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Evaluating the Efficiency of Video Transmission Using a New Circular Search Algorithm Based on the Motion Estimation for a Single User

[a] Shaymaa T. Ahmed , [b]Seba A.Sahy

[a]*Department of Computer Science, College of Basic Education, University of Diyala, Iraq*

[b]*Middle Technical University, Institute of Medical Technology Al-Mansur named, Iraq*

memprh@gmail.com sebaaziz@gmail.com

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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 not only to compress the video in efficient ways but also to use 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 (i.e. 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 maintain video quality. The methods used in the transmission process showed a great advantage in the performance of the channel encoding compared to that of another transmission system without channel coding.

1. INTRODUCTION

The development of the video communication process and the computing system becomes very easy through applying data compression and bandwidth efficiently. The design of wireless transmission systems such as broadcast video transmission and messages via the internet turns to be easily implemented. 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 problem and challenging task to design 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 which is 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 which 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) is used [1,4,5], to avoid the multipath channel properties that causes extensive ghosting of the transmission. This ghosting causes inter symbol interference (ISI), blur 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 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 is maintained by using (PSNR) [9, 10]. The main method of ME involves redistributing to redistribute the search points in the primary stage and reducing 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, section IV sums up the conclusions.

2. VIDEO TRANSMISSION SYSTEM

Figure 1 represents the suggested system for the transmission process. A video whose dim are 176 * 144 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 converts them into a 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 a 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 an WGN noise to the output signal samples x of BPSK modulation after it suffers from Rayleigh Fading. Thus, the received signal r is gotten from the following equation:

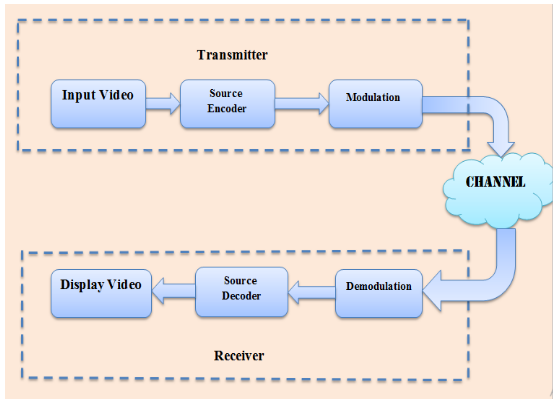
$r=hx+n$; .... (1)

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

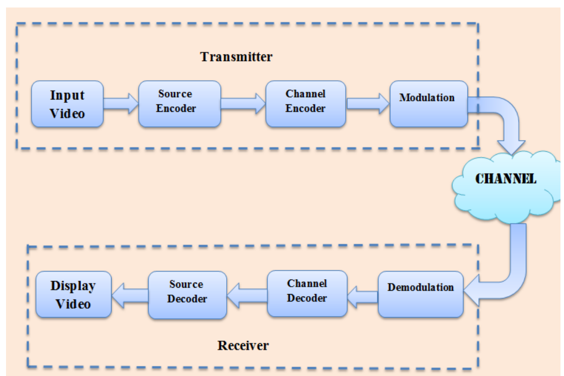
$r = x+n$; .... (2)

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

Then, the 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 present a brief explanation of the video transmission system.
Step 1: Split the uncompressed video into a number of images.
Step 2: Use the source encoding to reduce redundancy through H.263 with circular searching algorithm.
Step 3: Encode the compressed data 1-D bits by convolutional encoder.

Step4:convert the binary bits (0, 1) into (-1, 1) by simple modulated (BPSK) . **Step 5**: Introduce noise to simulate wireless channel errors. So 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 the 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 a 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 is generated. The sliding window moved block by block along the input stream, can determine the output of the encoder.

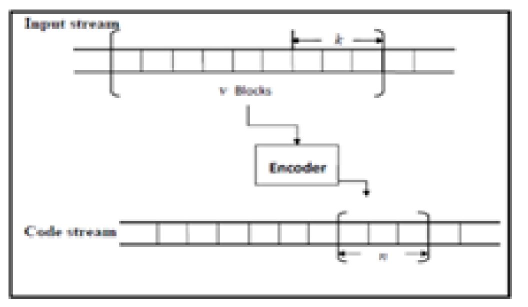


Fig 2. Code Structure of General Convolutional Codes.

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 the generator polynomial *g* that distinguishes the encoder connections. The use of 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].

3.2 Source Video Coding

It is important at this stage to know whether,the video input contains reduntant information as the latter can be eliminated by what is known as compression video.

Spatial and 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. The temporal space which depends mainly on motion estimation algorithms is 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 away which completely different from that of the original algorithm .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 generally, require more space than the other color models do. 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 parts with dimensions 16*16.
Step 3: Apply BM motion estimation algorithm with circular search algorithm**.**

Step 4: locate the search in 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.

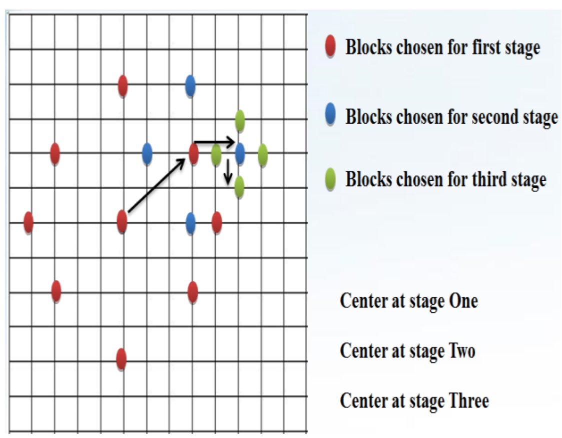


Fig 3. Circular Search Algorithm Process

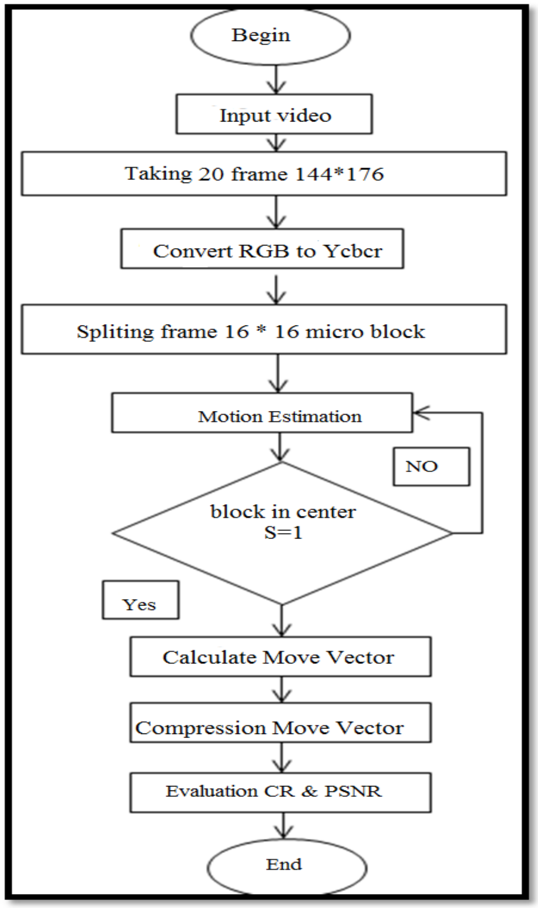


Fig4: The Block Diagram Source Coding Algorithm

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.

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 videos 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 its quality. The value of the threshold and the quality of the image correspond to the opposite. The higher the threshold value is, the greater the compression process will be 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 obtained can reduce the size of the video transmitter to make the transmission process effective. Compression ratio (CR) and frame quality (PSNR) are the tools that assess and test the compression process

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

.

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

3.2 Evaluation of System Performance Using AWGN Channel

For a complete test and evaluation of the system performance, two videos are are compressed big 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 is 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 than it is in the case without channel coding because of the discovery and correction of errors in the channel encoding process which uses convolution. Figures 6 shows the performance of the transmission system of the two different (Forman, Akiyo) videos without/ with CC. In these figures, it is seen that, the BER is inversely comparative to the signal of the 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.

