

What is Computer Vision?

PREPARED BY
A.RADIKA(ASST.PROFESSOR)

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?

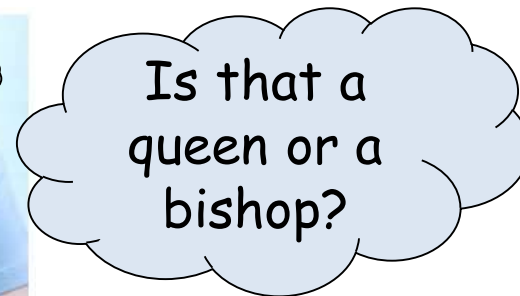
Where are the cars?

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



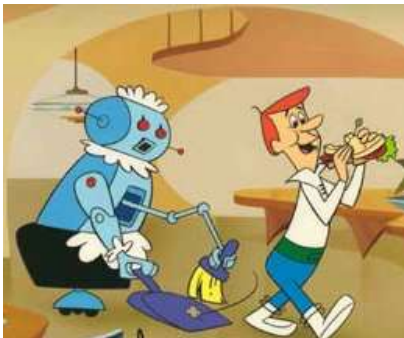
Safety



Health



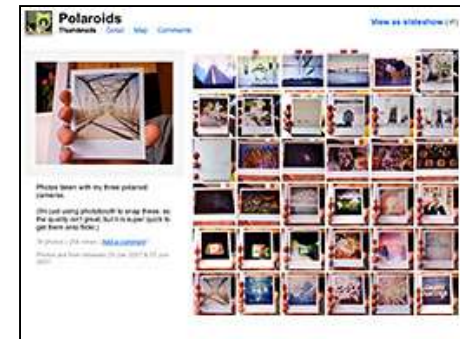
Security



Comfort



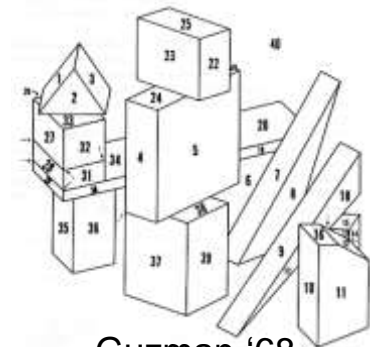
Fun



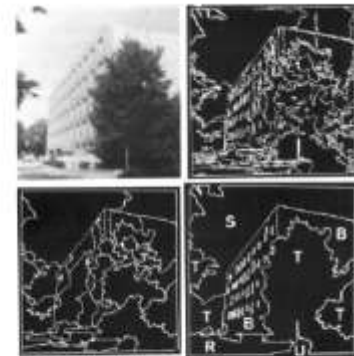
Access

Ridiculously brief history of computer vision

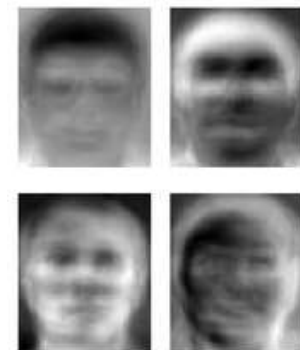
- 1966: Minsky assigns computer vision as an undergrad summer project
- 1960's: interpretation of synthetic worlds
- 1970's: some progress on interpreting selected images
- 1980's: ANNs come and go; shift toward geometry and increased mathematical rigor
- 1990's: face recognition; statistical analysis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



Guzman '68



Ohta Kanade '78



Turk and Pentland '91

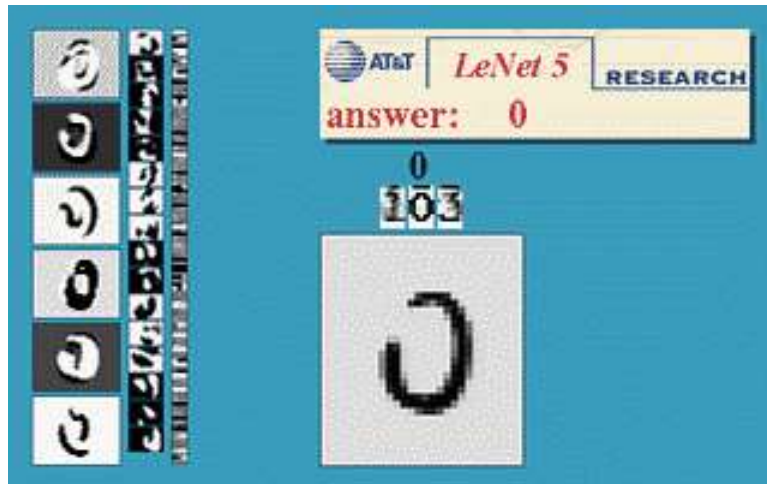
How vision is used now

- 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)



