

Computer Vision

Computer Vision and Nearby Fields

- Computer Graphics: Models to Images
- Comp. Photography: Images to Images
- Computer Vision: Images to Models

Computer Vision

Make computers understand images and video.



What kind of scene?

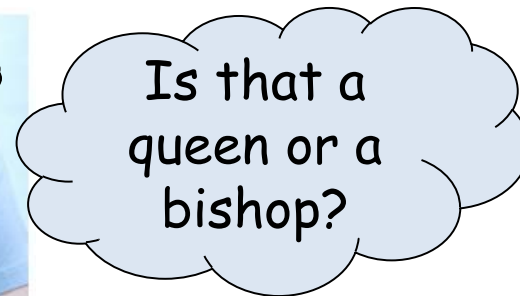
Where are the cars?

How far is the building?

...

Vision is really hard

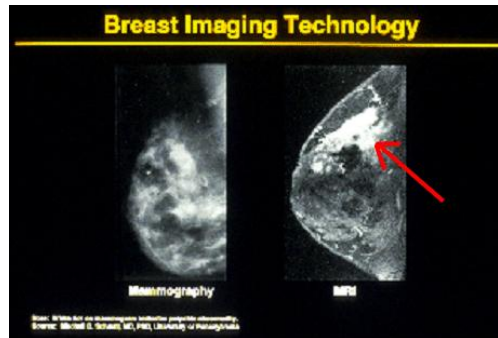
- Vision is an amazing feat of natural intelligence
 - Visual cortex occupies about 50% of Macaque brain
 - More human brain devoted to vision than anything else



Why computer vision matters



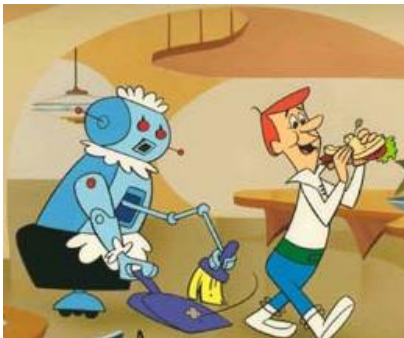
Safety



Health



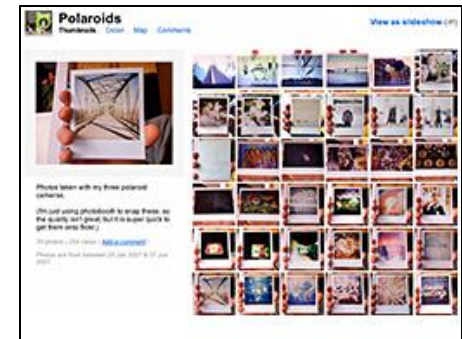
Security



Comfort



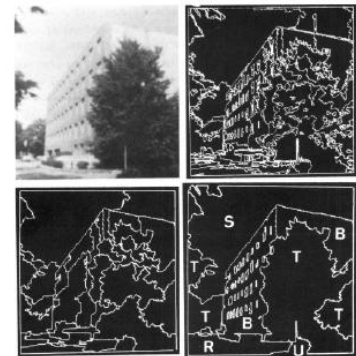
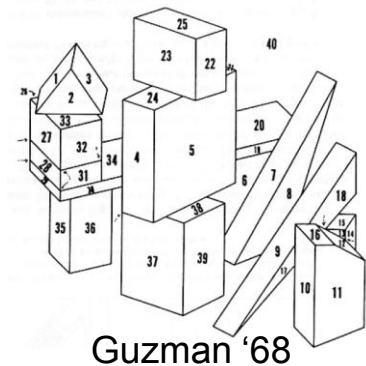
Fun



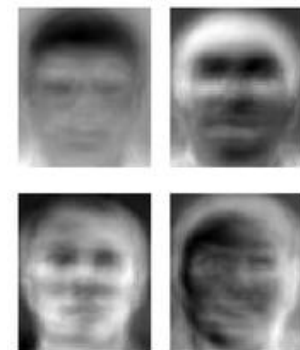
Access

Ridiculously brief history of computer vision

- 1966: Minsky assigns computer vision as an undergrad summer project
- 1960's: interpretation of synthetic worlds
- 1970's: some progress on interpreting selected images
- 1980's: ANNs come and go; shift toward geometry and increased mathematical rigor
- 1990's: face recognition; statistical analysis in vogue
- 2000's: broader recognition; large annotated datasets available; video processing starts



