Euclidean Distance Transform and Its Applications: Algorithms and Cellular Architectures

Thesis
submitted by

N. Sudha

for the award of the degree of

DOCTOR OF PHILOSOPHY

Department of Computer Science & Engineering
Indian Institute of Technology Guwahati
July 2000

Abstract

The present thesis embodies an in-depth study of Euclidean Distance Transform (EDT) of a binary image and its applications in the areas of Image Processing and Computer Vision. Main emphasis has been given for designing fast and parallel algorithm, which ideally suits for VLSI implementation specifically in Cellular Architectures. Earlier work in the field of distance transform and its applications has been reviewed along with their proposed VLSI architectures. Subsequently, an $O(n)$ time parallel algorithm is developed for EDT of an $n \times n$ binary image and its implementation in a cellular architecture is presented. Based on sound EDT computation, a linear time complex parallel algorithm has been developed for computation of the skeleton of a binary image with VLSI implementation. A novel technique for computation of discrete Voronoi diagram for binary image using EDT technique is also presented with cellular architecture. One of the most recent and popular area of research is the computation of the Hausdorff distance between images. We have exploited the EDT computation technique to compute Hausdorff distance in parallel. It is also shown that the same is realizable in cellular architectures. Further, applications of Skeleton, Voronoi diagram and Hausdorff distance are also explored successfully in this thesis.

Keywords : Euclidean Distance Transform, Skeleton, Voronoi Diagram, Hausdorff Distance, VLSI, Cellular Architecture, FPGA, Image Processing, Computer Vision.