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SIMULATION BASED VIDEO COMPRESSION THROUGH DIGITAL COMMUNICATION SYSTEM

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Abstract

The paper is about the transmission, compression, detection of the video based on simulation for the various communication applications. The video and image compression overcomes the problem of reducing the amount of data required to the information that has to be transmitted and this saves the bandwidth required for transmission of data and memory which is required for storage purpose. Hence video compression reduces the volume of the video data with a small change in quality of the video. Compressed video transmission can be done over a channel by huffman coding for the source at transmitter side and then channel codes is done by technique called hamming. The data which is to be sent through channel is a BPSK modulated so the received data is demodulated followed by the channel decoding, source decoding using inverse of the techniques used in the transmitter side to obtain the original transmitted video. The above procedure is done for the input video taken by camera and this compressed video can be transmitted then detected at receiver by digital communication system (DCS) which is simulated in the MATLAB.

Keywords: Huffman; IDCT; BPSK; DCS; DCT; Quantization.

1. Introduction

The recent study has shown that 95% of the total volume of data in the internet access consists of video and image related data form. The video and image in the uncompressed (raw) form requires large space for storage. This type of data requires large bandwidth for transmission over a network. So many researches are done on compressing the data. But in the recent times, the data storage and data transmission demand is in the increasing condition. So data compression is

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the best and the only option to remove the congestion in the network. This reduces bandwidth required for transmission and also takes less time.
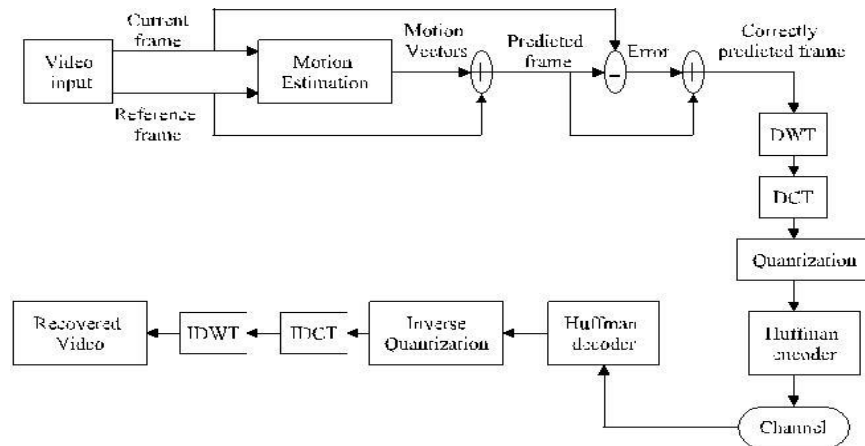
2. Video Compression

Figure 1: Video Compression Block Diagram

The video compression follows below steps:

- Divide the full video frame into blocks of pixels, where the processing can be done at block level.
- Spatial redundancies are exploited which exist in the video frame by coding the original blocks through spatial prediction, quantization, entropy encoding or else variable length coding.
- Now temporal dependencies are exploited which exists between the blocks in the successive frames. This is done by compensation and motion estimation. To determine the motion vectors the search is done in the previously coded frames which are then used by decoder, encoder to predict the subject block.
- Now again repeating the second step that is exploiting of remaining spatial redundancies.

Search Algorithm

Divide the each frame in the video into macro blocks then reference frames each MB is compared with all blocks in the B or P frame. If there are any matches found then we take the difference along the horizontal and vertical.Next is to calculating the SAD followed by MAD(Minimum Absolute Difference) which is based on the SAD generation of motion vector.

3. The proposed design model

3.1. Quantization and Discrete Cosine Transform

The operation of the DCT is to convert the pixel value of image to the corresponding frequency values. As we know that human eyes are sensitive to high frequency component that is associated with the image than that of lower frequency component.

If the amplitude of high frequency falls down on lower frequency then it will not be detected by our eye. So DCT and quantization eliminates the high frequency components so that the eye can detect the original image. The data inputs are in the form of sum of the cos functions which is represented by DCT. These oscillate at different frequencies and magnitude. Now image can be represented in two dimension matrix so 2-D DCT is used. The input sequence can be obtained by below equation.

$$D_{DCT}(i,j) = \frac{1}{\sqrt{2N}}B(i)B(j)\sum_{x=0}^{N-1}\sum_{y=0}^{N-1}M(x,y)\cos\left(\frac{(2x+1)i\Pi}{2N}\right)\cos\left(\frac{(2y+1)j\Pi}{2N}\right)$$

Where,

$$B(u) = \begin{cases} \frac{1}{\sqrt{2}} & if\ u = 0 \\ 1 & if\ u > 0 \end{cases}$$