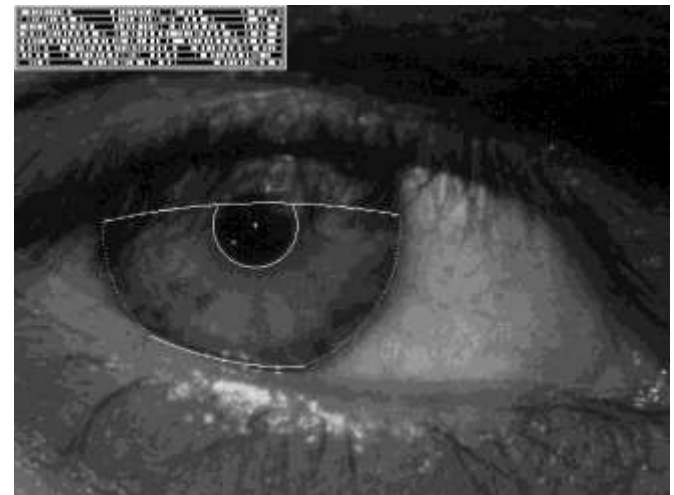
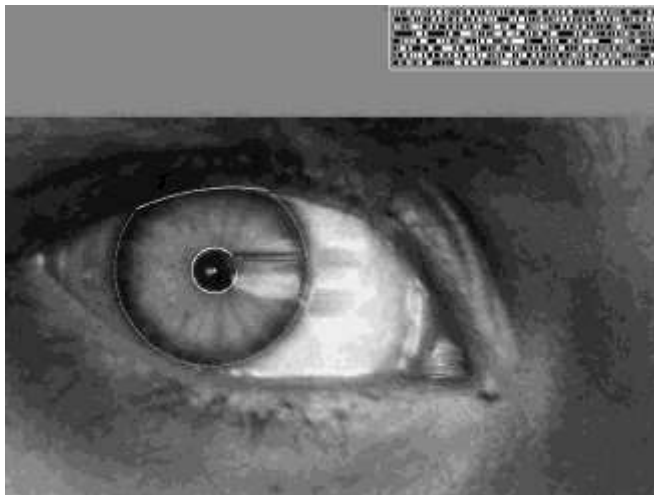
[LaneHawk by EvolutionRobotics](#)

“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 Carribean, 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

manufacturer products consumer products

Our Vision. Your Safety.

rear looking camera forward looking camera side looking camera

EyeQ Vision on a Chip

Vision Applications
Road, Vehicle, Pedestrian Protection and more

AWS Advance Warning System

News

- > 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
- > all news

Events

- > Mobileye at Equip Auto, Paris, France
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- Mobileye

