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Video Summarization by Removing Duplicate Frames from Surveillance Video Using Keyframe Extraction

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ABSTRACT: Nowadays Video data creation and its storage play a important role in every industry. We require it in security, entertainment industries, advertising industries and more other industries. In security field data is collected using CCTV camera and stored at data centers of organization. Same video content is referred to check if someone is violating the organizations security. In advertising industry product details are conveyed using seconds of video. If video length is more, then cost of advertisement creation is also more. Video summarization is also a technique in which your long period activity is represented using 5-10 minutes of video. Compare to verbal communication video representation is best way of communication and its trustworthy way to communicate your message.

By considering the importance of video data there is huge scope of improvement in video data processing. Video processing techniques can be used to remove redundant frames from video so that it will solve the problem of data storage. Video without redundant frames is the best input for information retrieval operation. As less time will require for retrieval of information compared to original video. So main object is to develop a system to compress the video i.e. to remove redundant data from video. This proposed approach is based on correlation method for key frame extraction and parallel processing. This approach uses a correlation technique to summarize video.

KEYWORDS: Key Frame Extraction, Parallel Processing, Correlation.

I. INTRODUTION

In recent years, sudden technical advancement in video data creation and its storage are improved a lot. So it is more about to how efficiently we handle those data with indexing and retrieval methods. As current activity of data creation and its storage is sequential, so it consumes more storage space. Video Storage space increases only due to the fact that video has 60-70% of data which is sufficient to represent all important video content and rest 30-40% data is redundant frames. As to solve this problem we have solution at the same time, by using data management. As for particular video there will be repeated video content which may not be useful and hence we can skip those data and extract whichever we want or one with less repetition. The popular term video summarization is the same meaning of what we are suggesting here. [6] As global video summarization will be fast and efficient data assessment system. As in video summarization methods, some popular techniques are being researched nowadays like trajectory curve, clustering , faber-shouder wavelet [3] and thepade's sorted n-ary block truncation coding [4]. In current paper among these mentioned methods, their advantages and weakness in particular applications are studied. In current work, review is made in field of key frame extraction and related research going on. Some works those are related to work are also mentioned in this review work.

In this paper, we use a simple technique for comparing frames and key frame extraction. Here frame difference calculate by using correlation technique. This is the very effective technique in finding a relation between two variables, here we use this technique to find how much two frames are similar or different from each other . Similar frame will consider as duplicate and it will be removed , others will be stored and those frames are known as

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key frames which is used for summary video. For retrieving proper information from video, here uses mapping , which map key frames to video retrieve proper video sequence from original video.

II. RELATED WORK

In video processing the rising concept is key frame extraction is, there are some approaches which is mentioned in literature. Aggregation mechanism use to combine the visual features extracted from the correlation of RGB color channels, color histogram, and moments of inertia to extract key frames from the video. which provides smooth output but it is time consuming[6]. Clustering method is good for key frame extraction . In that paper they uses Dominant-set clustering .This method dynamically decides the number of key frames depending on the complexity of video shots, but it does not consider temporal information [2]. For video summarization temporal information is needed. Another way the dominant block of each video frame is computed to construct feature matrix and the sliding window SVD is used for compute rank. if frames rank is maximum between two shots then frame is considered as key frame [3]. This is not good if we consider a frame in which details are distributed on entire image. So in such situation calculation of dominant block is extra overhead. In other techniques Haar features are used for comparing images but Haar features are environmental condition dependent. So result may vary based on conditions[4]. Scale invariant feature transform (SIFT) is adopted to compute the visual content discontinuity values. Then a new method, which is called the Local Double Threshold Shot Boundary Detection (LDT-SBD), is used to detect shot boundaries. Chain and rule matching mechanism used for extract key frames[5], but some of the cases it causes miss or false shot boundary detection. Correlation of color channel technique is used for key frame extraction[1], but in that framing and key framing operation perform one by another, thats why is consume more time. AdaBoost learning algorithm is applied to keyframe extraction for sequence of specific vehicle image of lane vehicle surveillance video, but it provides Suboptimal solution and it sensitive to noisy data and outliers[7].