Ohta Kanade '78



Turk and Pentland '91

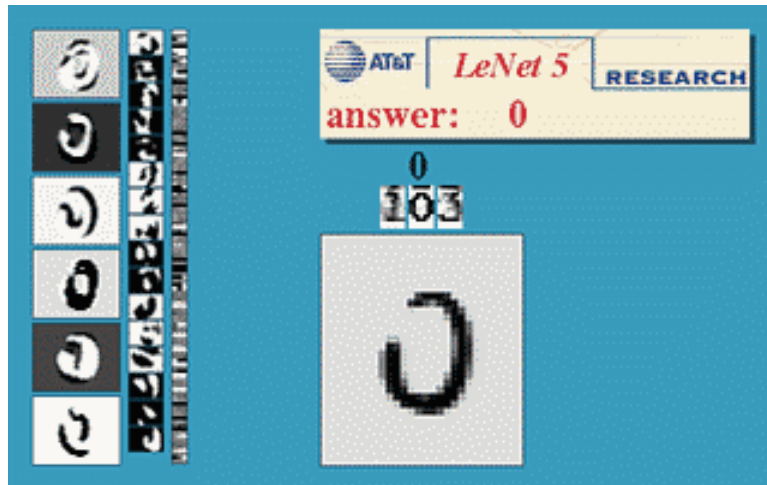
How vision is used now

- Examples of state-of-the-art

Optical character recognition (OCR)

Technology to convert scanned docs to text

- If you have a scanner, it probably came with OCR software



Digit recognition, AT&T labs

<http://www.research.att.com/~yann/>



License plate readers

http://en.wikipedia.org/wiki/Automatic_number_plate_recognition

Face detection

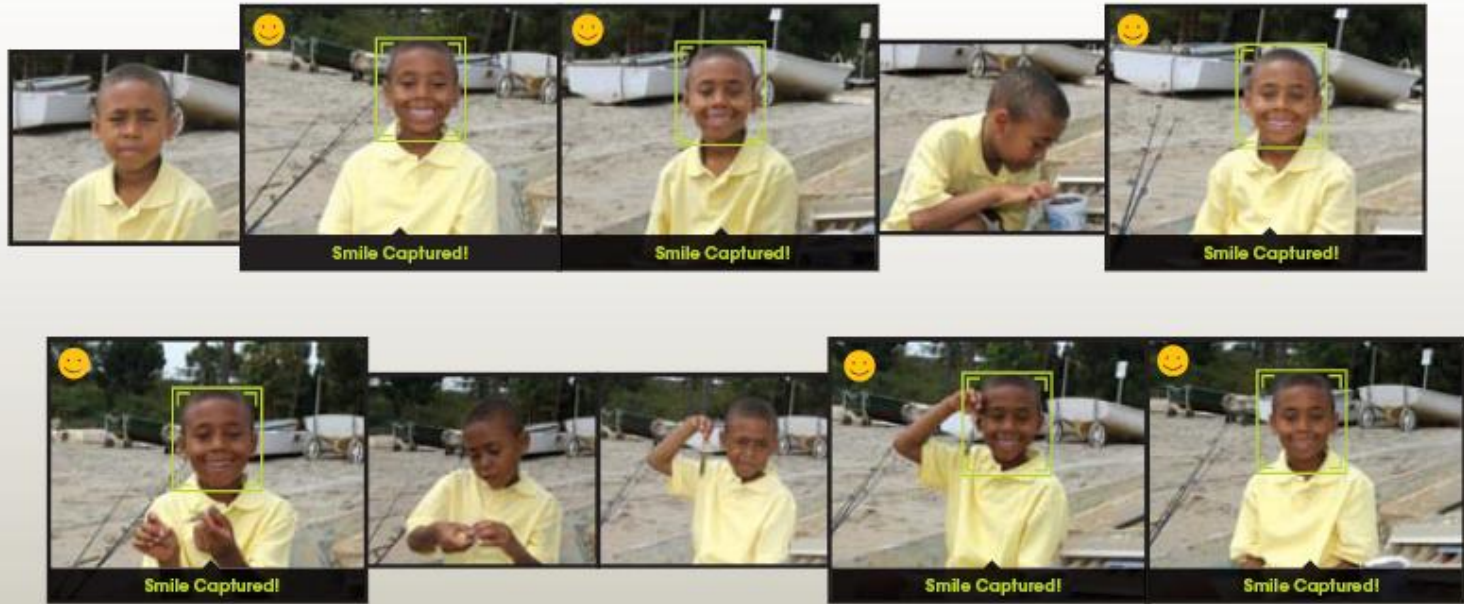


- Many new digital cameras now detect faces
 - Canon, Sony, Fuji, ...

