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A Novel Compression for Enormous Motion Data in Video Using Repeated Object Clips [ROC]

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Abstract: Entertainment industry is roofed with audio, video, graphics and multimedia. It deals with large variety of data. As the data increases, it becomes a troublesome problem especially in large database or real-time and telepresence applications, where the memory, bandwidth and storages are limited. So, in this study we propose, a novel compression method, which is achieved by video content analysis using Repeated Object Clips [ROC]. To achieve ROC, the key frame selection algorithm is used. In key frame selection process, we extract key frame from total number of frames. For selection process, initially frame separation process is carried out, then object detection and object segmentation is performed by level set method. By this novel technique moving object was tracked effectively and compression ratio increased significantly.

Keywords: Compression, computer vision, detection, frame, key frame, segmentation

INTRODUCTION

Multimedia contains both audio and video data. When compare to audio, video contains affluent source of information. So, it is very hard to handle the data and manipulate. Video generally contains sequences of still images with temporal and spatial difference. Here still images depict frames. Now a days, various technology (Liyuan *et al*., 2003) were emerged to represent the visual information accurately and effectively. To give the visual treat to user, developers focus on quality aspects. To achieve this, so many algorithm and methodology are introduced in market. As we know, when quality of visual information gets increased, then obviously, quantity of information also increased. But, from the bottom, still various troubles are behind the desks such as compression ratio, storage is also discussed in this study. Different application such as video database storage, retrieval and processing the video sequences (Talal and Al-Ani, 2003) can also incorporate our proposed method. The research efforts are mainly focused on video analysis at the object level and compress the raw video effectively, which consists of object detection and segmentation (Cheng-Hung *et al*., 2010).

In this study, we designed a simple technique to compress and decompress a video. Commercially, we cross over with several tools to perform lossy and lossless compression. From the research point of view, we gave a solution to reduce the effort of compression procedure.

LITERATURE REVIEW

In recent years, many research works is under gone for object tracking (Alan *et al*., 1998) object segmentation (Cheng-Hung *et al*., 2010) in image as well as video. When compare to image, video is little bit difficult to handle because content of frame change due to temporal and spatial domain. So far the various methods are specified effectively with some unusual drawback.

In video analysis, several object detection algorithms are developed. Such as Basic Background Subtraction (BBS), Multiple Gaussian Model (MGM) (jacinto and Jorge, 2006). bayes decision theory (Liyuan *et al*., 2003) proposed bayes decision theory to detect the foreground object from video. Here, initially general feature vector is recognized. Then suitable feature vector is derived from the general vector for both static and moving object. Two learning methods are also discussed and implemented for updating the feature vector. But, bayes decision theory not suitable for rare case, when moving object is goes into static object threshold level range means then this method fails to detect the object and consider static object. Current image and video compression standards shown in Table 1:

Compression is achieved by different methods; one of effective way is key frame selection method (Talal and Al-Ani, 2003). Recently, selection process algorithms emerged well and combine with standard compression algorithm.

In computer vision, compress the raw video and produces the information without any perception loss is multimedia field. Recently, good numbers of methods and algorithms were developed by both commercially and research oriented. On the other hand, drawbacks and effectiveness of existing system want to overcome and

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Table 1: Various standards and its application

Standard	Application	Bit rate
JPEG	Continuous-tone still-image compression	Variable
H.261	Video telephone and teleconferencing over ISDN	px64 kb/s
MPEG-1	Video on digital storage media (CD-ROM)	1.5 Mb/s
MPEG-2	Digital Television	2-20 Mb/s
H.263	Video telephony over PSTN	33.6? kb/s
MPEG-4	Object-based coding, synthetic content, interactivity	Variable
JPEG-2000 Variable	Improved still image compression	
H.264/ MPEG-4 AVC	Improved video compression kb/s	10's to 100's

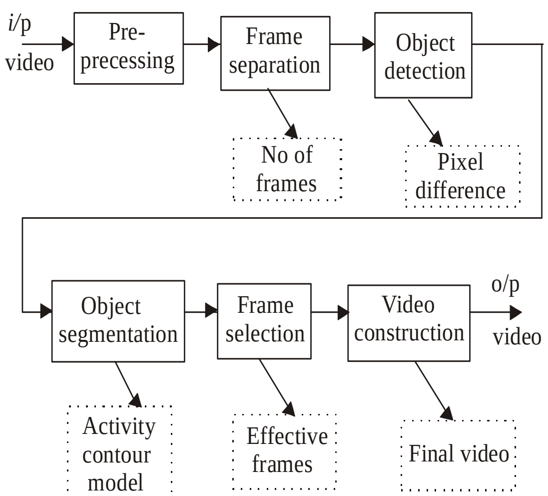

Fig. 1: Block diagram to compress a video

compensate for future multimedia field. To overcome this problem, the proposed method is designed simple and powerful to achieve the compression ratio high.

