EVALUATE THE EFFICIENCY OF VIDEO TRANSMISSION USING A NEW CIRCULAR SEARCH ALGORITHM BASED ON THE MOTION ESTIMATION FOR A SINGLE USER

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ABSTRACT

The successful transmission of video over wireless networks faces many challenges and problems that contribute to the weakening of efficient transmission systems because of the limited resources and the environment surrounding the wireless signal. Therefore, In order to deal with these challenges we need to compress the video in efficient ways in addition to a good transmission system that overcome the errors of the channel and correct potential errors during the transmission process. In this paper, the transmission system depends on the transmission of the video to a single user, a proposed system to simulate the transmission in the mobile networks and to measure the efficiency of the transmission system is added to the percentage of noise represented additive white Gaussian Noise (AWGN) channels. In many such practical systems, jointly source and channel coding the efficiency and performance of the transmission system can be greatly improved to obtain a transmission system without channel errors. The source coding decreases the redundancy in the signal sent to provide bandwidth and the channel/convolutional coding (CC) adds useful redundancy to combat channel errors. The circular search algorithm for motion estimation (ME) is used as a source coding method. The results show that the suggested system can produce a balance among the compression performance and remain video quality the methods used in the transmission process showed a great advantage in the performance of the channel encoding compared to another transmission system without channel coding.

Keywords: Convolutional coding, Video transmission, Block-Matching, Motion Estimation.

1. INTRODUCTION

The development of the video communication process and also of the computing system is very easy to apply data compression and bandwidth efficiently. And make the design of wireless transmission systems easy to implement such as broadcast video transmission and messages via the Internet. The major challenge in the field of video communication is the weakness of Internet services which may cause a major delay in data loss or loss of transmission. So, the services with wireless mobile channels are even more inferior. Thus, it is a problems and challenging task to design and effective transmission systems that operate in such band-limited and unreliable noisy transmission environments [1-3].

Data transmissions require data processing before the transmission process to make the data suitable for the transmission process. Multimedia, especially the video sending process requires a sending system and a compression process that makes sending and receiving video easy while maintaining quality and eliminating delay time .

Data compression is used to reduce the volume of multimedia through wireless channels during the transmission process to obtain an effective transmission system and free of delay problems. Data replication is eliminated and made suitable for transmission or storage. The next stage involves the process of returning the video or data state to its original pre-transmitter nature. This process is called decompression. There are many techniques to reduce bit error rates during data transfer such as modulator and channel coding techniques to reconfigure the original data (video sender) and improve the quality of the transmitter that is inversely proportional to the rates or errors of the channel known as bit error rate (BER). Error correction code such as convolutional codes (CC) [1,4,5], to avoid the multipath channel properties that causes extensive ghosting of the transmission. This ghosting causes inter symbol interference (ISI), blurring the time domain signal [4-8].

In this paper, the performance of the system is performed by using the coding of telegraph over wireless networks with the addition of some noise additive white Gaussian noise (AWGN) channels using binary phase shift key (BPSK) modulation. To reduce computational complexity motion estimation (ME) is used as a powerful technique for high compression ratio (CR) while maintaining quality video using (PSNR) [9, 10]. The main method of ME is to redistribute the search points in the primary stage and reduce them in the following stages. The main purpose of the compression process is to reduce the size of the video and eliminate the repetition that does not affect the way the video.

The main structure of the paper is as follows: Section II presents the proposed video transmission system models with the source and channel coding. Section III presents the simulation environment setting, performance evaluation of source coding algorithm and transmission system using two different streaming videos. Finally, conclusions are followed in Section IV.

2. VIDEO TRANSMISSION SYSTEM

Figure 1 represents the suggested system for the transmission process. A video of 176 * 144 dimensions is used for the video conferencing process or mobile networks. The video is divided into a group of images in video conferencing with model Quarter Common Intermediate Format (QCIF). It is normally used in video compression standard H.263/H.261 encoder/decoder. The source encoder carries out redundancy reduction coding for video streams and convert them into binary array of 2D to facilitate the transmission process. In Fig.1 (b), the output stream is encoded with channel coding, and modulated one by one, while in Fig.1 (a), the output stream is only modulated by binary phase shift keying (BPSK) constellations. H.263/ H.261 acts as an inner code while channel coding acts as an outer code. Then, the video stream can be transmitted via the wireless channels [10].

