جامعة 8 ماي 1945 قالمة
UNIVERSITE 8 MAI 1945 GUELMA

Faculty of Sciences and Technology

Telecommunications & electronics Department

Computer Vision and its Applications

K. ABAINIA

Last update: 07/12/2020

Course objectives ?

- ✓ Getting an overview on different computer vision applications
- ✓ Learning the basics of the image processing
- ✓ Enhance the programming skills

Background

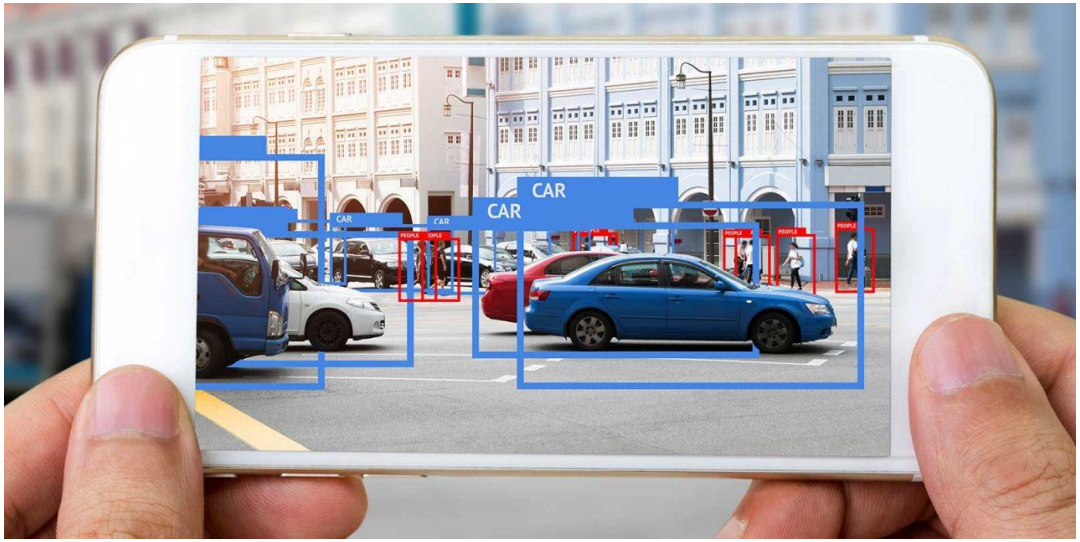
Computer vision ?

Forms of data

Sub-domains

Simulate the human visual system

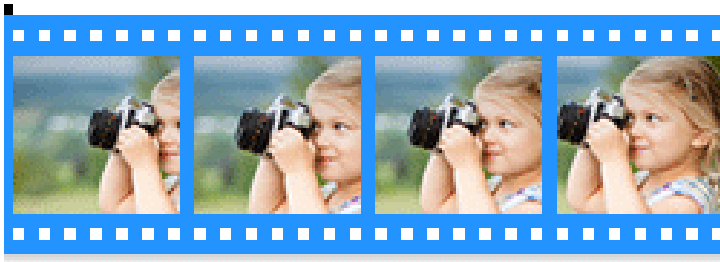
Analyze, process and understand digital images

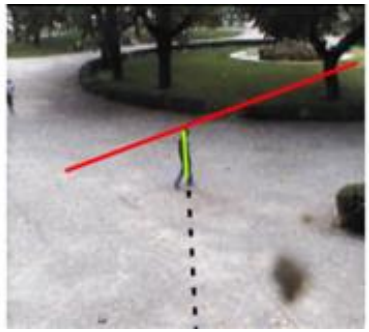


Input image => Model (geometry, physics, statistics and learning theory)

