Key Frame Extraction and Indexing for Multimedia Databases

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Abstract

The need for video processing tools has emerged in recent years. The main problem of video analysis is that it is a notoriously weak-structured problem. There is no fixed video style that we could use to parse directly. Moreover, there are many media formats and standards nowadays. Thus, in this paper, we introduce a new system to analyze and process different media file formats in an efficient and consistent manner. In addition to the different normal media browsing operations, the system implements three different video cut detection mechanisms. These three mechanisms are based upon the color histogram content summarization. One of these algorithms is based on the HSV color space. The other two algorithms are based on the RGB color space. A detailed algorithm will be depicted along with its approach to achieve quick performance although it tries to solve common problems for video cut detection. These problems are the detection of false cuts and missing true cuts. Then, a comparative study will be provided between the different mechanisms to measure their performance and reliability in different configuration environments. This work is part of the Mobile Agents Alliance project among Ottawa university, National Research Council (NRC) and Mitel Corporation in Canada.

1. Introduction

In the past decade, there has been significant work done in the area of image analysis and recognition so that we could partition a video source into separate segments. This process could be used to index the video within the multimedia databases and thus we could query and navigate through the database. Following are some of the algorithms used to measure the differences among consecutive frames. *Pixels-Pair wise comparison* [2] is a simple way to detect a quantitative change between a pair of images by comparing the corresponding pixels in the two frames to determine how many pixels have changed. The total percentage of the pixels changed is evaluated and if this percentage exceeds some preset threshold, we decide that a frame change has been detected. Many color space systems could be used for the comparison such as: RGB, HVC, HSV, YIQ or L*u*v. The advantage of this method is its simplicity. However, its disadvantages exceed the advantage. One disadvantage is that it has a large processing overhead to compare all consecutive frames. Also, it does not conclude if large objects moved within the shot before terminating the continuous shot.

The *Spatial, Temporal Skips* [2] *(Histogram Analysis)* [2, 3, 4] methods benefit from the redundant characteristic of the video frames either in the spatial dimension or the temporal dimension. The use of color histograms has been verified to be more robust against objects and camera movements within the same shot. Moreover, the very near video frames are similar except for the cut frames. We could compare temporally every defined number of frames instead of all the consecutive frames and/or spatially not all the pixels within the frames. Thus, we could save great processing time and resources during the analysis. We could use the color histogram distributions of the frames to make the comparison. The histogram comparison algorithm is less sensitive to object motion than the pixels-pair wise comparison algorithm. Figure 1 shows a histogram distribution function. There are many histogram difference measures that could be used to detect a shot cut.

For example: