

# Modeling of Moving Objects and Querying Videos by Trajectories

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## 1. Introduction

Content-based retrieval of videos in databases is a technique which has attracted considerable research interest during the last years[1]. Most papers in this area discuss how to retrieve some kinds of video scenes involving moving objects according to some example trajectories of these objects[2,3]. In this paper, we will present a model to describe the trajectories of moving objects and use it to retrieve video scenes.

## 2. Modeling moving objects

Proposing the moving objects are stable (they do not jump, combine or decompose during their movement), we define 9 directions of objects movement: static, left-up, up, right-up, right, right-down, down, left-down and left as a set of characters  $\bullet : \{0, a, b, c, d, e, f, g, h\}$  in order. By assuming that a video scene is divided into  $n$  equal time-intervals in the temporal dimension as, we define the trajectory string of a moving object involved in this video scene as a string  $W: w_1 w_2 w_3 \dots w_n$ , in which  $w_i \bullet$  refers to the moving a direction of the object from the  $i$ th frame to the  $(i+1)$ th frame.

From a trajectory string  $W$  of one giving object, we can construct a DFA  $M$ . Then, the language accepted by  $M$  is the set of the approximate trajectory strings of  $W$ . This conclusion will be used to define the similarity-match selection later.

## 3. Querying Videos by Trajectories

Referencing the algebra of relational database, we define the algebra and operations used in video scenes to present the retrievals and the queries. The definition of the operations is given by the object-oriented method.

The spatial projection operations create a new scene based of a existing scene. The parameters are some of the moving objects in. The new scene is the subset of

triples involving these objects. Comparatively, the temporal projection operations pay attention to changes of moving objects in a segment of time. The parameters are the start time point of the observation and the duration of a moving object.

The trajectory extractions extract the moving characteristics of object from video scene to gain the trajectory string of object.

The selection operations obtain a set consisting of a series of new video scenes from an existing scene, There are two kinds of selection operations: exact-match selection and similarity-match selection.

## 4. Conclusions

This paper presents a novel model based on trajectories to describe the moving objects in video data, while an object is represented by a triple(Name, time, string). Because of the discretization in the spatiotemporal space, we can see that the trajectory string is a kind of data structure describing the spatiotemporal relationships among moving objects. We have also shown that the set of approximate trajectory strings is a regular language. This conclusion gives the theoretical basis for the similarity-match algorithm of trajectories.

The discussion in this paper does not take into account the dynamic changes of moving objects, such as rotating and distorting. We will pay more attention to these aspects in future work.

## 5. References

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[3] Z. Aghbari, K. Kaneko, and A. Makinouchi, "Modeling and Querying Videos by Content Trajectories", In IEEE ICME, New York, 2000.