Feature-based Rapid Object Detection: From Feature Extraction to Parallelisation

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Abstract

This thesis studies rapid object detection, focusing on feature-based methods. Firstly, modifications of training and detection of the Viola-Jones method are made to improve performance and overcome some of the current limitations such as rotation, occlusion and articulation. New classifiers produced by training and by converting existing classifiers are tested in face detection and hand detection.

Secondly, the nature of invariant features in terms of the computational complexity, discrimination power and invariance to rotation and scaling are discussed. A new feature extraction method called Concentric Discs Moment Invariants (CDMI) is developed based on moment invariants and summed-area tables. The dimensionality of this set of features can be increased by using additional concentric discs, rather than using higher order moments. The CDMI set has useful properties, such as speed, rotation invariance, scaling invariance, and rapid contrast stretching can be easily implemented. The results of experiments with face detection shows a clear improvement in accuracy and performance of the CDMI method compared to the standard moment invariants method. Both the CDMI and its variant, using central moments from concentric squares, are used to assess the strength of the method applied to hand-written digits recognition.

Finally, the parallelisation of the detection algorithm is discussed. A new model for the specific case of the Viola-Jones method is proposed and tested experimentally. This model takes advantage of the structure of classifiers and of the multi-resolution approach associated with the detection method. The model shows that high speedups can be achieved by broadcasting frames and carrying out the computation of one or more cascades in each node.

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