



COMPUTER VISION

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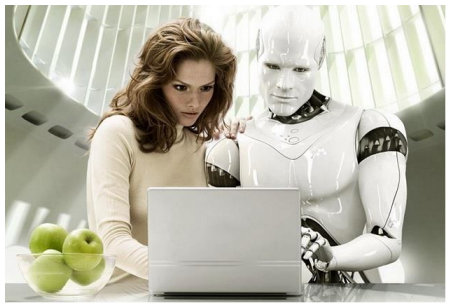
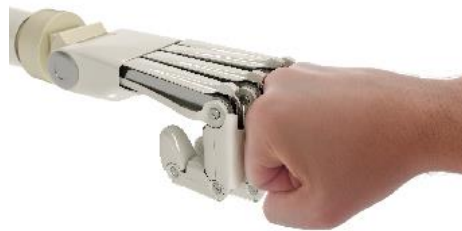
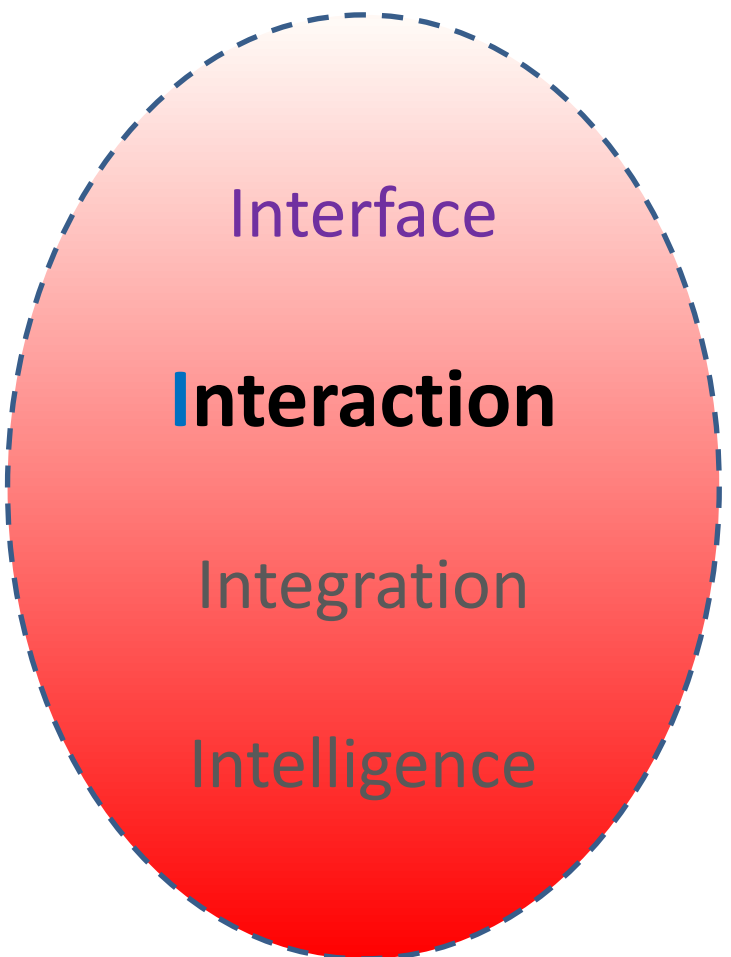
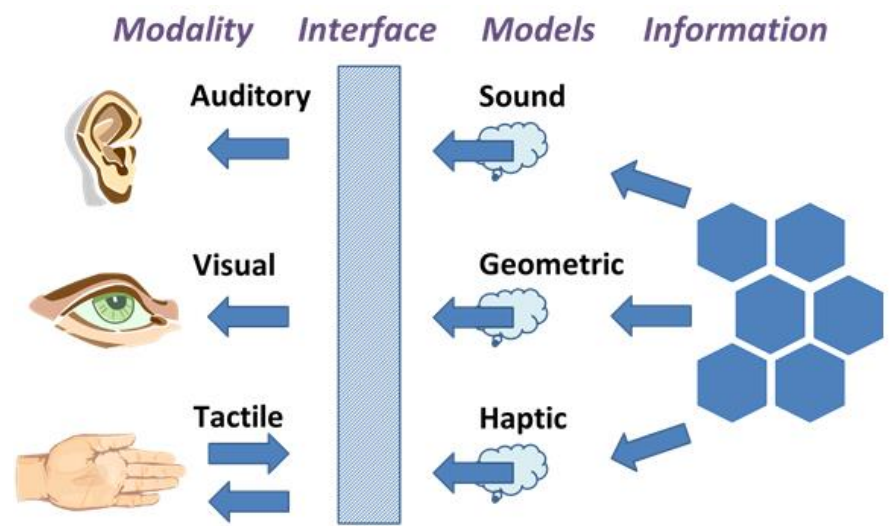
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About myself