Smile detection

The Smile Shutter flow

Imagine a camera smart enough to catch every smile! In Smile Shutter Mode, your Cyber-shot® camera can automatically trip the shutter at just the right instant to catch the perfect expression.



[Sony Cyber-shot® T70 Digital Still Camera](#)

3D from thousands of images



Object recognition (in supermarkets)



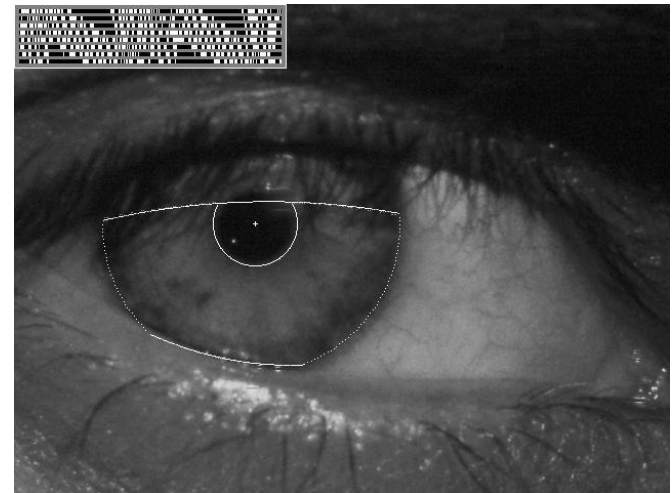
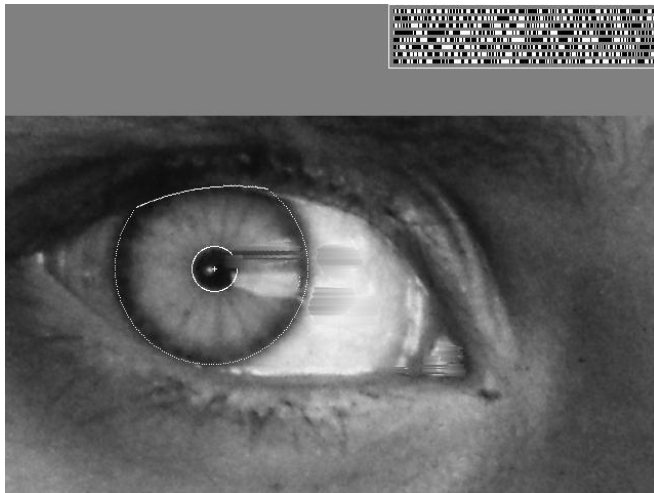
[LaneHawk by EvolutionRobotics](#)

“A smart camera is flush-mounted in the checkout lane, continuously watching for items. When an item is detected and recognized, the cashier verifies the quantity of items that were found under the basket, and continues to close the transaction. The item can remain under the basket, and with LaneHawk, you are assured to get paid for it... “

Vision-based biometrics



"How the Afghan Girl was Identified by Her Iris Patterns" Read the [story](#)
[wikipedia](#)



Login without a password...



Fingerprint scanners on many new laptops, other devices



Face recognition systems now beginning to appear more widely
<http://www.sensiblevision.com/>

Object recognition (in mobile phones)



Point & Find, Nokia
Google Goggles

Special effects: shape capture



The Matrix movies, ESC Entertainment, XYZRGB, NRC

Special effects: motion capture



Pirates of the Caribbean, Industrial Light and Magic

Sports



Sportvision first down line

Nice [explanation](#) on www.howstuffworks.com

<http://www.sportvision.com/video.html>

Smart cars

Slide content courtesy of Amnon Shashua

The screenshot displays the Mobileye website interface. At the top, there are navigation tabs for "manufacturer products" and "consumer products". The main header reads "Our Vision. Your Safety." Below this, a top-down view of a car is shown with three camera fields of view highlighted in yellow: "rear looking camera", "forward looking camera", and "side looking camera".

