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A Novel Approach of Low Complexity DWT/PCA Based Video Compression Method

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Abstract*— A video signal has high temporal redundancies due to the high correlation between successive frames. Actually, this redundancy has not been exploited enough by current video compression techniques. In this paper, we propose a new approach for video compression using DWT technique which tends to hard exploit the relevant temporal redundancy in the video to improve solidity efficiency with minimum processing complexity. It includes 3D (Three Dimension) to 2D (Two Dimension) transformation of the video that allows exploring the temporal redundancy of the video using 2D transforms and avoiding the computationally demanding motion recompense step. This transformation converts the spatial and temporal correlation of the video signal into a high spatial correlation.DWT technique transforms each group of pictures into one picture eventually with high spatial correlation. SPIHT (Set Partitioning in Hierarchical Trees) exploits the properties of the wavelet-transformed images to increase its efficiency. Thus, the De-correlation of the resulting pictures by the DWT (Discrete Wavelet Transform) makes efficient energy compaction, and therefore produces a high video compression ratio. DWT technique is more efficient especially for slow motion videos with high bit rate. Video segmentation, visual change estimation, and object tracking, enables the operation of the PCA-based video representation algorithm. It can be applied to compressed or raw video data.

Index Terms— **Video Compression, Discrete Wavelet Transform, SPIHT, PCA Algorithm.**

I. INTRODUCTION

There are many methods used for video compression, and the most famous and apply technique is Joint Picture Experts Group (JPEG), which is an ISO/ITU standard for compressing digital video. JPEG performs lossy compression for each frame similar to JPEG, which means pixels from the original images are permanently removed. The most famous methods are concentrated of Discrete Wavelet Transform (DWT). The grey scale image gives 256 levels of possible intensity for each pixel, so these images refer to 8 bits per pixel (bpp). The typical RGB color images, with 8 bits for Red, 8 bits for Green, and 8 bits for Blue, then the intensity I is defined by (I=R+G+B). The human eye is most sensitive to variations in intensity, so the most difficult part of compressing a color image lies in the compressing of the intensity. Digital video consists of a stream of images captured at regular time intervals. The images are represented as digitized samples containing visual (color and intensity) information at each spatial and temporal location. Visual information at each sample point may be represented by the values of the three basic color components RGB color space. A video signal can be sampled in either frames (progressive) or fields (interlaced). In progressive video, a complete frame is sampled at each time instant. While an interlaced video only a half of the frame is captured (either odd or even rows of samples) at a particular time instant which are called fields. A sequence of complete frames are used to calculate the frame differencing between the consequences frames according to a specific threshold.

In this paper we are proposing a technique by which we can separate the stationary and moving objects in real time s as to result in a lossless video compression. Lossless video compression means that the compressed file after decompressing will be exactly same as the original video. Now a days the techniques which are being used for video compression are all lossy compression type unlike ours "Object repetition based video compression". In this paper we present an object repetition based video coding approach that retains the relative advantages of both the hybrid based and block-based coders while minimizing the drawbacks of both. By employing motion segmentation techniques to separate moving objects from stationary backgrounds, the coder optimizes the bit allocation to those areas that are changing most frequently. This technique also provides the ability to selectively encode, decode, and manipulate individual objects in a video stream and, hence, supports content-based functionalities such as object scalability and object manipulation easily. In this paper we are proposing a technique by which we can separate the stationary and moving objects in real time so as to result in a lossless video compression. Lossless video compression means that the compressed file after decompressing will be exactly same as the original video. Now days the techniques which are being used for video compression are all lossy compression type unlike ours "Object repetition based video compression". In

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II. METHODOLOGY

First of all we are going to read a video file in our MATLAB2010a DWT based algorithm to start compression with that. Our input file may be of either in AVI or JPEG format.