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

Google cars

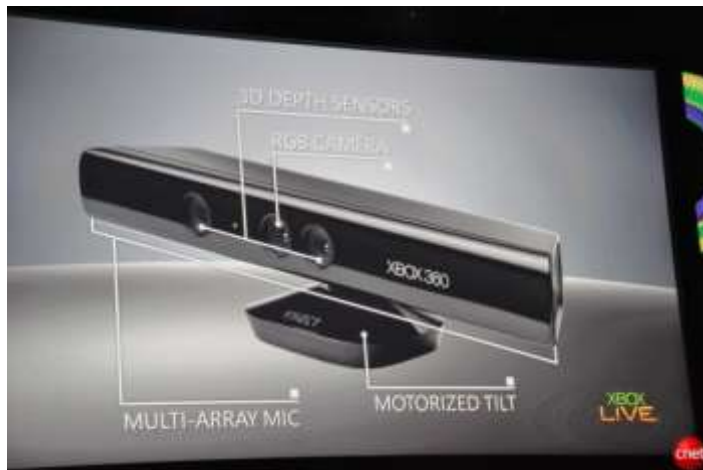


Interactive Games: Kinect

- 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

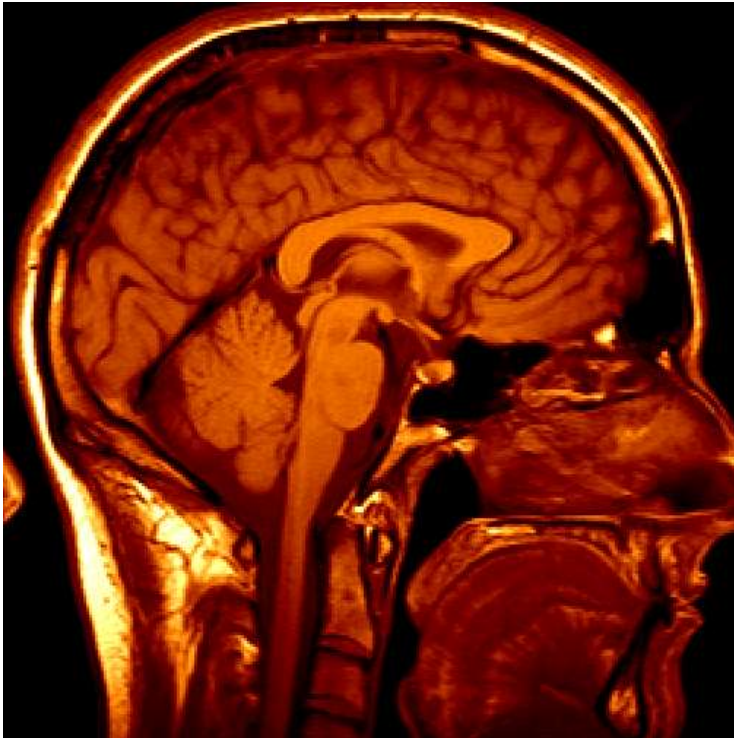


<http://www.robocup.org/>



Saxena et al. 2008
STAIR at Stanford

Medical imaging



3D imaging
MRI, CT



Image guided surgery
Grimson et al., MIT

Computer Vision (CSE 576)

Staff



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Rick Szeliski

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jhchen@cs.washington.edu

Web Page

- <http://www.cs.washington.edu/education/courses/cse576/08sp/>

