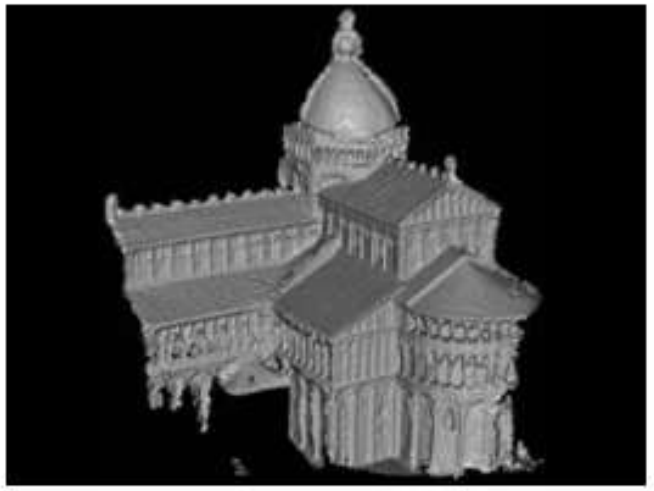
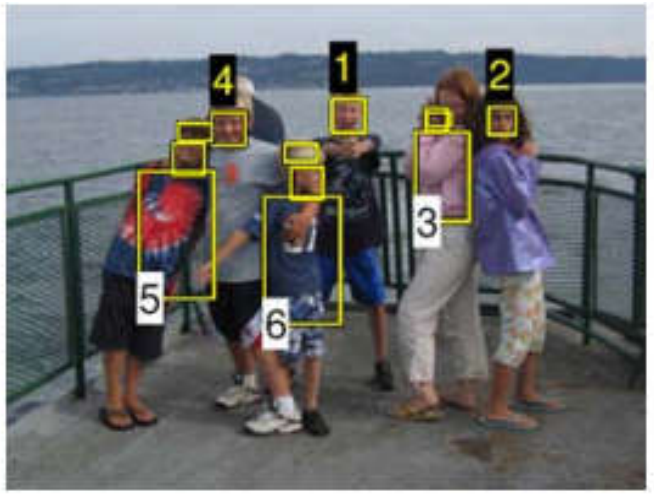
Computer Vision and Pattern Recognition - COE 406

Department of Computer Engineering
Faculty of Engineering
University of Baghdad
2018/2019

- Examples of computer vision algorithms [1]