- Both of these universal formats have the information regarding FPS and size of the images it contains. Than our next goal is to determine the stationary objects in each frame corresponding to the next frame so that we will only store non stationary objects for the very next frame and all these data will be stored in a encoding corner for every frame having its own information which is very much needed at the time of decompress video processing.
- We are referring a base paper in which we have this work for video compression technique but not very much good for the real time video compression techniques either have a demerit of loosely techniques DWT but here we are going to present a noble technique in which we will use object position change finding PCA algorithm to get our video process in real time and having lossless decompressions.

III. LITERATURE REVIEW

In this section, we are presenting the research work of some prominent authors in the same field and explaining a short description of various techniques used for video compression.

1. G.SureshP.Epsiba,Dr.M.Rajaram,Dr.S.N.Sivanandam "A Low Complex Scalable Spatial Adjacency Acc-Dct Based Video Compression Method",2010 proposed a video compression approach which tends to hard exploit the temporal redundancy in the video frames to improve compression efficiency with less processing complexity. Produces a high video compression ratio. Many experimental tests had been conducted to prove the method efficiency especially in high bit rate and with slow motion video. The proposed method seems to be well suitable for video surveillance applications and for embedded video compression systems.
2. Tzong-Jer Chen, Keh-Shih Chuang "A Pseudo Lossless Image Compression Method",2010 present a lossless compression which modifies the noise component of the bit data to enhance the compression without affecting image quality. Data compression techniques substantially reduce the volume of the image data generated and thus increase the efficiency of the information flow. Method is information lossless and as a result, the compression ratio is smaller.
3. Qiang L iu, Robert J. S clabassi, Mark L. Scheuer, and Mingui Sun "A Two-step Method For Compression of Medical Monitoring Video"2010 present a two-step method to compress medical monitoring video more efficiently. In the first step, a novel algorithm is utilized to detect the motion activities of the input video sequence. Then, the video sequence is segmented into several rectangle image regions (video object planes), which contain motion activities restricted within these windows. In the second step, the generated video object planes are compressed. Our experimental results show that the two-step method improves the compression ratio. Significantly when compared with the existing algorithms Object Based Real Time Lossless Video
4. Compression – A REVIEW Preeti Markan, Balwinder Singh Object Based Real Time Lossless Video Compression – A REVIEW while still retaining the essential video quality.
5. Raj Talluri, , Karen Oehler, Thomas Bannon, Jonathan D. Courtney, Arnab Das, and Judy Liao "A Robust, Scalable, Object-BasedVideo Compression Technique for Very Low Bit-Rate Coding" 1997 describes an object-based video coding scheme (OBVC) this technique achieves efficient compression by separating coherently moving objects from stationary background and compactly representing their shape, motion, and the content. In addition to providing improved coding efficiency at very low bit rates, the technique provides the ability to selectively encode, decode, and manipulate individual objects in a video stream. Applications of this object-based video coding technology include video conferencing, video telephony, desktop multimedia, and surveillance video.

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6. Ian Gilmour, R. Justin Dávila "Lossless Video Compression for Archives: Motion JPEG2k and Other Options"2011 algorithm is clearly for end-user distribution through narrow bandwidths, and where no subsequent re-coding or re-puposing is required. The optimisation of image quality within individual frames allows true lossless data-reduction for applications such as archiving, where no loss of image quality is acceptable.
7. Yucel Altunbasak, A. Murat Tekalp, and Gozde Bozdagi "Two-Dimensional Object-Based Coding Using A Content-Based Mesh And Affine Motion
8. Parameterization" 2008 present a complete system for 2-D object-based video compression with a method for 2-D content-based triangular mesh design, two connectivity preserving affine motion parameterization schemes, two methods for temporal mesh propagation, a polygon-based adaptive model failure detection/coding scheme, and bit rate control strategies.
9. Raj Talluri "A Hybrid Object-Based Video Compression Technique" 2009 describes a hybrid object-based video coding scheme that achieves efficient compression by separating coherently moving objects from stationary background and compactly representing their shape, motion and the content. In addition to providing improved coding efficiency at very low bit rates.