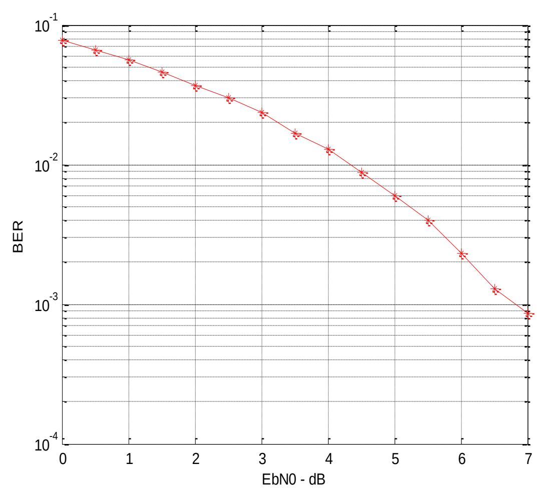


Fig 6. a The Proposed Transmission Systems (Forman Video) without Channel Coding.

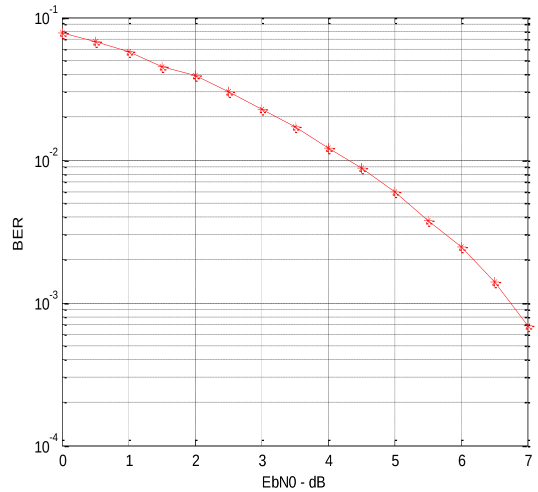


Fig 6. b The Proposed Transmission Systems (Akiyo Video) without Channel Coding.

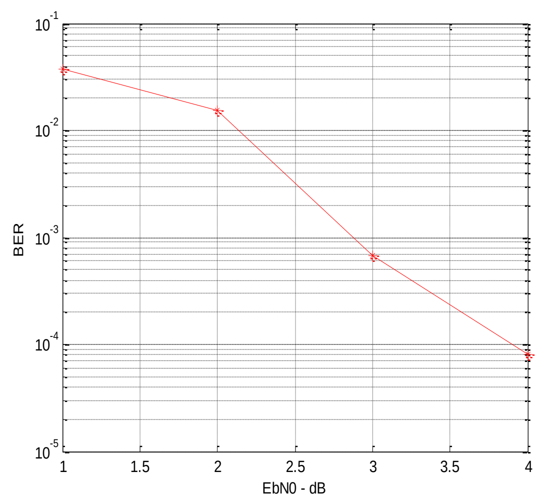


Fig 7. a The Proposed Transmission Systems (Forman Video) with Channel Coding.

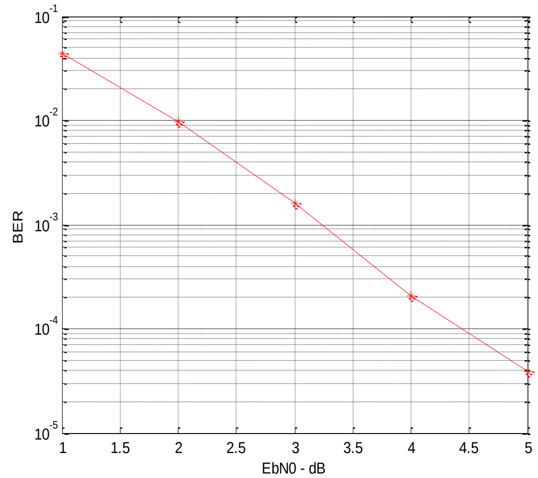


Fig 7. b The Proposed Transmission Systems (Akiyo Video) with Channel Coding.