Many forms of data

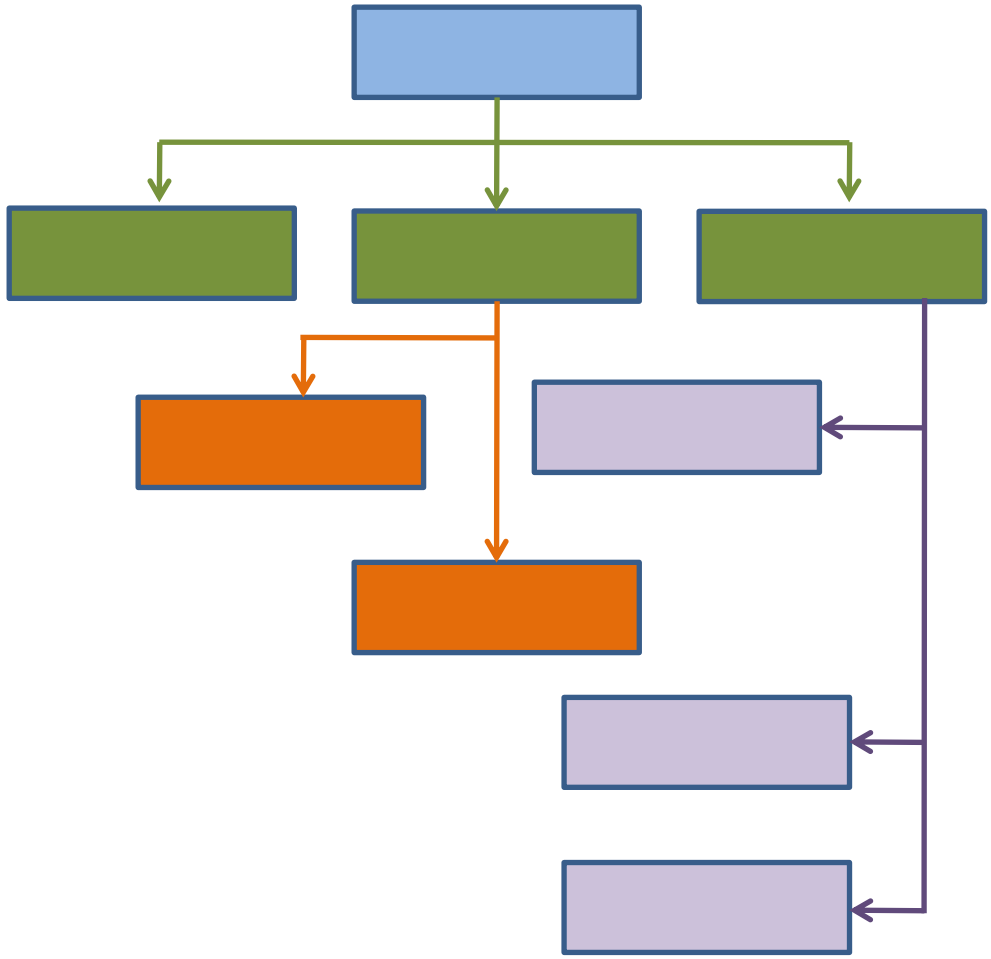
- Single image
- Video sequences
- Views from multiple cameras
- Multi-dimensional data from a medical scanner





Sub-domains of computer vision

- ✓3D reconstruction
- ✓Event detection
- ✓Video tracking
- ✓Object recognition
- ✓3D pose estimation
- ✓Education
- ✓Indexing
- ✓Motion estimation
- ✓Image restoration



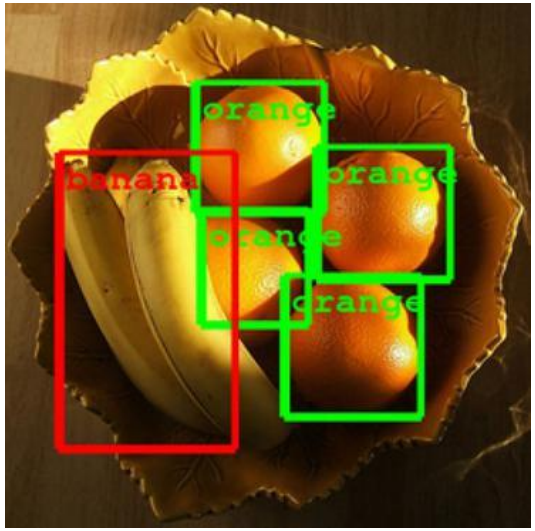
Applications

Object recognition (1)

