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# A Robust Weber's Local Descriptor for Copy Control

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## Abstract

Simple and robust local powerful descriptor called Weber Local Descriptor (WLD), which is put forward for detecting duplicated videos. Matching based on orthogonal moments has high computational complexity, especially for high dimension. Thus, to reduce the time complexity video is segmented into frame by twin threshold segmentation and key frames are extracted from each segment. Then, WLD descriptor is incorporated for feature extraction from each frame. Specifically, WLD consist of two components one is excitation and other is orientation. We use both these components to construct WLD histogram feature.Finally matching takes place between the features extracted from the reference video and the target video to check whether it is a duplicated or original video. The proposed method is more powerful to different noises, photometric and geometric transformations in the frame and detect the copied videos effectively with less computational complexity.

**Keywords**: Copied video detection, SIFT descriptor, Orthogonal moments, Keyframe, Dual threshold segmentation, transformations.

## Introduction

With the rapid improvement of multimediatechnologies,the cost of image, video data collection, creation of frames,and storage isbecomingincreasinglylow.Every dayhundredsof thousands ofvideoare created or generated and published. Amongthese huge volumesof videos or images there exist thelarge numbersofcopies ornear-duplicatevideos. Asasignificance,aneffectiveand efficientmethod for video copy detection has become more and more important.Theintentionofdetecting copied videoistodecidewhether aqueryvideosegmentisacopyofavideofromthevideodatabase.Acopy may have the impact ofvarioustransformations like cam-cording, picture in picture, crop, shift, contrast, blur, change of gamma.Fig.1shows theframeworkofcontent-basedvideo copy detection framework.Itiscomposedoftwo parts:

1) An offlinestep. Keyframesareextrincatedfrom the referencevideo databaseand featuresare extractedfrom these frame keyworks.The medium along withextractedfeaturesshouldbe robustand effective to transformationsby which the video or sequencemay undergo through this.Also, thefeatures and framescan be storedin an indexing structuretomake similaritycomparisonefficient.

2)Anonlinestep.Featuresareextractedfrom the targetvideosand comparedtothose stored in the referencedatabase with similar search.Hence,thematchingresultsare then analyzedand thedetectionresultsarereturned.

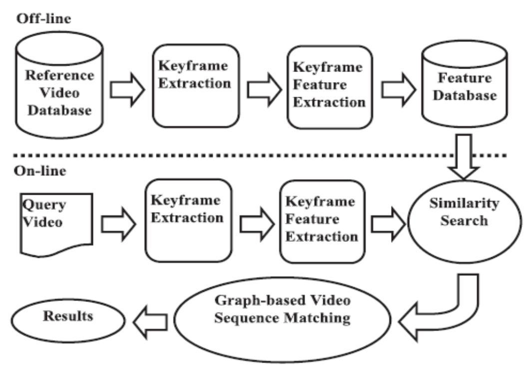



**Fig.1Frameworkofvideo copydetection.**

## Autodual-Threshold Method

Auto dual-threshold method is usedtodropunwanted excessivevideo frames. Thismethodology segments thecontinuous videoframes intovideo segmentsby excludingtemporalredundancyofthevisual information. Thismethod hasthetwo main characteristics.First, twothresholdsare used. Specially,onethreshold fordetectingabruptchangesof visual information offrames and another thresholdfor gradual changes.

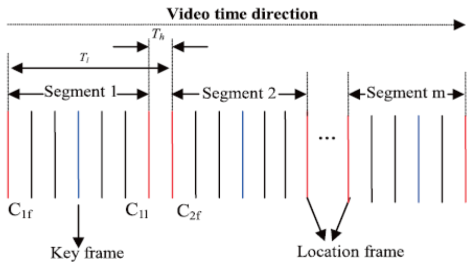



**Fig.2 Auto dual-thresholdmethod.**

Second, twothresholds valuesare calculatedadaptivelyaccordingtovideo content.particularly, the higher threshold $T_h = \mu+\alpha\sigma$,where$\mu$and $\sigma$ are the mean and standarddeviationofvalues betweencontigiousframes and $\alpha$ is suggestedto be between5and 6accordingto empiricalstudy.T he lowthreshold$T_l$ is fixed to be $b\times T_h$,wherebisselected from the range of 0.1-0.5.Then the auto dual-thresholdmethod toeliminatetheredundant frames isshowninFig.2.

From each video segment three frames are extracted, they arethe first frame, the keyframeand the last frame of this segment.For video sequence matching the keyframeis used, where thefirstand thelastframes are used forfinding outthe segmentlocation for copy detectionand matching.Eachsegmentisdesignated acontinuous ID numberalong the time direction. Fig.3shows anexamplevideo segmented byusing autodual-thresholdmethod.Forexample, A Shotas shown in the figure, and also itcan be further segmented throughoutinto m Segmentsbytheauto dual-thresholdmethod.

