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Video Processing - Challenges and Future Research

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ABSTRACT

Video has become an essential component of today's multimedia applications because of its rich content. In producing the digital video documents, the real challenge for computer vision is the development of robust tools for their utilization. It involves the tasks such as video indexing, browsing or searching. This paper is a complete survey of different video processing techniques and large number of related application in diverse disciplines, including medical, pedestrian protection, biometrics, moving object tracking, vehicle detection and monitoring and Traffic queue detection algorithm for processing various real time image processing challenges. Video Processing are hot topics in the field of research and development. Video processing is a particular case of signalprocessing, where the input and output signals are video files or video streams. In This paper, We present Video processing elements and current technologies related Video Processing.

Keywords— Video Processing, Video indexing , Object Tracking, Video Encryption,Video Classification, Video Embedding.

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I. INTRODUCTION

Video, a rich information source, is generally used for capturing and sharing knowledge in learning systems. Digital video is audio/visual data which is stored in a binary format. The information is stored as a sequence of digital data, rather than storing continuous signal in analog format. The information which is available in the natural world, are received through the five senses in the human body, and stored in analog format. Digital video information consists of discrete units of data that are placed so close together that the human senses perceive them as a continuous flow of data. Analog data, such as video recorded on tape, are transmitted as electronic signals of varying frequency or amplitude that are added to carrier waves of a given frequency. In order to make the information usable on a computer, analog-to-digital conversion translates an analog signal to a series of zeroes and ones, which represent, respectively, "negative" and "positive," "off" and "on," or "low" and "high." The opposite action, digital-to-analog conversion, recreates the analog signal for playback.

II. FUNDAMENTALS OF VIDEO

A. FRAME

In video technology sequence of images are called as frames and are measured as frames per second (FPS). The frame has a width of W pixels and a height of H pixels, and the frame size is calculated as W x H.

B. Color

The property of pixels is their colour. The colour of a pixel is represented by a fixed number of bits. If more bits are present, then more suitable variations of colours can be reproduced which is called as Colour Depth (CD) of the video.

C. Bitrate

Bit rate is a measure of the rate of information content in the digital video stream.

III. VIDEO PROCESSING

Video processing uses the combination of hardware and software for editing the images and sound recorded in video files. The algorithms which are available allow the users to perform editing functions using various filters. The desired effects can be produced by editing frame by frame or in larger batches.

Most modern personal computers have software that allows the user to compile images and videos, edit images, and create videos on a limited level. Video files are obtained from the recording device using a Universal Standard Bus (USB) cable. The files are then loaded into a computer software program or peripheral device

Uses:

- Televisionsets
- Vcrs

- Dvds
- Video Codecs
- Video Players
- Video Scalers

A. Features of Video Processing

a) Digital Zoom and Pan

- It is a method of decreasing (narrowing) the angle of view of a digital photographic or video image.
- It is done by cropping an image down to a centered area with the same aspect ratio as the original

b) Frame rate

- It is known as frame frequency is the frequency (rate) at which an imaging device produces unique consecutive images called frames.
- It is used by film and video cameras, computer graphics, and motion capture systems.
- The frame rate is expressed as frames per second (FPS).
- The main frame rate standards in the television namely 24p, 25p, and 30p.

c) Colour Space Conversion

- The Primary color is RGB. RGB colour space combination of three chromaticities of the red, green, and blue additive primaries.
- RGB uses additive colour mixing, because it describes the kind of light needs to be emitted to produce a given colour. Light is added together to create form from out of the darkness.
- RGB stores individual values for red, green and blue.

d) Video filters

- Video filter is a software component that is used to decode audio and video. Multiple filters are used in a filter chain, where each filter receives input from its previous-in-line filter upstream, processes the input and outputs the processed video to its next-in-line filter downstream. Such a configuration can be visualized in a filter graph.

B. Characteristics of video Processing

The following characteristics of video are considered as important and essential in digital video technology.

a) Number of frames per second (fps)

The frames per second is a measure of information used to store and display motion video. It is in film video and digital video. Each frame is a still image which displays frames in quick

succession that creates the illusion of motion. The more frames per second (fps), the smoother the motion appears. In general, the minimum number of frames needed to avoid jerky motion is 30 fps. The computer video formats, such as AVI, provide only 15 frames per second.