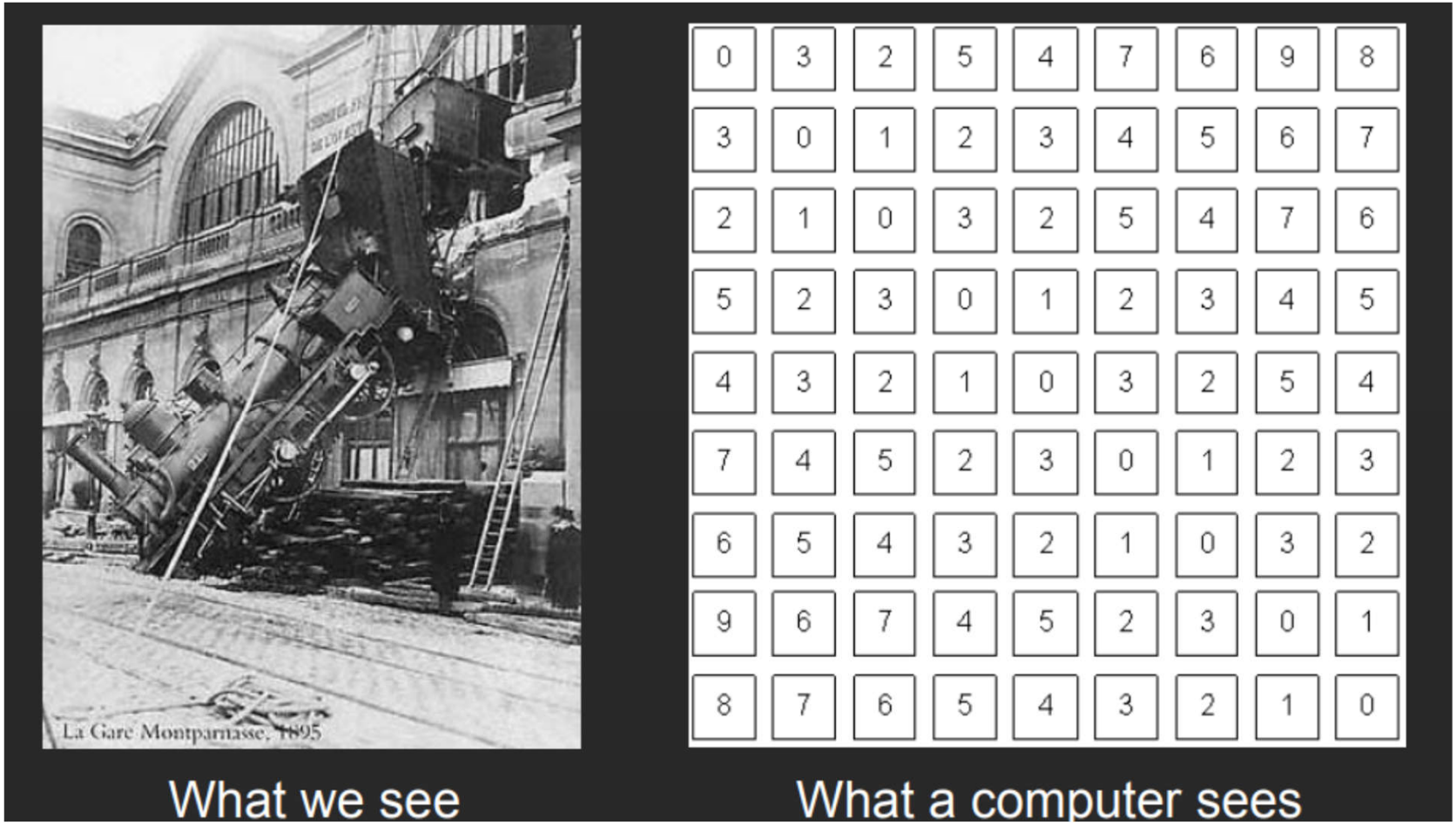
Topics

Introduction to Computer Vision and Pattern Recognition.	**Machine Learning for Computer Vision**
Human Vision, Color Spaces and Transforms	**Feature extraction**
Image coordinates and resizing	**Neural Networks**
Filters and convolutions	**Support Vector Machine**
Harris detector and matching	**Introduction to Convolutional Neural Networks**
Matching, RANSAC, HOG, and SIFT	**Object Detection**
Optical Flow	**Segmentation**
Machine Learning	**Face detection and recognition**

- Computer vision is the ability of computers to see (To bridge the gap between pixels and meaning)
  - Machine Vision
  - Robot Vision
  - Image Understanding
  - Video Analysis

- Pattern recognition is the automated recognition of patterns and regularities in data.
  - The objective behind pattern recognition algorithms is to provide a reasonable answer for all possible data and to classify input data into objects or classes based on certain features

Imaging



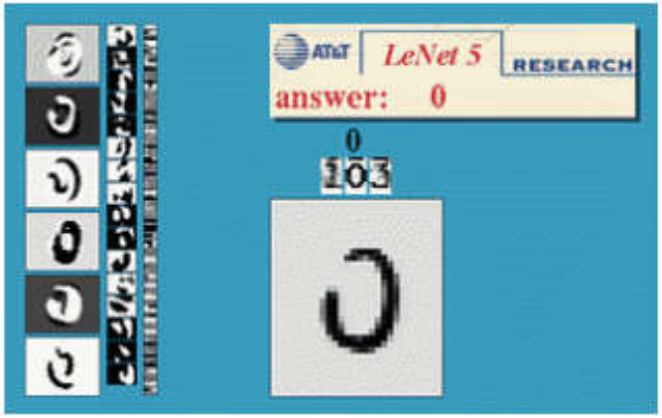
0	3	2	5	4	7	6	9	8
3	0	1	2	3	4	5	6	7
2	1	0	3	2	5	4	7	6
5	2	3	0	1	2	3	4	5
4	3	2	1	0	3	2	5	4
7	4	5	2	3	0	1	2	3
6	5	4	3	2	1	0	3	2
9	6	7	4	5	2	3	0	1
8	7	6	5	4	3	2	1	0