## Weber Local Descriptor (WLD)

Weber Local Descriptor (WLD) is simple, very powerful and robust local descriptor. It is based on Weber's law, states the fact that human perception of a pattern depends on not only the change of a stimulus but also the original intensity of the stimulus. Particularly, WLD contains two components: its differential excitation and its orientation. Differential excitation is a function of the ratio between the relative intensity differences of its neighbors against a current pixel and the intensity of the current pixel. An orientation is the action of orientating current pixel relative to certain positions. For a given image, we use the differential excitation and the orientation components to construct a concatenated WLD histogram feature.

**Weber's Law**

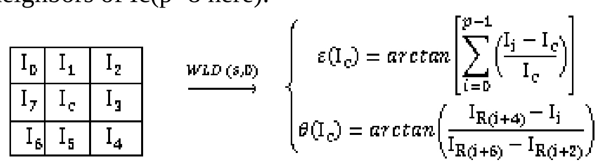
Weber's law states that the ratio of the increment threshold to the background intensity is a constant. This relationship, known since as Weber's Law,and it can be expressed as,

$$\frac{\Delta I}{I} = K \qquad (1)$$

where$\Delta I$represents the increment threshold (just noticeable difference for discrimination), $I$represents the initial stimulus intensity and $k$signifies that the proportion on the left side of the equation remains constant despite of variations in the $I$ term. The fraction ΔI/I is known as theWeber fraction.

**Differential excitation**

Differential excitation is the intensity differences between its neighbors and a current pixel as the changes of the current pixel. Specifically, a differential excitation $\varepsilon$(Ic) of a current pixelis computed as follows, where Icdenotes the intensity of the current pixel; Ii (i=0, 1, …p-1) denote the intensities of p neighbors of Ic(p=8 here).




(2)

Where, R(x)=mod(x,p)

To compute $\varepsilon$ ($Ic$), first calculate the differences between its neighbors and a center point:

$$f_{diff(\mathrm{I_i})} = \Delta \mathrm{I_i} = \mathrm{I_i} - \mathrm{I}_c \qquad (3)$$

By weber's law

$$f_{ratio(\Delta \mathrm{I_i})} = \frac{\Delta \mathrm{I_i}}{\mathrm{I}_c} \qquad (4)$$

Subsequently, we consider the neighbor effects on the current point using a sum of the difference ratios:

$$f_{sum}\left(\frac{\Delta \mathrm{I_i}}{\mathrm{I}_c}\right) = \sum_{i=0}^{p-1}\left(\frac{\Delta \mathrm{I_i}}{\mathrm{I_c}}\right) \qquad (5)$$

To increase the powerfulness of a WLD to noise, arctangent function is used as a filter on $fsum(\cdot)$.

$$f_{arctan}\left[\sum_{i=0}^{p-1}\left(\frac{\mathrm{I_i}-\mathrm{I_c}}{\mathrm{I_c}}\right)\right] = arctan\left[\sum_{i=0}^{p-1}\left(\frac{\mathrm{I_i}-\mathrm{I_c}}{\mathrm{I_c}}\right)\right] \qquad (6)$$

So, $\varepsilon$ ($Ic$) is computed as:

$$\varepsilon(\mathrm{I_c}) = arctan\left[\sum_{i=0}^{p-1}\left(\frac{\mathrm{I_i}-\mathrm{I_c}}{\mathrm{I_c}}\right)\right] \qquad (7)$$

Note that $\varepsilon(Ic)$ may take a minus value if the intensities of neighbors are smaller than that of a current pixel. Intuitively, if $\varepsilon(Ic)$ is positive, it simulates the case that the surroundings is lighter than the current pixel. In contrast, if $\varepsilon(Ic)$ is negative, it simulates the case that the surroundings is darker than the current pixel.By this means, we attempt to preserve more discriminating information in comparison to using the absolute value of $\varepsilon(Ic)$.

