Computer Vision for HCI

Introduction

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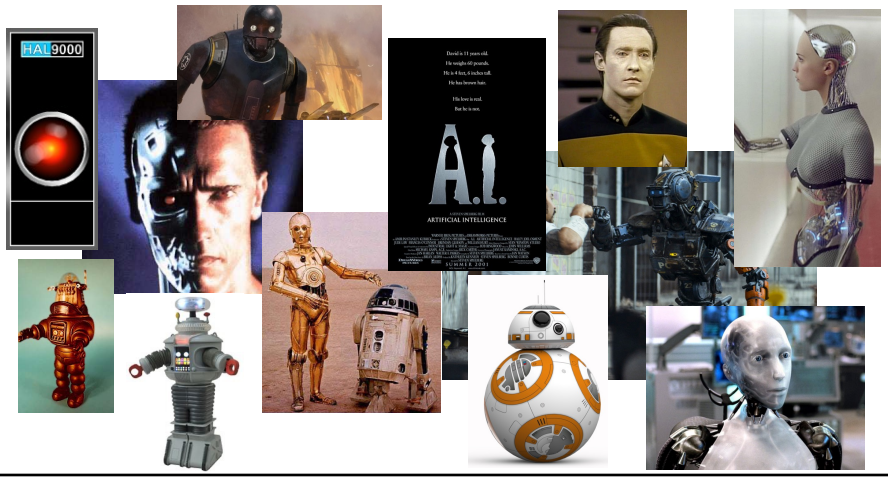
Machines That See?

- Science fiction
  - HAL, Terminator, Star Wars, I-Robot, etc.



2

Machines That See?

[movie]

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Definition of Computer Vision

- Goal of computer vision is to make <u>useful decisions</u> about real physical objects and scenes based on sensed images
  - ***Process of discovering from images <u>what</u> is present in the world, <u>where</u> it is, and what it is <u>doing</u>!***
- Construction of scene descriptions from images
- Require representations of shape, motion, color, context, etc.

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Computer Vision as Inverse Graphics

- Computer graphics
  - Descriptions to images
- Image processing
  - Images to images
- Computer vision
  - Images to descriptions (inverse graphics)

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Critical Issues

- Sensing
  - How do we get images of the world?
- Encoding information
  - How do images yield information for understanding the world?
- Representations
  - What representations should be used?
- Algorithms
  - What methods are there to process image information?
  - How do we choose which algorithms to use?

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Applications

- How can computer vision be used to facilitate more intelligent systems or natural computer interfaces?
  - Recognize object, people, gestures
  - Analyze movements/activities of person
  - Identity recognition
    - From face, fingerprints, motion, etc.
  - etc.

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- Agricultural / Forestry
  - Crop Treatment Control
  - Forest Survey/Tree Crown counting
  - Fruit Grading
  - Harvest Control
  - Plant Disease and Parasite Identification
  - Plant Health/Condition Monitoring
  - Species Identification
- Animal Husbandry
  - Fish Modeling and Tracking
  - Flock Tracking
- Architectural/Construction
  - Archeological Applications
  - Building Recognition
  - Model Reconstruction
  - Sewer Survey
- Character Recognition (Printed and Handwritten)
  - Roman Letters, Chinese, etc.
  - Slant Normalization
- Commercial Applications
  - Advertising
  - Bank Checks
  - Bar-Code Reading
  - Currency Verification
  - Seal Verification
  - Signature Identification and Verification
- Document Processing
  - Diagram Understanding
  - Document Mosaicing
  - Equation Understanding
  - Form and Layout Understanding
  - Letter Analysis
  - Post Code Recognition
  - Signature/Writer Verification
  - Skew Correction
  - Trademark Database Indexing
  - Watermark Extraction
- Industrial
  - Factory Automation
  - Food Manufacture
  - Inspection
  - Part Pose Estimation
  - Part Recognition
  - Process Control
- Military
  - Aircraft Identification/Tracking
  - Missile Tracking
  - Target Recognition/Tracking
  - Vehicle Detection
- Human
  - Body
  - Hands
  - Heads and Faces