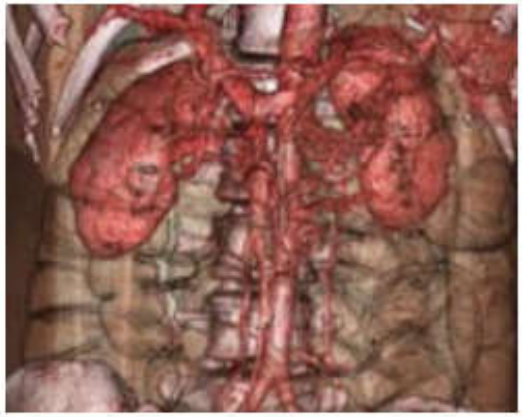
A picture worth a thousand words

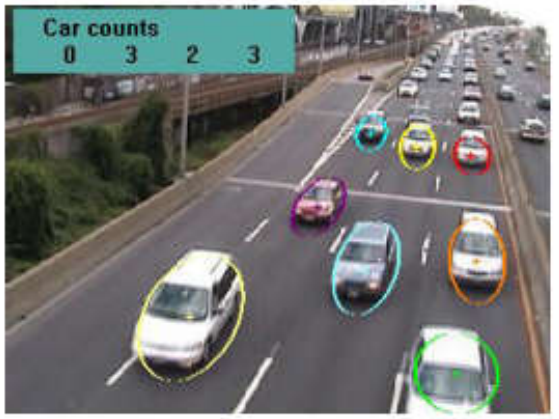
Video

Sequence of Frame, typically 30 frame per second (fps)

Nowadays

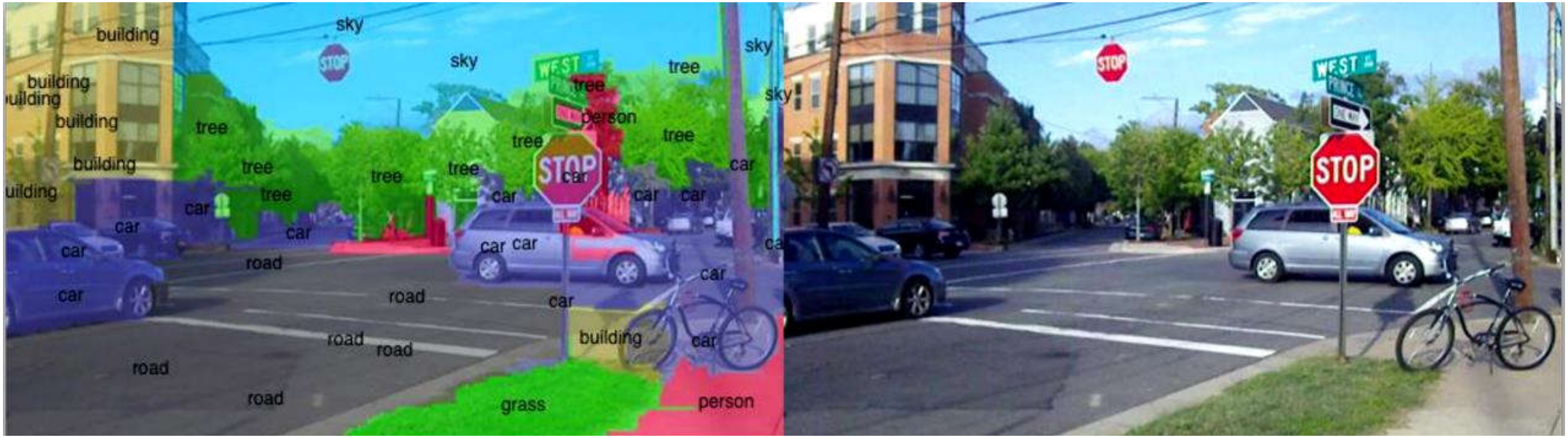






Some industrial applications of computer vision [1]