The Framerate ranges from six to eight frames per second (frame*/s*) for old cameras and 120 or more frames per second for new professional cameras. The minimum frame rate to achieve the illusion of a moving image is 15 frames per second.

b) Interlaced video vs Progressive video

Video can be stored as interlaced or progressive format. Interlacing is a way to reduce flicker in early mechanical and CRT video displays without increasing the number of frames per second. The horizontal scan lines of each complete frame are treated as if numbered consecutively and captured as two fields: an oddfield(upper field) consisting of the odd-numbered lines and an evenfield(lower field) consisting of the even-numbered lines.

i) ***Interlaced video***: It is a technique of doubling the perceived frame rate introduced with the signal without consuming extra bandwidth. Since the interlaced signal contains the two fields of a video frame captured at two different times, it enhances motion perception to the viewer and reduces flicker which results in an effective doubling of time resolution (also called temporal resolution) and is compared with non-interlaced footage.

ii) ***Progressive video***: It is made up of consecutively displayed video frames that contains all the horizontal lines that make up the image being shown. So in the resultant video, smooth images will be displayed, fast-motion sequences are sharper and artifacts are less relevant. The main drawback in using progressive video is the requirement of higher bandwidth.

c) Aspect ratio

Aspect ratiodefines the dimensions of video screens and video picture elements.

- The video formats are rectilinear which moves in straight lines, and ratio between width and height.
- The screen aspect ratio of a television screen is 4:3, or about 1.33:1.
- High definition (HD) televisions use an aspect ratio of 16:9, or about 1.78:1.
- The aspect ratio of a full 35 mm film frame with soundtrack (also known as the Academy ratio) is 1.375:1.

e) Video quality

The video quality can be measured with formal metrics like Peak Signal-to-Noise Ratio (PSNR) or with subjective video quality using expert observation. PSNR is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. PSNR is actually expressed in terms of the logarithmic decibel scale.

IV. CURRENT RESEARCH IN VIDEO PROCESSING

Many research is based on video processing . It covers the topic such as

- Video Segmentation
- Video Classification
- Video Indexing
- Video Tracking
- Video Compression
- Video Encryption
- Video Steganography

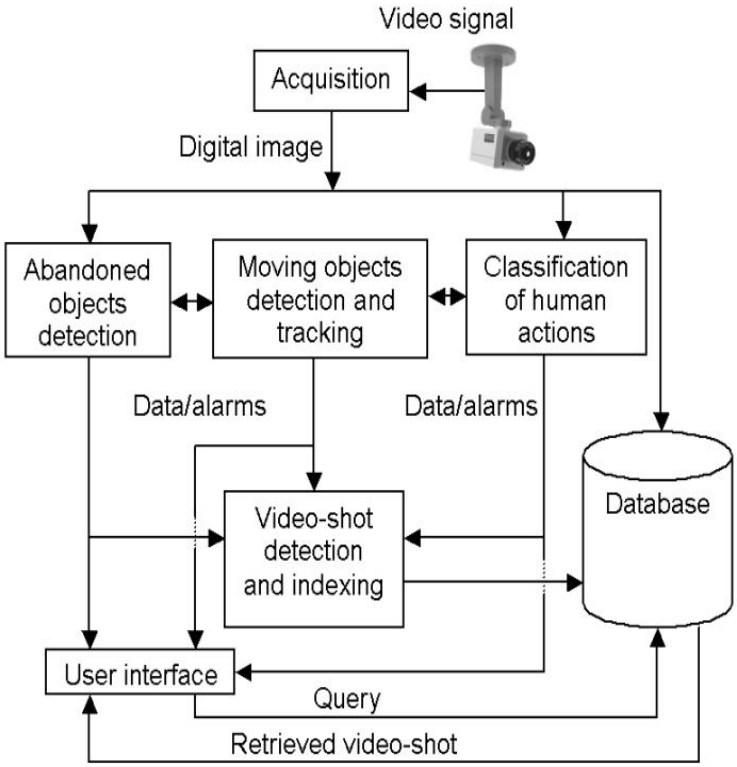


Figure 2 Overall flow of Video Processing

In the Figure 1 It is over all flow of video processing [9]. In this flow video is given as input and it converted into frames and then it process detection, tracking, classification and also indexing to retrieve the output.

