Video Phylogeny based on Fingerprint Features for Near-Duplicate Video Clips Detection and Parent tree generation

Thesis submitted in partial fulfillment of the requirements for the award of degree of

Master of Engineering

in

Information Security

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June 2016

CERTIFICATE

I hereby certify that the work which is being presented in the thesis entitled, "*Video Phylogeny Based on Fingerprint Features for Near-Duplicate Video Clips Detection and Parent tree generation*" in partial fulfilment of the requirements for the award of degree of Master of Engineering in *Information Security* submitted in Computer Science and Engineering Department of Thapar University, Patiala, is an authentic record of my own work carried out under the supervision of Dr. Jhilik Bhattacharya and refers other researcher's work which are duly listed in the reference section. The matter presented in the thesis has not been submitted for award of any other degree of this or any other University.

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This is to certify that the above statement made by the candidate is correct and true to the bes of my knowledge.

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Acknowledgement

The successful completion of any task would be incomplete without accomplishing the people who made it possible and whose constant guidance and encouragement made it a success. With profound sense of gratitude and heartiest regard, I express my sincere feelings of indebtedness to my Guide **Dr. Jhilik Bhattacharya**,Assistant Professor,CSED at Thapar University for his positive and excellent guidance, constant encouragement, keen interest, invaluable co-operation, generous attitude and above all his blessings have been persistent source of inspiration for me.I am grateful to **Dr. Deepak Garg**, Head of Department,CSED, Thapar University for the motivation and inspiration that triggered me for this thesis.

Last but not the least I would like to express my heartfelt thanks to my parents and my friends who with their thought provoking views, veracity and whole hearted co-operation helped me in doing this thesis.

ABSTRACT

Video Phylogeny is the task of reconstructing the ancestral tree among the pair of near duplicate videos. Due to the huge availability of various tools and software's, significant amount of available video content was reused by many social web sites such as face-book and you-tube. Various transformations are applied on these video content e.g. rotation, scaling, contrast and background modification. In this work we have introduced fast and robust fingerprint extraction and matching algorithms based upon Tree-lets,Wavelet Energy and Gabor over Wavelet for several types of video content alterations and then reconstructed a video phylogeny tree based upon threshold values of the resulting hash generated. The phylogeny tree further classifies these videos into various types based upon transformations applied say affine transformed, scaling, background and sub-scene changes. The key idea behind this method is to extract signatures or features (color, edges, temporal etc.) from video to determine whether it is an authorized copy or unauthorized copy of the parent video.The proposed technique is based on spatial and temporal features of video frames and is validated with real world data sets downloaded from you-tube.Moreover,the resulting fingerprint requires reduced number of bits and do not require huge storage space due to its small size.Our method has demonstrated robustness against common types of video transformation techniques.

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Chapter 1

INTRODUCTION

Video phylogeny tree describes the structure of evolution of hierarchical relationship among set of near duplicate videos[1].Video phylogeny tree can be designed on the basis of video fingerprint features extracted from reference set of videos.This section further describes various video fingerprinting methods and types of video signatures to analyze different frames and correlate near duplicate video clips using parent tree generation.

1.1 Video Fingerprinting

Video fingerprinting is a technique of uniquely identify and extract various components and characteristics of video which are termed as Fingerprints .These fingerprints are found to be effective for comparing and analyzing video clips.Video fingerprint generation involves decoding video data using a particular software and further implementing several feature extraction and matching algorithms.These fingerprints are highly compressed in contrast to the source video file and are stored in database for further matching.Various Video fingerprint methods have been widely used for the extraction of feature vectors from digital video content.Due to the huge availability of various tools and software's, significant amount of available online content was reused for modification say downloading an image from web and performing various processing operations such as cropping, resize, rotation and object insertion and all these operations results in duplicity. These duplicate versions are not the perfect copies but are called near duplicates versions of parent video. Most of the web sites such as you tube is facing these issues due to copyright enforcement and illegal distribution of pirated videos.Therefore various Content based video detection(CBVD) methods and algorithms have been designed to address this issue.The key idea behind this method is to extract signatures or features (color, edges, temporal etc.) from video to determine whether it is an authorized copy or unauthorized copy of the parent video.

The objective of Video fingerprinting is to identify and evaluate the query video stored

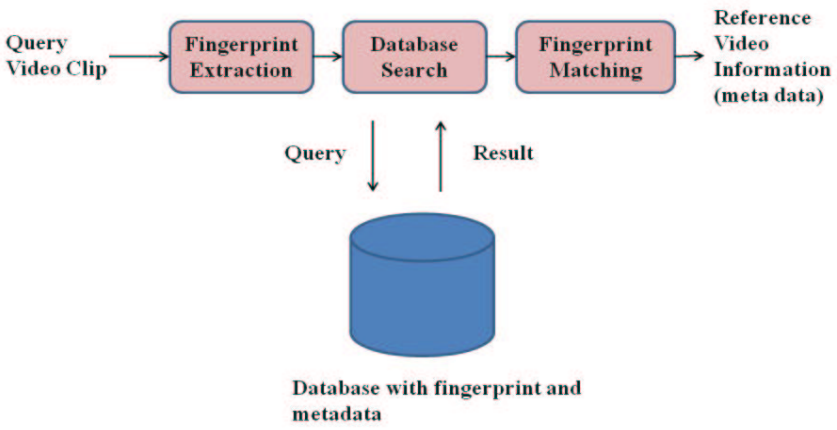


Figure 1.1: Structure of proposed Fingerprint Generation Method

in database by calculating the distance between the query fingerprint and reference fingerprint using feature extraction and matching algorithms as shown in figure 1.1.Video fingerprint database generally stores two types of information i.e. metadata and database rules.Metadata contains information such as title,owner and release date of query video whereas database search rules such as allow,deny and filter are applied on query video based upon certain conditions In general an effective fingerprint algorithm should satisfy the following properties

- **Robustness**-Fingerprints extracted from query video should match with the resulting fingerprints of degraded parent video.
- **Pairwise Independence** - Set of videos which are perceptually different and posses different characteristics features must have different fingerprints.
- **Database search Efficiency**- Fingerprints stored in database must be returned efficiently and fast.