In the receiver part the image is dequantized and IDCT can be performed to obtain the transmitted image. The equation of IDCT is given below:

$$D_{IDCT}(i,j) = \frac{1}{\sqrt{2N}}\sum_{x=0}^{N-1}\sum_{y=0}^{N-1}B(i)B(j)D_{dequant}(i,j)\cos\left(\frac{(2x+1)i\Pi}{2N}\right)\cos\left(\frac{(2y+1)j\Pi}{2N}\right)$$

3.2. Wavelet Transformation in Discrete Nature

Compression procedure, de-noising contains following steps:

- Decomposition: First choose wavelet, select level and compute wavelet decomposition.
- Threshold coefficients: For every level select the threshold, hard thresholding is applied.
- Reconstruct: Reconstruction is done in accordance with the approximations and the detailed coefficients from 1 to N.
- Global Thresholding: Compression features are connected to the scarceness of wavelet representation.
- The signal component is approximated by the following given elements: Coefficients and detailed coefficients.

3.3. Huffman Coding and Decoding Algorithm

- For the source symbols which are not equally probable, the technique used here is Huffman coding. This Huffman coding was proposed in the year 1952 by Huffman.
- Now considering symbol probability P(xi), i=1,2........,L. After this the condition for prefix is satisfied. In the Huffman code no codeword is prefix of any of the other codeword.
- The decoding can be done if the receiver has copy of Huffman code table which is generated at a transmitter part. There is no need to add delimeters in between the encoded pixel.

3.4. Binary Phase Shift Keying(BPSK) Modulation and Demodulation

In BPSK the transmitted signal is of sinusoidal amplitude. If the data is at one level and is at another level the phase difference is 180 degree at fixed phase. When the amplitude A is of the sinusoidal order:

$$A*cos(wt) \ \ or \ \ -A*cos(wt)$$

The data here is bit stream of binary digits at voltage level, so we take +1V or -1V.When data b(t)=1V this is logic 1,b(t)=-1V then it is logic 0. So V(bpsk) is given by:

$$V(bpsk)=b(t)*Acos(wt)$$

For recovering the baseband signal the diagram is shown in Fig.2
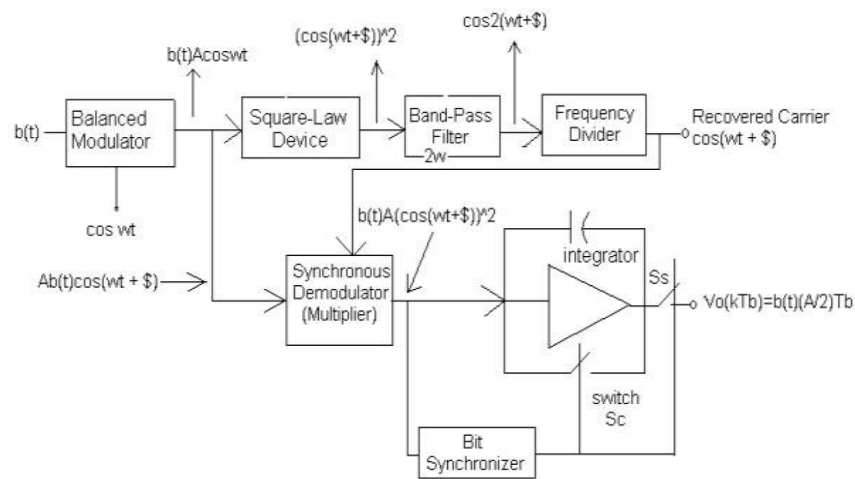

Figure 2: Scheme to obtain the baseband signal in BPSK
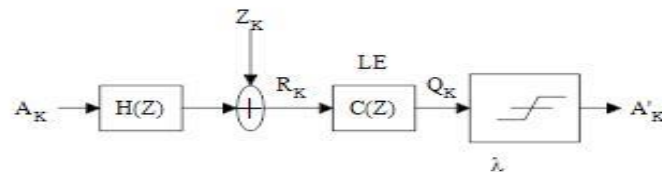
3.5. Channel Equalization

Figure 3: Calculating the Equalizer Coefficients Iteratively –LMS   Approach

This is the most popular inverse model and it is also called as Equalizer. It is used to reduce the distortion in the channel, here we are concentrating more on application of inverse modelling. The transmitted initial sequence of data that will be appearing at output of equalizer without any distortion. Here the effect of an ISI can be removed by equalization filter C(z).The channel equalization is done through LMS algorithm and it's coefficients are obtained by using below expression:

$c(k+1)=c(k)+\beta*E(k)*R_k$

Where, E(k) is the error signal given by

$E(k) = A(k)-Q(k) = A(k)-C'R(k)$ & β is the step size.

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3.6. DCS Design Methodology

The Fig.4 shows the basic scheme of digital system. The given video can be compressed using SEA and FFS algorithm for motion estimation and also to find motion vectors that are based on human eye perception property, the compressed output is the source encoded and then transmitted. Most of the channels are effected by noise.