The wireless channel adds AWGN noise to the output signal samples x of BPSK modulation after it suffers from Rayleigh Fading. Thus, the received signal r as in the following equation:

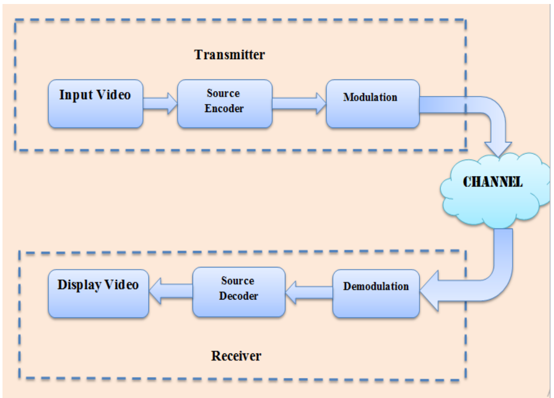
$$r=hx + n; \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where n represents the AWGN samples and h is the channel fading coefficients . For a simple AWGN channel without fading the received signal is represented as [7,10,11].

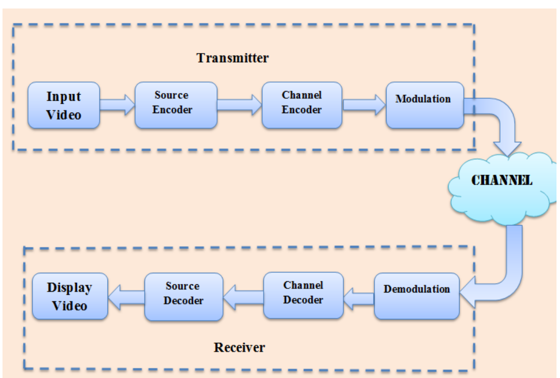
$$r = x+n; \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

In the receiver part , the inverse operation occurs. The received signal r is demodulated and converts from waveforms to digital signal. The BPSK demodulation reinstate the data and modification the information from (-1, 1) to (0, 1). In Fig 1. (b), Viterbi decoder is employed to correct transmission errors by the protection bits inserted through the convolutional encoder and rebuild the original data form of bit stream.

Then, bit streams are sent into H.263 decoder to rebuild the transmitted video.



(a)



(b)

Fig 1. The proposed video transmission (a) uncoded system and (b) coded system.

The following steps represent a brief explanation of the video transmission system.

Step 1: Split the uncompressed video into number of image.

Step 2: Source encoding is used to reduce redundancy through H.263 with Circular searching algorithm.

Step 3: Encode the compressed data 1-D bits by convolutional encoder.

Step 4: convert the binary bits (0, 1) into (-1, 1) by simple modulated (BPSK) .

Step 5: Introduce noise to simulate wireless channel errors. And the signals are transmitted via an AWGN channel**.**

Step 6: The reverse processes (demodulation, channel and source decoding) the receiver part, retrieve the transmitted video streaming to original state for display.

Step 7: Calculate the bit error rate (BER) as a function of signal to noise ratio (SNR).

2.1 Convolutional Encoding

The process of correcting channel errors during the transmission process is very important, especially when data transfer is difficult or impossible. The basic idea of channel error correction is to introduce the controlled frequency of the binary bit stream where there is high reliability by improving the transmission process. In convolution encoder, k data bits can be shifted to the register at once, and n code bits generated. The sliding window moved block by block along the input stream, can determine the output of the encoder.

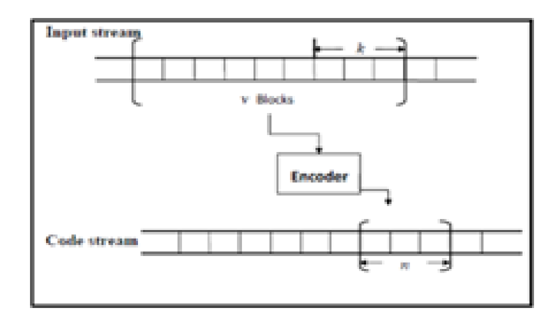


Fig 2. code structure of general convolutional codes.