IV.TWO DIMENSIONAL DWT

Two dimensional DWT is obtained via the implementation of low pass and high pass filters on rows and columns of image respectively. A low pass filter and a high pass filter are chosen, such that they exactly halve the frequency range between themselves. This filter pair is called the Analysis Filter pair. First, the low pass filter is applied for each row of data, thereby getting the low frequency components of the row. But since the lpf is a half band filter, the output data contains frequencies only in the first half of the original frequency range. The high pass filter is applied for the same row of data, and similarly the high pass components are separated, and placed by the side of the low pass components. This procedure is done for all rows. As mentioned above, the LL band at the highest level can be classified as most important, and the other 'detail' bands can be classified as of lesser importance, with the degree of importance decreasing from the top of the pyramid to the bands at the bottom. DWT is a multispectral technique used for converting signal or image into four different bands such as low-low (LL), low-high (LH), high-low (HL) and high-high (HH) as demonstrated in figure

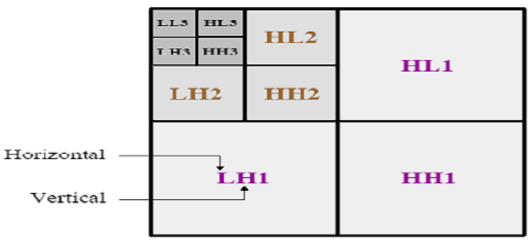

Fig 1: Decomposition of image Applying Dwt

A. Basic Flow of Design

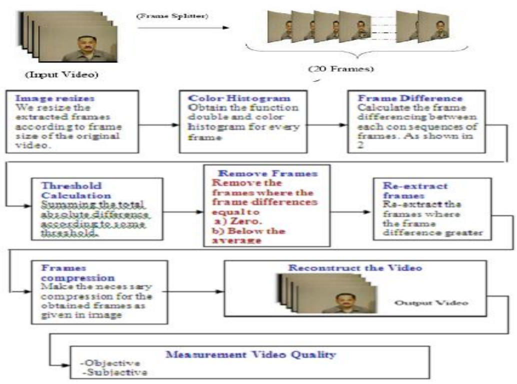

Fig 2: Structural Diagram of design

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B. Proposed Design of Video Compression

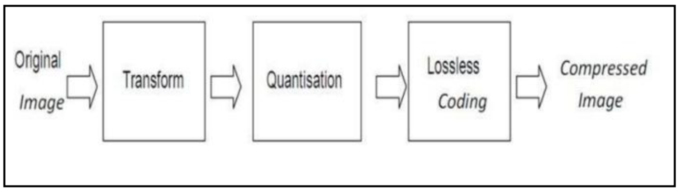

Fig 3 : Block diagram of video compression method by using DWT.

C. DWT AND PCA Algorithms

Discrete Wavelet Transform has become an important method for image compression. Discrete Wavelet based coding provides substantial improvement in picture quality at high compression ratios mainly due to better energy compaction property of wavelet transforms. Discrete Wavelet transform partitions a signal into a set of functions called wavelets. Wavelets are obtained from a single prototype wavelet called mother wavelet by dilations and shifting. The wavelet transform is computed separately for different segments of the time-domain signal at different frequencies.

- Subband coding: A signal is passed through a series of filters such as DWT .Procedure starts by passing this signal sequence through a half band digital low pass filter with impulse response h(n).Filtering of a signal is numerically equal to convolution of the tile signal with impulse response of the filter

$$x[n]*h[n]=\sum_{k=-\infty}^{\infty} x[k].h[n-k]$$

- PCA based Video Compression: The video representation and compression algorithms presented in this section are intended for use in two contexts that require the efficient encoding of video sequences. In the case of a distributed multimedia processing and retrieval sys-tem, the query-relevant video shots must be transmitted to the user's location .Within computational considerations; the proposed compression approach can represent the basis for encoding video data at very low bit rates. In both cases, the use of video segmentation, visual change estimation, and object tracking, enables the operation of the PCA-based video representation algorithm. A video segmentation algorithm can be applied to compressed or raw video data.