A. Video Segmentation

One of the main challenges in computer vision is automatic comprehension of complex dynamic content of videos, such as detection, localization, and segmentation of objects and people, and understanding their interactions. Image and video segmentation is very beneficial in several applications for finding the regions of interest in a panorama or annotating the data. Video Segmentation is actually the process of partitioning a piece of information into meaningful

elementary parts called as segments. Considering still images, (spatial) segmentation means partitioning the image to a number of arbitrarily shaped regions, each of them typically being assumed to constitute a meaningful part of the image, i.e. to correspond to one of the objects depicted in it or to a part of one such object. Considering moving images, i.e. video, the term segmentation is used to describe a range of different processes for partitioning the video to meaningful parts at different granularities. Steps of video segmentation is [7]

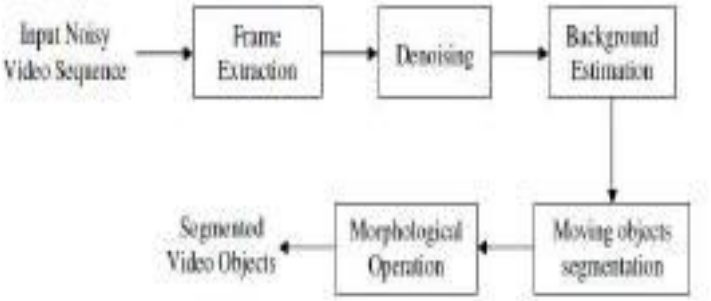


Fig. 1: Block diagram of the proposed video object segmentation approach [8]

B. Video Classification

Since large number of videos available in the real world we need an efficient method to classify the given videos. The main purpose of the video classification is to categories whether the given video is coming under which genre like sports, movie, funny videos, education etc… There are three following common methods are there to categories the video [4]. Apart from these three methods we can also use one more method combined approach (combination of more than one approach) to categories the videos.

- Audio Based approaches
- Text Based approaches
- Video Based approaches

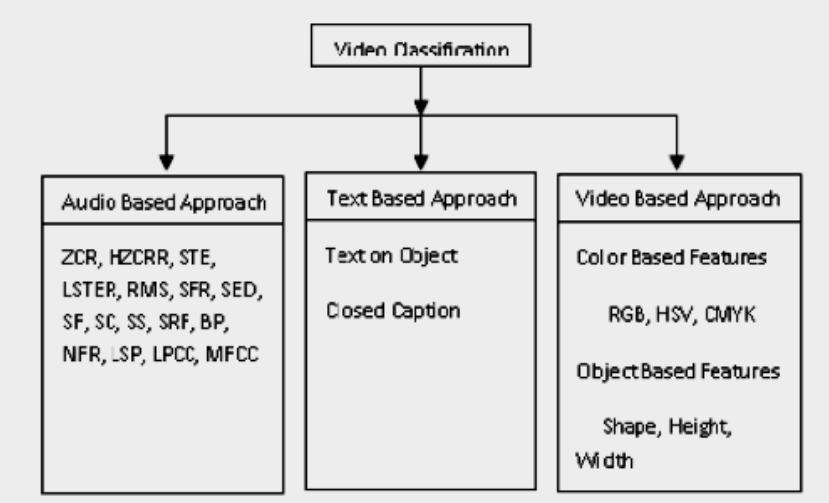


Fig. 3. Approaches of Video Classification

C. Video Indexing

Video indexing and retrieval of video is a thought-provoking problem among researchers because of the vast amount of records available in the internet. Video indexing is a process of tagging videos and organizing them in an effective manner for fast access and retrieval [7].Indexing is a data structure technique to efficiently retrieve records from the database files based on some attributes on which the indexing has been done. Indexing is database system is similar to what we see in books. Index is a way to find and sort records within a database table faster. This makes find data more quickly and efficiently. The user cannot see the indexes they are just used to speedup searches and queries. We know that data is stored in the form of records. Every record has a key field which helps it to be recognized uniquely. [11]