So, the blocks include k symbols, then output symbols are not only generated from the current block but also from the previous v_1 blocks. The v which is identified as the constraint length of this code is actually 1 plus the length of the longest shift register delay line in the encoder. The convolutional code $R= k/n$ could be defined as a (n,k,v) code in Fig. 2, with generator polynomial g that distinguishes the encoder connections. The using Viterbi decoding algorithm in receiver part, has the ability to detect and correct a limited number of errors without needing a reverse channel to appeal retransmission of data [12].

2.2 Source Video Coding

The video input contains a lot of redundancy and information is redundant or not important at this stage is to eliminate this data by what is known as compression video.

Where spatial and temporal space is used to eliminate repetition redundancy. Many compression techniques combine spatial and temporal space to reduce repetition. This is known as video compression. The reverse process is called decompression. In temporal space, which depends mainly on motion estimation algorithms, the best match between current image and previous image. The method is successfully adopted through video coding standards such as H.261, H.263, MPEG-1, MPEG-2 and MPEG-4 [4]. Fast BM algorithms have been proposed such as three-step search (TSS), new three-step search (NTSS), four-step search (4SS), and diamond Search (DS), to reduce the computational complexity [9-11]. The circular search algorithm proposed in [13] is used in this work. It is similar to the TSS with the redistribution of the search points in a completely different way compared to the original algorithm and in the remaining two stages the number of points is reduced to four points instead of nine points.

The video streaming include number of frames with RGB models, which is generally require more space than the other color models. Thus, these frames are converted into YCbCr color space, where Y is the luminance component and CbCr are the chrominance component. The algorithm flowchart is shown in Fig. 3.

Fig. 4 represents the searching method. This explained the search process to obtain the best match depending on the least displacement between the two pictures. The steps of video compression algorithm can be listed as:

Step 1: Input the original video and split it into no of frames size 176 *144.

Step 2: divide the Block into small part with dimensions 16*16.

Step 3: Apply BM motion estimation algorithm with circular search algorithm**.**

Step 4: the search location with center (0, 0), and select parameter p= 7, step size S = 4.

Step 5: Select the searching range (8 locations +/- S pixels.

Step 6: Choose a location from (8) locations select min cost.

Step 7: Evaluate the new step size, S = S/2.

Step 8: If (S=1) occur then stop search this is stop condition.

Step 9: Apply MV and coding.

Step 10: Calculate CR and PSNR.