Handouts

- signup sheet
- intro slides
- image filtering slides

Today

- Intros
- Computer vision overview
- Course overview
- Image processing

Readings

- Book: [Richard Szeliski, Computer Vision: Algorithms and Applications](#)
 - (please check [Web site](#) weekly for updated drafts)
 - Intro: Ch 1.0

What is computer vision?

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Terminator 2

Every picture tells a story



Goal of computer vision is to write computer programs that can interpret images

Can computers match (or beat) human vision?



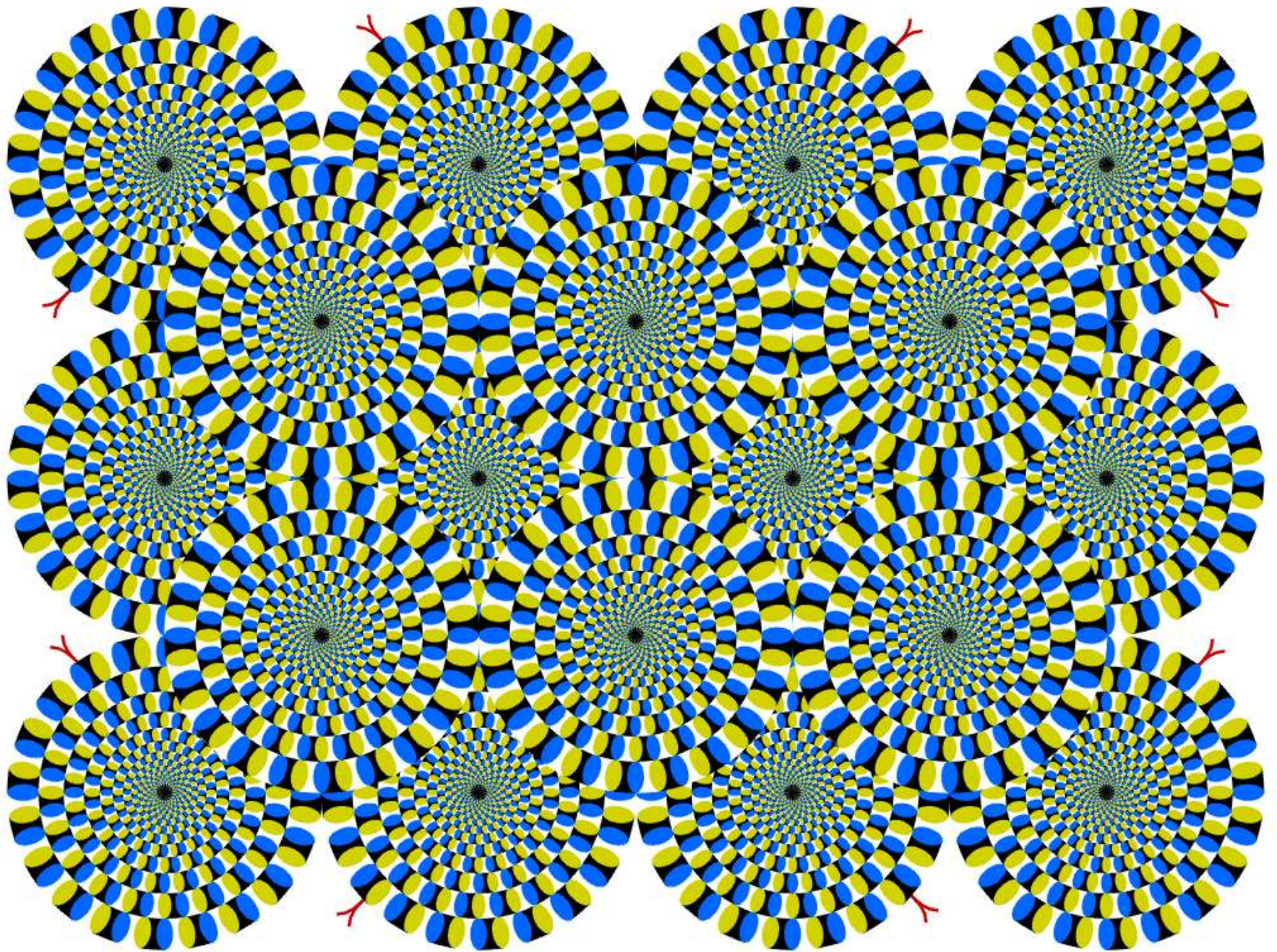
Yes and no (but mostly no!)