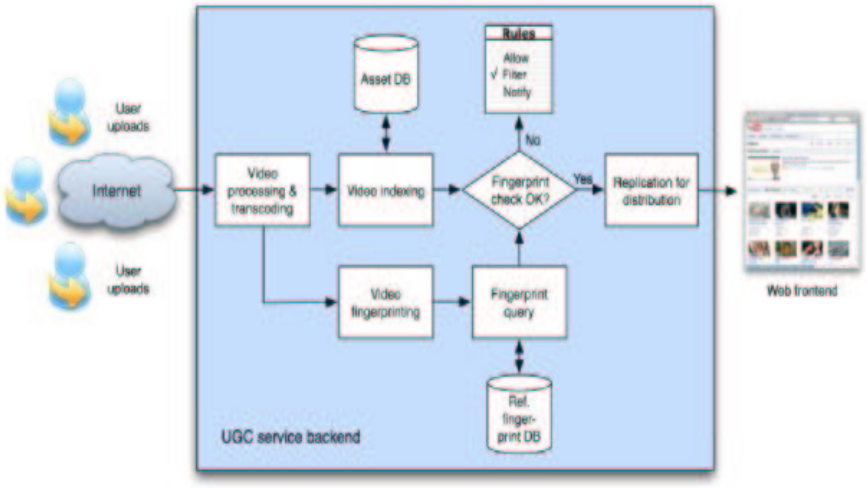


Figure 1.2: Video Content Filtering

1.1.1 Video Content Filtering

Video Content filtering is one of the important application of CBVD(Content based Video Identification).When user browse through the video content online on various social sites such as you tube then web protection will categorize that video according to the additional information about that video.Videos will be classified according to the content such as sports,movies,funny and adult or mature. You can apply settings to block any type of adult or mature videos which are not then allowed by the you tube as shown in figure1.2[2].

1.1.2 Video Content Tracking

Video Content tracking is the process of analyzing video content to determine temporal and spatial features of query video as shown in figure 1.3[2].Vaious application domains use this technique for feature extraction such as health care services,smart homes and safety and security.VCA(Video Content analysis) uses various algorithms such as video tracking using motion estimation by tracking motion features of a video with respect to a stable background.Image de-noising using wavelet curvelet and ridgelet are the further applications and enhancements in the field of Video Content Tracking.

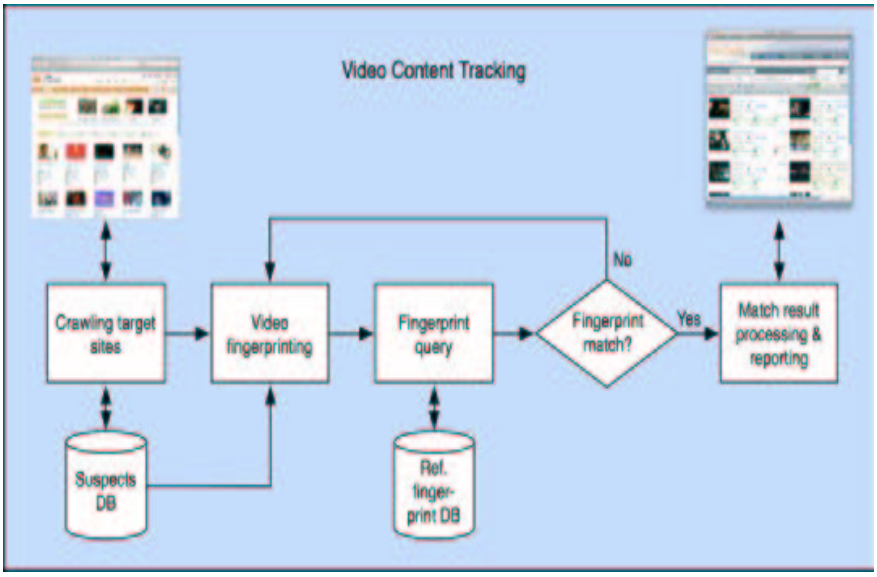


Figure 1.3: Video content Tracking

1.2 Types Of Video Signatures

Feature Extraction and matching is the core of video fingerprinting.Various Video fingerprint methods have been widely used for the extraction of feature vectors from digital video content.Depending upon the transformation applied say rotation scaling and background changes specific fingerprint method could be chosen based upon type of input video features.Following are the list of video features or signatures which are widely used. Various types of signatures such as spatial,color,temporal and transform discussed below are analyzed to form a resultant fingerprint as shown in figure 1.4.

1.Color based Signatures-Color based signatures depends on two factors whether the images are three Dimensional(3D) or gray level i.e. Two dimensional.Based upon these two methods various properties such as histogram,mean and variance,hue and saturation are applied on subsequent frames for feature extraction.

2.Spatial based Signatures-Spatial signatures specifies co-relationship among different pixel values of particular frame.It uses various methods such as Centroid of Gradient Orientations and ordinal signatures to calculate the center pixel values and store the information about the location of pixels.

3.Temporal based Signatures-Temporal based signatures deals with the correlation

TYPES OF VIDEO SIGNATURES			
Spatial signatures	**Temporal Signatures**	**Color Signatures**	**Transform Signatures**
Whole frame	Group of frames	Gray scale frames or Three dimensional frames	3D transforms
Blocks or subdivision of blocks	Key frames	Bins of histograms	GOP
Point of interest	Motion based	Mean and variance	

Figure 1.4: Types of video signatures

among different frames.It uses Motion based video fingerprinting methods and edge detection algorithm to extract information around the temporal regions in the key shots.