Nowadays

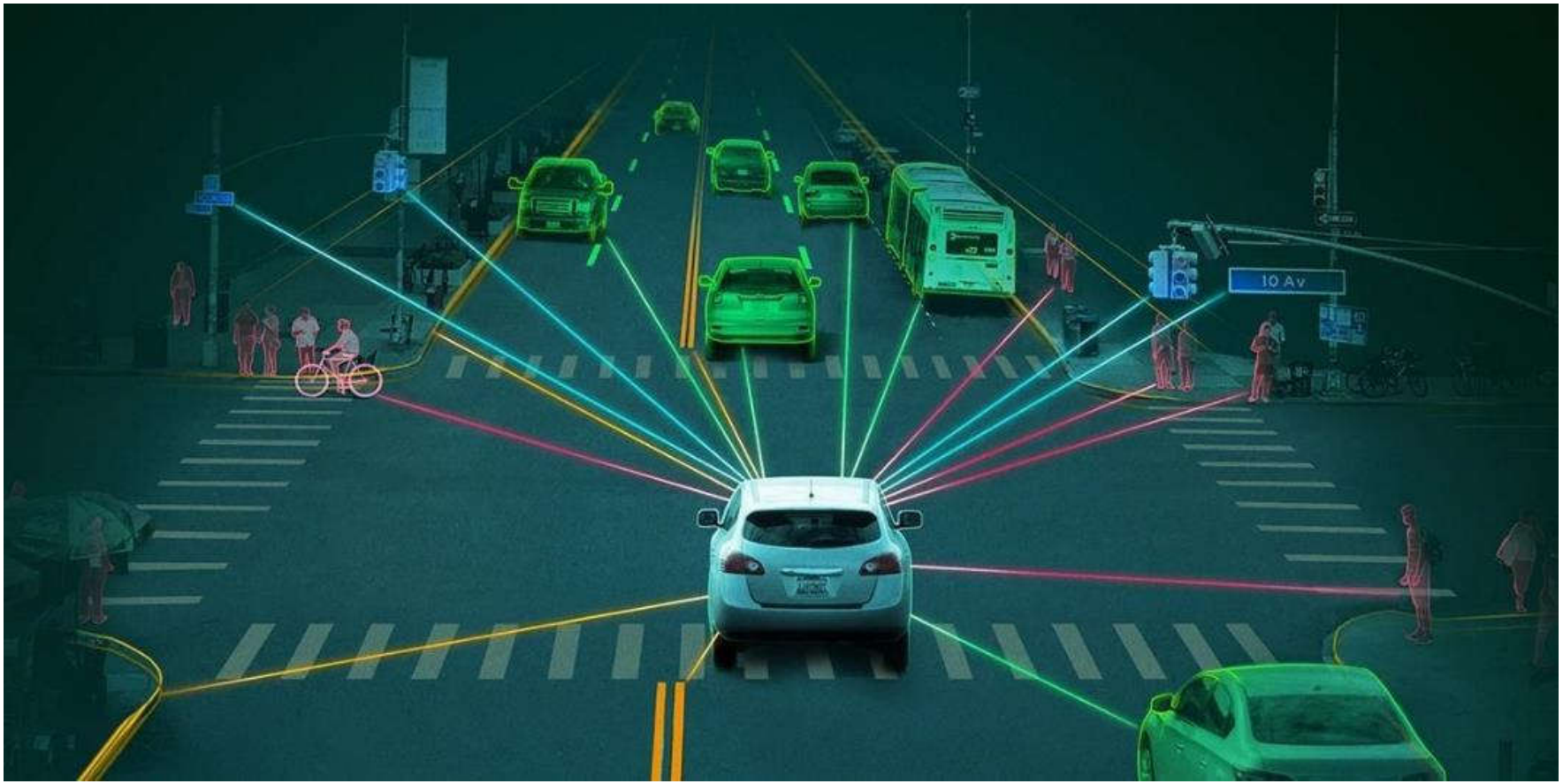


Source: [TechCrunch]

Nowadays

Source: [Affine Analytics]