- humans are much better at “hard” things
- computers can be better at “easy” things

Human perception has its shortcomings...



[Sinha and Poggio, *Nature*, 1996](#)



Current state of the art

The next slides show some examples of what current vision systems can do

Earth viewers (3D modeling)

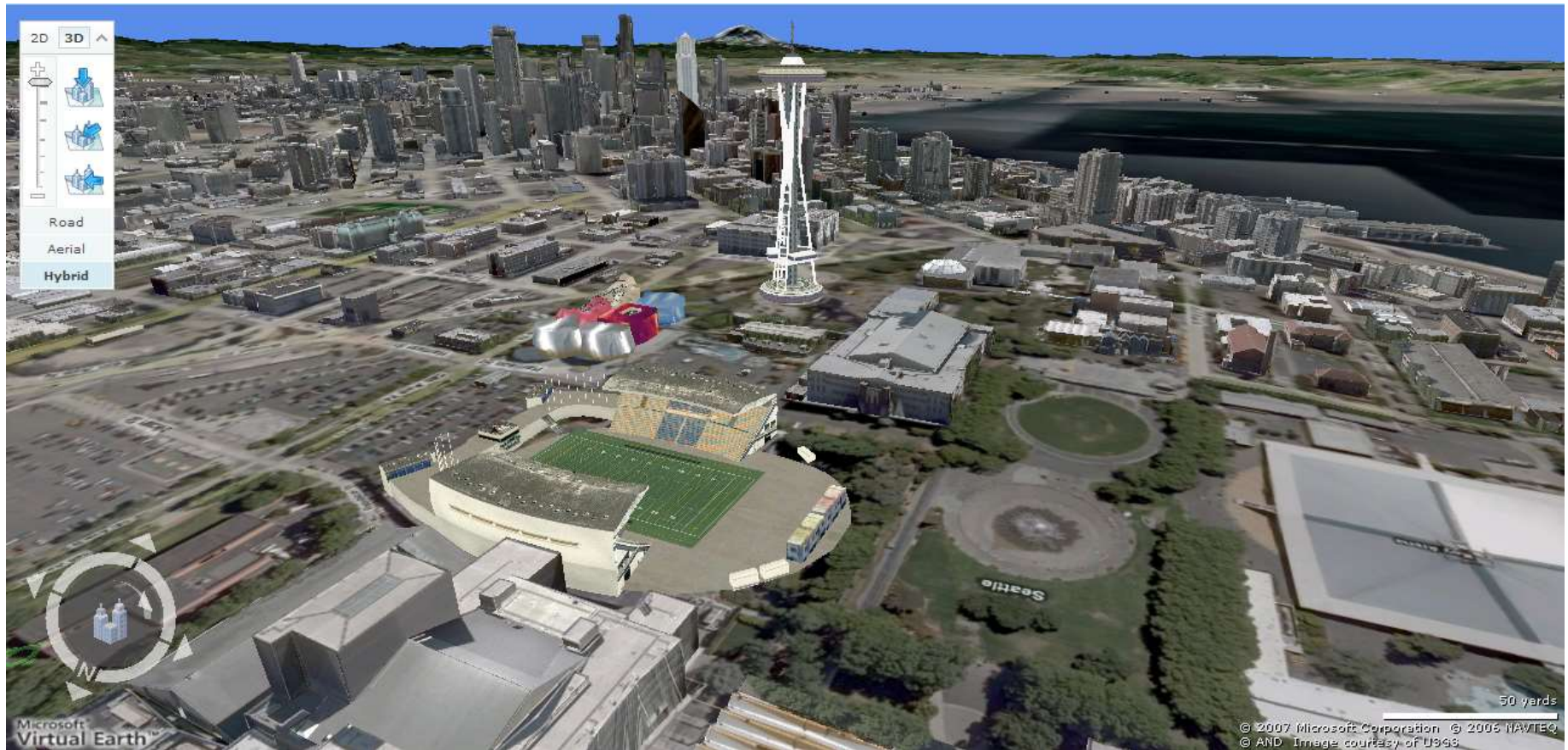


Image from Microsoft's [Virtual Earth](#)
(see also: [Google Earth](#))

Home

- Try it
- What is Photosynth?
- Collections
- Team blog
- Videos
- System requirements
- About us
- FAQ

"What if your photo collection was an entry point into the world, like a wormhole that you could jump through and explore..."

Try it



Try the Tech Preview

The **Photosynth Technology Preview** is a taste of the newest - and, we hope, most exciting - way to **view photos** on a computer. Our software takes a large collection of photos of a place or an object, analyzes them for similarities, and then displays the photos in a reconstructed **three-dimensional space**, showing you how each one relates to the next.

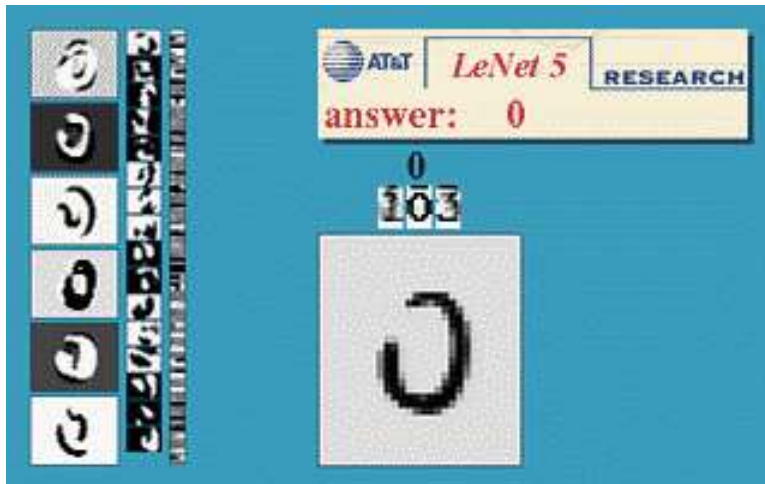
<http://labs.live.com/photosynth/>

Based on [Photo Tourism technology](#) developed here in CSE!
by Noah Snavely, Steve Seitz, and Rick Szeliski