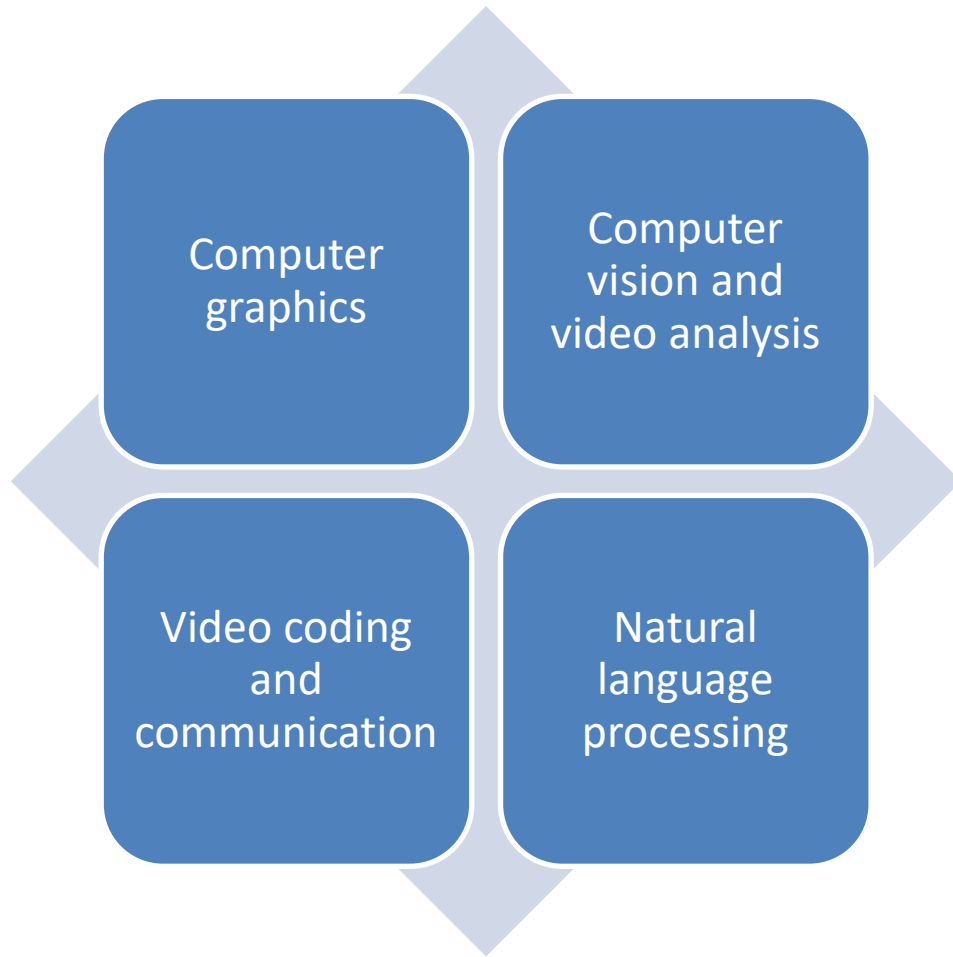
- Full name: **Le Thanh Ha**
- 2005-2010: Ph.D at Korea University, Korea
- 2010-now:
 - Assoc. Prof. at University of Engineering and Technology (UET), VNUH
 - Head of **Human Machine Interaction Laboratory**
- Expertise: Computer vision, Image/video processing and analysis, Machine learning

HMI Laboratory

Human Machine



Workgroups



<https://hmiuet.wordpress.com>

Digital Image Processing and Computer Vision

- Low-level process:
 - Inputs and outputs are images.
 - Noise reduction, contrast enhancement, ...

