CPE 428 Computer Vision Introduction

- What is computer vision and why?
- What are the applications?
- Components of a computer vision system.
- Challenges

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What is Computer Vision?

- "Computer vision is the study and analysis of digital images and videos in order to extract information and make sense of it."
- "The study of inferring properties of the world based on one or more digital images"

Traffic scene
— Number of vehicles
— Type of vehicles
— Location of closest obstacle
— Assessment of congestion

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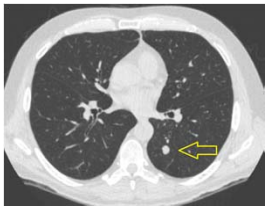
Why Computer Vision?

- An image is worth 1000 words.
- To develop human-level capabilities for computers and robots.
- Computer vision provides automated solution to reduce human labors or perform dangerous tasks.
- Lots of exciting progress and is continuously growing and will impact every aspect of our lives.

Applications of Computer Vision

Industry and Manufacturing



Medical Image Analysis

Surveillance

Lipreading

Fun Stuffs

OCR

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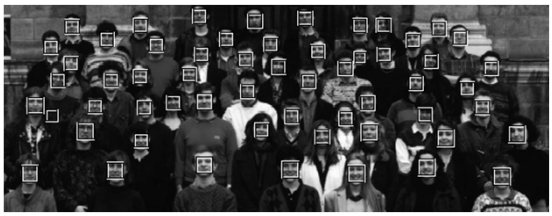
Face Detection and Recognition



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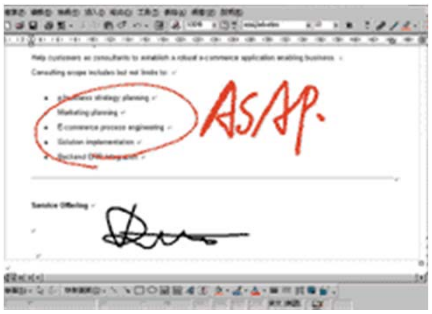
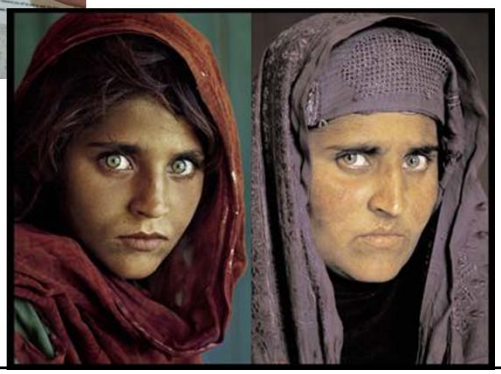
Biometrics



Biometrics - Iris Recognition



Robotics for space exploration

"Mars" rover

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

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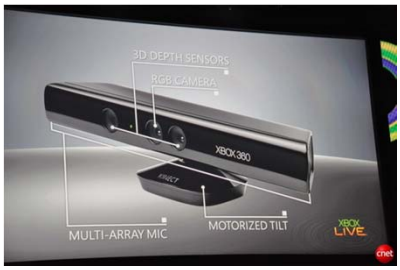
Self-Driving Cars

- Uber, Tesla, GM, Toyota

Microsoft Kinect



- Object Recognition: https://www.youtube.com/watch?v=fQ59dXOo63o
- 3D, VR, etc.

http://www.hongkiat.com/blog/innovative-uses-kinect/

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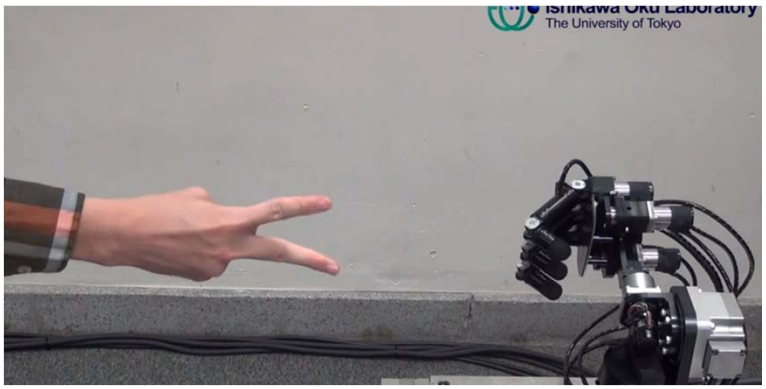
Janken Robot Wins Rock-Paper-Scissors



http://www.youtube.com/watch?v=3nxjjztQKtY

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Making the Invisible Visible

- http://www.youtube.com/watch?v=sVlC_-e-4yg

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General structure of a CV problem