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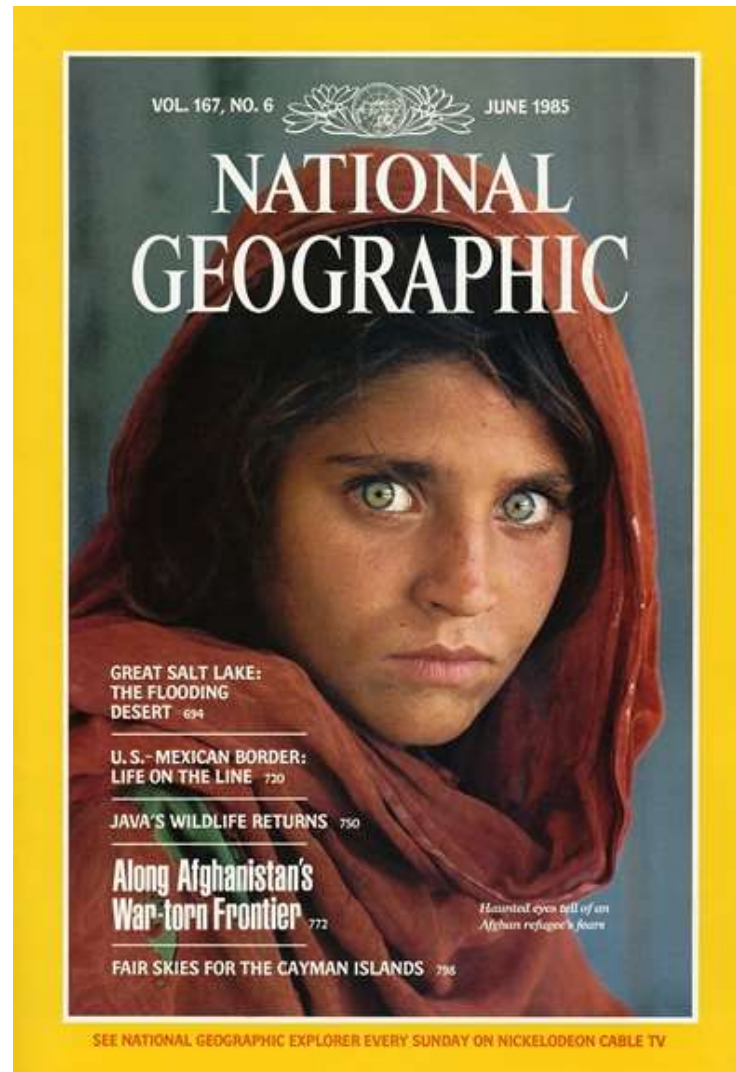
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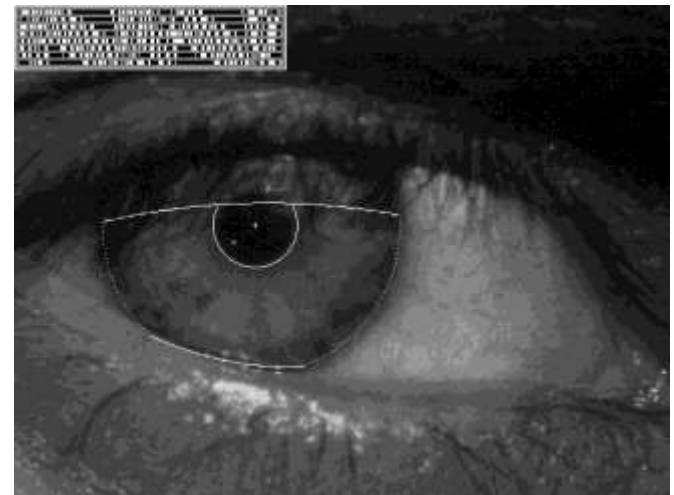
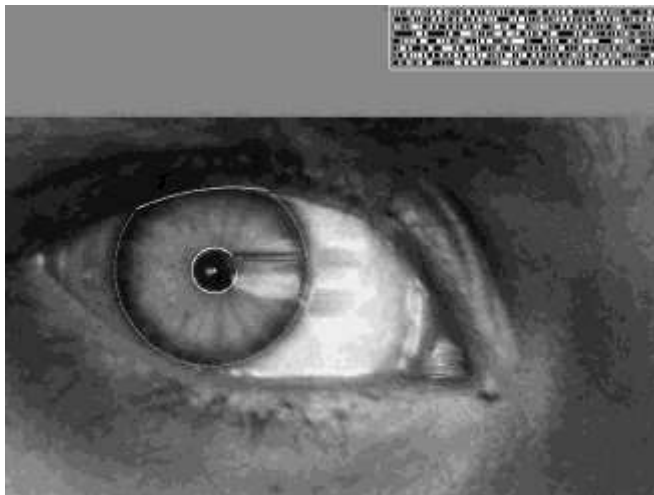


Who is she?

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This is becoming real:

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Pirates of the Caribbean, Industrial Light and Magic

[Click here for interactive demo](#)

Sports



Sportvision first down line
Nice [explanation](http://www.howstuffworks.com) on www.howstuffworks.com

Smart cars

Slide content courtesy of Amnon Shashua

The image is a screenshot of the Mobileye website. At the top, there are two navigation buttons: 'manufacturer products' and 'consumer products'. Below them is the slogan 'Our Vision. Your Safety.' and a top-down view of a car with three camera fields of view highlighted: 'rear looking camera', 'side looking camera', and 'forward looking camera'. The main content area is divided into three sections: 'EyeQ Vision on a Chip' featuring a chip image, 'Vision Applications' showing a pedestrian on a crosswalk, and 'AWS Advance Warning System' showing a car icon with a distance readout. To the right is a 'News' sidebar with two headlines about Volvo's collision warning system and a link to 'all news'. Below the news is an 'Events' sidebar with links to 'Mobileye at Equip Auto, Paris, France' and 'Mobileye at SEMA, Las Vegas, NV', followed by a 'read more' link.

manufacturer products consumer products

Our Vision. Your Safety.

rear looking camera forward looking camera side looking camera

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Mobileye

- Vision systems currently in high-end BMW, GM, Volvo models
- By 2010: 70% of car manufacturers.
- [Video demo](#)

Vision-based interaction (and games)



Nintendo Wii has camera-based IR tracking built in. See [Lee's work at CMU](#) on clever tricks on using it to create a [multi-touch display](#)!



