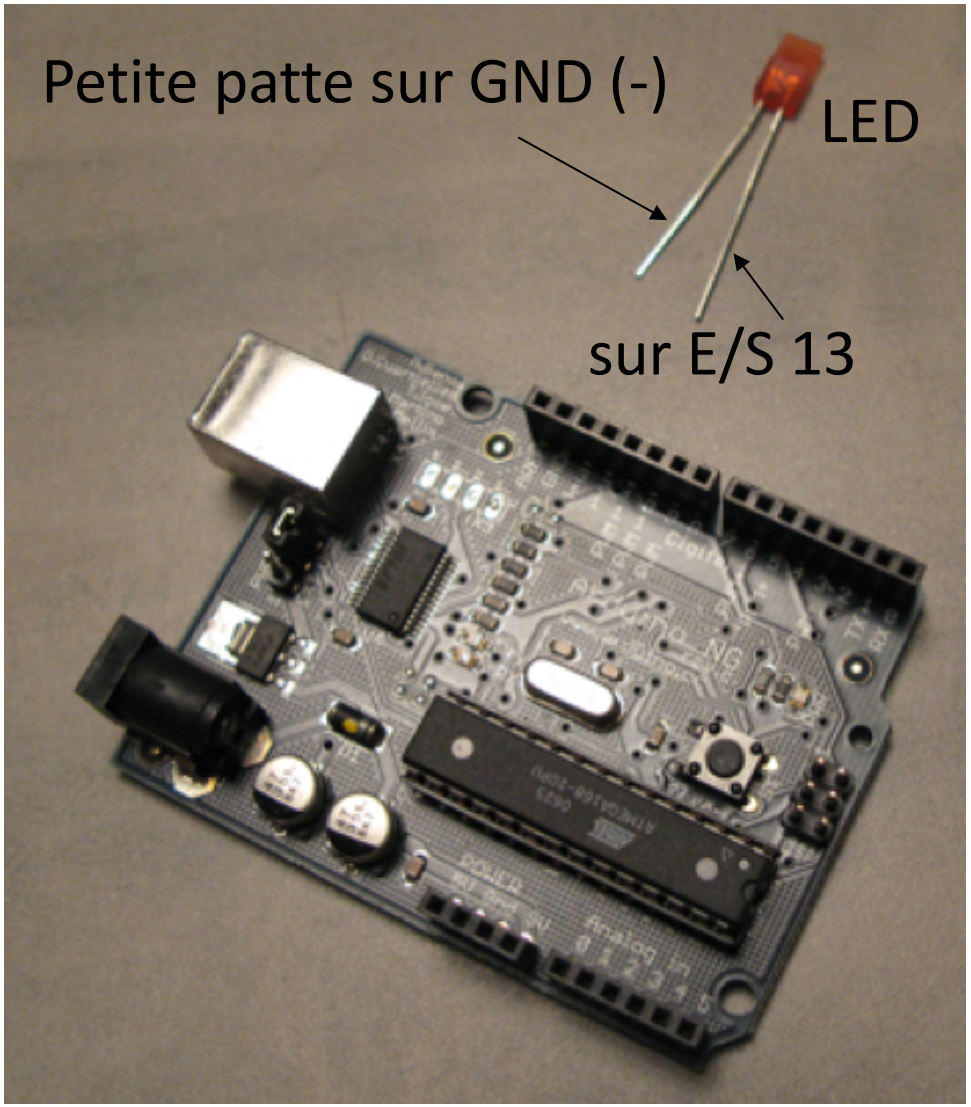
La carte ARDUINO

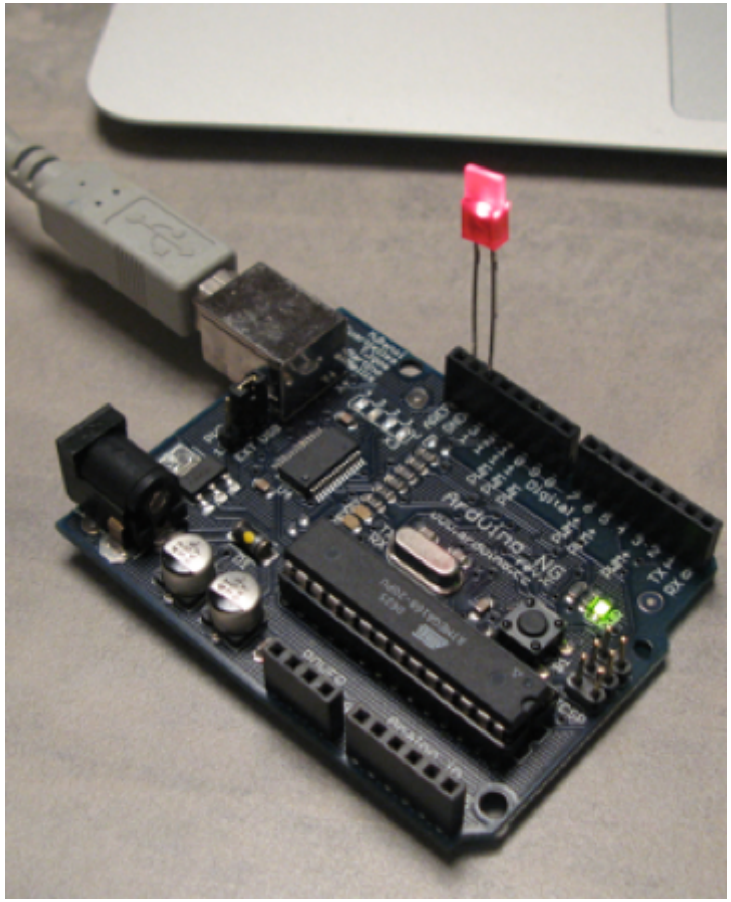
(Science et vie junior - février 2012)