Digital Image Processing

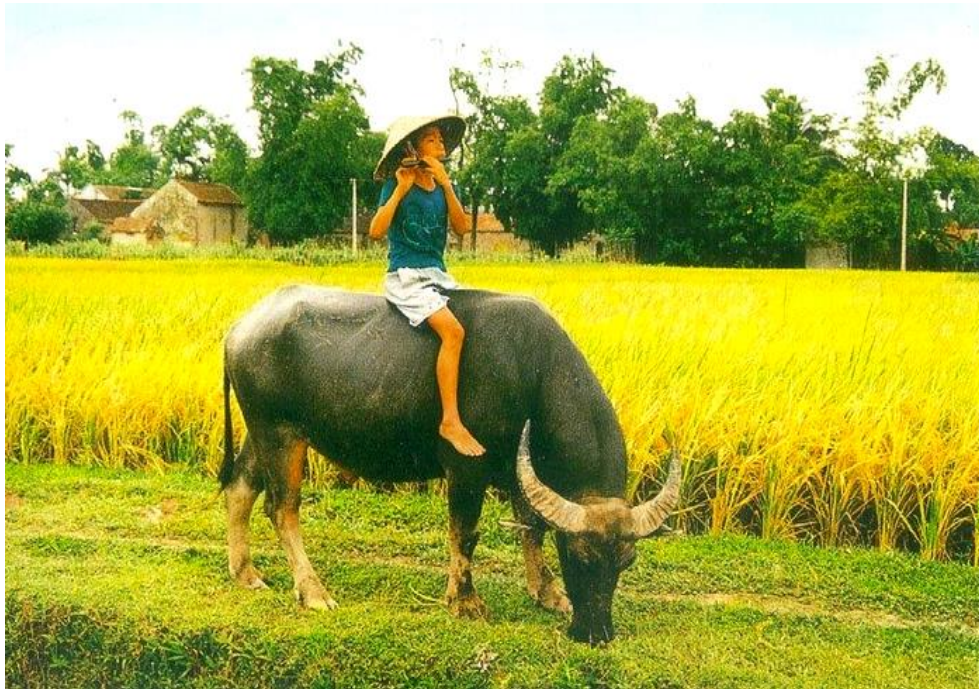
- Mid-level process:
 - Extract attributes from images.
 - Segmentation, single object recog., ...

- High-level process
 - Perform cognitive functions

Computer Vision

What is computer vision?

- Make computers understand images and video.



What kind of scene?

Where is the buffalo?

How far is the house?

What is computer vision?



- How many flowers?



- What is the pup thinking?

What is computer vision?

- Is there anyway to reconstruct the 3D structure of this building?

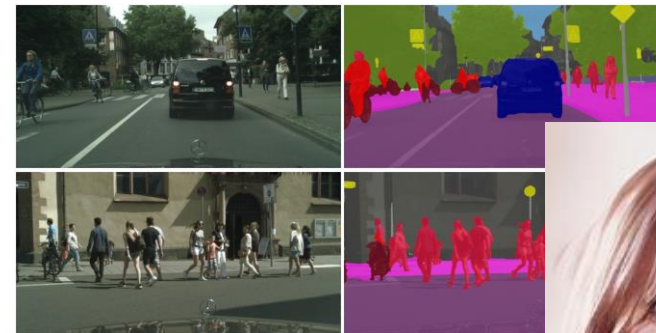
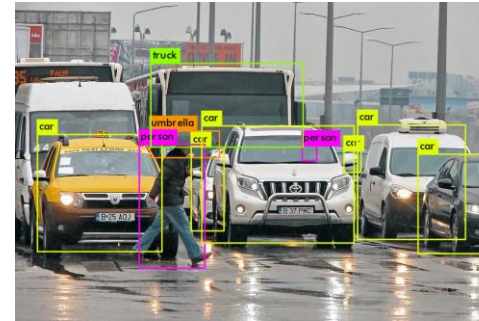


Vision is really hard

- Vision is an amazing feat of natural intelligence
 - Human receive more than 80% information coming from visual system
 - More human brain devoted to vision than anything else

Computer vision topics

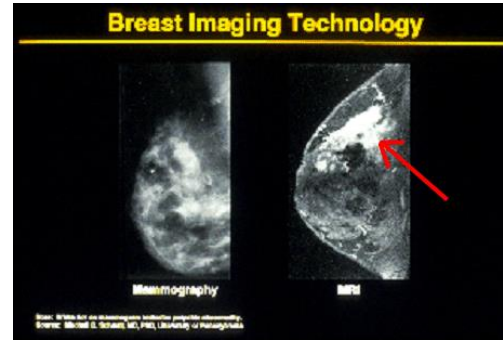
- Virtual & Augmented Reality
- Biometric
- Object detection
- Optical Character Recognition
- Image video segmentation
- Scene understanding
- Image generation
- ...