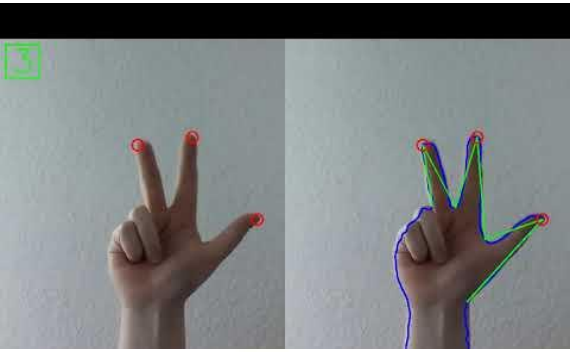
Finding, identifying or verifying objects within an image/video

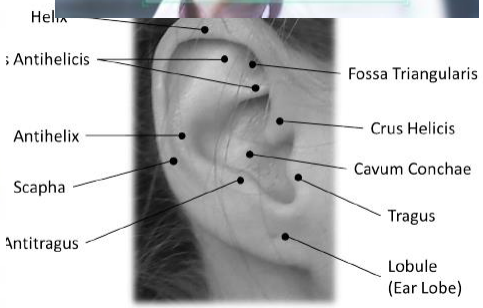
+ Can deal with objects of different sizes/scales, translated and rotated objects

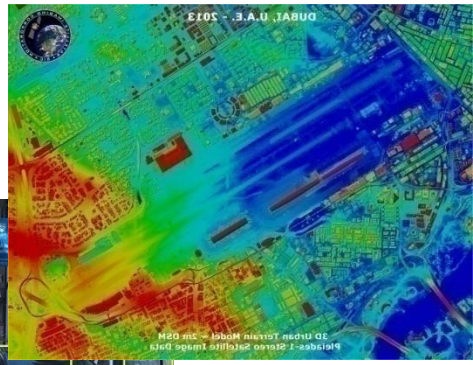
- Obstructed objects

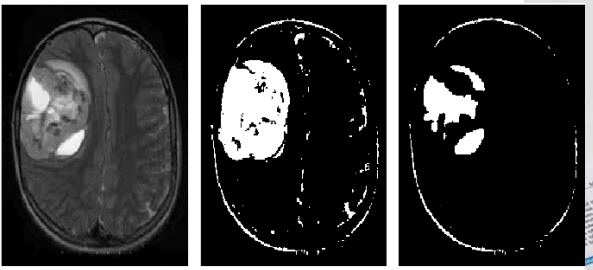


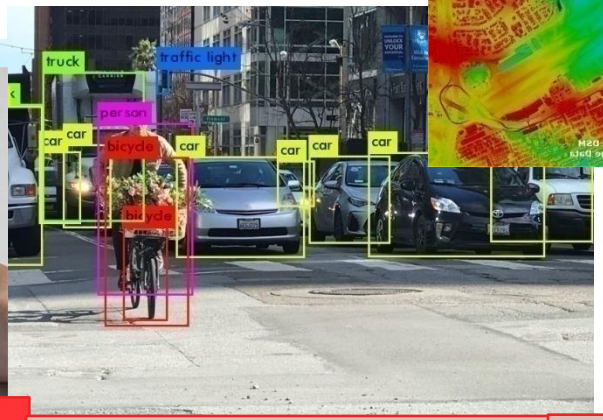
Object recognition (2)











Video tracking (1)

