COMPUTER VISION AND COMPUTER GRAPHICS

Computer Vision

Computer vision is concerned with modeling and replicating human vision using computer software and hardware. Formally if we define computer vision then its definition would be that computer vision is a discipline that studies how to reconstruct, interrupt and understand a 3d scene from its 2d images in terms of the properties of the structure present in scene.

It needs knowledge from the following fields in order to understand and stimulate the operation of human vision system.

- Computer Science
- Electrical Engineering
- Mathematics
- Physiology
- Biology
- Cognitive Science

Computer Vision Hierarchy

Computer vision is divided into three basic categories that are as following:

Low-level vision: includes process image for feature extraction.

Intermediate-level vision: includes object recognition and 3D scene Interpretation

High-level vision: includes conceptual description of a scene like activity, intention and behavior.

Related Fields

Computer Vision overlaps significantly with the following fields:

Image Processing: it focuses on image manipulation.

Pattern Recognition: it studies various techniques to classify patterns.

Photogrammetry: it is concerned with obtaining accurate measurements from images.

Computer Vision Vs Image Processing

Image processing studies image to image transformation. The input and output of image processing are both images.

Computer vision is the construction of explicit, meaningful descriptions of physical objects from their image. The output of computer vision is a description or an interpretation of structures in 3D scene.

Example Applications

- Robotics
- Medicine
- Security
- Transportation
- Industrial Automation

Robotics Application

- Localization-determine robot location automatically
- Navigation
- Obstacles avoidance
- Assembly $peg-in-hole, welding, painting$
- Manipulation $e.g. PUMArobotmanipulator$
- Human Robot Interaction HRI: Intelligent robotics to interact with and serve people

Medicine Application

- Classification and detection $e.g. lesionorcellsclassificationandtumordetection$
- 2D/3D segmentation
- 3D human organ reconstruction $MRIorultrasound$
- Vision-guided robotics surgery

Industrial Automation Application

- Industrial inspection $defectdetection$
- Assembly
- Barcode and package label reading
- Object sorting
- Document understanding $e.g. OCR$

Security Application

- Biometrics $iris, fingerprint, facerecognition$
- Surveillance-detecting certain suspicious activities or behaviors

Transportation Application

- Autonomous vehicle
- Safety, e.g., driver vigilance monitoring

Computer Graphics

Computer graphics are graphics created using computers and the representation of image data by a computer specifically with help from specialized graphic hardware and software. Formally we can say that Computer graphics is creation, manipulation and storage of geometric objects $modeling$ and their images $Rendering$.

The field of computer graphics developed with the emergence of computer graphics hardware. Today computer graphics is use in almost every field. Many powerful tools have been developed to visualize data. Computer graphics field become more popular when companies started using it in video games. Today it is a multibillion dollar industry and main driving force behind the computer graphics development. Some common applications areas are as following:

- Computer Aided Design CAD
- Presentation Graphics
- 3d Animation
- Education and training
- Graphical User Interfaces

Computer Aided Design

- Used in design of buildings, automobiles, aircraft and many other product
- Use to make virtual reality system.

Presentation Graphics

- Commonly used to summarize financial, statistical data
- Use to generate slides

3d Animation

- Used heavily in the movie industry by companies such as Pixar, DresmsWorks
- To add special effects in games and movies.

Education and training

- Computer generated models of physical systems
- Medical Visualization
- 3D MRI
- Dental and bone scans
- Stimulators for training of pilots etc.

Graphical User Interfaces

- It is used to make graphical user interfaces objects like buttons, icons and other components