Nowadays



Source: NVIDIA

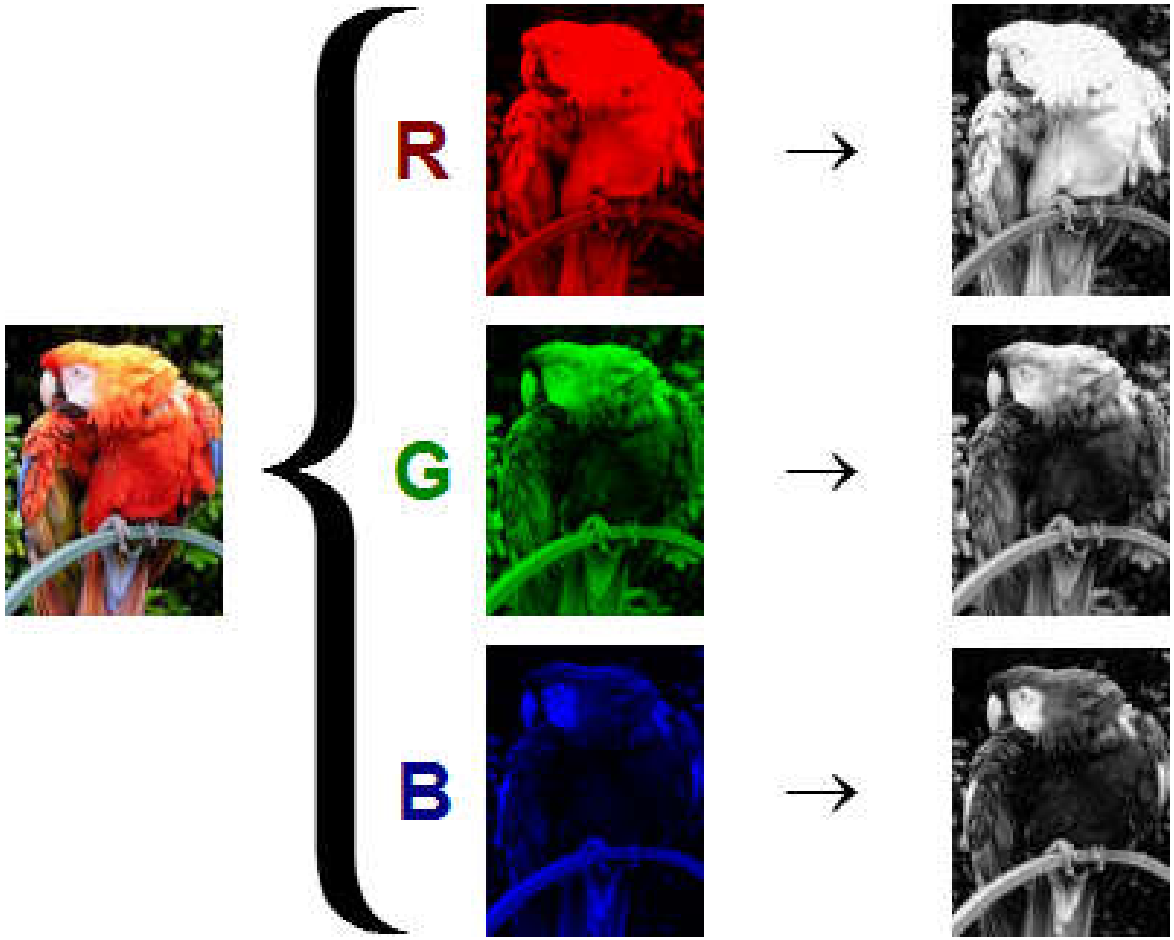
Now days

Computer Vision for Quality Assurance. Source: Catalysts

Image

- An image *I* is a 2D array or matrix, where each element in the array is intensity value or gray level)

Gray Image



$$I = \{I_R, I_G, I_B\}$$

Image Resolution

- How many Rows and Column in the image

128 × 128

512 × 512

34	23	58	89	106	97	89	83	83	81
97	39	23	67	75	89	89	89	89	81
139	73	26	67	67	58	75	81	81	75
141	147	94	106	64	7	23	58	81	83
56	89	147	155	114	73	48	58	73	81
23	64	115	148	155	114	48	25	48	73
23	56	74	81	73	64	73	81	89	89
73	56	45	62	57	56	73	81	82	82
97	64	81	106	116	97	89	82	82	82
97	81	89	86	89	97	81	78	82	97