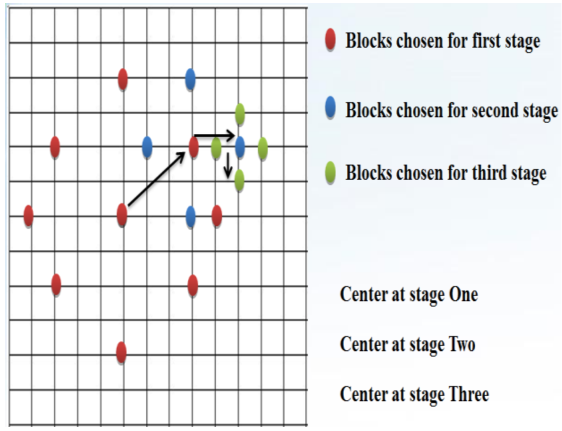


Fig 3. Circular Search Algorithm process

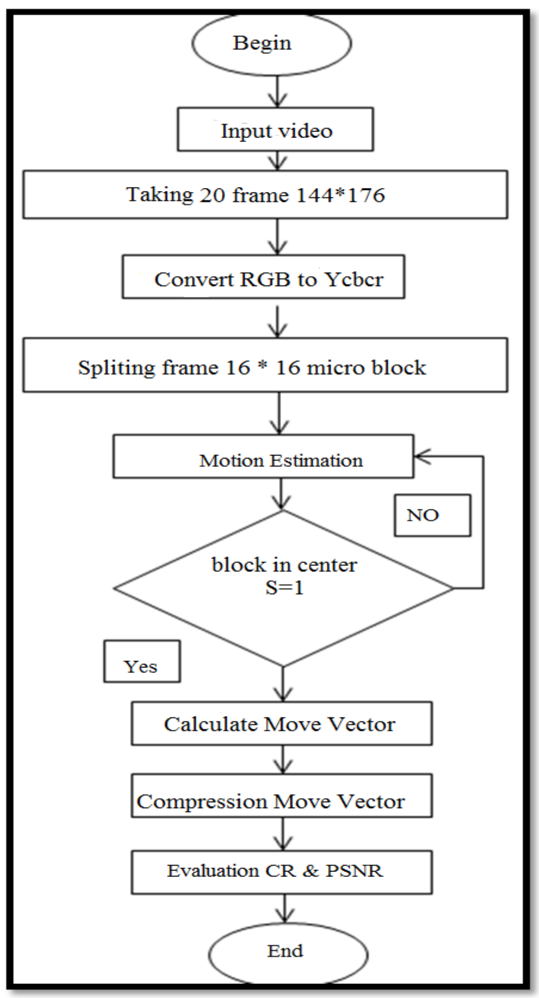


Fig4: The Block diagram source coding algorithm

3. RESULT AND DISCUSSION

3.1 Simulation environment & compression

Figure 5 illustrates the models used in the compression and transmission process. Two standard models with dimensions 176 * 144 were selected with 20 video frames with parameters such as threshold value and number of images representing each case. The results show great efficiency for the transmission system while maintaining the quality of the video transmitted

Fig 5. The two (Forman, Akiyo,) tested videos.

Table 1: Source Encoding (input and output) Result

No frame	1	1_20 AV	Output
Forman	48.5	970	32.5
Size. Akiyo	38.5	770	20.7KB
Type	BMP	BMP	Video
Dimension	144*176	144*176	144*176

Table 2: Video compression test results

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Type Video	AV (CR)	AV (PSNR)
Forman	32.473	31.556
Akiyo	31.792	32.914

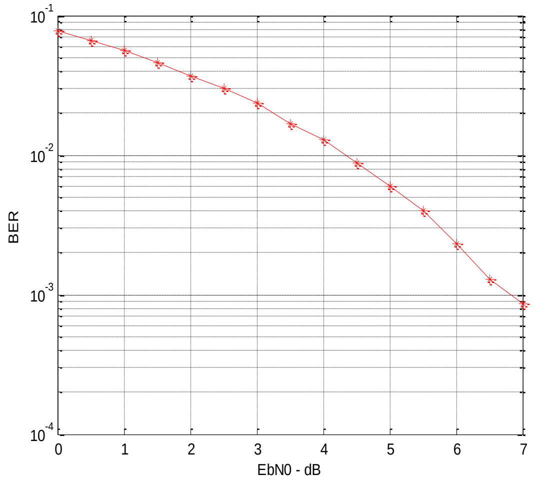
3.2 Performance calculation of H.263/video compression

In this part, the system performance is tested and evaluated in terms of compression ratio and image quality. In addition to simulating the transmission process where the appropriate environment is created closer to the real effects suitable for the transmitter. Scientific test depends on the two video and different parameters are entered by the user of the system .The selection of parameters provides the best compression process for the video while maintaining the quality of the video. The value of the threshold and the quality of the image correspond to the opposite. The higher the threshold value, the greater the compression process thus the inverse of the quality of the video. However. The quality of the video depends on the style of selecting the appropriate parameters for the compression process. Where the best compression process is obtained can reduce the size of the video transmitter to make the transmission process effective. Compression ratio (CR) and frame quality (PSNR) are tools that assess and test the compression process

3.2 Evaluation of system performance using AWGN channel

For a complete test and evaluation of system performance two videos are used where the videos are compressed using a new algorithm. A stream of bits is transmitted through the (AWGN) channel to provide an environment in the real transmission process using the simplest BPSK modulation. The simulation of the videos was performed to calculate the bit error rate during the transmission process for different *Es/No*, signal/ symbol energy to noise power density ratio

Performance is generally different in assessing and calculating bit errors during the transmission process. Performance In the case of using channel encoding it is much better in the case of without channel coding because of the discovery and correction of errors in the channel encoding process by used convolution. Figures 6 show the performance of the transmission system of the two different (Forman, Akiyo) videos without CC and figures 7 with CC. In these figures, it is seen that, the BER is inversely comparative to the signal to noise ratio (SNR). AWGN provides a desirable gain for higher values of SNR. Great video quality at the reception end can also be achieved through reducing the BER of the transmission channel.