- Image acquisition
- Pre-processing
- Feature Extraction (lines, corners, contours, regions, optical flow, etc.)
- Image Understanding

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Three Stages of Computer Vision

- low-level: noise reduction, edge detection
- mid-level: image segmentation and clustering
- high-level: object recognition and scene interpretation

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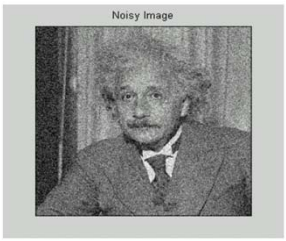
Low-Level (Digital Image Processing)



noise reduction

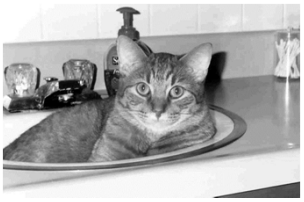


image enhancement

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Low- to High-Level

low-level → edge image

mid-level ↓

high-level ← consistent line clusters

Building Recognition

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Challenges of Computer Vision

- Vision is deceivingly easy
- Building computer vision systems is hard.
- Why don't we just copy the human visual system?
- Loss of information in 3D->2D
- Appearance variation due to illumination, orientation, deformation, scale, rotation, occlusion, etc.

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Why is Computer Vision Hard?

Figure 1

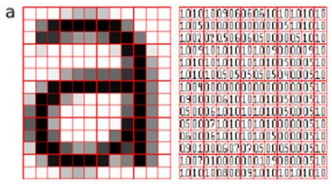

Figure 2

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Related Disciplines

- Image processing
- Pattern recognition
- Computer graphics
- Artificial intelligence
- Projective geometry
- Neuroscience
- Machine Learning
- Mathematics

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Outcome of this course

- Gain basic understand of how computer vision works
- Have the ability to apply computer vision techniques to applications of interest

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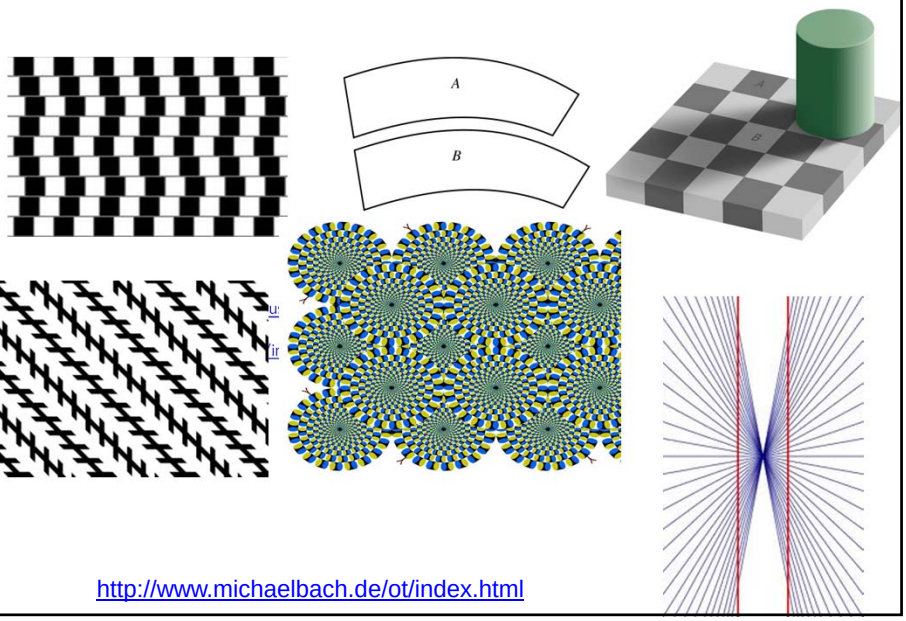
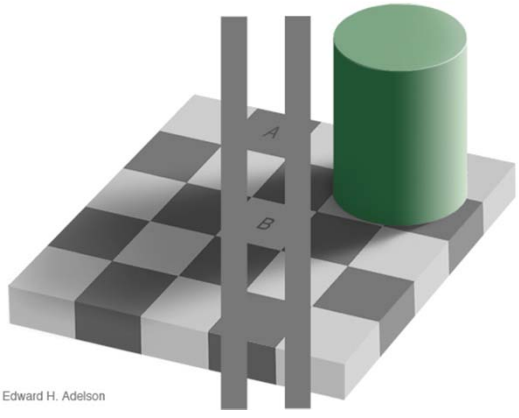
Some Optical Illusions



http://www.michaelbach.de/ot/index.html



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