Conclusion

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 which is without the coding channel showed less efficiency in the performance of the transmission system. However, when we use the coding channel we get rates of bite less than those of the first case . The overall result shows that the propose system maintains not only the quality transmission but also the quality of the video all of the transmission systems.

Reffrences

[1] A. Bajaj, S. J. Basha, and P. Patidar, "Performance of Image Over AWGN Channel Using BPSK Modulation", International Journal of Computer Technology and Electronics Engineering (IJCTEE), December 2012.

[2] H. L. Kumawat, and S. Sharma, " An Implementation of A Forward Error Correction Technique Using Convolutional Coding with Viterbi Decoding ", International Journal of Soft Computing and Engineering (IJSCE), 2012.

[3] Kader, M. A., Ghani F., and Ahmad, R. B., Image Transmission over Noisy Wireless Channels Using HQAM and Median Filter .International Journal of Information and Electronics Engineering 2013.

[4] R. Ahmed and J. N. Avaritsiotis, "The propagation parameters on RFID-localization accuracy," 2015 Science and Information Conference, London, 2015.

[5] R. K. Akotkar and S. B. Kasturiwala, "Hybrid approach for video compression using block matching motion estimation," 2016 World Conference on Futuristic Trends in Research and Innovation for Social Welfare (Startup Conclave), Coimbatore, 2016.

[6] Srinivas Bachu, et al , A Review on Motion Estimation in Video Compression", K L University, Hyderabad, Telangana, Dept. of ECE, India Spaces, 2015.

[7] Samia, Shimu, Khan A. Wahid and Anh Dinh, "Wireless transmission of HD video using H.26 compression over UWB channel", Journal of Real-Time Image Processing, V. 7, N 4, p 233--246, Dec 2012.

[8] Saeed A. Gathban, Salah A. Aliesawi and Salah S. Mustafa , " Block Matching for Motion Estimation using a new Search Algorithm", accepted for publication in Journal of Engineering and Applied Sciences, 2017.

[9] Y. Charfi, " Efficient Error Protection for Image and Video Transmission Over Noisy Channels", Ph. D. Thesis, Department of Computer Science & Information Science, University of Konstanz, May 2004.

الخلاصة

ويواجه البث الناجح للفيديو عبر الشبكات اللاسلكية العديد من التحديات والمشاكل التي تسهم في إضعاف أنظمة الإرسال الفعالة بسبب محدودية الموارد والبيئة المحيطة بالإشارة اللاسلكية. لذلك، من أجل التعامل مع هذه التحديات نحن بحاجة ليس فقط لضغط الفيديو بطرق فعالة ولكن أيضا لاستخدام نظام نقل جيد التغلب على أخطاء القناة وتصحيح الأخطاء المحتملة أثناء عملية الإرسال. وفي هذه الورقة، يعتمد نظام الإرسال على إرسال الفيديو إلى مستعمل واحد، ويضاف نظام مقترح لمحاكاة الإرسال في الشبكات المتنقلة وقياس كفاءة نظام الإرسال إلى نسبة الضوضاء (أي أبيض مضاف قنوات الضوضاء. وفي كثير من هذه الأنظمة العملية، يمكن أن يحسن المصدر المشترك والقناة التي تشفر كفاءة وأداء نظام الإرسال تحسنا كبيرا للحصول على نظام إرسال دون أخطاء في القناة. ويؤدي تشفير المصدر إلى تقليل التكرار في الإشارة المرسلة لتوفير عرض النطاق ويضيف التشفير القناة / التلافي تكرارا مفيدا لمكافحة أخطاء القناة. وتستخدم خوارزمية البحث الدائرية لتقدير الحركة كطريقة ترميز المصدر. وتظهر النتائج أن النظام المقترح يمكن أن يحقق التوازن بين أداء الضغط والحفاظ على جودة الفيديو. وأظهرت الأساليب المستخدمة في عملية الإرسال ميزة كبيرة في أداء تشفير القناة مقارنة بأداء نظام إرسال آخر دون تشفير القناة

الكلمات المفتاحية: التشفير التلافي، نقل الفيديو، مطابقة الحظر ،تقدير الحركة.