The bottom section is divided into three main product areas:

- EyeQ Vision on a Chip:** Features an image of the EyeQ chip and a "read more" link.
- Vision Applications:** Shows a pedestrian crossing a street with a bounding box, with text "Road, Vehicle, Pedestrian Protection and more" and a "read more" link.
- AWS Advance Warning System:** Displays a circular sensor unit with a car icon and the number "0.8", with a "read more" link.

On the right side, there is a "News" section with two headlines:

- "Mobileye Advanced Technologies Power Volvo Cars World First Collision Warning With Auto Brake System"
- "Volvo: New Collision Warning with Auto Brake Helps Prevent Rear-end ..."

Below the news is a "read more" link. Further down is an "Events" section with two headlines:

- "Mobileye at Equip Auto, Paris, France"
- "Mobileye at SEMA, Las Vegas, NV"

A "read more" link is also present at the bottom of the events section.

- Mobileye

- Vision systems currently in high-end BMW, GM, Volvo models
- By 2010: 70% of car manufacturers.

Google cars

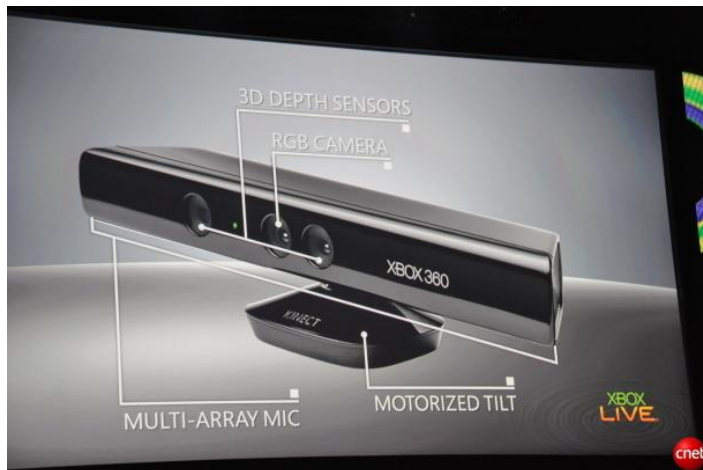


Interactive Games: Kinect

- Object Recognition:

<http://www.youtube.com/watch?feature=iv&v=fQ59dXOo63o>

- Mario: <http://www.youtube.com/watch?v=8CTJL5IUjHg>
- 3D: <http://www.youtube.com/watch?v=7QrnwoO1-8A>
- Robot: <http://www.youtube.com/watch?v=w8BmgtMKFbY>



Vision in space



NASA'S Mars Exploration Rover Spirit captured this westward view from atop a low plateau where Spirit spent the closing months of 2007.

Vision systems (JPL) used for several tasks

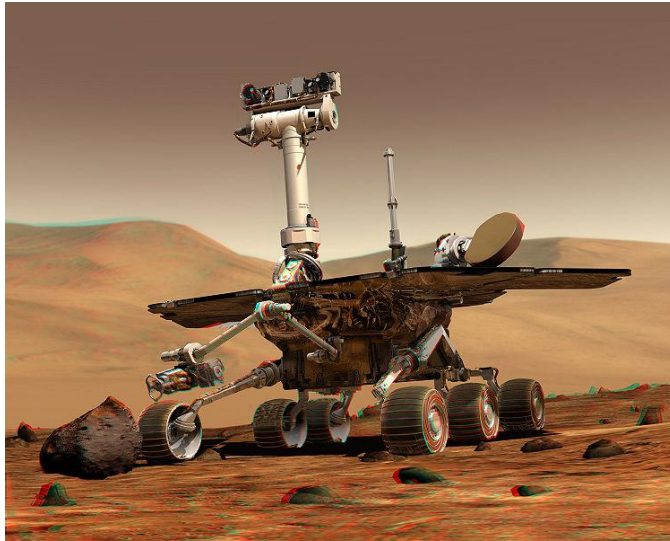
- Panorama stitching
- 3D terrain modeling
- Obstacle detection, position tracking
- For more, read “Computer Vision on Mars” by Matthies et al.