Spatial signatures are widely used in practice due to its robustness against various forms of attacks such as affine transformation and distortion.Temporal and color based signatures can be used as a secondary signatures whereas spatial signatures are used as primary signatures to enhance the discrimination against various types of video content. Transform domain signatures are not widely practised due to its high computational cost.

1.3 Application Areas

Video fingerprinting have been widely used for dealing with issue of piracy,copyright infringement,visual redundancy and illegal distribution of online video content.Broadcast monitoring is one of the major application era of video fingerprinting by keeping track of video distribution and hence providing solutions to the content providers and distributors.Promising

applications are video database scanning,web monitoring,file sharing and distribution services.

1.Web Monitoring-Tracking of illicit tv programs,film media and various live sports activities and events are the major web monitoring services and applications of fingerprint features and matching.

2.Broadcast Monitoring-Broadcast monitoring is one of the major application era of video fingerprinting by keeping track of video distribution and hence providing solutions to the content providers and distributors.Depending upon the type of query video content,broadcasting could be based on watermarking or fingerprinting.Video fingerprint technology could be used for the tracking of real time TV commercials and program being aired.

3.Copyright infringement and Digital Rights Management-Online Registered content and confidential video data should be easily scanned and verified by publisher with the help of fingerprint technology and could further report and take an action against illegal distribution and piracy under copyright law and enforcement.

4.Online content distribution and tracking-Illegal video content such as Child pornography,Terrorist videos and abusive content should be easily tracked by the authorities using fingerprint technology.Due to the huge availability of various tools and software's, significant amount of available video content was reused by many social web sites such as face-book and you-tube. Various transformations are applied on these video content e.g. rotation, scaling, contrast and background modification.These modifications could be easily tracked using fingerprint matching algorithms.

Chapter 2

LITERATURE REVIEW

Now a days, a wide variety of multimedia content such as images and videos can be easily distributed, modified and shared using various kinds of software and platforms resulting in near duplicate media objects called Multimedia phylogeny[3].Various Application areas in the field of near duplicate media are security,forensics,copyright infringement and content based retrieval.As certain online content was reused for modification say downloading an image from web and performing various processing operations such as cropping, resize, rotation and object insertion and all these operations results in duplicity. These duplicate versions are not the perfect copies but are called near duplicates versions of parent video.A duplicate is a pairwise equivalence relationship between the source video to its variations through series of transformation applied say cropping, compression and color correction [4]. Most of the web sites such as you tube is facing these issues due to copyright enforcement and illegal distribution of pirated videos.

In the last few years, Image phylogeny has received a lot of attention from researchers.Image Phylogeny Tree describes the evolution of near duplicate images with respect to the structure of transformations applied to them. Various phylogeny techniques such as dissimilarity metrics fusion, minimum spanning tree and Oriented Kruskal's algorithm have been proposed for the computation of Image phylogeny tree (IPT) [5] [6]. In 2010 Dias *et al.*[7] formally proposes an initial approach to deal with reconstruction of Image Phylogeny Tree (IPT) with the watermarking and fingerprinting techniques and further provides a solution to calculate dissimilarity matrix between pair of images using modified oriented kruskal minimum spanning tree algorithm.Performance of the algorithm is validated using four evaluation metrics on the basis of ground truth trees.However more recent work done on image phylogeny is based upon forest reconstruction [8], which proposed a novel approach based upon optimal branching to deal with phylogeny forests.The Algorithm uses the AOB(Automatic optimum branching) and E-AOB(Extended Automatic Branching) techniques for the parent tree generation. Similarly a graph based approach based upon manifold learning and data clustering

have been proposed for image phylogeny forest reconstruction based upon shortest path between the neighboring nodes [9].Forgery detection in near duplicate images due to the presence of illumination inconsistencies are solved using Hog edge algorithm [10].Skin detection method is used as a illumination estimator to detect forged image,so that it would be helpful to detect any pornography composition.

Feature extraction is a prerequisite for detection and recognition of near duplicate image frames. Work reported in literature mainly focuses on SURF (speeded-up robust features) and RANSAC (Random Sampling Consensus) algorithm [11].SIFT features have also been used for video duplicity detection based upon different sources and views of various video capturing tools[12]. Image and video fingerprinting techniques were also explored and used extensively for duplicity detection.In general,fingerprinting method should ensure certain properties i.e. robustness, pair-wise independent, speed and database search efficiency [13],[14],[15].Video fingerprinting is a technique of uniquely identify and extract various components and characteristics of video which are termed as Fingerprints .These fingerprints are found to be effective for comparing and analyzing video clips.Video fingerprint generation involves decoding video data using a particular software and further implementing several feature extraction and matching algorithms.These fingerprints are highly compressed in contrast to the source video file and are stored in database for further matching.The objective of Video fingerprinting is to identify and evaluate the query video stored in database by calculating the distance between the query fingerprint and reference fingerprint using feature extraction and matching algorithms.More recently, similar work is introduced which is based upon Motion based video fingerprinting features such as motion magnitude and motion activity for detecting near duplicate video clips copies [16]. In 2014 a hybrid fingerprinting technique is introduced that allows fast key generation and retrieval[17], which provides good accuracy and robustness for various types of video content alterations. For extending this work for video phylogeny, S. Lameri *et al.* [18] have proposed a method for the reconstruction of one or more parent sequences from a given set of partially overlapped near duplicate video shots used.The algorithm reconstructs the content of the source video by splicing together sets of near-duplicate video shots which are extracted from the same parent sequence.Video phylogeny tree can be designed on the basis of video fingerprint features extracted from reference set of videos.Various Video fingerprint methods have been widely used for the extraction of feature vectors from digital video content.Depending upon the transformation applied say rotation scaling and background changes specific fingerprint method could be chosen based upon type of input video features.Techniques that are most commonly used in the field of Content Based Video Identification(CBVD) includes color histogram, temporal,spatial and ordinal signatures.[19],[20].