METHODOLOGY

Proposed system:

Overview: The following Fig. 1 shows the proposed system, compression algorithm consists of following steps: First, Segment the video sequence into frames which represented as still images. Second, Object detection can be achieved through pixel difference algorithm in each frame. Third, active contour model is used to segment the object in each frame then calculate the path of object throughout the video sequences. Fourth, a compression technique is applied to key frame sequences.

Fig. 2: Frame by frame separation

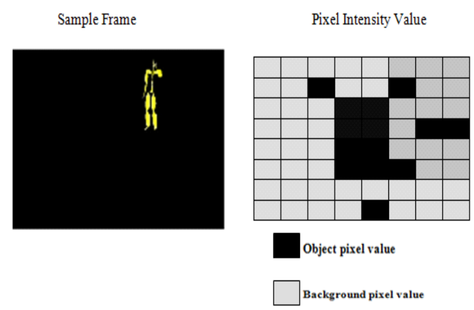

Fig. 3: Sample frame and represented in pixel value

Frame separation: Video can be represented by sequence of shots, scenes and clips. A shot is a sequence of frames which represents a continuous action in temporal and spatial domain. Each frame consists of 2D still images. Video captured takes at rate of 30 frames per sec. For approximately, 22 min video sequences contain 660 frames. The raw video of a single animated motion over 1 min have size of

$$\left\{\frac{320\times 240\ pixels}{frame}\right\}\left\{\frac{30\ frame}{\sec}\right\}\left\{\frac{3colors}{pixel}\right\}\left\{\frac{8bits}{color}\right\} = 200mb/s$$

The Fig. 2 represents how frame by frame separation process is carried out. Generally, Animated or raw video, can`t process directly. Because on hand we only have compressed format. So, analyze the motion in moving clip is impracticable due to temporal and spatial difference. Before get into frame separation process, theoretically uncompress the input video for video processing. The proposed method has automatic frame separation by length of video. Because each frame is highly correlated with adjacent frame. Due to the frame separation we can transparently work with the moving object and compute the pixel differences.

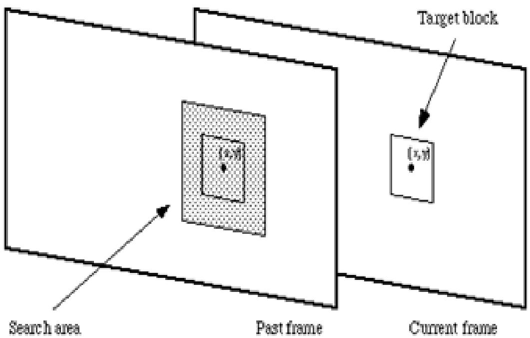

Fig. 4: Object detection using pixel difference between past frame and current frame

Each frame consists of pixel value [R, G and B]. Each pixel value has intensity from 0 to 255. Figure 3 we are represents both object pixel value and background pixel value. It differs for consecutive frames. Object pixel value helpful to identify the path of object through which tracking of object in the video sequence is achieved. In sample video, background pixel value won't change until it detects the object. Using the frame separation we can track the moving object throughout the sequence.

Object detection: Figure 4 depicts how to detect the object by comparing the current frame and reference frame to locate the object position.

Algorithm: Pseudo- code to detect object for segmentation

Input :
C, count of frames in the input video
F, a set of 'C' frames (1....C)
T, Threshold value
Output :
P, Object path of the frames (1... C)
Method :
(1) for ←1 to C do
Find pixel value of each F_i and populate in a list (say L_i)
Increment i
end for
(2) Initialize i to 1,
(3) M←L_i
N←L_{i-1}
(4) for i ←2 to C do
Pi-1←Difference between M and N
if (P_{i-}1>T) then
M←P_{i-1}
else
M←L_i
Increment I
End for
(5) retum

The pseudo-code is used for object detection. Detection is done by pixel difference between the reference frame R and consecutive frame L. The whole image coordinates are represented as pixel value. The pseudo-code figure out the step by step process.
In the above pseudo code:

- Find pixel value for total number of frames
- Initialize the frame number i with 1
- The very first frame is assigned to M
- Corresponding next frame is assigned to N at 1st iteration
- Loop get starts and end up to total number of frames C

Then find the pixel difference between M and N for every iteration. After verify with threshold value T we confirm that resultant frame is an reference frame R and second iteration gets started.