III. APPROACH

In the proposed system , we can extract frames from video, and simultaneously at the same time we compare those extracted frames and choose unique frames from them . For Choosing unique frames we use keyframe extraction algorithm. We can apply keyframe extraction algorithms directly on this frame, but it will work in linear way which will increase computational time. To decrease computational time Task is used. Task is mainly used for parallel processing. Here the operation of extracting frames and creating and applying Tasks on it , is done parallel. Also using of parallel processing we can decrease processing speed. Fig.1. shows the flow diagram of proposed system.

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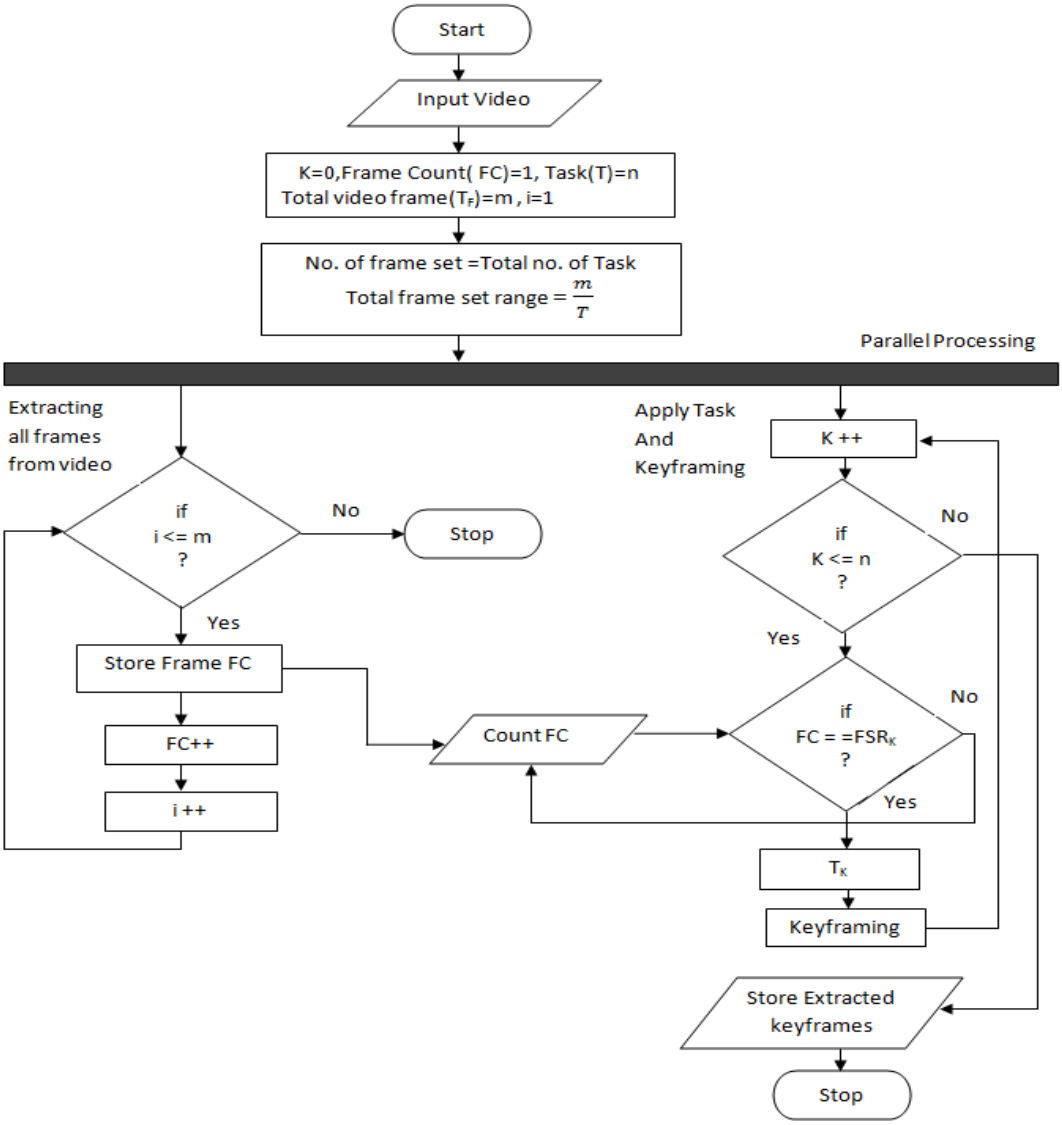

