Flexible Shape-Based Query Rewriting

Georges Chalhoub[1], Richard Chbeir[1], and Kokou Yetongnon[1]

[1] Computer Science Department, LE2I – Bourgogne University
BP 47870 21078 Dijon - France
gchalhoub@bdl.gov.lb
{rchbeir, Kokou}@u-bourgogne.fr

Abstract. A visual query is based on pictorial representation of conceptual entities and operations. One of the most important features used in visual queries is the shape. Despite its intuitive writing, a shape-based visual query usually suffers of a complexity processing related to two major parameters: 1-the imprecise user request, 2-shapes may undergo several types of transformation. Several methods are provided in the literature to assist the user during query writing. On one hand, relevance feedback technique is widely used to rewrite the initial user query. On the other hand, shape transformations are considered by current shape-based retrieval approaches without any user intervention. In this paper, we present a new cooperative approach based on the shape neighborhood concept allowing the user to rewrite a shape-based visual query according to his preferences with high flexibility in terms of including (or excluding) only some shape transformations and of result sorting.

1 Introduction

A visual language is based on pictorial representation of conceptual entities and operations through which users compose iconic or visual sentences [25]. Several visual features (such as icons, predefined shapes, primitive shapes, sample images, etc.) can be combined together using spatial, temporal and logical operators. Shape-based queries are widely used in visual languages due to their simplicity and intuitivity. Three main categories of shape-based visual languages are provided in the literature: Iconic-based [15, 17, 19], Sketch-based [18, 20], and Query By Image [21, 26]. Using these user-friendly languages, the user can easily visualize and graphically query the database. However, several limitations are identified and related to the use of each one of these methods. For instance, when using iconic-based languages, the query may encounter some ambiguities when the operators and objects number increases [19]. In sketch languages, the queries are user-talent dependent and may lead to several interpretations [19]. Query by image queries are very restrictive when the user does not have a sample image expressing his needs. To handle these limitations and make the retrieval process more cooperative, several techniques have been provided in the literature [7, 8].

Widely used in several search engines and for textual data, the query rewriting technique has been studied in several domains [12]. The relevance feedback is one of the query rewriting techniques [22, 23, 24]. It aims at providing users the opportunity

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to evaluate search results by selecting relevant (or irrelevant) ones. The system can then iteratively rewrite the initial query in function of the selected sets given by the user after each step. However, most of current approaches do not allow the user to specify neither the degree of relevance (or irrelevance) of each result, nor the order of searching and/or displaying retrieval results. In essence, shape retrieval is a complex task due to several transformations (occlusion, articulation, rotation, translation, scaling, etc.) that a shape may undergo. When retrieving similar shapes, current techniques are able to consider only a set of domain-related transformations within a predefined execution order. Moreover, in order to keep the retrieval interfaces user friendly, they attempt, even when using relevance feedback techniques, to simplify the user intervention by limiting the input or feedback parameters which is very restrictive when formulating complex queries (which transformations to include or to exclude?, which sorting order?, etc.). In [12], an interesting rewriting approach has been provided for multimedia queries. The authors have defined a relaxation and a constraint functions to rewrite only textual-oriented queries using the user profile. In this paper, we extend their approach to shape features and define a formal language for shape rewriting. Here, the relaxation function allows considering all types of shape transformation (stretching, occlusion, rotation etc.), while the constraint function aims at:

1. Including and/or excluding shapes from the relaxation result,
2. Assigning an order to relaxation results according to the user requests.

This paper is organized as follows. First, we explain the motivation of this work. After, we give a snapshot of the related work. In section 4, we detail our rewriting method, and give some examples. Section 5 is devoted to present our implementation. Finally, we conclude and pin down some of our future directions.

2 Motivation

To explain the motivation of this work, let us consider the following example: A journalist takes using a digital camera some snapshots in front of the finish line of the 100, 200, and 400 meters men competitions in the 10th IAAF World Championships in Athletics. Afterwards, he stores the captured pictures in an image database (or repository) without any annotation. The journalist uses a retrieval tool that extracts from the stored images a set of corresponding shape representations as shown in figure 1. The tool provides a shape-based sketch and iconic-based image retrieval interface, with a relevance feedback technique to refine the user query. It uses global similarity measure between shapes (figure 2) allowing the user to express the similarity degree by giving a similarity threshold[1] $\varepsilon \in [0, 1]$.

To write his weekly report, the journalist wants to look for only Golden winners' shots taking at the final stage of the competition. He formulates his query Q by drawing a sample shape (imagining a typical one when wining a competition at the arrival stage) as follows:

Q: 

[1] Is related to the number of links to consider when computing the similarity.