Digital Shape Classification Using Local and Global Shape descriptors

by

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Approved by Pun Chi Man
Supervisor

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Abstract

SHAPE CLASSIFICATION USING LOCAL AND GLOBAL DESCRIPTORS

by Lin Cong

Thesis Supervisor: Associate Professor Pun Chi-Man

Shape Classification Using Local and Global Shape descriptors

In this thesis we introduced an important research topic of shape classification, which is not mature and under hot investigation and whose techniques are to be used in many digital devices in the future. The background of shape classification as well as the framework was introduced. Furthermore, we discussed some problems and difficulties in designing reasonable shape descriptors which is robust and effective to non-rigid transform. Some of the state-of-the-art are systemically reviewed and classified the literature by the characteristics of the shape descriptors.

In our proposed method, we developed our three shape descriptors individually according to existed psychological understanding of how human's perception of shape forms. For the Regional Area Descriptor (RAD) and Regional Skeleton Descriptor (RSD), we used the shape's skeleton as a primitive descriptor for further elaboration. By analyzing the advantages and disadvantages of use of the skeleton in shape classification, we tried avoid its disadvantages of high computational cost and difficulties in matching and take it advantages which could represent a shape's topological structure. For the tangent function, the descriptors is generating from the contour by finding out landmark points on it. The tangent function of landmark points is concise and able to preserve important information of shape and avoid the drawback of contour based approach, easily affected by noise, by deleting trivial points of contours while remaining the useful ones. In the matching stage, a dynamic programming based Optimal Path Searching, which is widely used

in pattern recognition, is customized into our method. The matching algorithm is capable in handling non-rigid transform by tolerating local deforms. And finally, the distances of three shape descriptors are combined by a simple, of low cost, linear combination.

In the stage of experiment, firstly the developed descriptors are individually tested on the widely used 99shape and articulated dataset, which examine the properties of RST invariance and the articulation invariance of each. Data of result is demonstrated using precision-recall criteria which make it easy to compare to others in literature. The result showed overall effectiveness of each is not good enough, however, is capable to classify certain classes of shapes. A combination of the distance yielded from three shape descriptors is conducted later as well. The result has greatly improved and comparable to some state-of-the-art. Moreover, to our delight, the effectiveness on articulated dataset showed superior than most of the algorithm in literature.

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LIST OF ABBREVIATIONS

RSD. Regional Skeleton Descriptor

RAD. Regional Area Descriptor

TF. Tangent Function

WD. Wavelet Descriptor

HHM. Hidden Markov Model

PCA. Principal Component Analysis

PREFACE

In this paper we focused on designing novel shape descriptors and proposed three novel descriptors RAD, RSD and tangent function. The RAD and RSD are based on the primitive skeleton of shape while the tangent function is developed from the contour by finding out the important landmark points and collecting regional information around them. In the matching stage, a customized Optimal Path Searching algorithm is adopted into our setting, which is an efficient dynamic programming based algorithm. The proposed shape descriptors are tested on common used datasets and the results are analyzed and compared to the state-of-the-art. The experimental results show comparable to other approaches in literature

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