A PREAMBLE TO COMPUTER VISION

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ABSTRACT

Computer Field is rapidly developing with new technologies day by day. The emerging technology is Computer Vision that is concerned with the theory and technology for building artificial system that obtain information from various images or multi-dimensional data. Artificial Intelligence deals with autonomous planning or deliberation for robotical systems to navigate through an environment. Information about the environment could be provided by a computer vision system, acting as a vision sensor and providing high-level information about the environment and the robot. Computer Vision is inverse of computer graphics. Computer Vision seeks to generate intelligent and useful descriptions of visual scenes and sequences and of the objects that populate them, by performing operations on the signals received from video cameras. This paper portrays the relation of Computer Vision with various fields, Applications, Tasks of Computer Vision and its Hardware requirements.

Introduction

Computer Vision is a field that includes methods for acquiring, processing, analyzing, and understanding images and, in general, high-dimensional data from the real world in order to produce numerical or symbolic information, *e.g.*, in the forms of decisions. A theme in the development of this field has been to duplicate the abilities of human vision by electronically perceiving and understanding an image. This image understanding can be seen as the disentangling of symbolic information from image data using models constructed with the aid of geometry, physics, statistics, and learning theory. Computer vision has also been described as the enterprise of automating and integrating a wide range of processes and representations for vision perception. As a scientific discipline, computer vision is concerned with the theory behind artificial systems that extract information from images. The image data can take many forms, such as video sequences, views from multiple cameras, or multi-dimensional data from a medical scanner. As a technological discipline, computer vision seeks to apply its theories and models to the construction of computer vision systems. Computer Vision are based on statistics, optimization or geometry .these methods can be modified in order to gain processing speed without losing too much performance. It includes 3D analysis from 2D images.

Correlation with various Fields

Artificial Intelligence - autonomous planning or deliberation for robotical systems.

Physics - various measurement problems are addressed using Computer Vision.

Neurobiology - study of Biological Vision System. Biological Vision studies and models the physiological processes behind visual perception in humans and other animals.

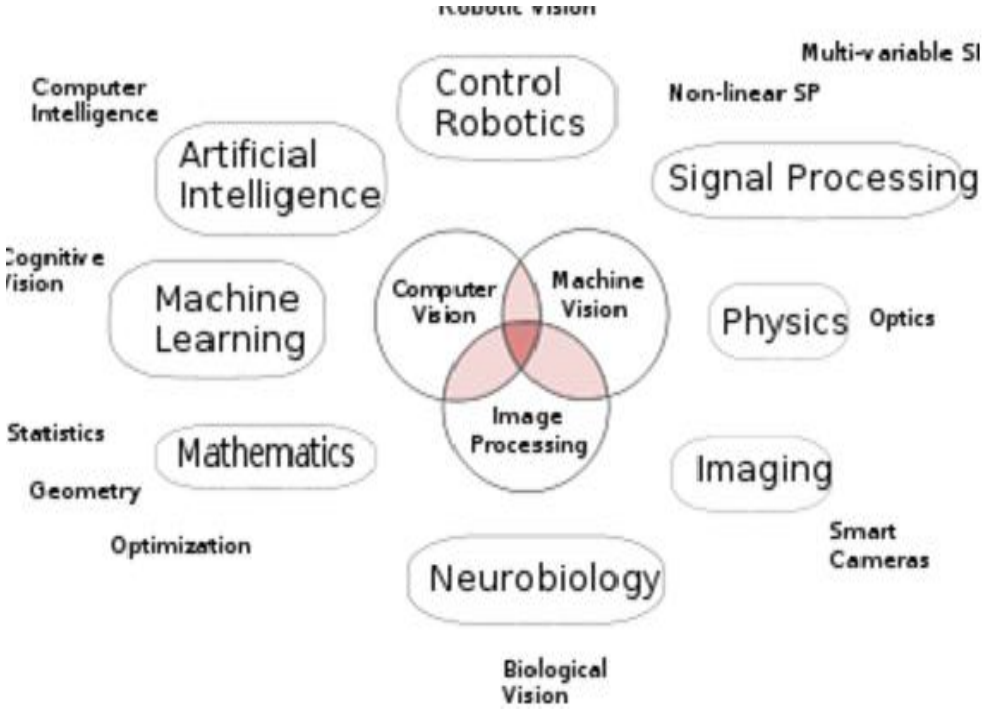
Signal Processing - processing two variable signals or multi variable signals