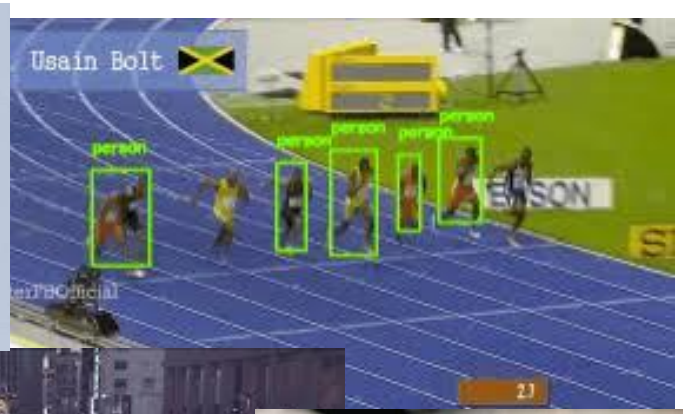
Locating a moving object over time

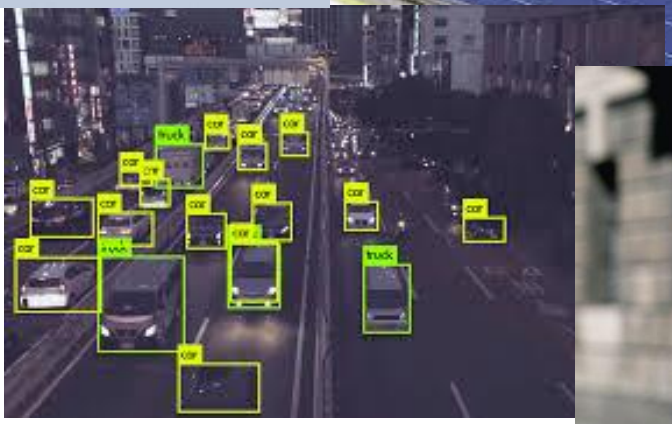
- **human-computer interaction**
- **security and surveillance**
- **traffic control**

+ Low light conditions and sudden changes in illumination

- Moving fast regarding the frame rate
- Object changes orientation over time
- Unstable and vibrating camera

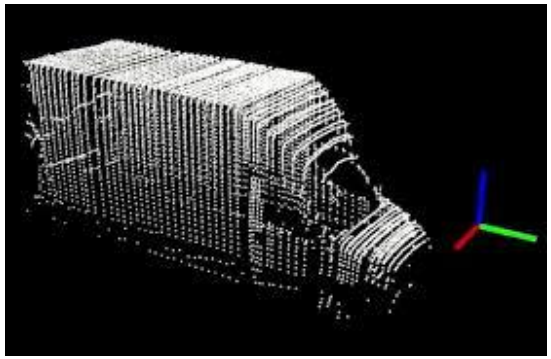
Video tracking (2)





3D reconstruction (1)