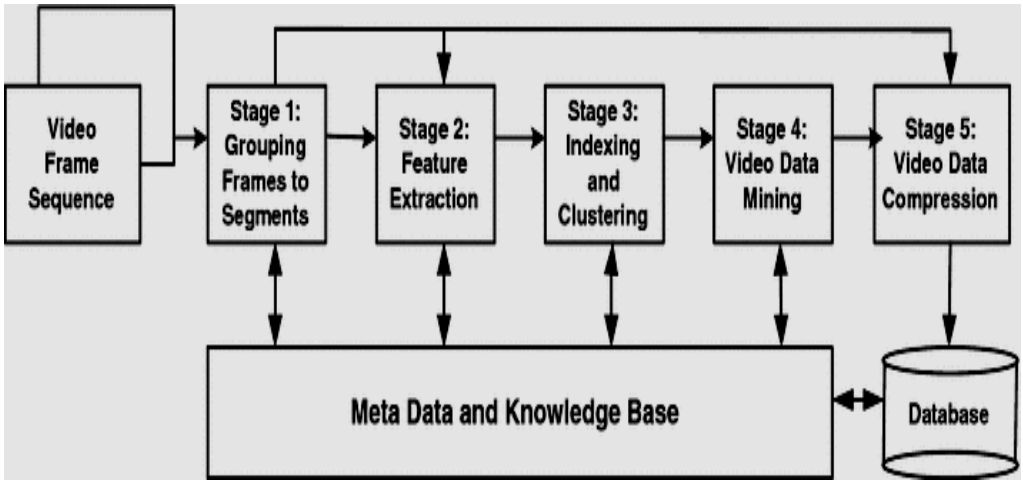


Fig.4. Flow of Video Indexing

D. Video Tracking

In real-time application, most of the research is focused in visual tracking system. Since this is mainly used for the application of robotics, surveillance tracking, human to machine interface, etc. to extract the target status. There are more number of visual tracking system to identify the targeted region from the frame of given video. Since the performance of tracking can affect by sudden illumination changes, shadowing effect and uneven background.[8]

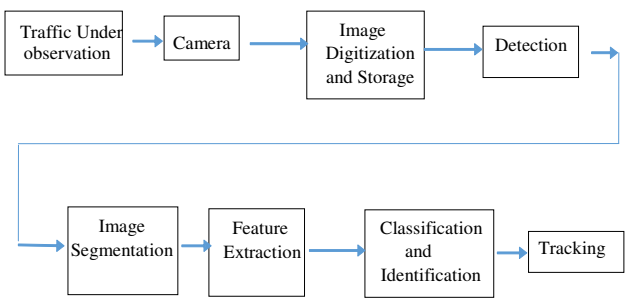


Fig. 5. Flow of Video Tracking

The overall steps involved in the general video tracking system is represented in Fig.5. From the figure it is clear that the video traffic is captured using the camera [6] ,(Hu, Chen, Chen, Huang, & Wu, 2015). The captured video frames from traffic monitoring or other video tracking applications are converted and saved in the digital format. After the captured view of suitable target area, the segmentation process are done . In which target area are segmented from the original video frame. The features are taken out from target area and are obtained using the feature extraction algorithm. By using the extracted features, the classification algorithm classifies the video frames and identifies the object for enabling the tracking operation.

E. Video Compression

Video compression technology encompasses a wide range of research areas such as communications, information theory, image processing, computer vision, psychophysics, etc. Compression techniques come in two general flavors: Lossless and Lossy. As the name states, when lossless data is decompressed, the resulting image is identical to the original. Lossy compression algorithms result in loss of data and the decompressed image is not exactly the same as the original.