Computer vision matters



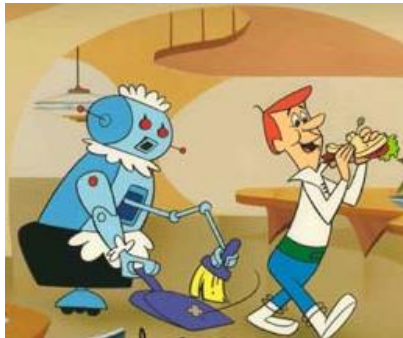
Safety



Health



Security



Comfort

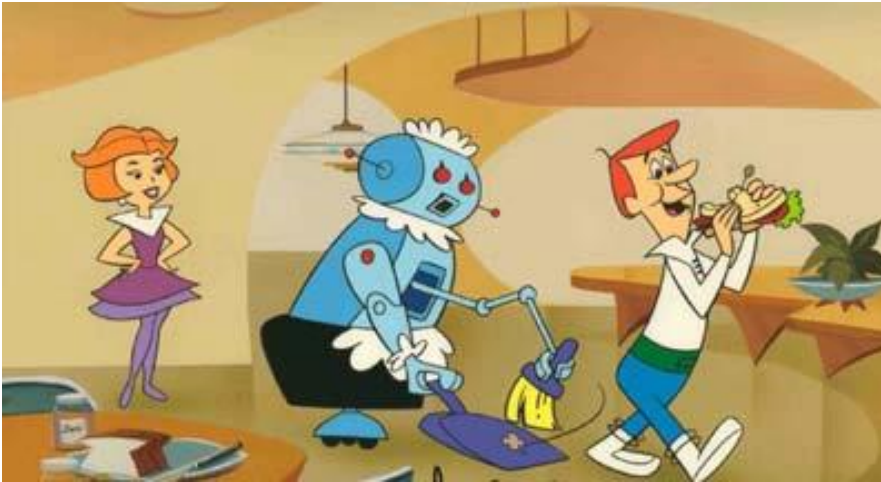


Fun



Access

Two reasons for computer vision



Household Robots



Assisted Driving

Let's see

Real applications of computer vision

Earth viewers (3D modeling)



Image from [Google Earth](#)