Title of paper	Year	Proposed Work
First step towards image phylogeny	IEEE 2010	The authors formally proposes an intial approach to deal with the construction of IPT(Image Phylogeny Tree) with watermarking and fingerprinting techniques
Image phylogeny through dissimilarity metrics fusion	IEEE 2014	The authors proposed the oriented kruskal algorithm for the reconstruction of phylogeny tree and for the computation of distance matrix
Image Phylogeny Forests Reconstruction	IEEE 2014	The authors proposed a novel approach based upon optimal branching to deal with phylogeny forests.The Algorithm uses the AOB(Automatic optimum branching)and E-AOB(Extended Automatic Branching)techniques for the parent tree generation.
Manifold learning and spectral clustering for image phylogeny forests	IEEE 2016	The authors proposed a graph based approach based upon manifold learning and data clustering have been proposed for image phylogeny forest reconstruction based upon shortest path between the neighboring nodes.
Near-duplicate detection and alignment for multi-view videos	IEEE 2015	SIFT based features have been used for video duplicity detection based upon different sources and views of various video capturing tools

Exposing Digital Image Forgeries from Near Duplicate Images	IEEE 2014	The authors introduced a Hog edge algorithm Forgery detection in near duplicate images due to the presence of illumination inconsistencies.
Near-duplicate video clips detection with motion based video fingerprinting.	IEEE 2011	The author introduced a video fingerprinting based scheme to detect near duplicates video clips and fingerprint consist of two motion features, including motion magnitude and motion activity.
Content-based video fingerprinting for fast key generation and retrieval	IEEE 2014	The authors introduced a hybrid fingerprinting technique is introduced that allows fast key generation and retrieval, which provides good accuracy and robustness for various types of video content alterations
Who is my parent? reconstructing video sequences from partially matching shots	IEEE 2014	The authors proposed a method for the reconstruction of one or more parent sequences from a given set of partially overlapped near duplicate video shots used.The algorithm reconstructs the content of the source video by splicing together sets of near-duplicate video shots which are extracted from the same parent sequence.

Table 2.1: Literature Review

Chapter 3

PROBLEM STATEMENT AND OBJECTIVES

3.1 Problem Statement

The goal of the overall work is to introduce an fast and robust fingerprint extraction and matching algorithm among the duplicate copies of the video content and identify the source video with the help of resultant fingerprint. Since wide variety of multimedia content such as images and videos can be easily distributed, modified and shared using various kinds of software and platforms resulting in near duplicate media objects.These duplicate versions are not the perfect copies but are called near duplicates versions of parent video. Most of the web sites such as you tube is facing these issues due to copyright enforcement and illegal distribution of pirated videos.Thus identification of parent video is necessary among near duplicate video copies due to copyright issues and illegal distribution.

3.2 Objectives

- The main objective is to introduce fast and robust fingerprint extraction and matching algorithms for several types of video content alterations and then reconstruct a video phylogeny tree based upon threshold values of the resulting hash generated.
- The phylogeny tree further classifies these videos into various types of transformations applied (rotation, scaling and background change) according to threshold value of proposed fingerprint technique.
- The key idea behind this method is to extract signatures or features (color, edges, temporal etc.) from video to determine whether it is an authorized copy or unauthorized

copy of the parent video.

Chapter 4

METHODOLOGY

This chapter provides the detail explanation about the fingerprint generation algorithm and various techniques for feature extraction.For each Fingerprint average matching percentage is calculated between the query video and the reference video ,if the value is less then predetermined threshold then the comparison returns no match.Algorithm was coded in Matlab R2014a.

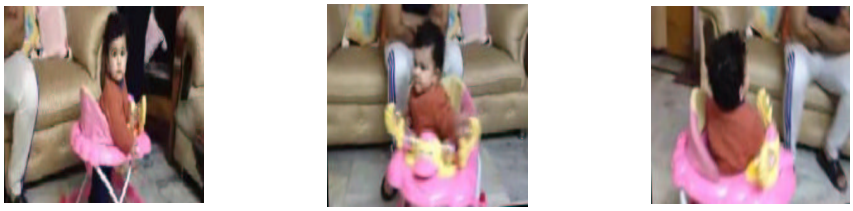
4.1 Video Fingerprint Generation Method

In this work we have used various video fingerprinting methods for determining near duplicate video clips copies and further these copies are used to create a Video Phylogeny tree. The phylogeny tree further classifies these videos into various types of transformations applied say rotation, scaling and background change according to threshold value of proposed fingerprint technique. The key idea behind this method is to extract signatures or features (color, edges, temporal etc.) from video to determine whether it is an authorized copy or unauthorized copy of the parent video. This work have several advantages because tree-let approach is used which increases flexibility and accuracy in the level of details obtained.The proposed Fingerprint generation method is fast and robust to the various types of video transformations. This technique is divided into following steps.

- Pre-processing the input video and Scene Change Detection
- Three step Feature extraction using Tree-lets, Wavelet Energy and Wavelet-Gabor for video fingerprint generation.