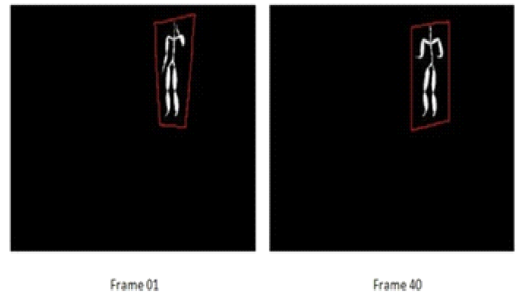

Fig. 5: Initial contour for frame 1 and 40

Object segmentation: In compression algorithm, after completing the object detection in each frame, next stage is segmentation; it is most important step and gives complete analysis of motion object in whole video sequences. Many segmentation algorithms (Daniele, 2004; Zhong and Chang, 1997) use a preprocessing step to reduce the noise in image and increase the accuracy for further process.

The proposed method is based on the desired object boundaries. The idea behind the active contour model is initialize the contour manually so after performing corresponding iteration, desired final contour object can be achieved. In order to demonstrate the tracking, when used in raw or animated video for single actor, the final active contour extracted for the previous frame is used to initialize the active contour evolution for following frame (daniele, 2004).

Figure 5 shows that initial contour is applied to selected frame. Straightforward object segmentation is achieved. Here experimentally worked with 300 iteration.

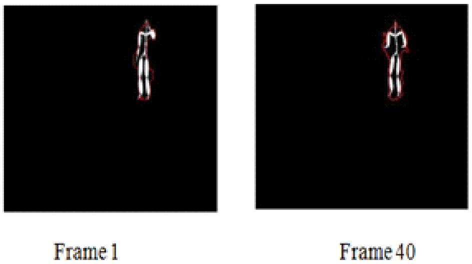

Fig. 6: Final contour after 300 iteration

$$E = \int_0^1 \frac{1}{2}\left[\alpha\left|X'(s)\right|^2 + \beta\left|X''(s)\right|^2\right] + E_{ext}\big(X(s)\big)ds$$

After completing the loops, the desired contour is evolved (Chenyang and Jerry, 1998) the internal process of segmentation is carried out in flow diagram. Level set initial energy minimizing function as follows:

And above energy function E must satisfy the Euler equation which can measured with two forces, internal and external forces. Then to simulate the snake using below function with time t,

$$x_t(s,t) = \alpha X''(s,t) - \beta X''''(s,t) - \nabla E_{ext}$$

The Fig. 6 shows, the final contour after the iteration. Here approximately we segment the object from frame with detecting the boundaries of object.

Figure 7 represents the flow of object segmentation process. After, complete analysis of object movements in total frames. We can easily determine the necessary frames which are reconstruct the final compressed video.

Key frame selection: After above course of action are completed successfully the key frame selection process get started to select the necessary frames to decode the

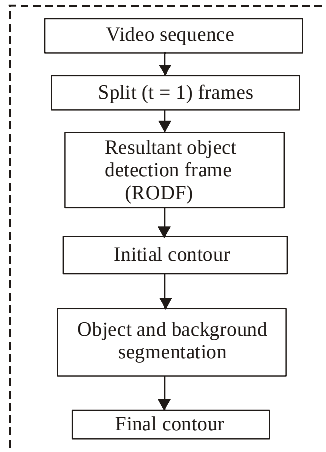

Fig. 7: Flow diagram for object segmentation

video without any visual loss (Satishkumar and Sanjay, 2011). Previous step data are buffered and used in this step. Here, repeated motion or similar motion frames are computed and effectively reduces redundant frame information. Experimentally; maximum 71 redundant frames got reduced after performing the key frame selection process. Several steps are performed in determining key frame.