Fig.1. Flow diagram of proposed system

Below shows the algorithm of proposed system. To find frame difference correlation and parallel processing is used, correlation finds similarity between two frames. While finding these all differences of frame, first frames are divided into "Ts" non- overlapping sections so as to improve performance and reduce computing complexity and time[1][6]. At last step mean of all section differences is computed.

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Algorithm 1 :Proposed system of parallel processing for frame extraction form video and keyframe extraction

Initization :
int Framecount = 1;
Step 1 : Take video
Step 2 : -Set total frames of video :
TF=Total frames in video is m
-Extracting frames from video :
for(int i = 1; i <= m ; i++) , in Parallel
Store Frame(Framecount)
Framecount ++
Step 3 : Use 'n' number of Tasks (T) i.e. $T_1, T_2, ..., T_n$
Set total no. of frames set and range of each frame set(FSR)
No. of Frame set = Total no. of Tasks
Frame set range (j) = $\frac{Total \text{ frames in video}}{\text{Total no.of } Tasks}$
i.e. FSR_1 = 1 to j
FSR_2 = j+1 to 2j
.
.
FSR_n = ((n - 1) j) + 1 to nj
Step 4 : for (int K = 1; K < = no. of Tasks ; K++) , in Parallel
Step 5 : if (Framecount = = range of frame set FSR_K) then
apply T_K with keyframing on FSR_K and start processing T_K
and goto Step 4
else
Repeat Step 5
Step 6 : Store all extracted keyframes.

Figure 2 : Algorithm for Parallel processing

The above algorithm shows , how to work both process parallely. In that first we need to initialize framecount which is used for storing extracted frames from video. Then take a video after that compute total number of frames . Also , set the total number of tasks as well as declare the total number of frame set which is equal to total number of threads , and set the range of each frame set . Here are two process , framing and key framing they both work parallel for faster computation. It checks framecount value is exactly equal to range of frame set, if this condition is true then

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apply task with keyframing on that frameset, if the condition is false then it checks framecount which is provided by framing process.

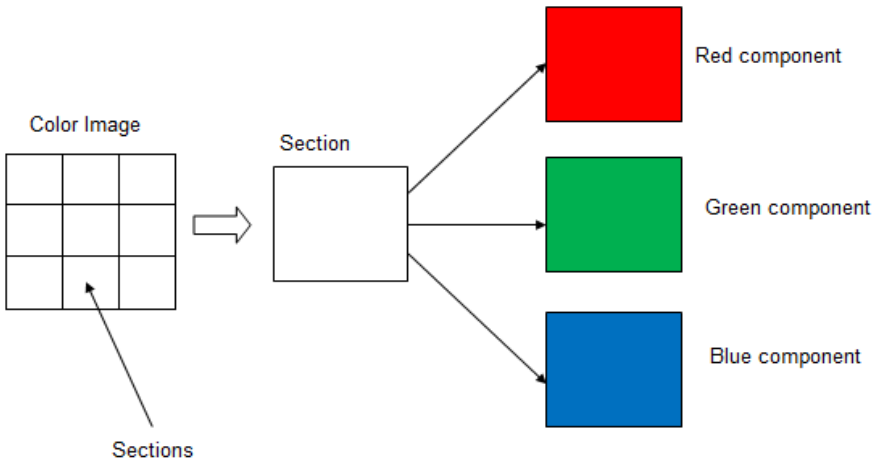

Fig.3. Image divided into sections.