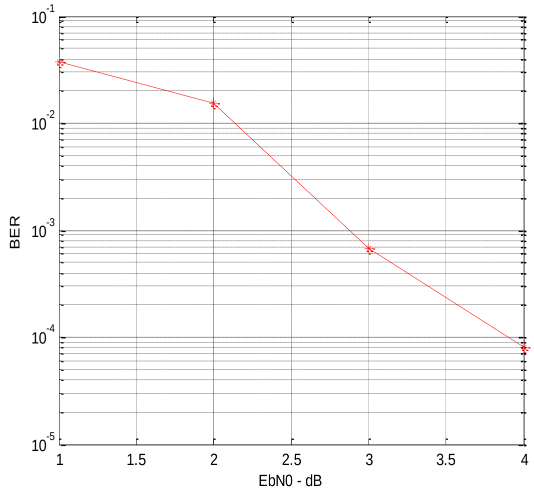
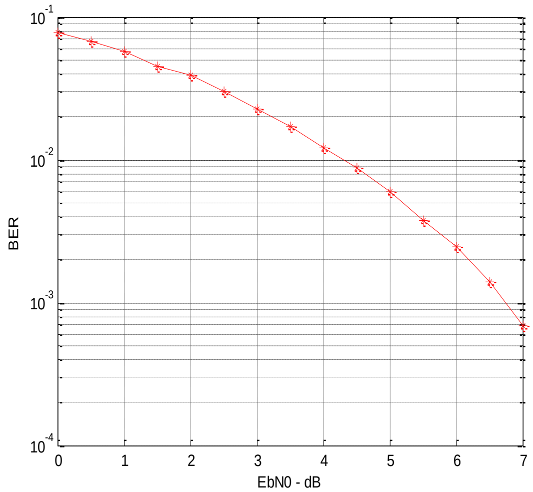


Fig 6. a the proposed transmission systems (Forman video) without channel coding.

Fig 7. a the proposed transmission systems (Forman video) with channel coding.



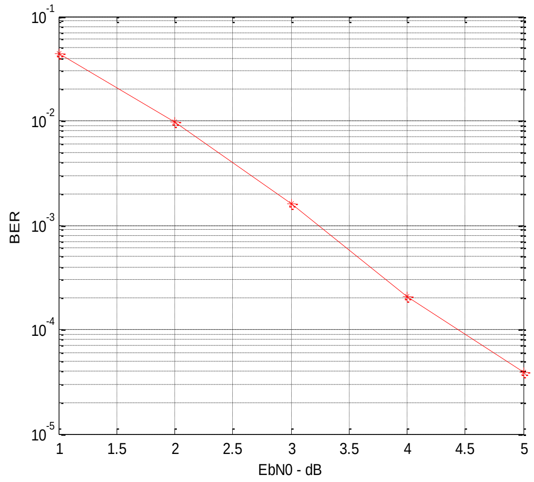


Fig 6. b the proposed transmission systems (Akiyo video) without channel coding.

Fig 7. b the proposed transmission systems (Akiyo video) with channel coding.

4. CONCLUSIONS

In this paper, a video transmission system over wireless networks is proposed for a single user. Video compression is done in a new way, namely the circular search algorithm, which is based mainly on the estimation of the direction of motion. The video compression process minimizes the video size and removes redundancy and unnecessary data to be suitable for the transmission process. The proposed transmitter system consists of two parts, the first part without the coding channel, which showed less efficiency in the performance of the transmission system. While the use of the coding channel we get the rates of bit errors (BER) less than the first case by the end result of the quality of the quality of transmission and maintain the quality of video is an important process in all successful transmission systems.

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