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**Orientation**

For the orientation component of WLD, it is calculated as:

$$\theta(\mathrm{I_c}) = arctan\left(\frac{\mathrm{I_{R(i+4)}}-\mathrm{I_i}}{\mathrm{I_{R(i+6)}}-\mathrm{I_{R(i+2)}}}\right) \quad (8)$$

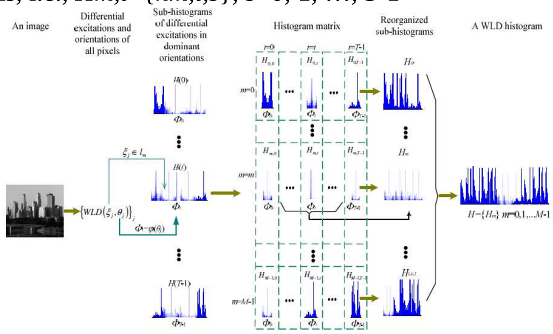
where $I_i$ ($i$=0,1,…$p$/2-1) are the neighbors of a current pixel, $p$ is the number of neighbors ,$R(x)$ is to perform the modulus operation, i.e.,R(x)=mod(x,p)

The quantization function is as follows:

$$\varphi(\theta) = \frac{2t}{T}\pi, \text{and } t = \mathrm{mod}\left[\left[\frac{\theta}{2\pi/_T}+\frac{1}{2}\right], T\right] \quad (9)$$

**WLD histogram**

The WLD features for each pixel are computed are encoded into a histogram *H*. The differential excitations are then grouped as *T* sub-histograms *H*(*t*) (*t*=0, 1, …, *T*-1), each sub-histogram *H*(*t*) corresponding to a dominant orientation. Subsequently, each sub-histogram *H*(*t*) is evenly divided into *M* segments,.Furthermore, a segment *Hm,t*is composed of *S* bins, i.e., *Hm,t*={*hm,t,s*}, *s*=0, 1, …, *S*-1




**3. An illustration of WLD histogram for a given Image**

## Graph Basedvideosequencematching Methodfor Videocopy Detection

A new graph-based videosequence matching method thatmake use ofthevideo'stemporal characteristics to solve the problem of the efficiency of video copy detection.Then the proposed graph-basedvideo sequencematchingmethod forvideo copy detectionispresentedasfollows:

Step1: Videos areSegmented intothevideo framesandfeatures are extracted fromthe keyframes.Accordingtothe methoddescribedinSection 2, weperformthedual threshold technique tosegmentthevideo sequences,and then extract SIFTfeaturesofthekeyframes.

Step 2: Query video and target video are matched.Assume that $Q_C = \{c_1^Q, c_{2\ldots}^Q c_m^Q\}$ and $T_C = \{c_1^T, c_{2\ldots}^T c_n^T\}$ are the segments sets of the query video and target video from step 1.

Step 3: Generate the matching result graph according to the matching results.The vertex $M_{ij}$ represent the match between $c_i^Q$ and $c_j^T$.To find out whether there exists an edge between two vertexes,two calculations are performed.

Time direction consistency: For Mij and Mlm, if there exists (i-l)*(j-m) then Mij and Mlm satisfy the time direction consistency.

Time jump degree: For Mij and Mlm, the time jump degree between them is defined as

$$\Delta t_{lm}^{ij} = max(|t_i - t_l|, |t_j - t_m|) \quad (10)$$

There existsanedge betweentwo vertexes, ifthefollowingtwo requirementsaresatisfied:

1. The two vertexes should meettime direction compatibility.
2. Thetimejump degree

Requirement1indicatesthat thevideo subsequencetemporal order between thetarget video and query video must be consistent.If Requirement 1ismeet,Requirement2isused toconstrainthe timespan oftwomatching resultsbetween thequery video and the target video. Eventhoughthe timespan exceeds a certain threshold,also itisconsideredthat there does not existcertain correlationbetweenthetwomatchingresults.

Step4: To find thelongestpathinthematchingresultgraph.Searchingso melongest paths in the matching result graph is the problem. These longest pathscan find outnot only the location ofthe video copies but alsothe time length of thevideo copies.The methodcan search the longest path betweentwoarbitraryvertexes inthematching result graph.

Step5:Output theresultofdetection.Ithasmorethanonepath ornopath,foreachvertex ofthematchingresult graph.AsinFig.5,forthevertexes M1;29,M1;76,and M2;76,they have no path to other vertexes.For M1;26,four pathsare available.Accordingly,we can get some discretepathsfrom the matching result graph,thus easy todetect more than one copy segmentsbyusing thistechnique