Normally surveillance video has a high frame rate thats why we need not to process all frames so we use skip factor "S_f" to get frames at regular interval. After applying the skip factor finally we get total no. of frames (T_n).

T_n=Total frame/S_f

A. *Finding frame difference.*

Calculate difference of the two frames using correlation. We cannot compare two image directly ,here we need to calculate correlation for each color channel(Red, Green, Blue). Let f and f' be the two frames for the calculation of correlation coefficient. Each frame has been divided into "Ts" sections of size p*q. Then the correlation coefficient for a section "t" for frames and for color channel "c" is given by [1][6].

Section wise correlation can be computed by using,

$$Corr(f,f')_{t,c} = \frac{\sum_{i=0}^{p-1}\sum_{j=0}^{q-1}\left(f_{t,c}(i,j)-\overline{f_{t,c}}\right)\left(f'_{t,c}(i,j)-\overline{f'_{t,c}}\right)}{\sqrt{\sum_{i=0}^{p-1}\sum_{j=0}^{q-1}\left(f_{t,c}(i,j)-\overline{f_{t,c}}\right)^2\left(f'_{t,c}(i,j)-\overline{f'_{t,c}}\right)^2}} \quad (1)$$

Where, f and f ' are two frames , $\overline{f_{t,c}}$ and $\overline{f'_{t,c}}$ are the mean of section(t) for color each channel(c) respectively, i and j are row and column number of the pixel, p and q are the width and height of section.

Color wise correlation can be computed by using,

$$Corr(f,f')_c = \frac{1}{T_s}\sum_{k=1}^{T_s} Corr(f,f')_{k,c} \quad (2)$$

Final correlation between two frames will be calculated using,

$$Corr(f,f') = \frac{Corr(f,f')_R + Corr(f,f')_G + Corr(f,f')_B}{3} \quad (3)$$

Where,

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$Corr(f,f')_R$: correlation between RED channel
$Corr(f,f')_G$: correlation between GREEN channel
$Corr(f,f')_B$: correlation between GREEN channel
Corr(f,f') : final correlation value of two frames

B. *Retrieving proper matching video sequence*

For retrieving proper matching video sequence we use mapping. We can found frame number from extracted key frame number . So that , this frame number we can mapped to the original frame number in the video as below,

Original video frame number = Extracted frame number * Skip factor
Time = Original video frame number / Frame rate of original video,

This time can be supplied to the original video as argument which is used to start video at that particular location skipping previous video content.

C. *Parallel processing*

This is the operation in which a process divides into parts, which are executed simultaneously on different processors of same computers. Parallel processing is helpful for run program run faster. For increasing the speed and performance of the system we are use parallel processing. For that purpose we need to declare no. of frame set and range of each frame set (FSR). According to the range of frame set we assign thread for parallel processing.

No. of Frame set = Total no. of Tasks (4)

$$\text{Frame set range (j) } = \frac{\text{Total frames in video}}{\text{Total no.of Task}} \quad (5)$$

i.e. FSR1 = 1 to j
FSR2 = j+1 to 2j
.
.
FSRn = ((n - 1) j) + 1 to nj

IV. EXPERIMENTS AND RESULTS

Taking video from different location in our MIT campus. Most of the video used in result analysis is taken from college and also some of them taken from internet. Below are some experiments carried out on a system which consists of Intel i5 processor, 2.50 GHz clock pulse and 8 GB RAM. On the part of software Visual Studio 2010, Emgu wrapper for OpenCv used.