A.Pre-processing and Scene Change Detection Initially the input video is Pre-processed into a fixed resolution of 480*320 and to a fixed frame rate re-sampling of 30 Fps (frames per second). Scene may be defined as a subset of video on which the fingerprint

Figure 4.1: Scene Extraction from input video sequence using Edge detection



(a) Shot 1 (b) Shot 2 (c) Shot 3

Figure 4.2: Input Video Clip Divided into Sub-Scenes

feature extraction method is applied. Scene change detection is implemented using edge detection algorithm to extract individual shots from input video. First, the mean of every block of edge image is calculated and then the absolute difference between the means of two consecutive frames is compared against a threshold to determine a shot change. Figure 4.1 show a video sequence divided into scene cuts using edge detection algorithm.

Figure 4.2 below shows the input video clip divided into sub scenes

B. Feature Extraction Feature extraction is applied over each sub scenes obtained for a video for extracting features.This work uses a combination of three features Tree-lets,Wavelet energy and wavelet-gabor as further explained in the subsequent paragraphs.

- Treelets
- Wavelet energy
- Wavelet-Gabor

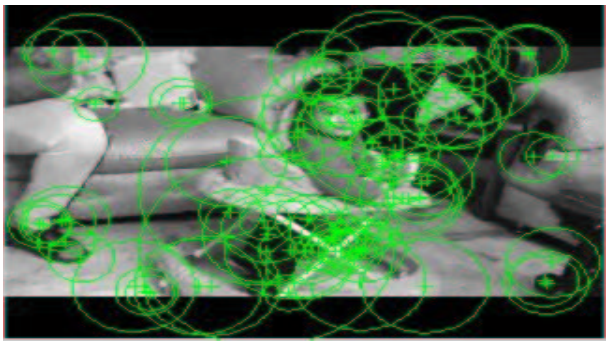


Figure 4.3: 80 SURF strongest points

4.1.1 Treelets

Treelets [21] is a analysis tool for high scale dimensionality reduction and large scale unstructured data.Equation 4.1 represents the Treelet basic equation

$$x = \sum \frac{u_k}{w_k} \tag{4.1}$$

where m is the number of variables in the new sub space,wk is the selecting loading vector and uk is its corresponding coefficient. Treelet energy can be computed as follows as represented in Equation 4.2.

$$\varepsilon_{(w_k)} = \frac{\varepsilon|(w_k)(T_x)|^2}{\varepsilon||x||^2} \tag{4.2}$$

Before implementing treelets transformation, we have extracted 80 SURF strongest features from each of the subscenes as shown in Figure 4.3.

In this work,we have used image patch retrieval problem [22] around a keypoint for the computation of treelets energy.This technique is based upon higher order treelets which describes the relationship among rows and columns of a image patch.For each keypoint, we have calculated 10 different patches [x1.....x10] of size 5* 5 around a keypoint and reshaped them into one dimensional array[1 25] and the resulting fingerprint generated is of size 2000.

Fingerprint size = No of surf strongest points * size of each image patch = 80*25 = 2000

Figure 4.4 shows the treelets energy plot around keypoints.

Treelets energy decomposition levels are further classified into alternate decomposition level and full decomposition level on the basis of energy plot as shown in figure 4.5 and figure4.6.

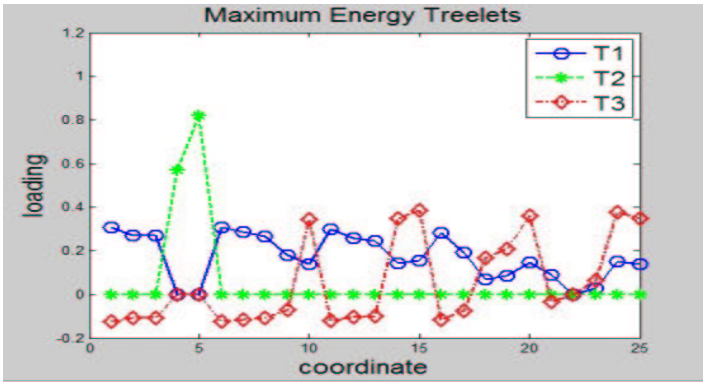


Figure 4.4: Maximum Energy Treelets Plot

4.1.2 Wavelet Energy

Discrete wavelets coefficients can be extracted from a video sequence to use them as a fingerprint features [23].Figure 4.7 shows 2d Wavelet transformation is applied on all the sub-scenes of input video and are further divided into four wavelet subbands LL, LH, HL and HH as shown in Figure 4.8.

Energy associated with each of horizontal, vertical and diagonal subbands are computed as Eh, Ev, Ed and Ea is the percentage of energy corresponding to approximation. The wavelet coefficients can be obtained as:

$$Wavelet(T) = f_{approx}(T) = Region(\rho)g(2T - \rho) \tag{4.3}$$

$$Wavelet(T) = f_{detail}(T) = Region(\rho)h(2T - \rho) \tag{4.4}$$

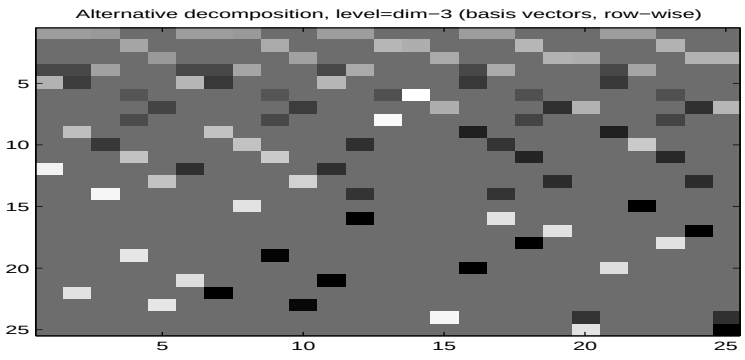


Figure 4.5: Alternate decomposition level

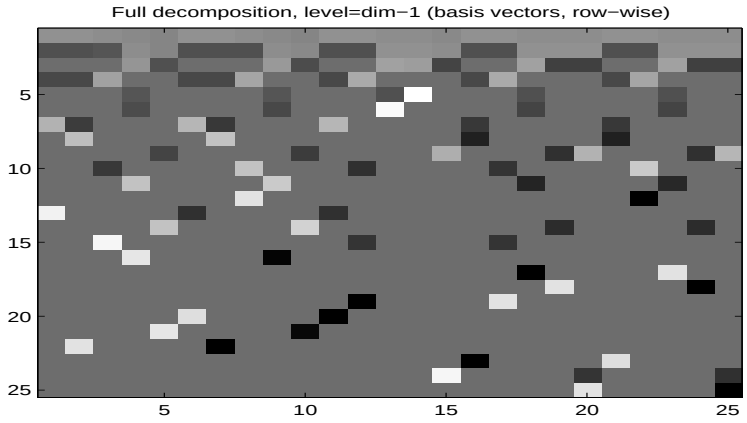


Figure 4.6: Full Decomposition Level

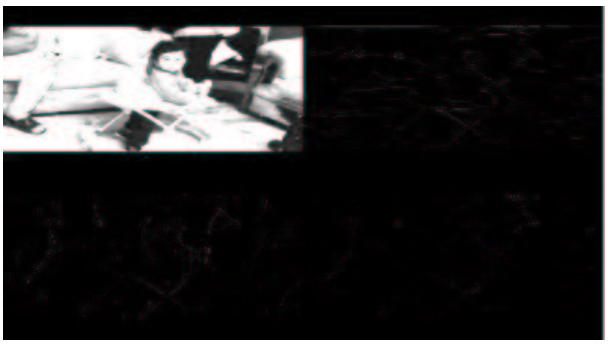


Figure 4.7: 2d Wavelet of input image

$$f(T) = [f_{approx}(T) f_{detail} f(T)] \tag{4.5}$$

$$wherep \rightarrow polar(x, y), g \rightarrow highpassfilter, g \rightarrow lowpassfilter$$

For each subband,the energy is calculated as Ei=wk2 where wk represents the wavelet coefficients in the ith subband. Energy difference between the corresponding near duplicate video shots is calculated against a threshold value for the reconstruction of phylogeny tree. We have considered Eh, Ev and Ed energies for its accuracy and size of each fingerprint is 6.

4.1.3 Wavelet-Gabor

Gabor filters are also known as bandpass filters which are used for feature extraction and capture useful information in specific bandpass channels.The Gabor wavelet function is given

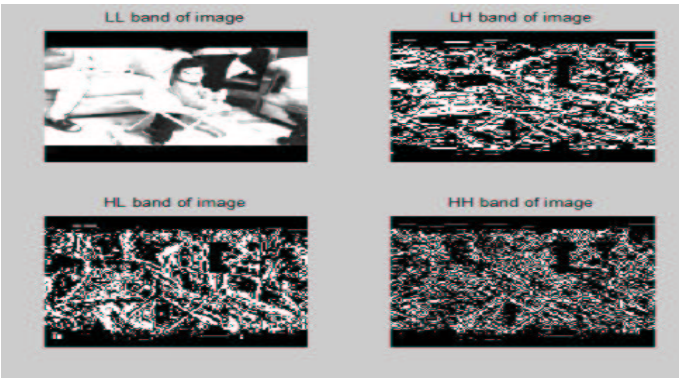


Figure 4.8: LL,LH,HL and HH band of input image

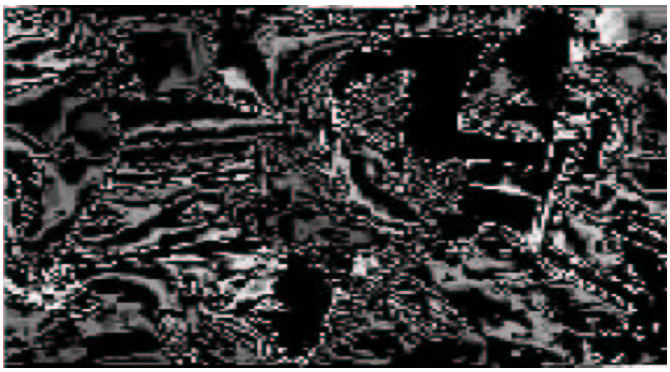


Figure 4.9: Gabor over LL band of wavelet image

as, using the Gabor kernel v, is constructed using five scales v=0,1,2,3,4 and eight orientation =0,1,.7,hence resulting in a very high dimensional representation as represented in Equation 4.6.]

$$\Psi_{\mu,\nu(z)} = \frac{||k_{\mu,\nu}||^{e^{\frac{--||||_{\mu,\nu}||||^2 z^2 [e^{ik\mu\mu,\nu} z - e\frac{\delta^2}{2}]}{2\delta^2}}}}{g^2} \tag{4.6}$$

$$where k_{\mu,\nu} = k_{\nu e^{i\Phi}}, \delta = 2\Pi, k_\nu = \frac{k_{max}}{f_v}, f = \sqrt{2}, k_{max} = \frac{\Pi}{2}, \Phi_y = \frac{\Pi\mu}{8},$$

$$z = (r, c) and || || denote the normoperation.$$

Further,this technique is extended by applying gabor over LL band of the wavelet image as shown in Figure 4.9. Gabor filter of size 129 * 129 is applied on each of the subscene and the size of fingerprint is 16,641.For each Fingerprint average matching percentage is

calculated between the query video and the reference video ,if the value is less then predetermined threshold then the comparison returns no match.The proposed Fingerprint generation method is fast and robust to the various types of video transformations and common video attacks.

