Computer Vision for Interaction

Background

Simple Algorithms

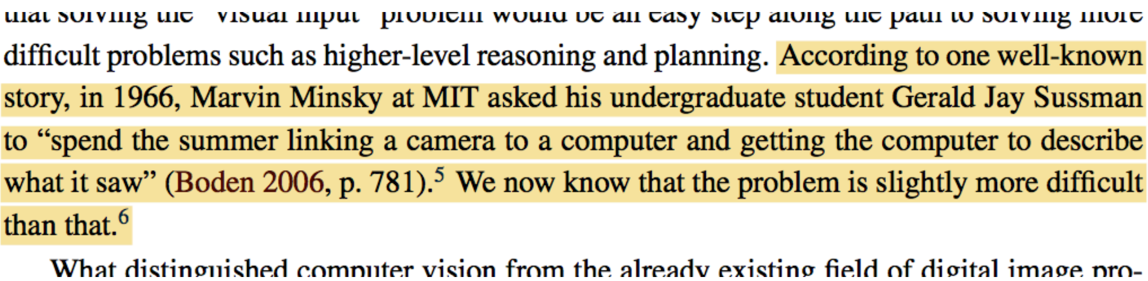
Computer Vision

- Extracting descriptions of the world from pictures or sequences of pictures[1].
- Algorithms to acquire, process, and analyse images or video to establish some level of understanding to control a computer or interpret information.
- Computers that can "see"
- Using the camera as a "sensor"

CREDIT: 1. Forsyth, Computer Vision: A Modern Approach.