Noise causes errors in between the input and output sequence of data in digital communication system. So we use channel coding to eliminate this, which is performed by Huffman coding and also next procedure is to do hamming coding. The encoded sequence is modulated by BPSK and is transmitted on the noisy channel and after this equalization is done. In the receiver block, the reverse procedure is done that is demodulating. Hence at last we obtain compressed video.
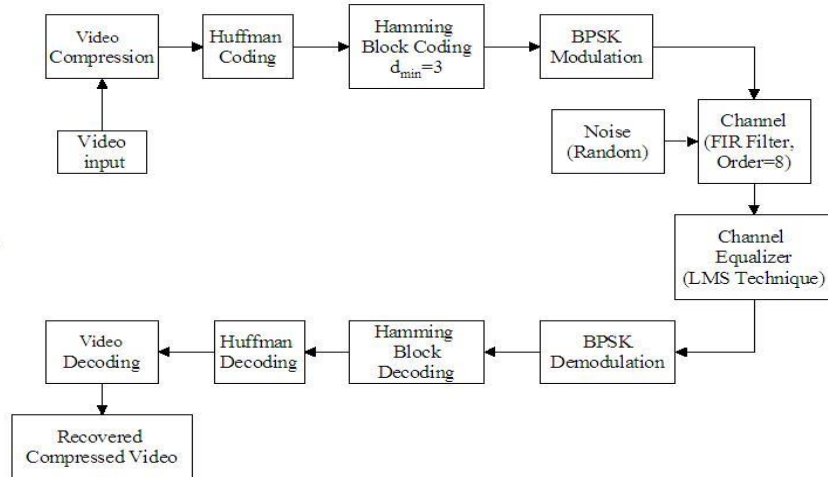

Figure 4: Block diagram of Digital Communication system

4. Results

The Results obtained for different videos with comparision of input video and compressed video are shown below.
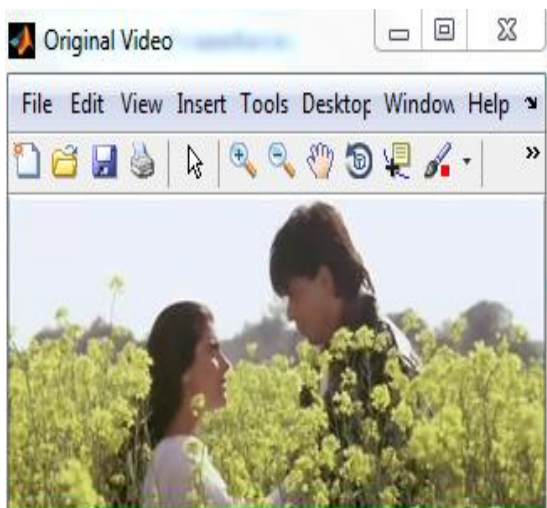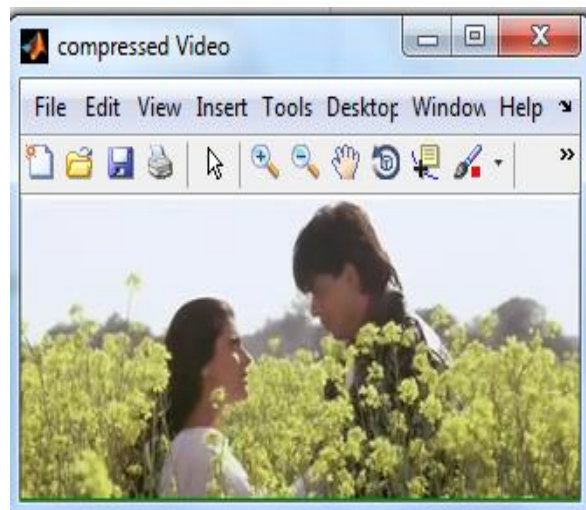

Figure 5: DDLJ Input Video

Figure 6: DDLJ Compressed Video

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Figure 9: MAHABHARATH Input Video   Figure 10: MAHABHARATH Compressed Video

PARAMETERS	DDLJ VIDEO	MAHABHARATH VIDEO
Elapsed time	80.025486 seconds	96.0124875 seconds
Mean Square Error (MSE)	8.2415	13.1542
Peak Signal to Noise Ratio (PSNR)	72.3129	70.1624
Original size of Video	3205KB	2154KB
Frame size of Input video	640X360	320X240
Compressed Video Size	525KB (256X256)	322KB (256X256)
Compression ratio	9.0245	10.2451

5. Conclusion

Here we taken a video and then it is compressed and finally the compressed video is transmitted then detected by the designed System. This is simulated in the Matlab. The Compressed video size, Compression ratios are obtained.

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