Construct a 3D model from a single/multiple images



+ Construct a 3D model from a single image

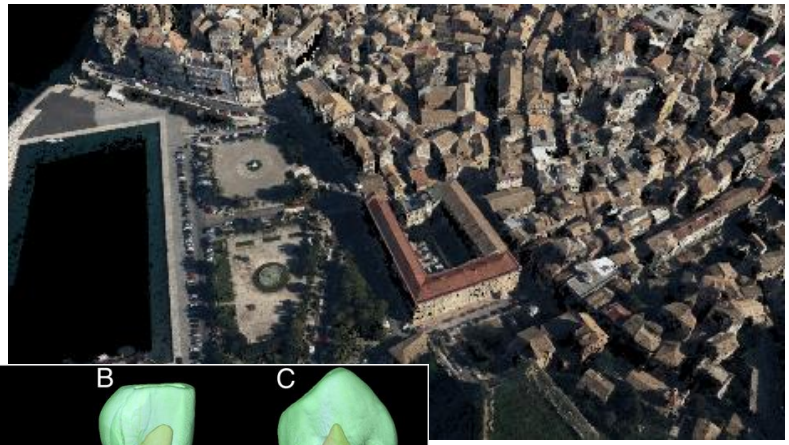
- Number of views/images

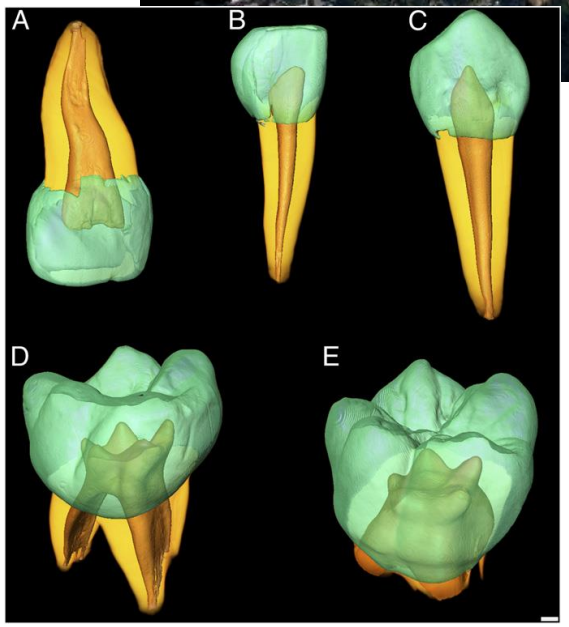
- Lack of tiny details (inaccurate result)

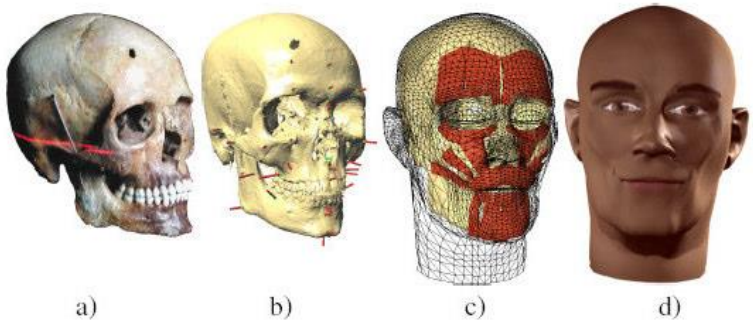
- Scene with a lot of objects (static or dynamic)

- Camera calibration

3D reconstruction (2)





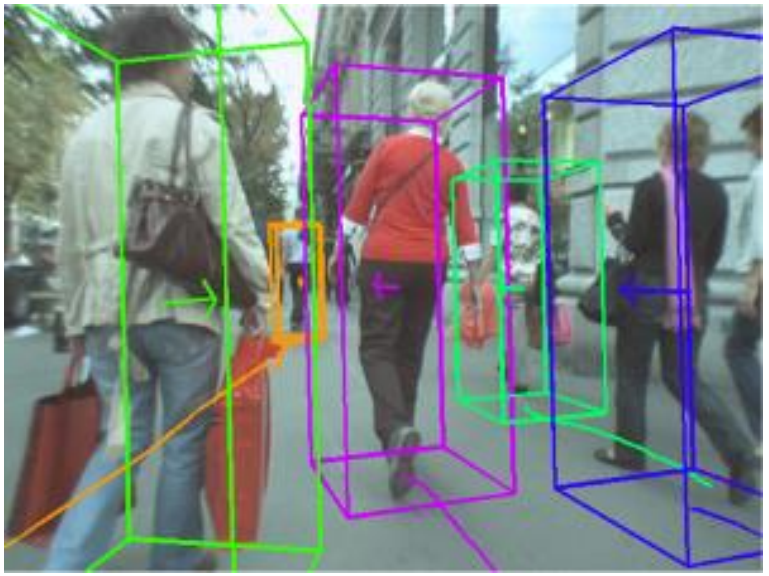


Event detection (1)