History

- Computer vision once considered a simple initial step for AI

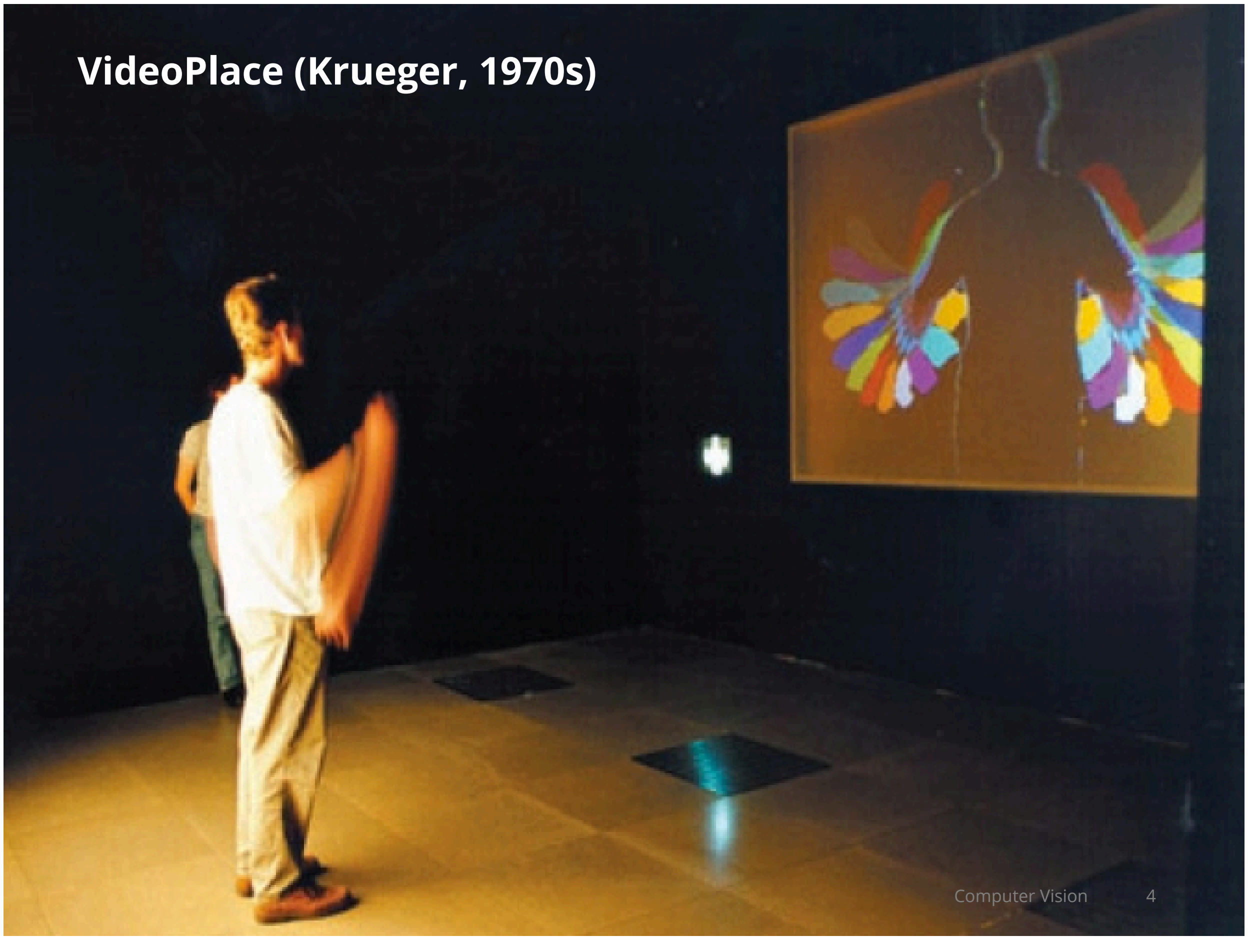


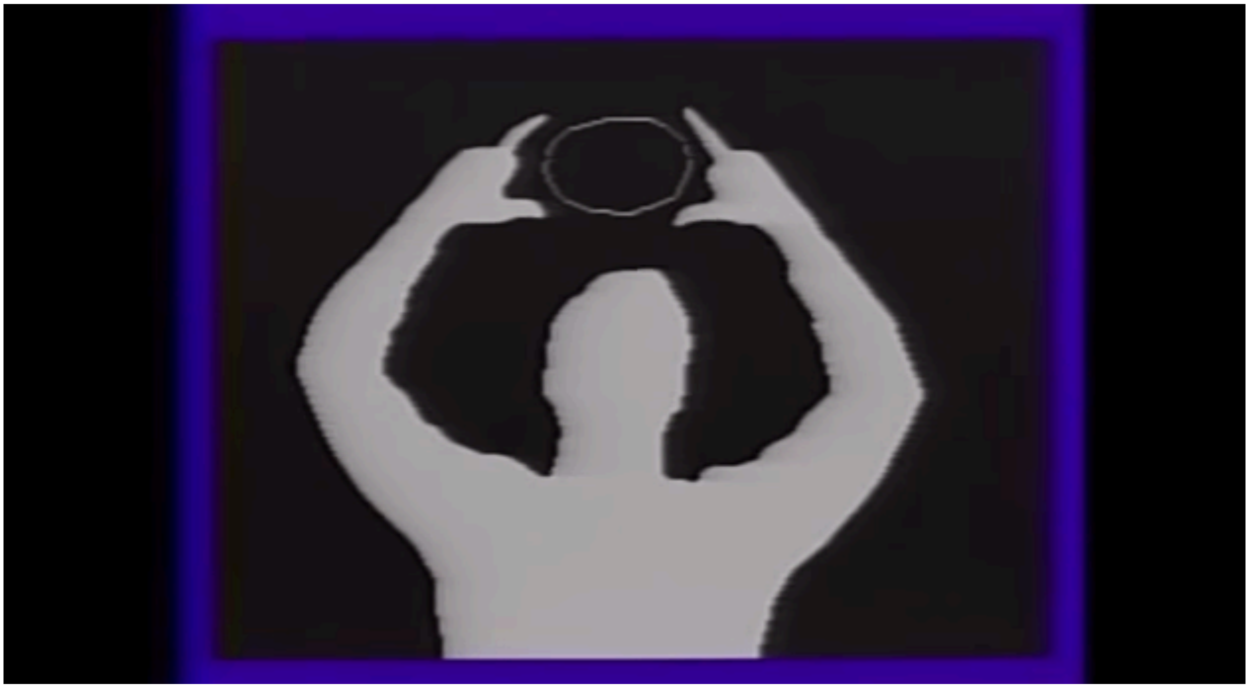
that solving the "visual input" problem would be an easy step along the path to solving more difficult problems such as higher-level reasoning and planning. According to one well-known story, in 1966, Marvin Minsky at MIT asked his undergraduate student Gerald Jay Sussman to "spend the summer linking a camera to a computer and getting the computer to describe what it saw" (Boden 2006, p. 781).[5] We now know that the problem is slightly more difficult than that.[6]