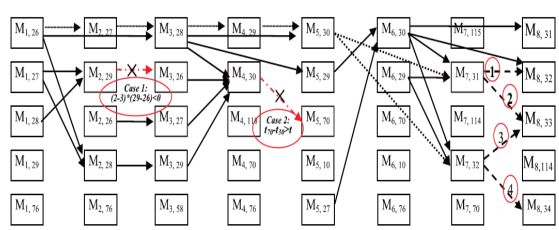


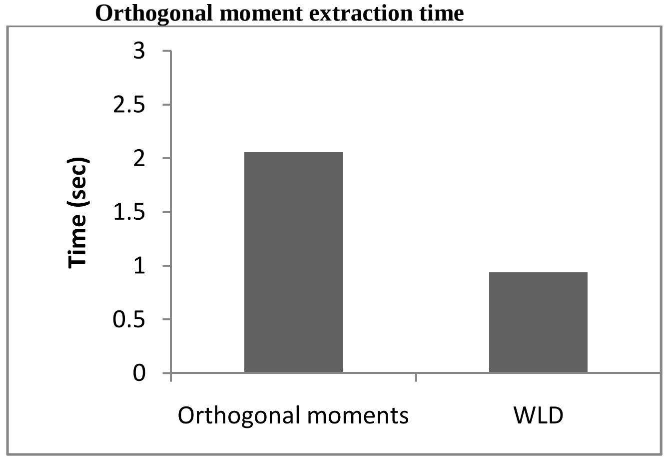
**Fig.4 Matching results between query video and target video.**

## Results

The purposeofthis studyisto detect the copyvideos in large video data set.Inthistest, we comparethe proposed approachwith orthogonal moments. We comparethe time complexity and accuracyof our proposed Weber's Local Descriptor with the existing method. The time complexity is low in the proposed method because all the operations involved is only addition, which consumes less time where the operations involved in orthogonal moment is multiplication which consumes more time The number of features extracted in WLD is high , hence automatically the accuracy of copy detection is high in WLD compare to orthogonal moment.

| No of Frames | No of Key frames | keyframe detection | No of Features | Feature extraction |
|---|---|---|---|---|
| 120 | 11 | 0.025s | [11 x 3 x 360] | 0.94s |
| 119 | 11 | 0.006s | [11 x 3 x 360] | 0.88s |
| 119 | 10 | 0.003s | [11 x 3 x 360] | 0.79s |
| No of Frames | No of Key frame | keyframe detection | No of Features | Feature extraction |
| 120 | 11 | 0.025s | [11 x 3 x 256] | 2.06s |
| 119 | 11 | 0.006s | [11 x 3 x 256] | 1.98s |
| 119 | 10 | 0.003s | [11 x 3 x 256] | 1.81s |

**WLD Feature extraction time**
**Orthogonal moment extraction time**




**7.Time complexity comparision**

## Conclusion

WLD based video sequence matching method can be used efficiently for detecting the copied video.Since,matching based on orthogonal moment descriptor has high computational complexity. Thus, to reduce the time complexity video is segmented into frame by Twin threshold segmentation and key frames are extracted from each segment. Then, WLD descriptor is incorporated for feature extraction from each frame. Finally matching takes place between the features extracted from the reference video and the target video to check whether it is a original video or duplicated video. Experimental results also shows this method can be used efficiently for detecting the copied video with less computational complexity.

## *References*

[1] *Jie Chen, Shinguang Shan, Guoying Zhao, "WLD: A Robust Local Image Descriptor",IEEE Transaction on pattern analysis and intelligence,Vol.32, no.9, September 2010.*

[2] *X.Wu, C.-W. Ngo, A.Hauptmann,and H.-K. Tan, "Real-Time Near-DuplicateEliminationforWeb Video Search with Content and Context,"IEEETrans.Multimedia,vol.11,no.2,pp. 196-207, Feb.2009.*

[3] *TRECVID 2008Final ListofTransformations, http:/www.nlpir.nist.gov/projects/tv2008/active/cy.detection/final.cbcd.video.transformations.pdf,2008.*

[4] *Final CBCDEvaluation Plan TRECVID 2008 (v1.3),http://wwwnlpir.nist.gov/projects/tv2008/Evaluation-cbcd-v1.3.htm,2008.*

[5] *O.Kücüktunc, M.Bastan, U.Güdükbay, and Ö.Ulusoy, "VideoCopy Detection Using Multiple Visual Cues and MPEG- 7 Descriptors,"J. Visual Comm. Image Representation, vol. 21, pp. 838-849, 2010.*

[6] *M. Douze, H. Je´ gou, and C. Schmid, "An Image-Based Approach to Video Copy Detection with Spatio-Temporal Post-Filtering," IEEE Trans. Multimedia, vol. 12, no. 4, pp. 257-266, June 2010.*

[7] *M. Douze, A. Gaidon, H. Jegou, M. Marszalek, and C. Schmid, TREC Video Retrieval Evaluation Notebook Papers and Slides: INRIA- LEAR's Video Copy Detection System, http://www-nlpir.nist.gov/projects/tvpubs/tv8.papers/inria-lear.pdf, 2008.*

[8] *A.Hampapurand R.Bolle,"ComparisonofDistance Measures forVideo Copy Detection,"Proc.IEEEInt'lConf.Multimediaand Expo(ICME),pp. 188-192,2001*