« blink » : le Hello world de l'Arduino



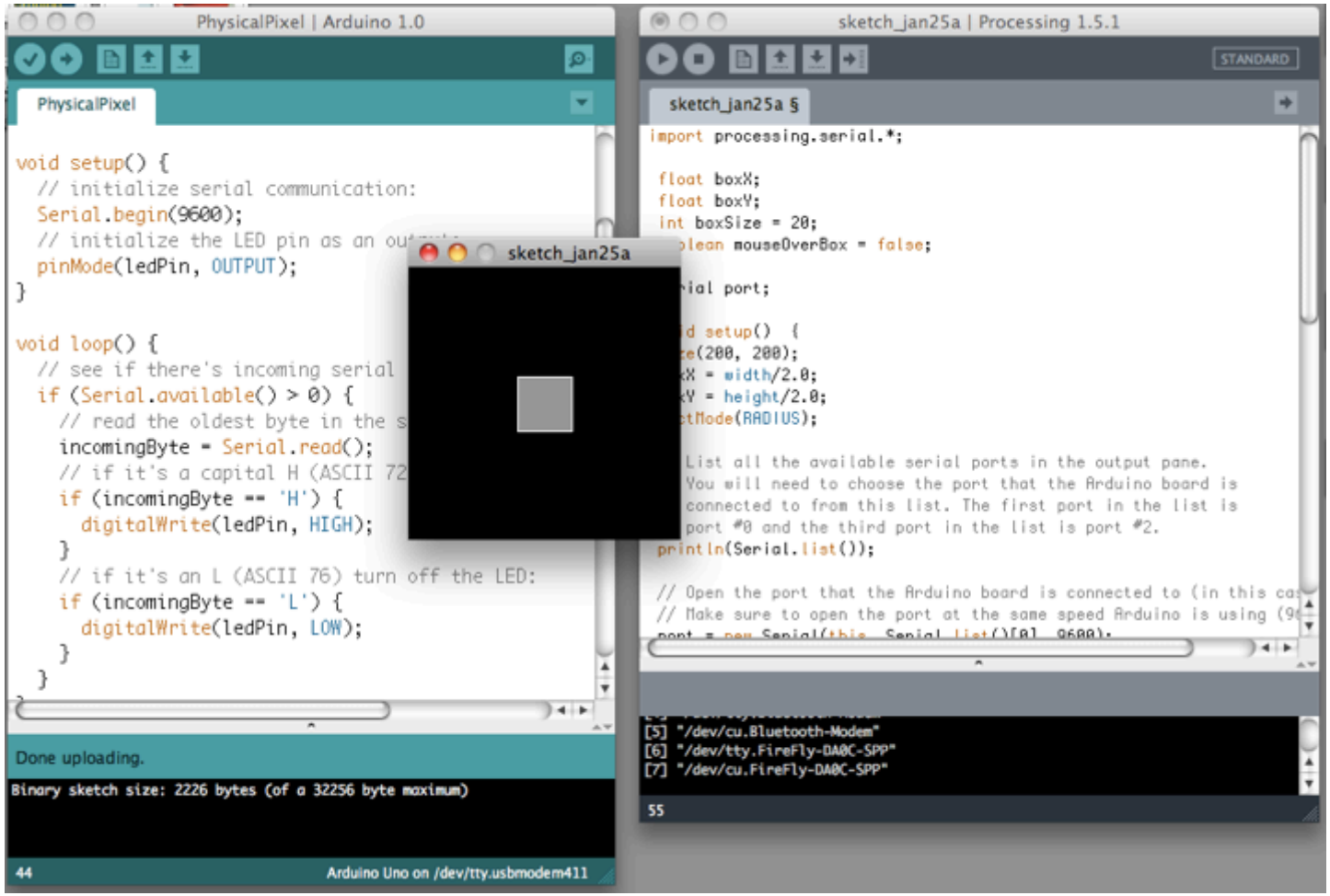
Blink : le montage





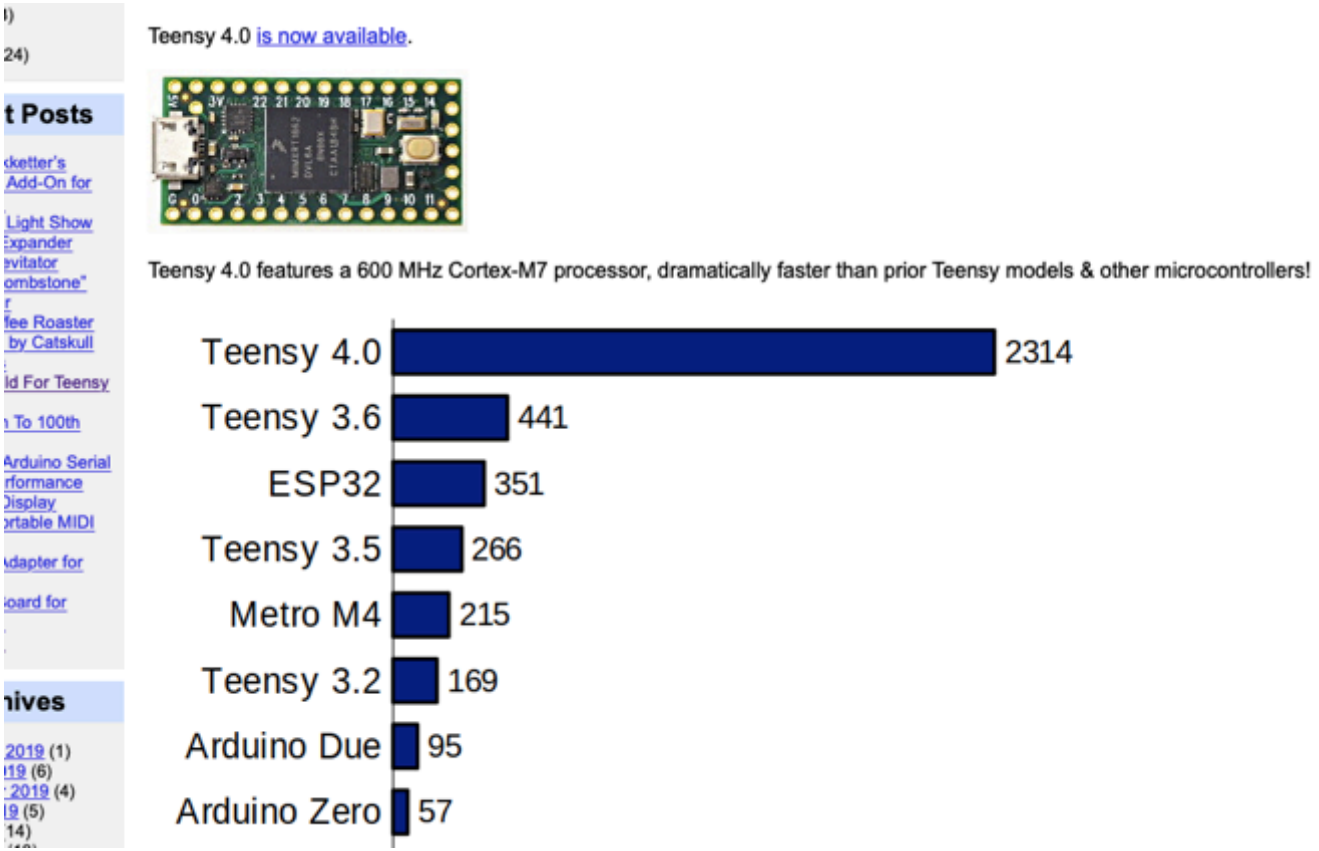
Fiat lux …

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



=> à suivre cours de J. Dupire

PUB



https://www.pjrc.com/teensy-4-0/