What distinguished computer vision from the already existing field of digital image pro-

CREDIT: Szelisky, Computer Vision: Algorithms and Applications

VideoPlace (Krueger, 1970s)





VIDEOPLACE (Krueger, 1985)

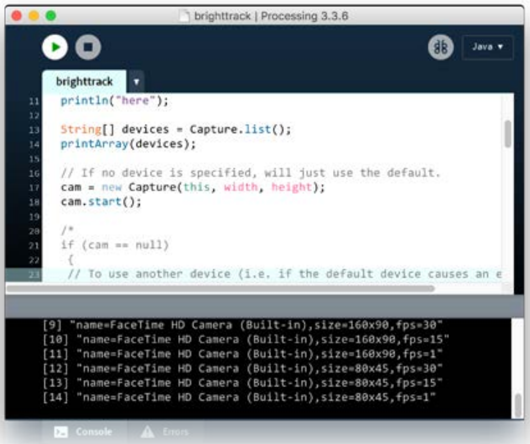
– http://youtu.be/d4DUIeXSEpk

VIDEOPLACE Mini-documentary (1988)

– https://youtu.be/dmmxVA5xhuo?t=4m5s

Processing

- Language and IDE designed for artists and designers
  - originally Java-based, now Python and JavaScript too
  - Cross platform, free and open-source
  - Well documented (many books), large community
  - Many libraries (include UI toolkits)
  - https://processing.org/

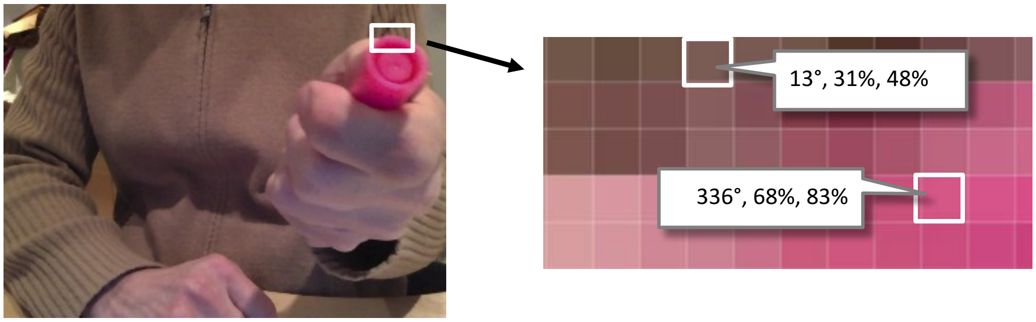


```
println("here");

String[] devices = Capture.list();
printArray(devices);

// If no device is specified, will just use the default.
cam = new Capture(this, width, height);
cam.start();

/*
if (cam == null)
 {
 // To use another device (i.e. if the default device causes an e
```

```
[9] "name=FaceTime HD Camera (Built-in),size=160x90,fps=30"
[10] "name=FaceTime HD Camera (Built-in),size=160x90,fps=15"
[11] "name=FaceTime HD Camera (Built-in),size=160x90,fps=1"
[12] "name=FaceTime HD Camera (Built-in),size=80x45,fps=30"
[13] "name=FaceTime HD Camera (Built-in),size=80x45,fps=15"
[14] "name=FaceTime HD Camera (Built-in),size=80x45,fps=1"
```

A (Very) Simple Computer Vision Algorithm

```
for each video frame:
   most_special = pixel[0,0]
   for each pixel:
      if pixel[x,y] is more pink
         most_special = pixel[x,y]

   use most_special's location as user input
```