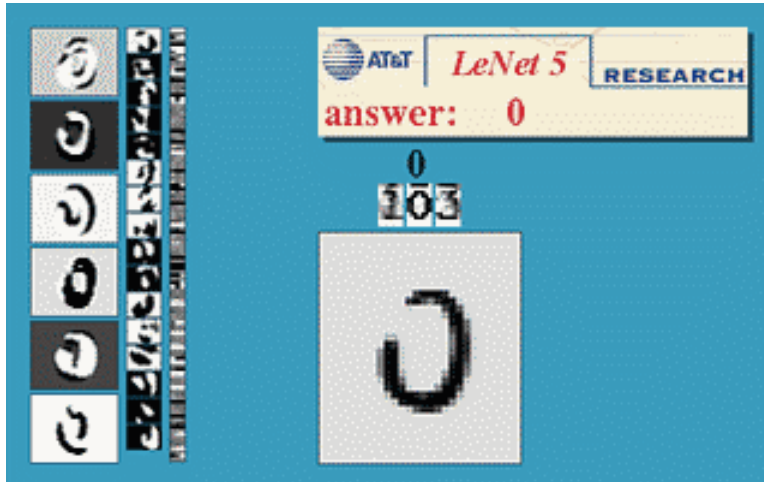
3D from thousands of images



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

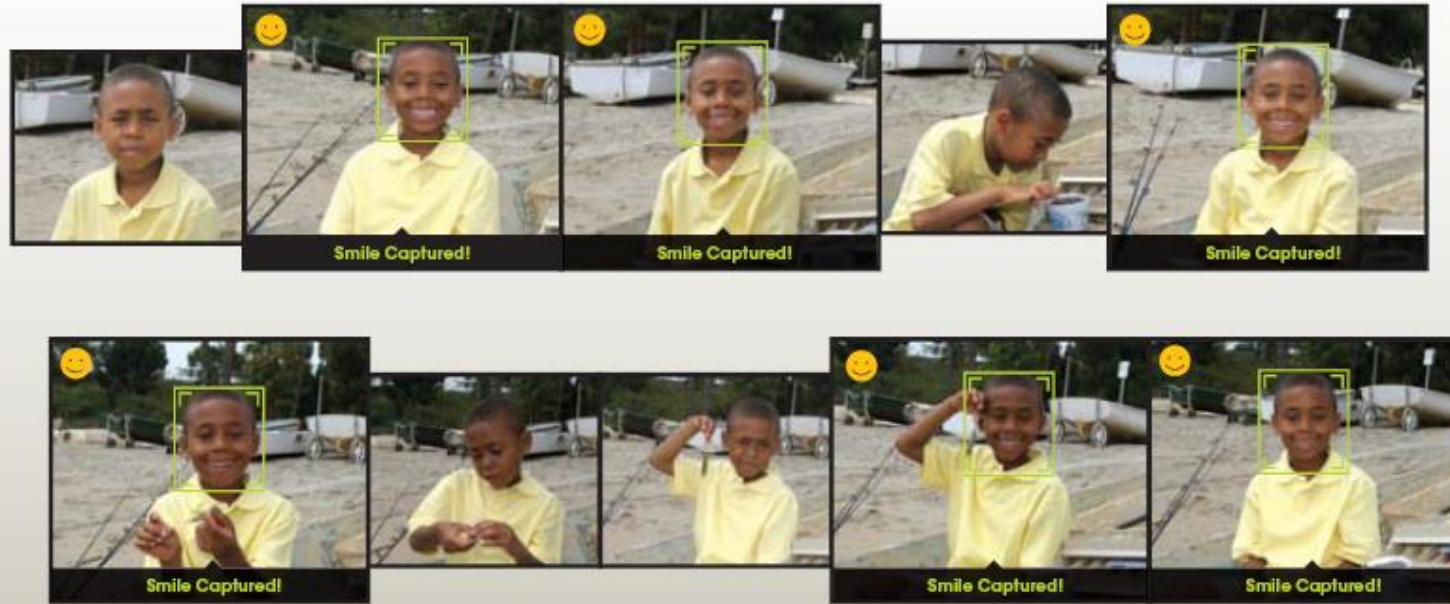


- Many new digital cameras now detect faces
 - Canon, Sony, Fuji, ...

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](#)

Object recognition (in supermarkets)



[LaneHawk by EvolutionRobotics](#)

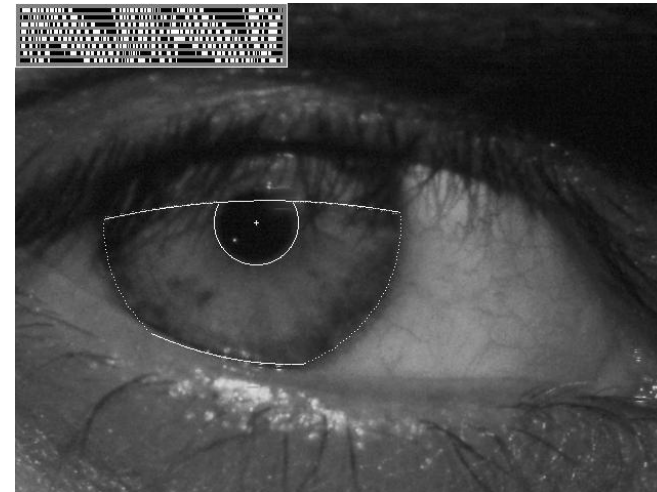
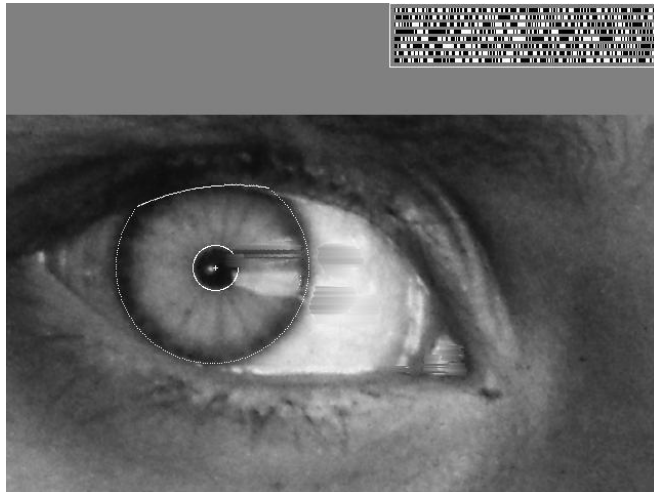
“A smart camera is flush-mounted in the checkout lane, continuously watching for items. When an item is detected and recognized, the cashier verifies the quantity of items that were found under the basket, and continues to close the transaction. The item can remain under the basket, and with LaneHawk,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

Smart cars

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 central image shows a car from a top-down perspective with three yellow cones representing camera fields of view: 'rear looking camera', 'side looking camera', and 'forward looking camera'. To the right, a 'News' sidebar lists two articles: 'Mobileye Advanced Technologies Power Volvo Cars World First Collision Warning With Auto Brake System' and 'Volvo: New Collision Warning with Auto Brake Helps Prevent Rear-end'. Below the main image, there are three product highlights: 'EyeQ Vision on a Chip' with an image of a chip, 'Vision Applications' showing a pedestrian on a crosswalk, and 'AWS Advance Warning System' with a circular display showing a car icon and the number '0.8'. Each highlight has a 'read more' link. The 'Events' sidebar on the right lists 'Mobileye at Equip Auto, Paris, France' and 'Mobileye at SEMA, Las Vegas, NV', also with a 'read more' link.

- [Mobileye](#)
 - Vision systems currently in many high-end models

<http://mobileye.com/technology/applications/vehicle-detection/forward-collision-warning/>

<http://mobileye.com/technology/applications/pedestrian-detection/pedestrian-collision-warning/>

Google cars



Oct 9, 2010. ["Google Cars Drive Themselves, in Traffic"](#). [The New York Times](#). John Markoff

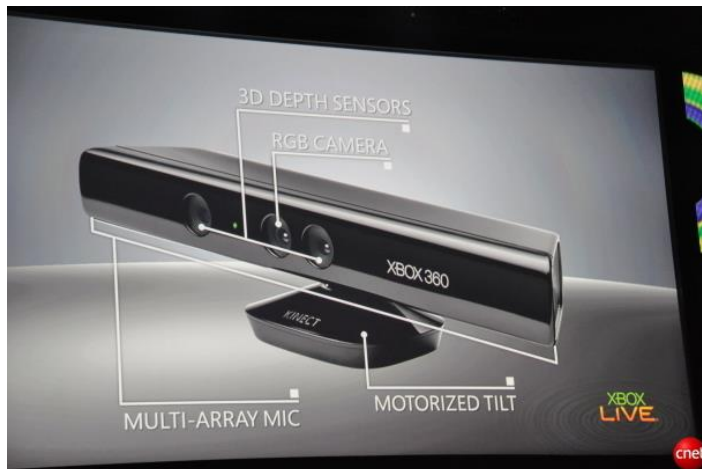
June 24, 2011. ["Nevada state law paves the way for driverless cars"](#). [Financial Post](#).

Christine Dobby

Aug 9, 2011, ["Human error blamed after Google's driverless car sparks five-vehicle crash"](#). [The Star](#) (Toronto)

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



Landing Site Panorama, with the Heights of Mount Sharp, taken by Curiosity on August 27, 2012.

Vision systems (JPL) used for several tasks

- Panorama stitching
- 3D terrain modeling
- Obstacle detection, position tracking

Industrial robots



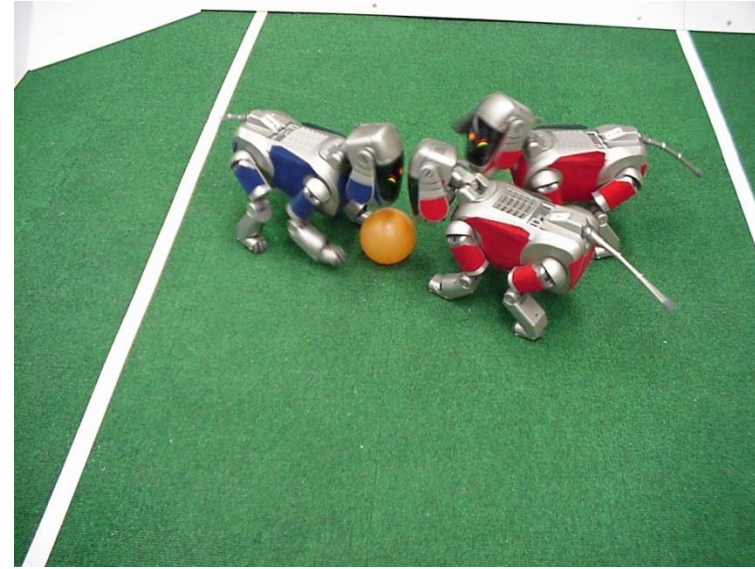
Vision-guided robots position nut runners on wheels