[Digimask](#): put your face on a 3D avatar.



[“Game turns moviegoers into Human Joysticks”](#), CNET
Camera tracking a crowd, based on [this work](#).

Vision in space

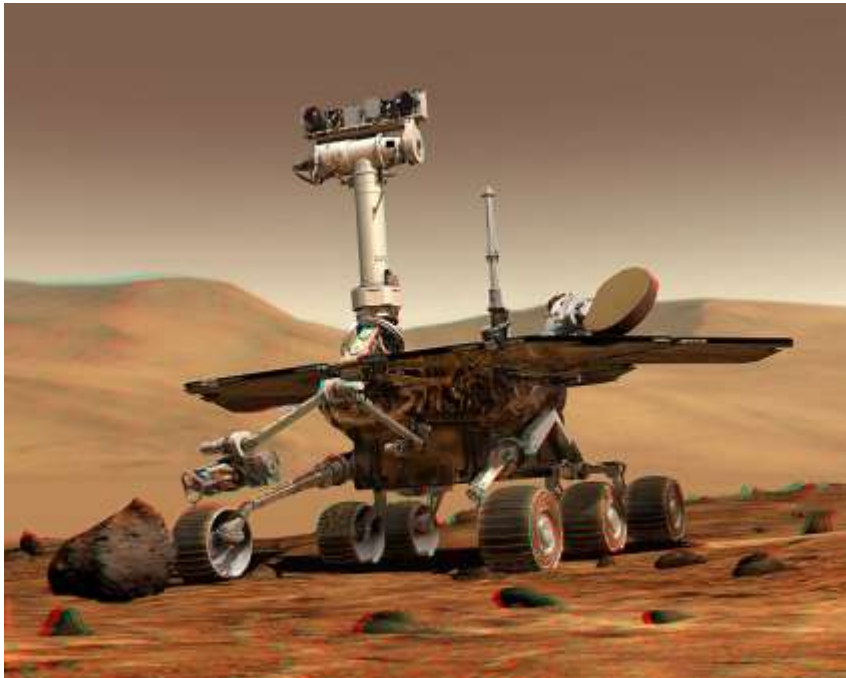


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Robotics



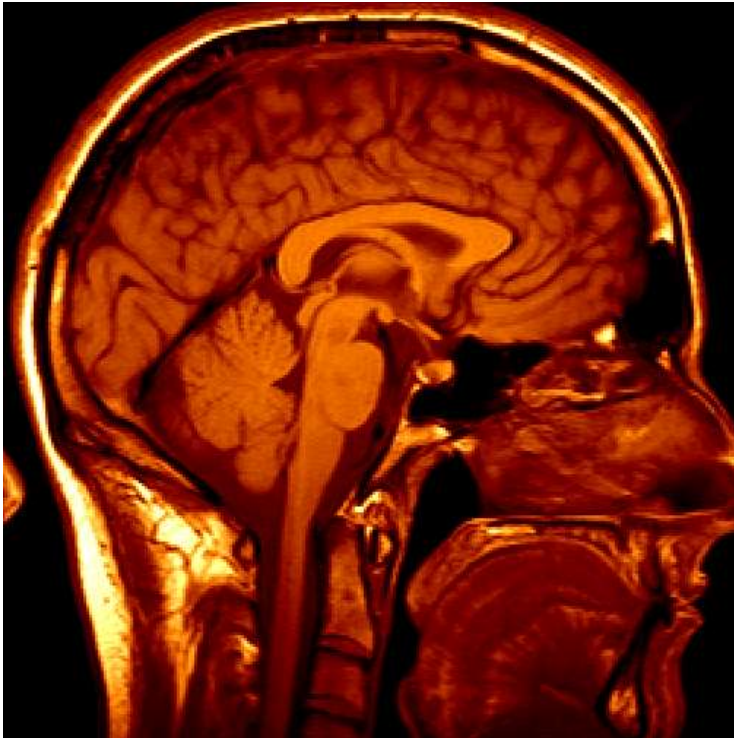
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http://en.wikipedia.org/wiki/Spirit_rover



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

Medical imaging



3D imaging
MRI, CT



Image guided surgery
[Grimson et al., MIT](#)

Current state of the art

You just saw examples of current systems.