Chapter 5

EXPERIMENTAL RESULTS

This chapter provides you brief explanation about the experimental results.The proposed fingerprint generation is validated and tested on different video data sets and based upon the results a phylogeny tree has been designed using near duplicate edge detection method.Graphical user interface is designed for the same to make this application more user friendly.Reliable and accurate results are obtained using the proposed fingerprint generation method.

Testing phase : During the initial testing 50 sample videos have been tested using different feature extraction methods such as counterlet, curvelet,ridgelet and wavelet.But the scheme is not able to detect the near duplicate copies with accurate results as shown in Table 5.1.Results are not accurate for the various types of transformations and variations applied to the video copies.Thus the treelet,wavelet and gabor feature extraction methods are used due to its high detection accuracy.

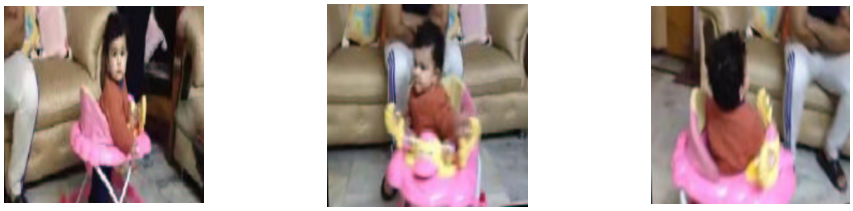
5.1 Video Phylogeny Tree Generation

Video phylogeny tree describes the structure of evolution of hierarchical relationship among set of near duplicate videos.For the reconstruction of phylogeny tree based on proposed technique we are considering various types of variations such as rotation, scaling, background and sub scene changes of video shots.And the tree-lets,wavelet and gabor features are applied on these video scenes. Further Figure 5.1 and Figure 5.2 represents the affine transformed and scenes of different background respectively.

The proposed fingerprint technique is validated using 150 videos and results are shown in Table 5.2 and our scheme is able to detect Near duplicate video clips Copies with high accuracy for various types of variations and alterations.Since Treelet approach is used which results in high flexibility and robustness. Algorithm was coded in Matlab R2014a . For higher variations say background change or 10 degree rotation the values are higher as compared to the affine transformed and Sub-scene changes.Reliable and accurate results are obtained

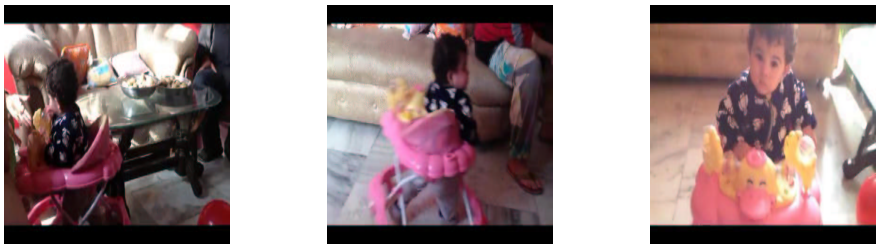
Fingerprint technique	Sub-Scene Change	3 degree rotation	10 degree rotation	Background change
Counterlet	1.600e-3.651e	1.300e-1.600e	3.200e-5.300e	6.540e-8.230e
Curvelet	1.830-2.200e	1.400e-1.700e	2.400e-3.500e	4.200e-6.400e
Ridgelet	3.000e -4.200e	2.500e-8.900e	1.130e-6.620e	2.200e-8.500e

Table 5.1: Initial Testing Results



(a) Shot 1 (b) Shot 2 (c) Shot 3

Figure 5.1: Scenes 3 degree affine transformed



(a) Shot 1 (b) Shot 2 (c) Shot 3

Figure 5.2: Scenes from a different background

Fingerprint technique	Sub-Scene Change	3 degree rotation	10 degree rotation	Background change
Treelet	1-2	2-3	3.4-4	4-4.5
Wavelet Energy	0-0.5	0.5-0.7	2.5-3	3-4
Wavelet-Gabor	0-0.7	0.7-2.5	2.5-3	4-5

Table 5.2: Range Of threshold Values of Proposed Fingerprint

using the proposed fingerprint generation method.

Further for each Fingerprint average matching percentage is calculated between the query video and the reference video ,if the value is less then predetermined threshold then the comparison returns no match.For phylogeny tree reconstruction seven input videos (V1,V2.....V7) are selected where V1 is the Parent video,V2 and V5 are Subscene changes,V4 and V7 are affine transformed and V3 is the Background change video.Further these videos are classified according to the type of transformation applied based upon the threshold values(Table 5.2)of fingerprint features as shown in Figure 5.3.

Further, individual sub-scenes of the respective videos are compared against the given threshold for duplicate detection and matching. Figure 5.4 shows the input videos V1,V2 and V7 and the corresponding sub- scenes. for every video pair Vi,Vj, each of the subscene Sik and Sjk are compared.A edge of weight 5(firm edge) is assigned for each match, whereas an edge of weight 1(dotted line) is assigned if the subscenes have a transformed match. If Average matching percentage between the query video and the reference video is less than the predetermined threshold ,then the query video does not have any relation with parent video.

5.2 Graphical User Interface

Graphical user interface have been designed in Matlab for this application to make it more user friendly and interactive for the end users.Users can easily upload a video from a file or a folder and apply scene change edge detection algorithm for extracting the key shots as shown in figure 5.5.

Further fingerprint generation could be done by selecting one of the checkbox from

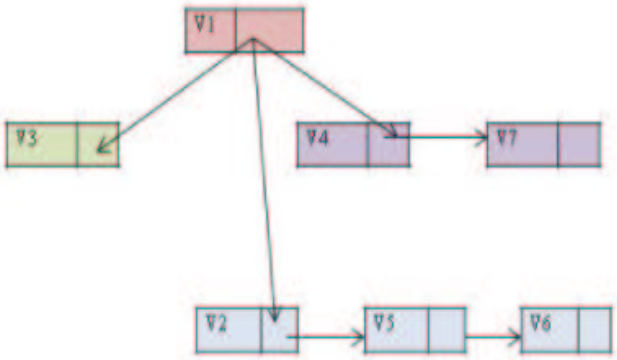


Figure 5.3: Phylogeny Tree reconstruction based upon Fingerprint features

treelet,Wavelet and Wavelet-Gabor from one of the following options as shown in figure 5.6.

