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CONTENT AUDITING USING VIDEO SIGNATURES

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***Abstract*--The large amount of broadcast and multimedia distribution channels introduces a new challenge for the advertisement industry. Keeping track of ad placements and effectiveness is highly necessary. This paper introduces a novel method for content monitoring and control through the use of video signatures. A video tomography based video signature is used. The goal is to determine the number of times a particular advt. clip is included in a video stream. The proposed method is low complexity and can monitor video streams in real-time. The proposed method not only allows the monitoring of the broadcast transmission, but also permits the extraction of user statistical behavior if this solution is included in setup boxes.**

I. INTRODUCTION

Monitoring systems plays a crucial role in the broadcasting operations for any network. Monitoring solutions provide a means to capture continuously the transmitted programming, details, schedules and events. All this information when stored as logs or databases permits the analysis and retrieval of any content that was made available at any particular time. Advertisers and the advertisement industry have become more interested in these types of applications where they can follow all details of the contracted air time.

A patent exists [1] that proposes a solution for this task; a server, with web capabilities, is loaded with software that permits to the server record all the events that occurred on a broadcast transmission. To do so, the software relies on the assumed existing metadata, populating the database with the metadata details.

The proposed approach to ad tracking is based on using video signatures to detect the presence of ads in a video stream. Video tomography based signatures we had developed for video copy detection was used for content tracking [2]. The tomography technique has been used to analyze camera work and detection of shot changes, which seems to be the obvious next step for monitoring and auditing systems. The proposed video signature information allows for easy extraction from live feed broadcast material. This type of signature extraction and comparison technique is a very compact and dependable method, because the signature size per second of content is 48 Bytes [2]. This permits the generation of very small databases with a large number of diverse materials. It also allows the querying process to be very fast. Another advantage of this technique is that its simplicity and size allows it to be included in setup boxes; therefore, information like updates and consumer statistics can be delivered and gathered with very low overhead for the cable provider.

The rest of this paper is organized as follows: Section 2 presents a background of the signature generation and comparison, Section 3 shows experiments and results obtained, and Section 4 reflects the Conclusions.

II. BACKGROUND AND MOTIVATION

The main idea for the signature generation is to have a simple and unique element that summarizes the identity of a video. The signature generation based on tomography images is an excellent solution because of its fast extraction and comparison. The tomography images are images produced by extracting a small sample from each frame of a movie, and then each sample is relocated in consecutive order one after another. The particular information stored in these images hold the spatiotemporal characteristics from the original movie; these characteristics are the key for the positive identification of a video content.

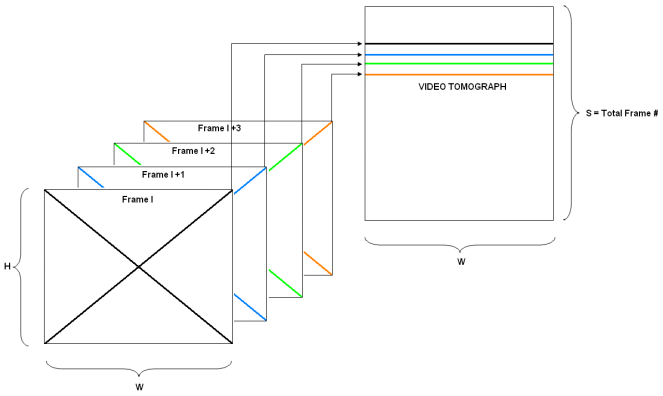

Fig. 1 Video Tomography and Signature

Tomography images are exclusively made from the Luma (Y) component. The next step in the process is to analyze the tomography image, trying to locate the main characteristics of the video. An edge detection mechanism is used which reduces the information without losing the main features. Most of the movies or moving pictures (TV shows, musical videos, films, and advertisements) show a sequence of shots, all of them related, but at the same time unique. Hence, to be able to increase the uniqueness of the signature, those segments need to be identified and included in the signature.

Several techniques exist for segment identification [3]; pixel-wise comparison of adjacent frames [4], gray level histogram comparison [4] [5], statistical differences [5].We developed a low complexity approach based on the analysis of DC images. This method consists of generating a DC image from each frame and comparing the DC images of successive frames. A just noticeable difference metric was used and a threshold of 25 was used to determine whether the corresponding pixels of the two DC images are marked as

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similar. The number of such differences for a pair of DC images is counted and if it is significant, then a shot change is detected.

After obtaining the shot segmentation, an edge detection procedure is applied. Then from each obtained image several metrics are extracted (histogram count of vertical and horizontal transitions, total number of white pixels, and line sub sampling count of transitions) to obtain each one of the signatures.

The comparison phase comprises signature extraction from the desired video stream and constant access to the database to compare the different elements in the signatures. Because the signature for each clip is composed of several small signatures, only initial comparisons are done between hard cut defined positions. Also this feature can determine if the query clip has suffered any time reduction with which the audit report can be more precise, accurate and detailed.

III. EXPERIMENTS AND RESULTS

The proposed application was tested using a HD 24 hour video recorded from a public channel broadcast on May 23, 15 different advertisement videos where extracted from it, signature generation was performed on the original video and the 15 commercials to then execute the match procedure.

For the comparison procedure, the Euclidean distance is measured between the first shot signature from the selected commercial and each shot that have been detected after a hardcut from the 24h video, each commercial transition is very well defined and a very clear hard cut is detected before the beginning of the advertisement video, this allows to decrease the amount of comparisons and increase the speed for the proposed solution.

Commercial index	# of appearances	# of correct detections	# of false detections
Commercial 1	4	4	0
Commercial 2	1	1	0
Commercial 3	1	1	0
Commercial 4	1	1	0
Commercial 5	2	2	0
Commercial 6	1	1	0
Commercial 8	1	1	0
Commercial 9	1	1	0
Commercial 13	5	5	0
Commercial 14	1	1	0
Commercial 15	1	1	0
Commercial 16	1	1	0
Commercial 17	7	7	0
Commercial 18	1	1	0
Commercial 20	1	0	1

Table 1 Signature comparison results signature type 1.

Signature 1 count of transitions (black to white) along 16 specific positions at the tomography shot image [2] [3].

Commercial index	# of appearances	# of correct detections	# of false detections
Commercial 1	4	4	0
Commercial 2	1	1	0
Commercial 3	1	1	0
Commercial 4	1	1	0
Commercial 5	2	1	1
Commercial 6	1	1	0
Commercial 8	1	1	0
Commercial 9	1	1	0
Commercial 13	5	5	0
Commercial 14	1	1	0
Commercial 15	1	1	0
Commercial 16	1	1	0
Commercial 17	7	7	0
Commercial 18	1	1	0
Commercial 20	1	1	0

Table 2 Signature comparison results signature type 2.

Signature number 2 is extracted by dividing the image in 16 blocks (4 by 4 grid), and then for each block the total number of horizontal transitions is counted among the whole block.

Average time per shot comparison.
28 us.

Table 3 Time measurement for comparison procedure.

IV. CONCLUSIONS

As seen on Table 1 and 2, this method proves to be a excellent method for auditing advertisement content in real time. This procedure can be extended to monitor diverse broadcast content like movies, musical videos, and other prerecorded material. Also, since the database for this type of signatures is very small (5kB per commercial) it can be integrated within setup boxes and be updated as needed without using large amounts of memory inside the system. The comparison method can be optimized by measuring the time for each shot detected and compared with the database; if there is too great a difference in time, then it can be immediately discarded.

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