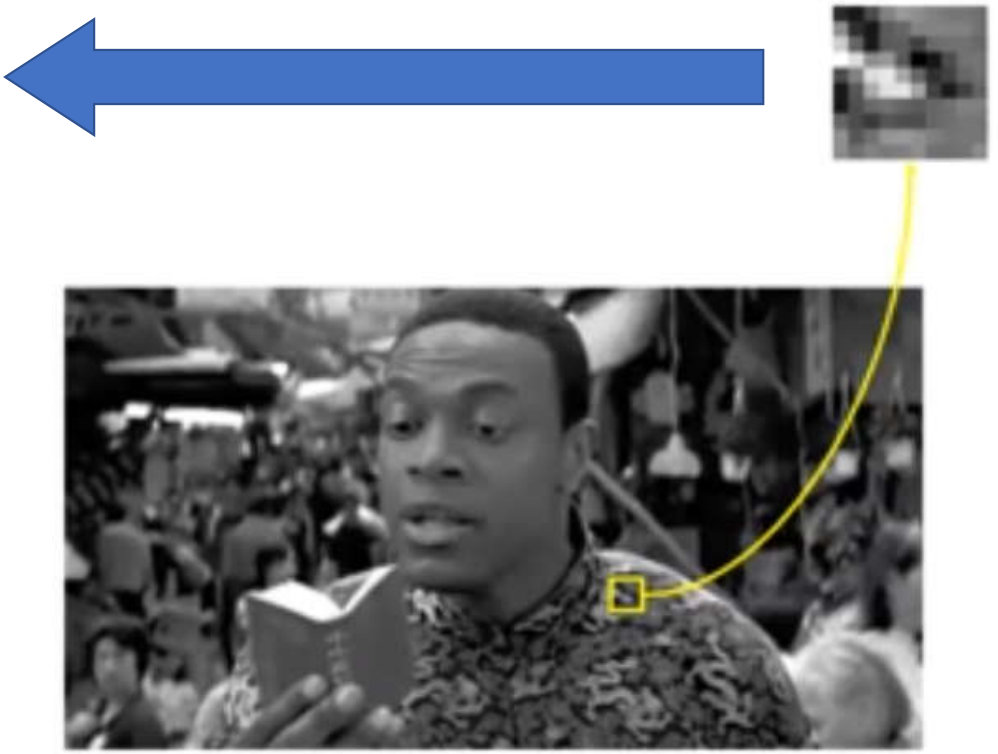


Image Format

- JPEG
- PNG
- BMP
- TIF

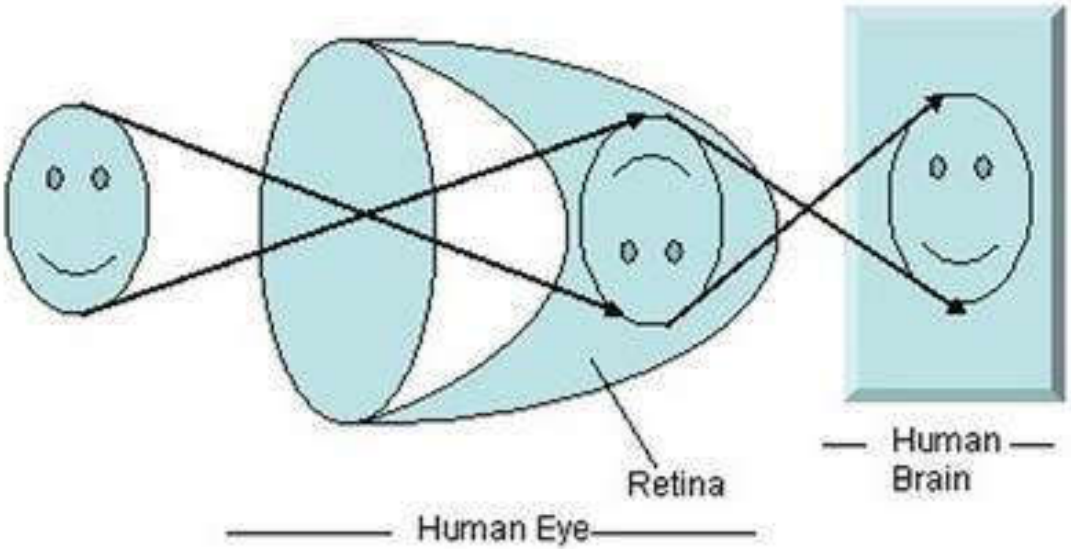
Video Format

- AVI
- MPEG

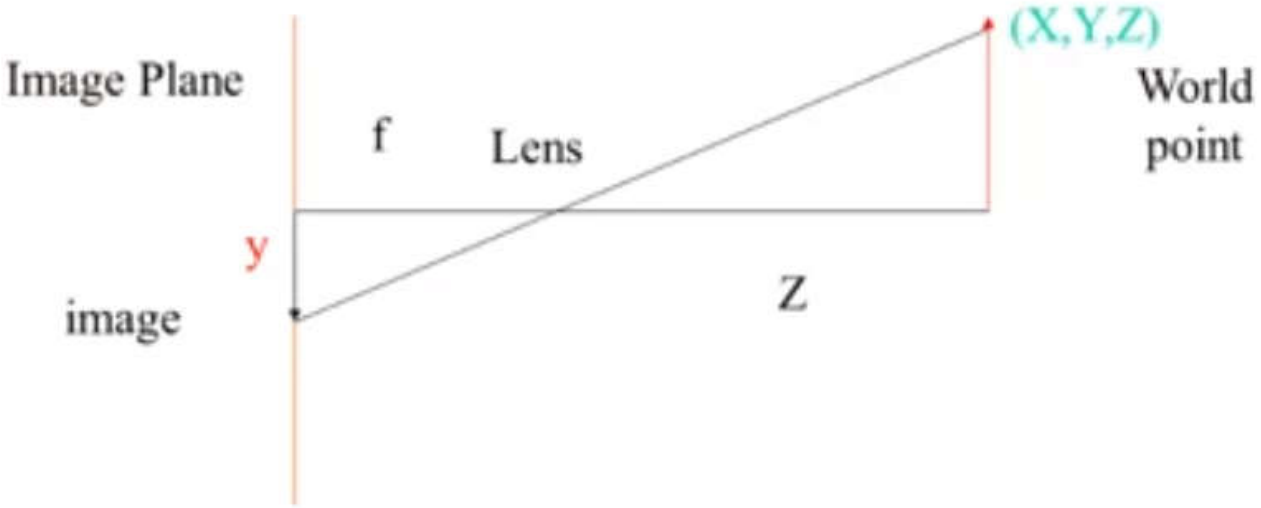
Image Formation

- Light source
- Camera Parameters
- Scene
  - Surface Reflectance
  - Surface Shape

Image Formation



Source: [Tutorials Point]