Industrial robots



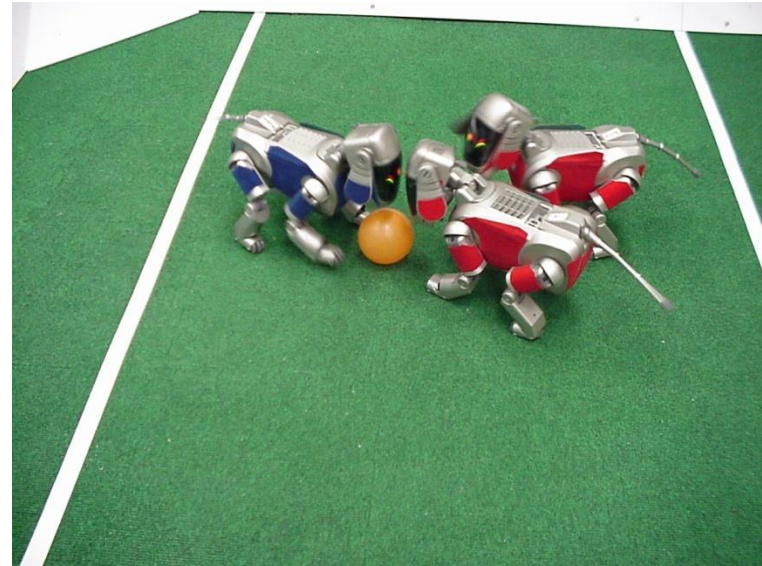
Vision-guided robots position nut runners on wheels

Mobile robots

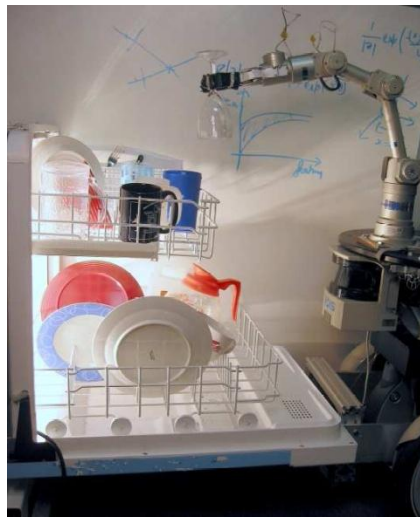


NASA's Mars Spirit Rover

http://en.wikipedia.org/wiki/Spirit_rover

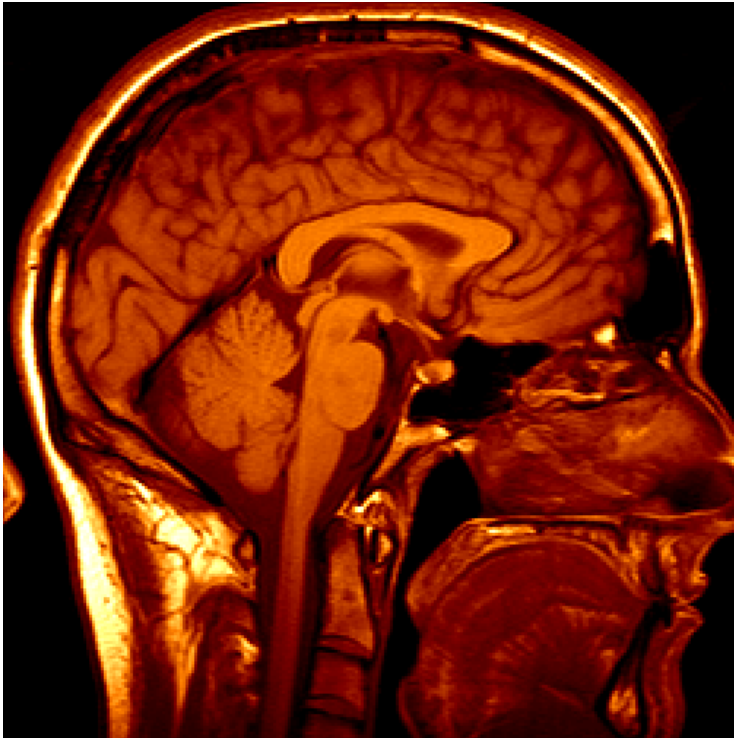


<http://www.robocup.org/>



Saxena et al. 2008
STAIR at Stanford

Medical imaging



3D imaging
MRI, CT



Image guided surgery
Grimson et al., MIT