Abstract

Recognition of complex objects in overlapping positions is of prime importance for industrial applications. This thesis presents techniques for feature extraction, representation and matching of objects with movable component subparts which are invariant to scale, position and orientation. The feature extraction technique is a modification of the standard Hough transform for line detection. The modification is based on a new parameterization of line segments that exploits the gradient direction information of the edge image. The absence of the end point information in the standard Hough transform is overcome in the modified Hough transform based technique presented here. It also merges the process of edge linking and detection of line segment into a single process thereby resulting in better performance. A parallel formulation of the above technique on an SIMD architecture is also proposed which is based on the partioning of the of the edge points on the basis of their gradient direction information.

A two level representation scheme has been developed for the representation of objects with movable parts. At the first level an object is represented in terms of its component subparts and their range of movements. The subparts are represented in terms of the primitives and the spatial relations between the pairs of primitives. A formal methodology for matching is developed on the pattern of abductive reasoning using "hypothesize and test" control strategy. The hypotheses generation process is based on the causal association between an object and its manifested subparts, and a subpart and its manifested spatial relations in the image. A likelihood value for each hypothesis is computed on the basis of the total available evidence and individual hypotheses are ranked on the basis of their likelihood values. Hypothesis verification process is formulated as a generalized Hough transform which uses a pair of image and a pair of model features to compute the transformation parameters. Because of the use of pairs of features, the chances of unwanted matches are drastically reduced and hence the sparse parameter space is stored as a one dimensional array of transformation parameters. Experimental results obtained on complex multi-object scenes have yielded very encouraging results.

Key Words :

Abductive inference, gradient direction, hierarchical representation, Hough transform, hypothesize and test, matching, movable objects, occlusion, parallel hardware, primitives, shape recognition spatial relations.