V. IMPLEMENTATION RESULTS

A. Coding:

```
[filename, pathname] = uigetfile('*.bmp;*.jpg', 'Pick an Image');

if isequal(filename,0) || isequal(pathname,0)

warndlg('image is not selected');

else

input=imread(filename);

input = imresize(input,[256 256]);

figure;imshow(input);

title('Input Image');

end

1. %One Level Wavelet Transform
```

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```
[LL LH HL HH]= dwt2(input,'haar');

dec2d = [...LL,LHHL,HH...];

figure;imshow(dec2d,[]);

title('Wavelet Transformed Image');

[row col] = size(input);

[row1 col1] = size(LL);

out = zeros([row1 col1]);

for i=1:8:row1

for j=1:8:col1

out(i:i+7,j:j+7) = dct2(LL(i:i+7,j:j+7));

end

end

rsz = round(reshape(out,[1 row1*col1]));

Level=8;

Speed=0;

xC=cell(1,1);

xC{1}=rsz;

[y, Res]=Huff06(xC, Level, Speed);

save y y;

Bitstream=y;

cc=length(y);
```

2. %Input video without compression

```
[filename, pathname] = uigetfile('*.avi', 'Pick an Image');

if isequal(filename,0) | isequal(pathname,0)

warndlg('image is not selected');

else

a=aviread(filename);

movie(a);

end
```

3. %Frame separation

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```
str1='frame';

str2='.bmp';

file=aviinfo(filename); % to get inforamtaion abt video file

frm_cnt=file.NumFrames % No.of frames in the video file

h = waitbar(0,'Please wait...');

for i=1:frm_cnt

frm(i)=aviread(filename,i);        % read the Video file

frm_name=frame2im(frm(i));      % Convert Frame to image file

filename1=strcat(strcat(num2str(i)),str2);

imwrite(frm_name,filename1);      % Write image file

waitbar(i/frm_cnt,h)

end

close(h)

helpdlg('Frame seperation is Completed');
```

4.% Encoding

```
str1='frame';

str2='.bmp';

q=100; %%%%%%%%%%%%%%%%% quantization value

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Bitstream=[];

Bitst=[];

j1=1;

tic;

for i=1:10

filename_1=strcat(strcat(num2str(i)),str2);%%%%%%%%%%%%%%% form filename

Image1=imread(filename_1);

Image1=rgb2gray(Image1);

[row col]=size(Image1);

Image1=imresize(Image1,[256,256]); % resize for wavelet

[r_1 c_1]=size(Image1);
```

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```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% DCT

Enc = myDCT(Image1);

[r c]= size(Enc);

for i=1:r

for j=1:c

QEnc(i,j)=Enc(i,j)/q;


end

end

QEnc=round(QEnc);

%%%%%%%%%%%%%%%%%%%%%%% zig zag scanning

ZQEnc=toZigzag(QEnc)

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% RUN LENGTH ENCODING

j=1;

t=ZQEnc

a=length(t);

count=0;

for n=1:a

b=t(n);

if n==a

count=count+1;

c(j)=count;

s(j)=t(n);

elseif t(n)==t(n+1)

count=count+1;

elseif t(n)==b

count=count+1;

c(j)=count;

s(j)=t(n);