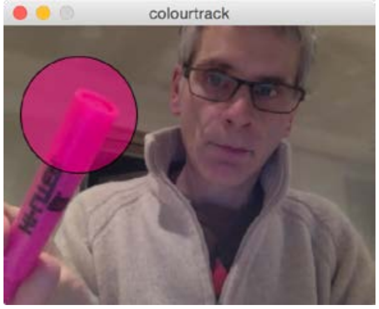


distance(■ , ■) < distance(■ , ■)

pink

more pink

colourtrack

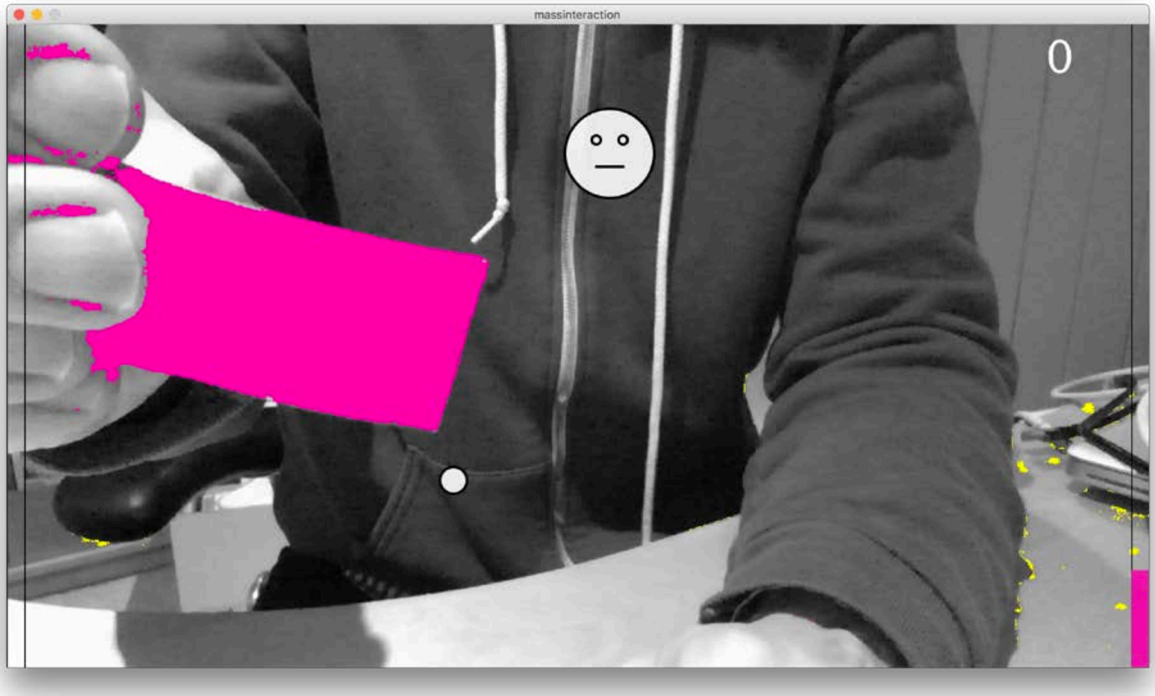


```
int closestX = 0;
int closestY = 0;
float closestDist = 360;

for (int y = 0; y < height; y++) {
  for (int x = 0; x < width; x++) {

    int i = x + y * width;

    float b = brightness(pixels[i]);
    float s = saturation(pixels[i]);

    float h = hue(pixels[i]);
    float d = dist(trackHue, 100, 100, h, s, b);

    if (d < closestDist) {
      closestDist = d;
      closestX = x;
      closestY = y;
    }
  }
}
```

Another (Very) Simple Computer Vision Algorithm

```
for each video frame:
   count = 0
   for each pixel:
      if pixel[x,y] is pinkish
         count = count + 1

   use count of pinkish pixels as user input
```