Image Processing and Image Analysis - tend to focus on 2D images, how to transform one image to another, that is pixel-wise operation.

Machine Vision - process of applying a range of technologies & methods to provide imaging-based automatic inspection, process control and robot guidance in industrial applications, mainly in manufacturing.

Imaging - focus on the process of producing images.

Pattern Recognition - extracts information from signals, based on statistical approaches and artificial neural networks.



Relation between Computer Vision and Various other fields

Applications of Computer Vision:

- Controlling processes, *e.g.*, an Industrial Robot.
- Navigation, *e.g.*, by an autonomous vehicle or mobile robot.
- Detecting events, *e.g.*, for visual surveillance or people counting.
- Organizing information,
  - *e.g.*, for indexing databases of images and image sequences
- Modeling objects or environments,
  - *e.g.*, medical image analysis or topographical modeling.
- Interaction, *e.g.*, as the input to a device for computer-human interaction.
- Automatic inspection, *e.g.*, in manufacturing applications.

Tasks of Computer Vision

Recognition - It includes Object recognition, identification, and detection.

- **Object Recognition** - object classes can be recognized, usually together with their 2D positions in the image or 3D poses in the scene.

- **Identification** - an individual instance of the object is recognized. This includes, identification of a specific person's face or

finger print.

- **Detection** - the image data are scanned for a specific condition.

Motion Analysis - tasks related to motion estimation where an image sequence is processed to produce an estimation of the velocity, either at each points in the image or in the 3D scene or even the camera that produces images.

Scene Reconstruction - It is computing 3D model of the scene from more images or Video.

Image Restoration - removal of noise from filters.

Functions of Computer Vision Systems

The organization of Computer Vision System is highly application dependent. Some Systems are stand-alone applications which solve a specific measurement or detection problem, while others constitute a sub-system of a larger design which, for example, also contains sub-systems for control of mechanical actuators, planning, information databases, man-machine interfaces etc. The functions are

Image Acquisition - A digital image is produced by several image sensors, the resulting image data is 2D or 3D volume or an image sequence.

Pre-processing - before applying Computer Vision Method to extract some information from image data, the following processes are implied.

Re-Sampling - it assures the image coordinate system is correct

Noise Reduction - to assure that noise does not introduce false information.

Contrast Enhancement - to assure the relevant information can be detected.

Scale Space - to enhance image structures at locally appropriate

scales.

Feature Extraction - Image features at various levels of complexity are extracted from the image data.

Segmentation - detecting the image points or regions relevant for further processing.

High-level Processing - here the input is a small set of data, for example a set of points or an image region which assumed to contain specific object.

Decision Making – making final decision that is pass/fail on automatic inspection applications, match/no-match in recognition applications, flag for further human review in medical,military,security and recognition applications.

Hardware Requirements of Computer Vision

The basic elements are a power source, image acquisition device, processor as well as control and communication cables or some kind of wireless interconnection mechanism. Also it contains Software and one display to monitor the System.

Conclusion

Computer Vision is computing the properties of the 3D world from one or more digital images. Computer Vision is very useful in medical image processing to extract information to diagnose the disease of a patient. The largest areas of Computer Vision are Military Applications. It is used in detection of missile guidance. Due to this technology many fields like medical, military, artificial intelligence, neuro biology etc are benefited.

REFERENCES

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