j=j+1;
```

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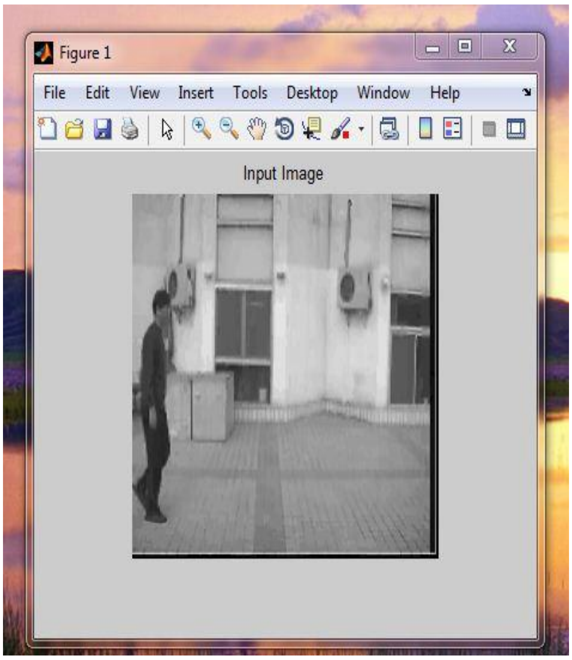
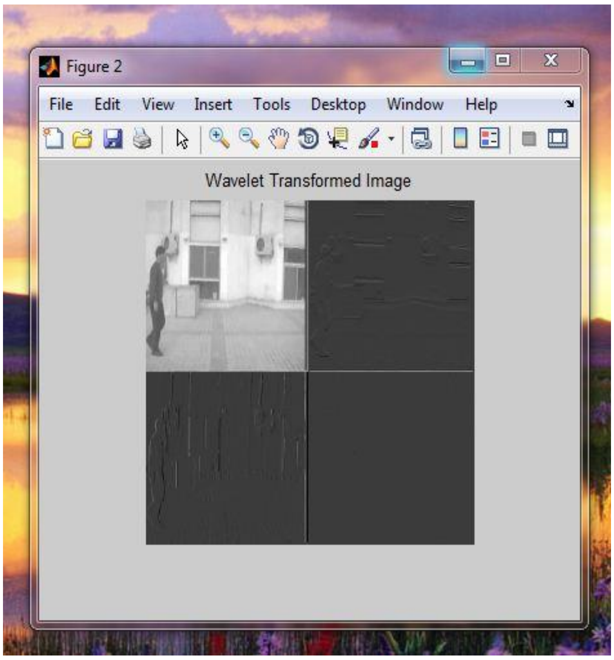
```
count=0;
end
end
R1=length(c);
R2=length(s);
x=s;
mm=c;
Level=8;
Speed=0;
xC=cell(2,1);
xC{1}=x;
xC{2}=mm;
[y, RES1]=Huff06(xC, Level, Speed);
save y y;
helpdlg('EncodingCompleted');
end
```

B. Simulation Screen Shots:

1. Input Image



2. Video Compressed and retrieval by using dwt



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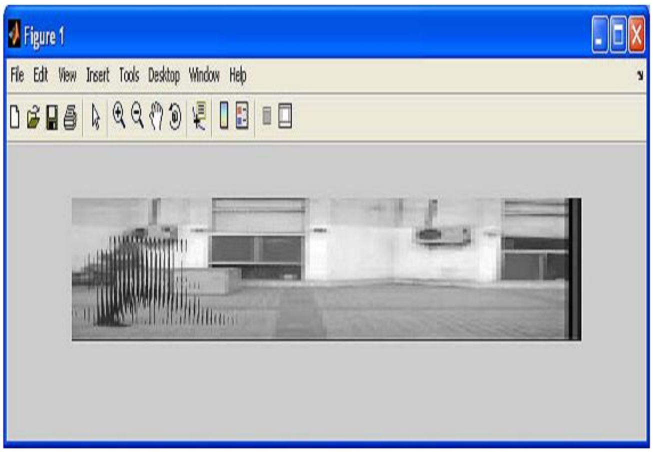
3. Encoding Model



VI. CONCLUSION

In the paper Video compression techniques using DWT were implemented. DWT is used for transformation in JPEG standard. DWT performs efficiently at medium bit rates. Disadvantage with DWT is that only spatial correlation of the pixels inside the single 2-D block is considered and the correlation from the pixels of the neighbouring blocks is neglected. Blocks cannot be decorrelated at their boundaries using DCT. DWT is used as basis for transformation in JPEG 2000 standard. DWT provides high quality compression at low bit rates. The use of larger DWT basis functions or wavelet filters produces blurring near edges in images. DWT performs better than DCT in the context that it avoids blocking artefacts which degrade reconstructed images. However DWT provides lower quality than JPEG at low compression rates. DWT requires smaller compression time.

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