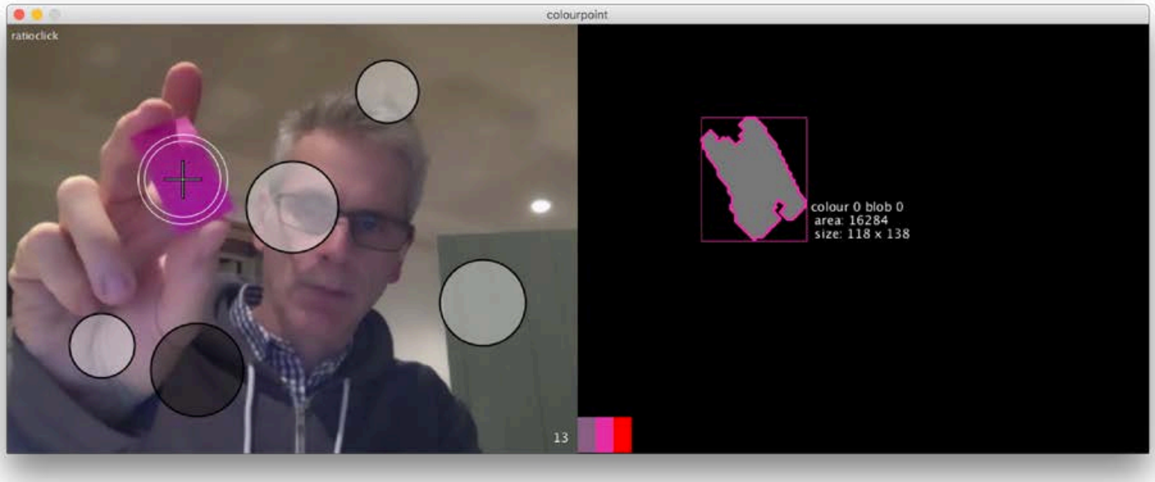
massinteraction



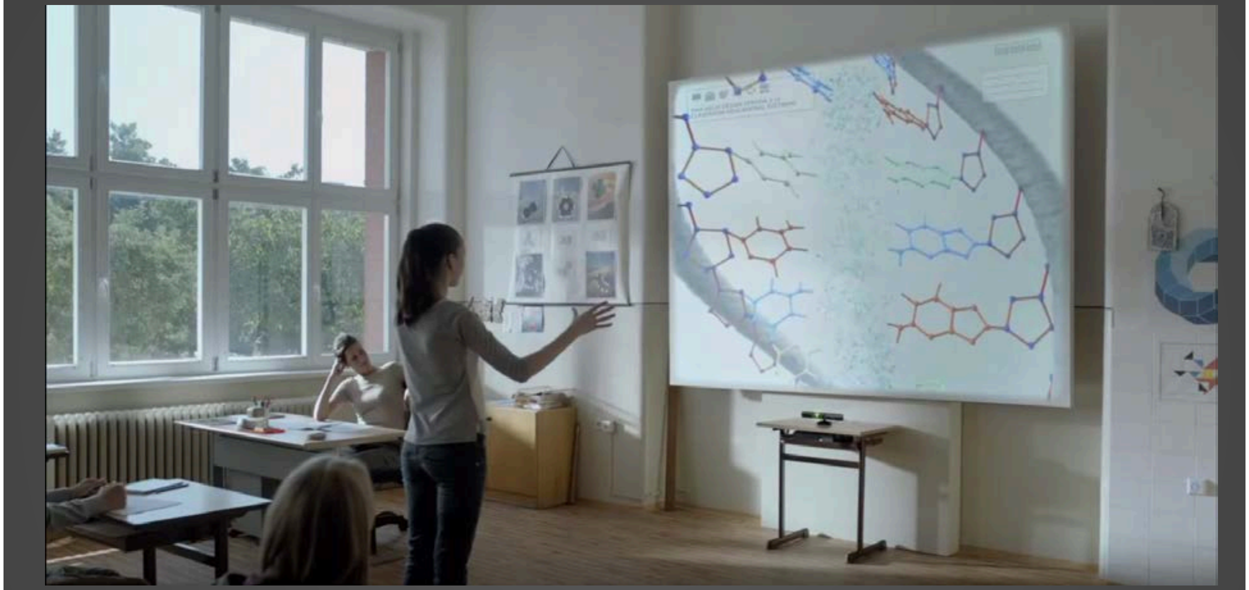
OpenCV

- Open source computer vision library focused on realtime applications
  - C++, C, Python, Java and MATLAB interfaces
  - Windows, Linux, Mac OS, Android
  - https://opencv.org/
- Many algorithms:
  - detect and recognize faces
  - identify objects
  - track moving objects
  - extract 3D models of objects
  - stitch images
  - follow eye movements
  - augmented reality marker tracking
  - …

colourpoint



```
colour 0 blob 0
 area: 16284
 size: 118 x 138
```



The Kinect Effect

- https://youtu.be/oq98_35sQko

Computer Vision for Interaction

- A camera can be a sensor for detecting user input
- Simple computer vision algorithms