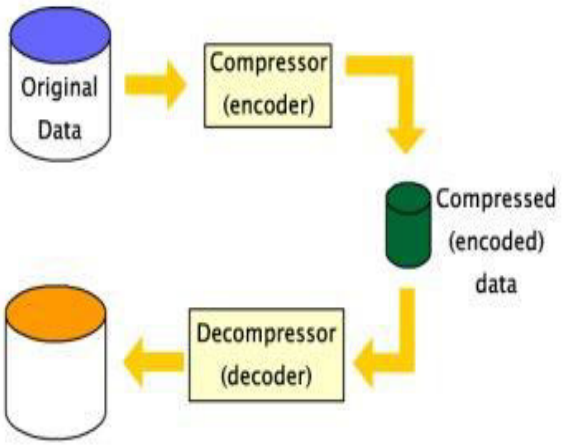


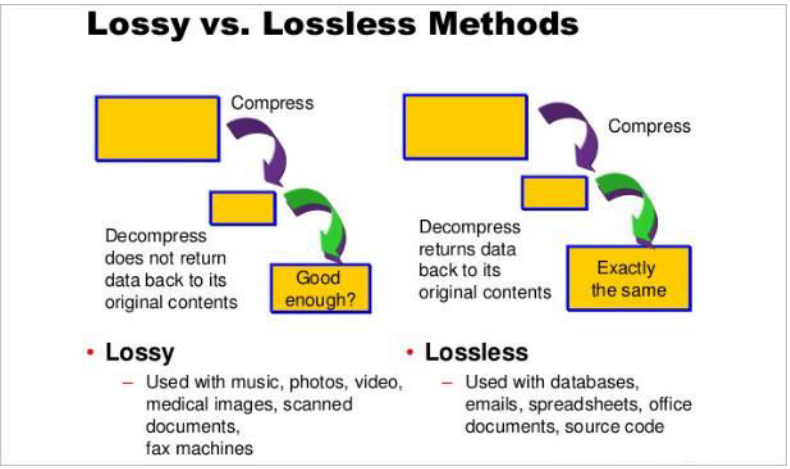
Fig 6. Compression techniques

a) Lossless Compression

In lossless compression10,12] scheme, the reconstructed image, after compression, is numerically identical to the original image. It is used in many applications such as ZIP file format & in UNIX tool gzip. It is important when the original & the decompressed data be identical. Some image file formats like PNG or GIF use only lossless compression. Most lossless compression programs do two things in sequence: the first step generates a statistical model for the input data, and the second step uses this model to map input data to bit sequences in such a way that "probable" (e.g. frequently encountered) data will produce shorter output than "improbable" data.

b) Lossy Compression:

Lossy compression technique provides higher compression ratio than lossless compression. In this method, the compression ratio is high; the decompressed image is not exactly identical to the original image, but close to it. Different types of lossy compression techniques are widely used, characterized by the quality of the reconstructed images and its adequacy for application. A lossy compression scheme, may examine the color data for a range of pixels, and identify subtle variations in pixel color values that are so minute that the human eye/brain is unable to distinguish the difference between them .



F. Video Encryption

Encrypting of video files is not an easy work. Video has a sequential set of images with audio information. Because of the huge size videos the encryption process is difficult. Video has audio part and we have to encrypt that audio part also. Cryptography is used to study of mathematical techniques to secure the information. The cryptography techniques are typically divided into two types

a) Symmetric key Algorithm

A single key which is used for encryption and decryption. That is named as private key. The sender and receiver used the same key for encryption and decryption. Examples of symmetric key algorithm are AES, 3DES, Blowfish.

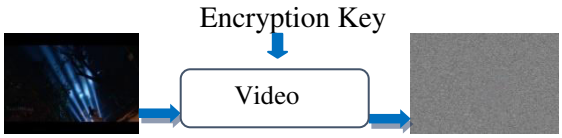
b) Asymmetric key algorithm:

Double key is used for encryption and decryption. One for public key which is used by the sender for encryption, another one is private key which is used by the receiver for decryption. AES was designed for both hardware and software implementation, this means that AES can be easily used, upgraded and is more flexible but on the other hand side its

physical security is limited especially when it comes to key storage. Twenty one algorithms were presented to NIST out of which fifteen algorithms were accepted as AES candidates, of which five candidates were chosen as finalists. The five finalists are MARS, RC6, RIJNDAEL, SERPENT and

TWOFISH. On November 26, 2001 NIST announced that the rijndael encryption algorithm became the AES. The Following are existing ways to encrypt the video. [13]

- Fully Layered Encryption
- Scrambling Based Encrytpion
- Selective Encryption
- Perceptual Encryption
- Chaotic Encryption



Original Video Encrypted video

Fig.7. Video Encryption

G. Video Steganography

Steganography is the technique of hiding the secret data like message, image, audio and video to secure the secret information from unauthorized users. Video steganography hides the data into video, where the container video hides the secret data known as cover object and the result obtained after hiding is known as stego object. The main aim of providing security[1] to video are,

- To improve the data security
- To improve the visual quality of stego object
- To reduce the size of the stego video for fast transmission

Normally, the steganography system contains the cover file, which includes (image, audio, video) and the secret message. It is hidden inside the cover file, where the secret message is unseen. The process of steganography is shown in the following Figure 7.