A. *Frame reduction rate and Required time for keyframing* :
8 different videos taken as dataset which has following properties:
There are few surveillance video(CC1, CC, CC3, CC4) for result analysis which has following properties:
Frame size = 1920* 1080 (same for three video)
Correlation threshold = 0.98
Partitions (or number of tasks) = 5
Frame rate of original videos = 30
Frame rate of summary videos = 3 (lower than original)

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Other videos is taken from internet as dataset which has which has different properties like as some of them are high definition, some of them as standard definition, Some of them are black and white, also low quality.

As shown in Table 1 video frames reduced by great amount after processing. Also Keyframes includes all objects from original video in almost all cases.

Video	Original video Size Total Frame Duration(sec)	Summary video Size Total Frame Duration(sec)	Keyframing Time For System (in seconds) Existing	 Proposed	Video frame reduced by (%)	Efficiency
CC1	85.7 MB 1589 63	1.64 MB 22 7	30	24	98.61	25
CC2	31 MB 460 15	405 KB 6 2	10	8	98.69	25
CC3	35 MB 506 16	687 KB 10 3	30	10	98.02	30
CC4	2.53 MB 1825 60	168 KB 16 5	19	15	99.12	26.6
Video1	32.4 MB 7035 234	6.92 MB 225 74	86	74	98.80	16.21
Video2	43.3 MB 5736 229	10.1 MB 222 74	116	92	96.13	26.08
Video3	37.3 MB 15319 511	10.4 MB 460 153	159	140	96.99	13.57
Video4	248 MB 32977 1319	84.1 MB 1292 430	641	482	96.08	32.98

Table 1. Comparison between existing and proposed system

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B. *Relation between different parameters:*

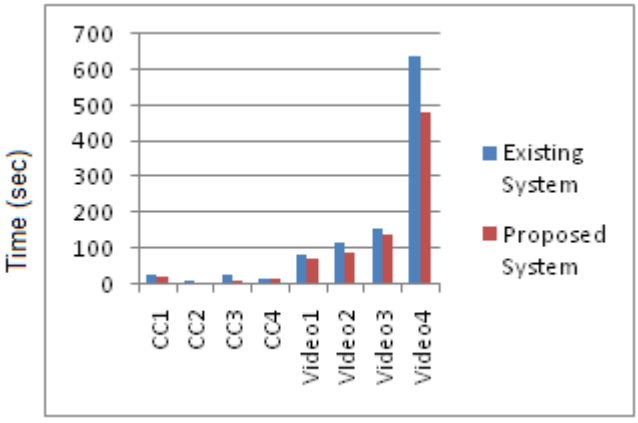

Fig.4. Graph of required time for keyframe extraction

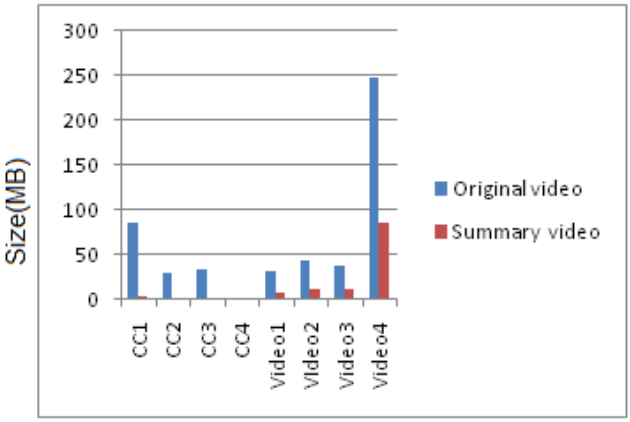

Fig.5. Graph for Size of original video and summary video

V. CONCLUSION

The work discussed in the report contains details of keyframe extraction technique and parallel processing algorithm. To implement this system , I used correlation and parallel processing technique. The keyframe extraction system developed by referring all mentioned paper for giving better performance compared with previous implementations, in terms of duration of summary video and processing time .

The idea of using parallel processing is works for me to achieve desired goal. The Proposed system gives the solution for speed up computational process. This system is work faster because of parallel processing apply on framing and keyframing techniques. It generates summary video which is used for video analysis.

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