- Treelets
- Wavelet energy
- Wavelet-Gabor

For each Fingerprint average matching percentage is calculated between the query video and the reference video ,if the value is less then predetermined threshold then the comparison returns no match.

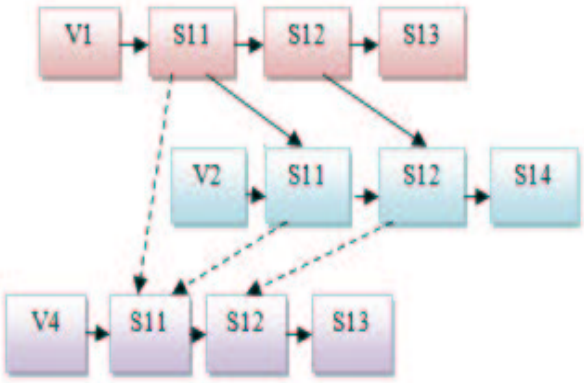


Figure 5.4: Near duplicate Edge Detection

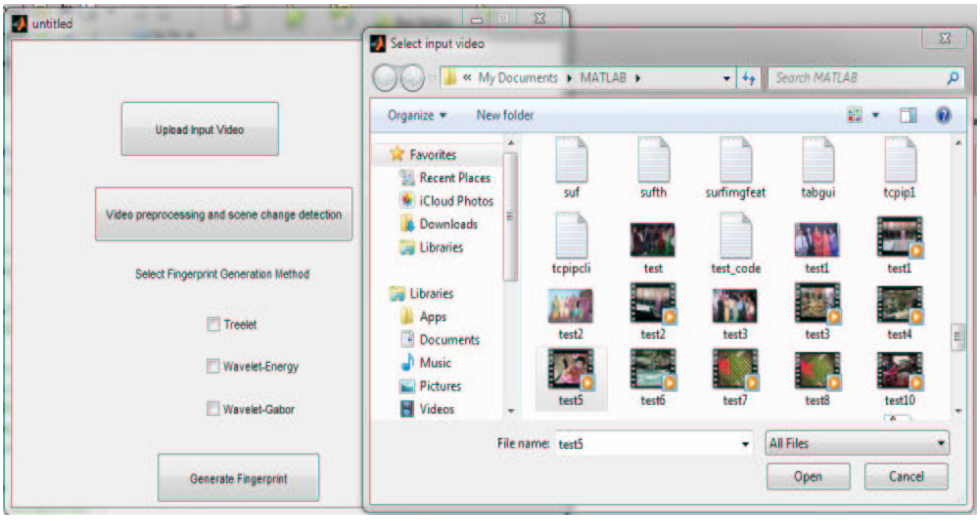


Figure 5.5: upload input video

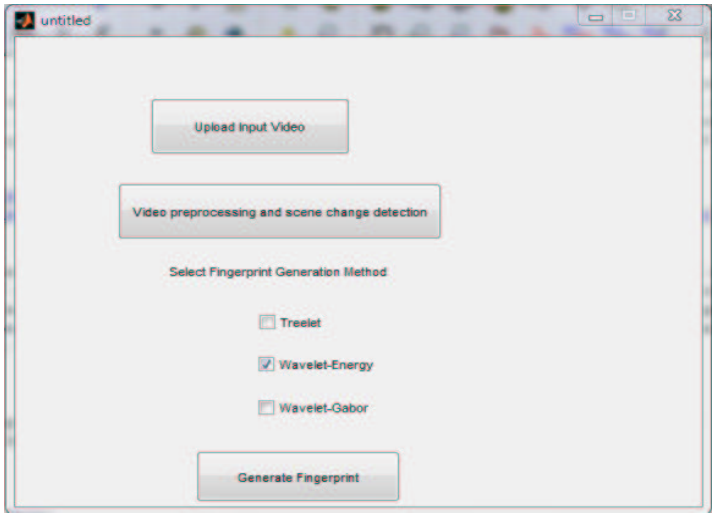


Figure 5.6: Selecting Fingerprint Generation Method

Chapter 6

Conclusion

In this work,we have due introduced fast and accurate fingerprint algorithm for feature extraction and matching of near duplicate videos.Based upon the feature vectors of treelets,wavelet and wavelet-gabor threshold values are calculated and phylogeny tree has been reconstructed.The resulting fingerprint technique requires reduced number of bits and do not require huge storage space due to its small size.Oue method has demonstrated and robustness against common types of video transformation techniques. During Initial testing various sample videos have been tested using different feature extraction methods such as counterlet,curvelet,ridgelet and wavelet.But the scheme is not able to detect the near duplicate copies with accuracy and precision.Results are not accurate for the various types of transformations and variations applied to the video copies.Thus the treelet,wavelet and gabor feature extraction methods are used due to its high detection accuracy.As future work,proposed technique could be validated against other transformation techniques.

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Publications

- A Paper on Video Phylogeny based on Fingerprint Features for Near-Duplicate Video Clips Detection and Parent tree generation have been accepted in 2016 International Conference on Advanced Communication, Control and Computing Technologies - ICAC-CCT' 16.
- A Paper on "Smart Childcare robot" have been communicated in International Arab Journal of Information Technology (IAJIT).

Link Of video Presentation

https://youtu.be/XCDyGBaX3cA