Predict a future action/anomalies from the current scene

Direct events

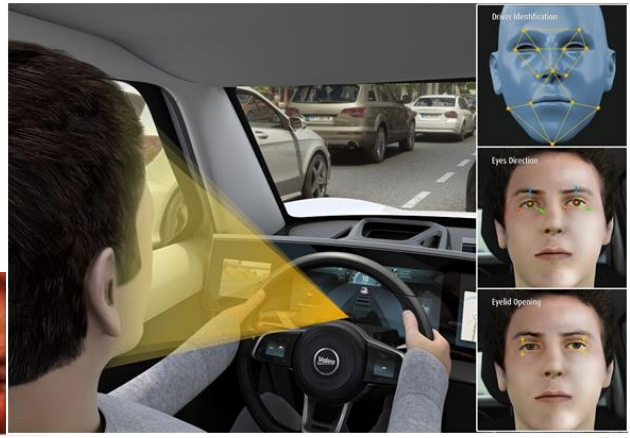
Composite events

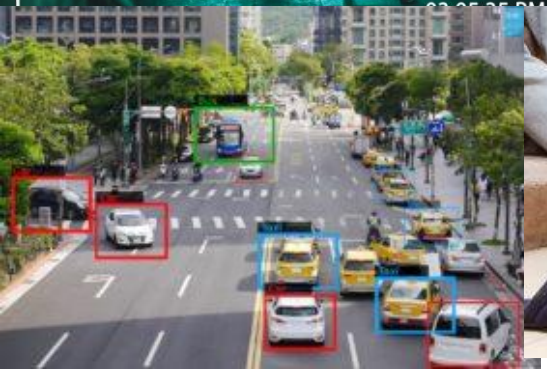


+ Analyze the crowd behavior and identify the crowd abnormality

- Fails with background changes

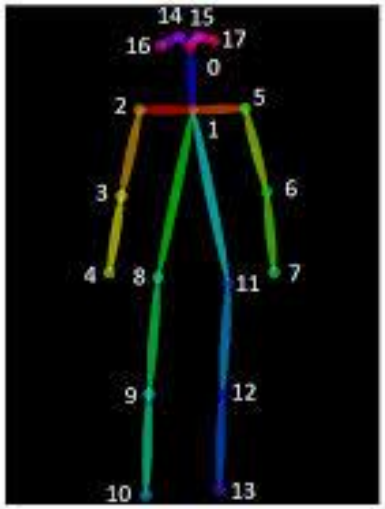
Event detection (2)





3D pose estimation (1)

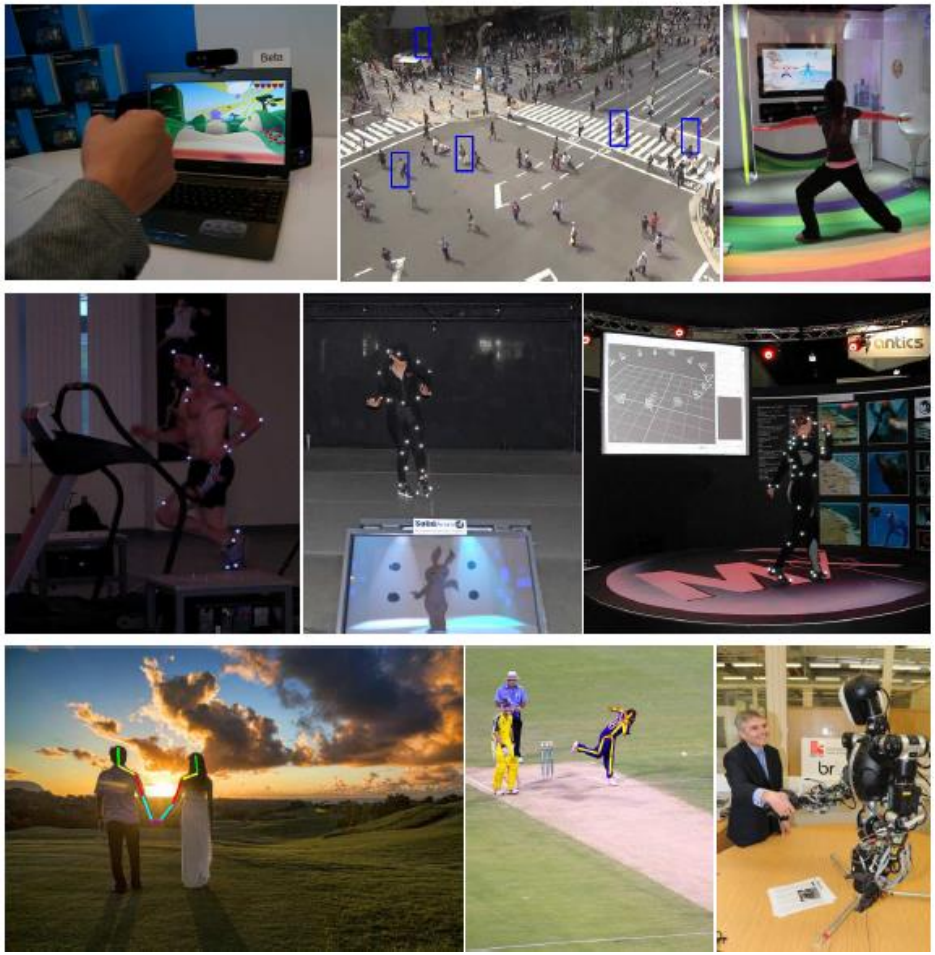
Obtain a posture of the human body from input images or video sequences



