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THE GENERAL ANALYSIS GRAPH - THE KEY FOR OBJECT RECOGNITION APPLICATIONS

Abstract:

The study of visual object recognition is often motivated by the problem of recognizing 3-d objects given that we receive 2-d patterns of light on our retinae and feel and hear additional information of these objects. Recent findings from human psychophysics, neurophysiology and computational vision provide converging evidence for a view-based recognition framework in which objects and scenes are represented as collections of viewpoint-specific local features rather than 2-d templates or 3-d models. In nature, vision systems are of paramount importance to survival. The eye-brain combination makes it possible to absorb, compress, process and react very fast to large amounts of information about the surroundings, others senses provide further information to verify hypotheses given by the visual system. The efficiency of the biological systems in such areas is beyond the capabilities of today's technical systems even with the fastest available computer systems.

Computer Vision tries to recognize and locate position and orientation in a 3-d environment. An object is globally defined as something mental or physical toward which thought, feeling, or action is directed. A priori knowledge about the object is used implicitly or explicitly by all recognition systems, and is described by an explicit object model (a system of assumptions, data, and inferences that describe the object). A suitable model holds implicit structural information regarding the spatial relations between local features.

A naive intuition would state that vision is essentially a bottom-up process. It begins with the sensory input of the retinal images and other senses and goes "upward" to perceptual and then conceptual interpretations. However, the perception of the present state of affairs produces expectations about the future and these expectations imply a top-down component to processing, because prior high-level interpretations influence current processing at lower level. Vision (and in this respect recognition) is a mixture between bottom-up and top-down strategies in order to maximize performance. We can define this mixture in strategies also from the recognition point of view by the kind of information represented in the hierarchical recognition scheme. To implement this recognition framework, the General ANAlysis Graph (GANAG) is introduced. This hierarchical, shape based graph is built and used in order to recognize, verify and classify objects.

This presentation summarizes contributions to the problem of recognition and classification, where the focus lies on the shape as recognition feature applied in Machine Vision. First an overview of the framework is given, the view-based recognition strategy is motivated, and the hierarchical matching concept is introduced. This is followed by examples in two completely different fields of applications; Industry and Cultural Heritage. The two different application areas show that the concept developed for Visual Inspection and Visual Surveillance will also work in areas like Art History and Archaeology.