- Many of these are less than 5 years old

This is a very active research area, and rapidly changing

- Many new apps in the next 5 years

To learn more about vision applications and companies

- [David Lowe](http://www.cs.ubc.ca/spider/lowe/vision.html) maintains an excellent overview of vision companies
 - <http://www.cs.ubc.ca/spider/lowe/vision.html>

This course

<http://www.cs.washington.edu/education/courses/cse576/08sp/>

Project 1: features

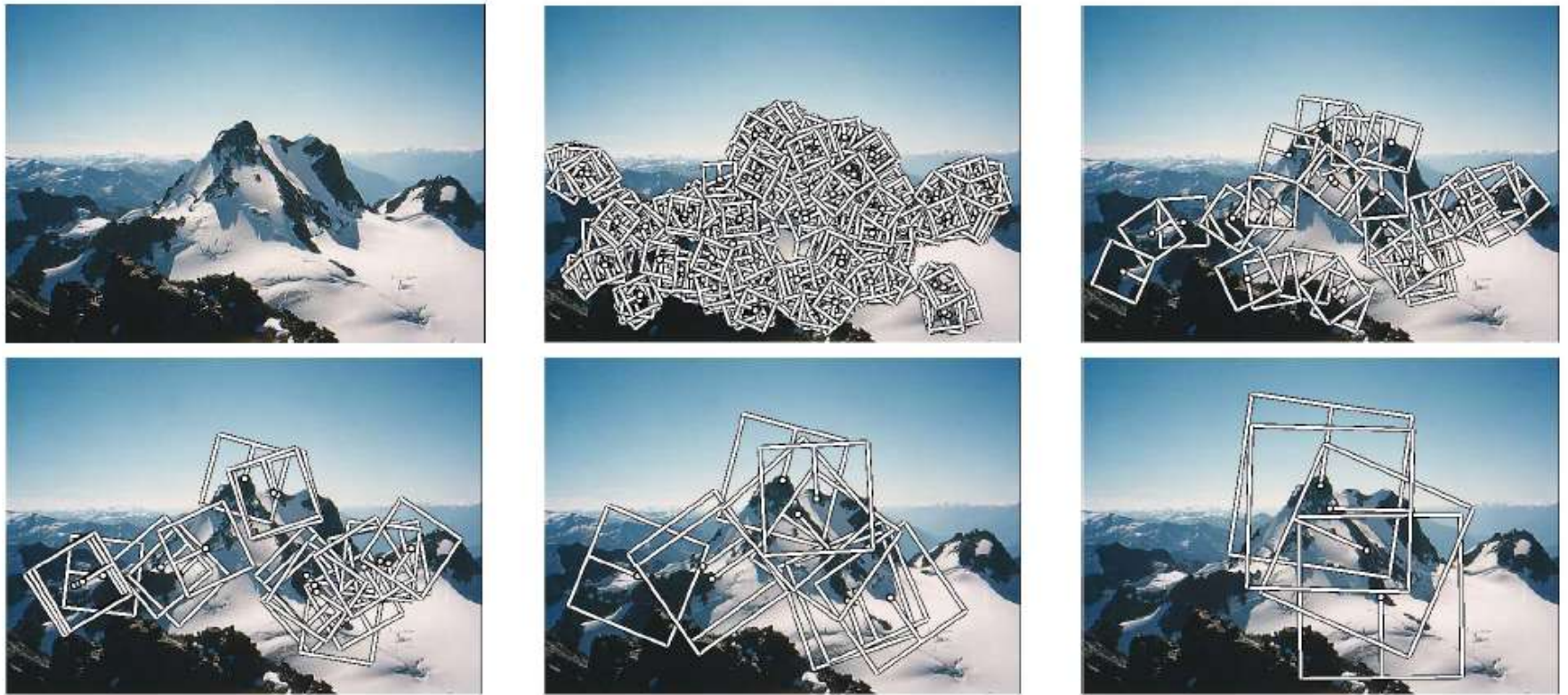


Figure 1. Multi-scale Oriented Patches (MOPS) extracted at five pyramid levels from one of the Matier images. The boxes show the feature orientation and the region from which the descriptor vector is sampled.

Project 2: panorama stitching

<http://www.cs.washington.edu/education/courses/cse576/05sp/projects/proj2/artifacts/winners.html>



Indri Atmosukarto, 576 08sp

Project 3: Face Recognition



Final Project

Open-ended project of your choosing
(in teams of two)

Grading

Based on projects

No midterm or final

General Comments

Prerequisites—*these are essential!*

- Data structures
- A good working knowledge of C and C++ programming
 - (or willingness/time to pick it up quickly!)
- Linear algebra
- Vector calculus

Course does ***not*** assume prior imaging experience

- computer vision, image processing, graphics, etc.