+ Synthesize unseen (regarding the dataset) 3D human skeletons

- Many people in an outdoor environment

3D pose estimation (2)



Motion estimation (1)

Measure/estimate the movement of an object within a video

+ Video coding and simultaneous localization and mapping (robotics)

- High motion sequence

Motion estimation (2)

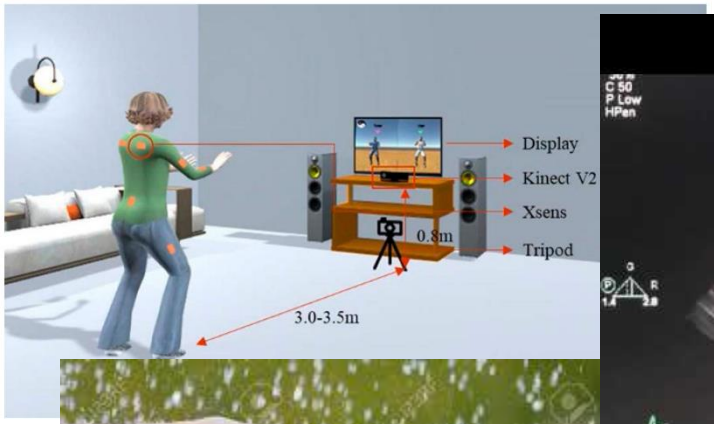


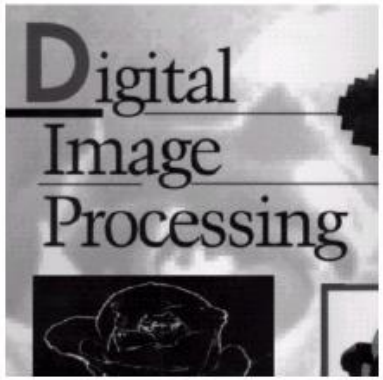
Image restoration (1)

Clean and transform a noisy and corrupted image into the original

+ Underwater image enhancement

- Prior knowledge about the environment

Image restoration (2)



Education

Maximize the students' academic output by offering a customized learning experience based on their strengths and weakenesses

+ Improving engagement level, conducting online exams, reducing instances of fraud

- Technology is not ready yet to be implemented, and requires studying/modeling different behaviors

Indexing

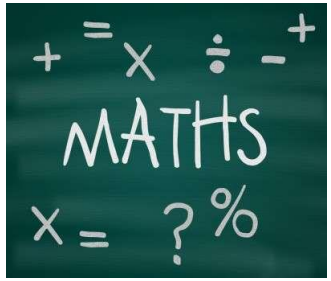
Organize a set of images in order to facilitate the search later

- **by meta-data (textual information)**
- **by graphical content**

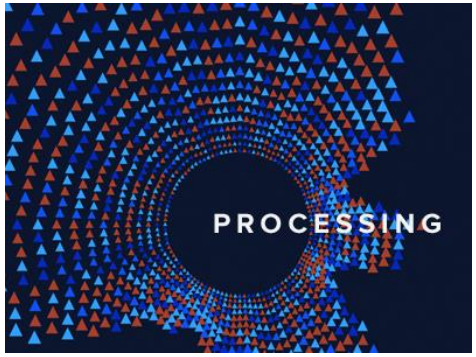
+ Can deal with different resolutions and images sub-regions

- Reach the human performance

Knowledge



Computer vision



Conclusion

- Overview on computer vision
- Different applications with achievements and limits
- Pre-requisites of computer vision