- $-\frac{y}{Y} = \frac{f}{Z} \quad \Rightarrow \quad y = -\frac{fY}{Z}$

$$x = -\frac{fX}{Z}$$

- Computer vision application trying to recover 3D images from 2D images and it is called 3D shape and it is called ***shape from X***
  - *Stereo*
  - *Motion*

DSC06903_1500x.jpg

DSC06904_1500x.jpg

DSC06905_1500x.jpg

DSC06906_1500x.jpg

DSC06907_1500x.jpg

DSC06908_1500x.jpg

DSC06909_1500x.jpg

DSC06910_1500x.jpg

DSC06911_1500x.jpg

DSC06912_1500x.jpg

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DSC06914_1500x.jpg

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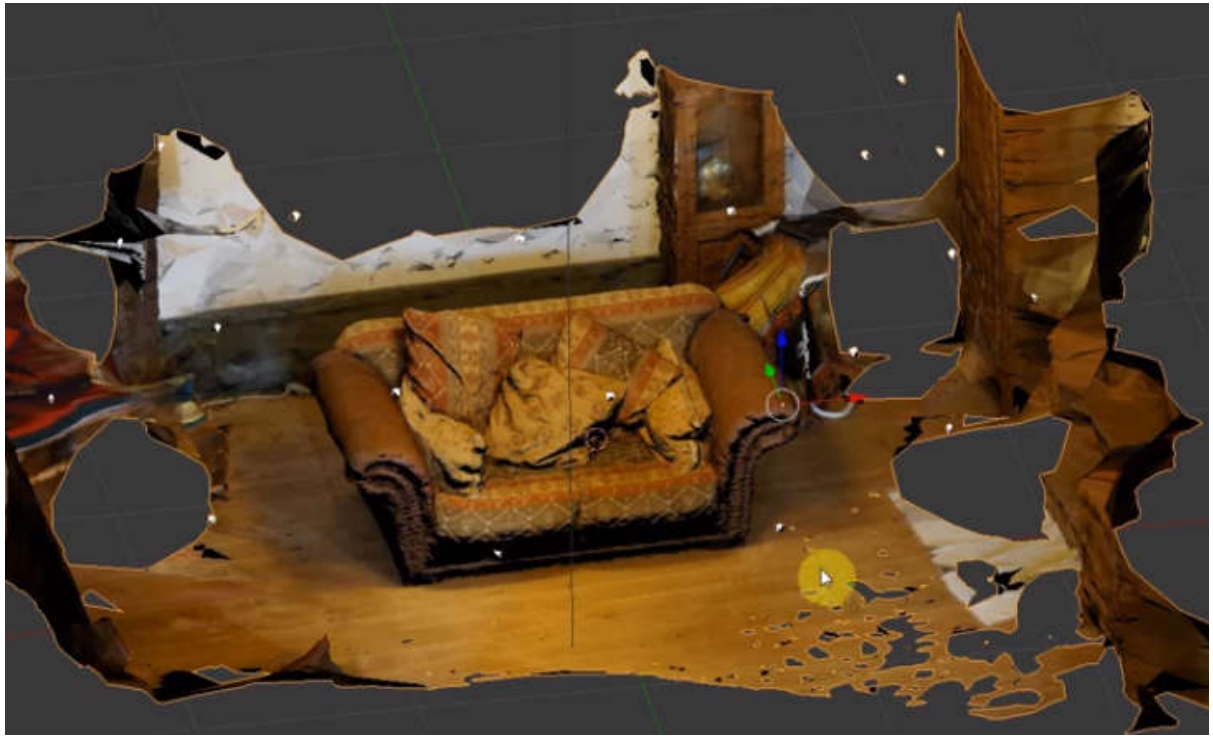
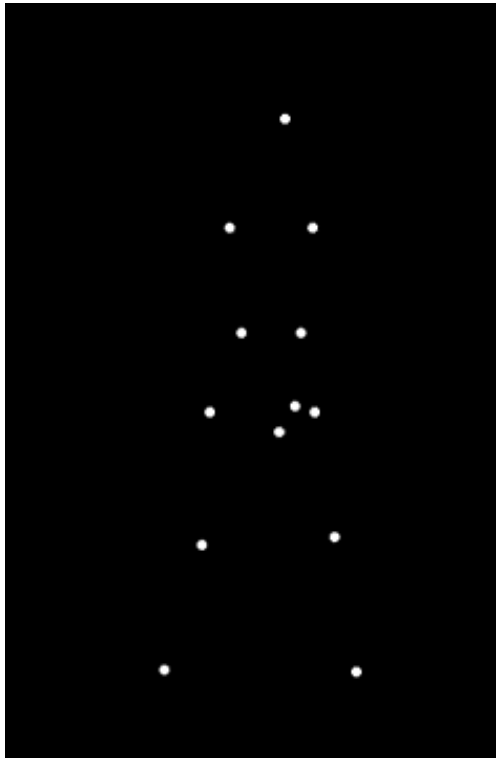
DSC06920_1500x.jpg