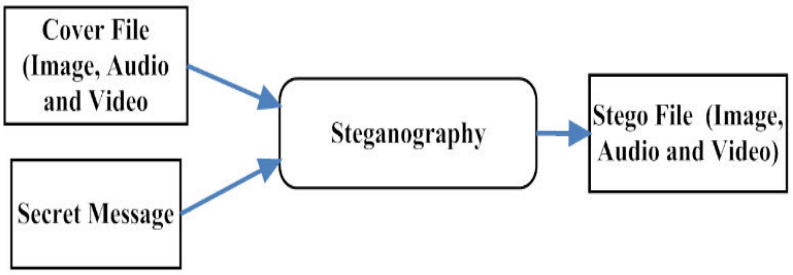


Fig. 8. Process of steganography

Video steganography[2, 3] is defined as the process of separating the video into images, audio or frame for data hiding. The main aim of this technique is to hide any type of file into a video format for providing security. Due to its size and memory requirements, the use of video steganography is more suitable than other multimedia files.

In video steganography[4, 5], the video is encrypted by extracting into audio and frames. After applying encryption, the stego video will be generated and the stages involved in video steganography are shown in Fig 2.The major advantages of video steganography are as follows:

- Highly secure – The generated random data are placed in the unused frames of the video.
- Capacity –The video steganography has no limitations that can be able to hide large amount of information.
- Imperceptibility – Due to the quick display of frames, it has lowest chances of perceptibility.

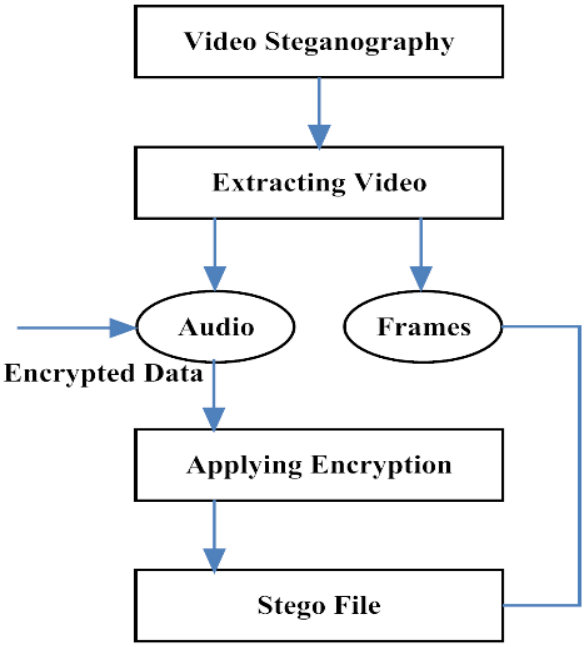


Fig.9. Stages involved in video steganography

V. ISSUES AND CHALLENGES

a) Challenges in compression: Due to tremendous amount of storage and o transmitting voluminous data effectively needed . The performance of Compression is enhanced using motion-compensated prediction, where it predicts each frame block wise from the previous frame. While the prediction errors occurs and effectively compressed than the original frame data. In video conferencing field lacking of bit rate representation and still a big challenge to deal with.

b) Challenges in enhancement: In enhancement, mail goal is to improve their quality. An image contains poor quality due to the contrast is low, noisy, and blurred etc. Algorithms are developed but still an challenging task

c) Challenges in recognition: An effective recognition of object is not yet proposed or developed to detect the object or person having and behaves according if found suspicious. The area has vast scope to deal with.

d) Challenges in security: Secure signal processing is an emerging technology to handle video processing. It deals with lots of research attention due to the t demand enabling prosperous functionalities for individuals data reserved online. But treating multimedia as ordinary data

and applying cryptographic ciphers such as RSA and AES, information leak is minimized so such an approach is inefficient for practical video processing applications.

CONCLUSION

Digital Video Processing is to improve the quality of the pictorial information and to facilitate automatic machine interpretation. Video Processing is a complex task because of illusion ,loss of information, extensive knowledge requirement for interpretation ,presence of noise and artifacts, amount of data involved in processing and other considerations such as lighting .In this paper showed the video processing have a great capacity in the multimedia applications.

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