First, we determine number of repeated frames to be used as input to key frame selection process. Selecting evenly space frames, according to length and occurrences rate of frame in the video. Here reasonable amount of time or uses regular intervals are large then important details can be failed to spot. Instead, we start with collection of frames for a sample video which has sequence of action performed by single actor. From the sequences of data, extract the repeated motion and corresponding frames. The temporal and spatial difference is less for repeated motion clips or frames. Using this step, we are ready to construct the predicted frame for aligned motion

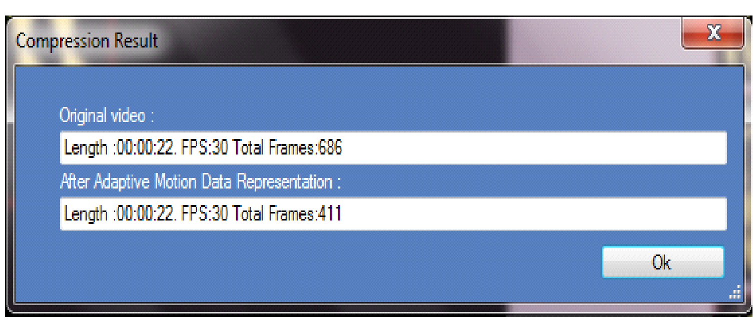

Fig. 8: Compression result

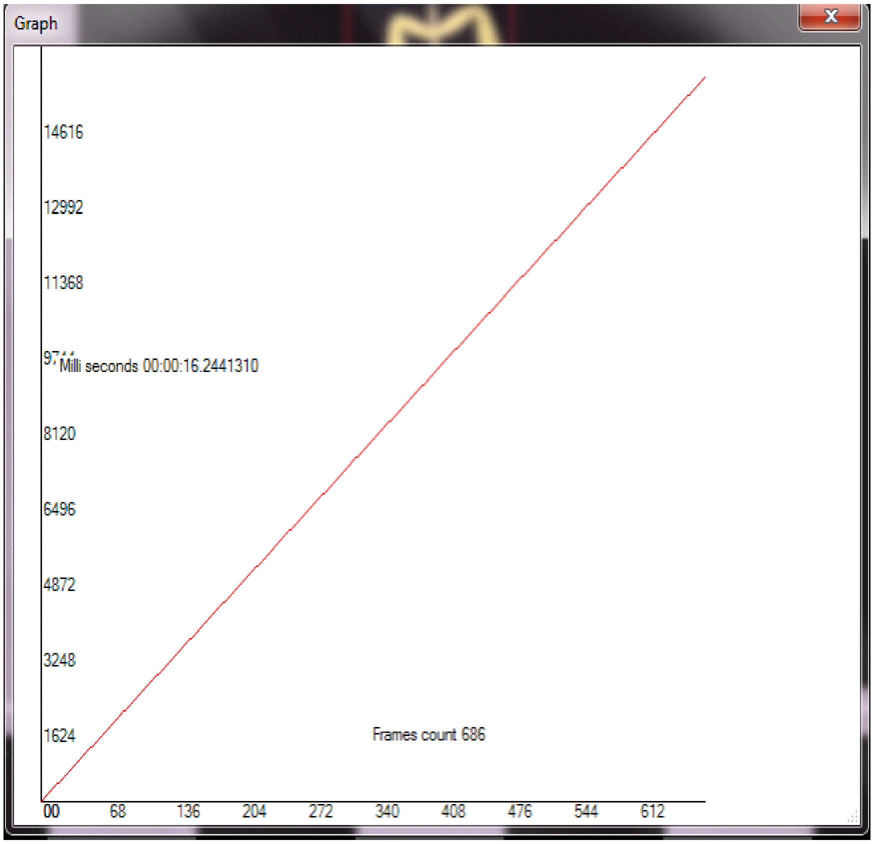

Fig. 9: Time vs. frame

sequence. Because our human eye perception is high and rapid change in action should give unsatisfactory result to end user.

EXPERIMENTAL ANALYSIS

The result of the proposed method is shown in this section. Experiment is conducted on animated video and different raw video. Each video has different parameters such as frame size, length, storage size. For eg: animated video has 22 sec duration and 2.31 MB size with 1197 kbps bit rate. It consists of 686 frames with 240x320 dimensions. While process gets started, the input video is in compressed format such as avi, mpeg. So, further compression process not allowed and won't give the expected result. For that, initially uncompress the input video. Here uncompressed video size is 200 MB. Then corresponding steps and process such as frame separation, object detection, segmentation and key frame selection are conceded. The compression efficiency is calculated using the compression ratio.The quality of an uncompressed video is measured using PSNR. The Fig. 8 and 9 shows as frame reduced between original video and compressed video.

CONCLUSION AND FUTURE WORK

An efficient video compression method based on various steps such as object detection, object segmentation, key frame selection is developed that mainly focus on calculation of pixel difference. Many parameters are applied in the each step and reduces the meaningless (redundant frames). The proposed system tested with different types of videos and corresponding screenshots are figure out in this study. Here, we analyzed for object motion and behavior for whole sequences. In future, we concentrate on large video database. The output of compressed video is in good quality and good performance as well as it has a specific compression ratio.

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