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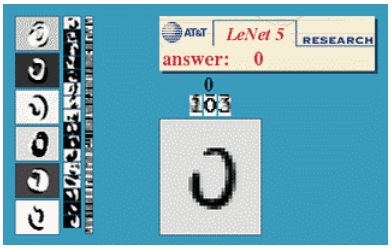
Optical Character Recognition (OCR)

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

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Face Detection

- Digital cameras detecting faces

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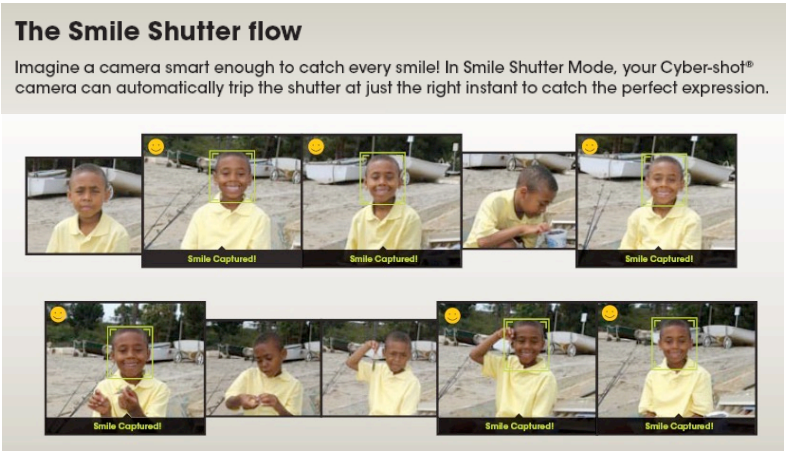
Smile Detection



Sony Cyber-shot® T70 Digital Still Camera

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Face Recognition

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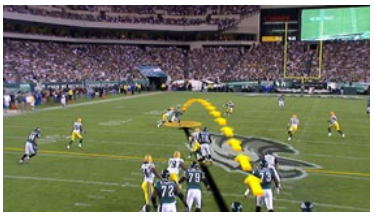
Sports

Sportvision first down line
(Nice description on www.howstuffworks.com)



Pass Track

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Automatic Surveillance

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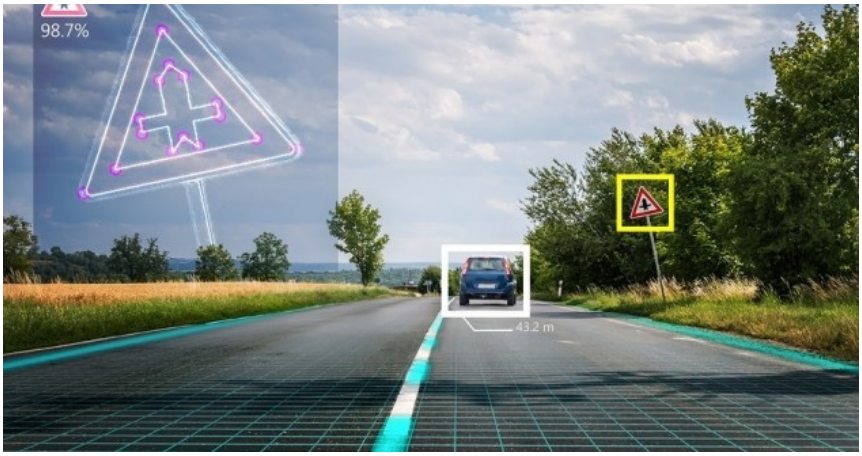
Smart/Autonomous Cars



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Industry Computer Vision Labs

- Microsoft
- Amazon
- Google
- Tesla
- Disney
- …
- Many startup companies

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Matlab

- What is Matlab?
  - High-performance language for technical computing
  - Integrates computation, visualization, and programming in an easy-to-use environment
  - Excellent image processing toolbox
- Required for class homework assignments
  - Available on department/college machines
  - Free to OSU students!
- Online help
  - http://www.mathworks.com/access/helpdesk/help/techdoc/matlab.shtml

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Python

- We are going to also let students use Python (instead of Matlab) for the homework assignments
- Must implement techniques (not call library functions)
  - As with using Matlab

NumPy for Matlab users
https://docs.scipy.org/doc/numpy/user/numpy-for-matlab-users.html

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Let’s go!!!

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