DSC06921_1500x.jpg



Moving Light Display

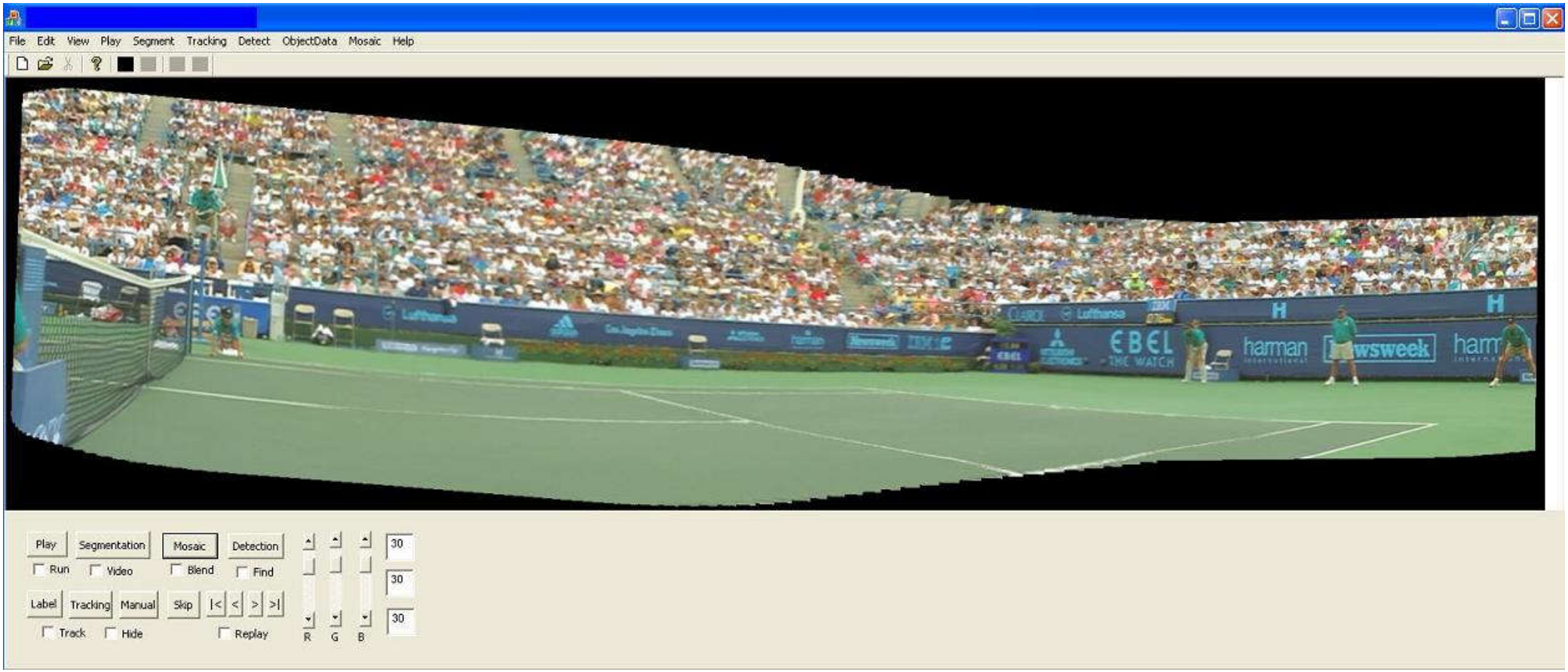


Useful in dark scenes

Flow motion

- **https://www.youtube.com/watch?v=GIUDAZLfYhY**

Video clip and Mosaic



Application

- Object Detection
- Object Recognition
- Face Recognition
- Video Surveillance and Monitoring
  - Detection and Tracking
- Robotics
- Unmanned Aerial Vehicle (UAV)

Next

- Human Vision, Color Spaces and Transforms

References

- [1] Computer Vision: Algorithms and Applications, Rick Szeliski, 2010.
- Fundamentals of Computer Vision, Mubarak Shah, 1997.
- Feature extraction image processing for computer vision, Nixon, Mark S and Aguado, Alberto S, 2012, Academic Press.
- Color image processing: methods and applications, Lukac, Rastislav and Plataniotis, Konstantinos N, 2006, CRC press.