Mobile robots

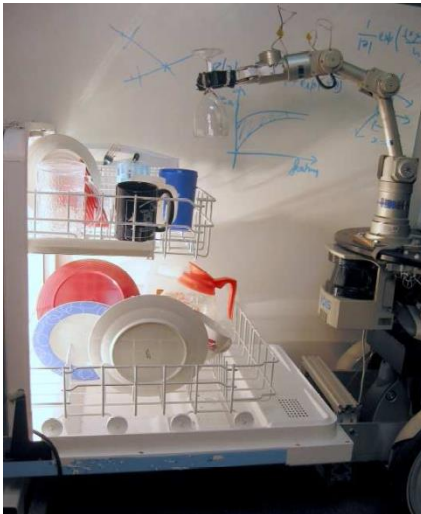


NASA's Mars Curiosity

<http://mars.jpl.nasa.gov/msl/mission/overview/>



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

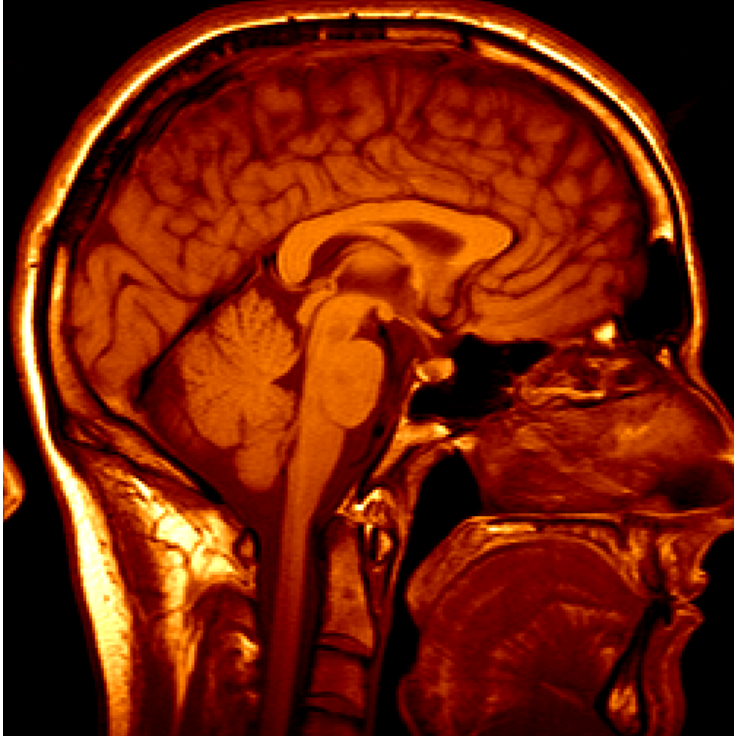


Saxena et al. 2008
[STAIR](#) at Stanford



<http://www.youtube.com/watch?v=DF39Ygp53mQ>

Medical imaging



3D imaging
MRI, CT



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

Content

1. Human visual system
2. Image formation
3. Early vision: Just one image
4. Early vision: Multiple images
5. Middle-level vision
6. High-level vision
7. Application and topics

Course projects

- Small projects will be given to individual or a group.
- Our topics are mainly related with AI applications for surveillance cameras
- Students have to do the given project and make a presentation:
 - + PPT Slide and presentation
 - + Making report
 - + Implementation

Textbook

- Textbook: “Computer Vision: A Modern Approach”, Forsyth, Ponce, 2011.
- Related book: “Digital Image Processing”, R. C. Gonzalez, R. E. Woods, Third Edition.

Course Evaluation

- Assignment: 10%
- Attendance: Every lecture at the beginning
- Project: 30%
- Final exam: 60%