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Performance Analysis Of Rate Control Video Transmission Over Wireless Networks

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ABSTRACT:

This paper proposed a technique of bit-rate control for video streaming over constant bit-rate communication channel, where the MPEG-2, standard variable bit-rate (VBR), is adapted to be used as a constant bitrate (CBR). The target image quality and by feedback based on the buffer level controlled on the output rate of the video encoder. A CBR transport over networks, result is a good performance compared with that of VBR. It introduced simplicity of network monitoring and analysis, where the VBR video streaming over CBR channel can be adapted to avoid the problem of congestion of the network. In this paper we study important issue of adapted VBR-compress the video for transport over a CBR channel. That developed systems are implemented using Matlab (Ver 8.1) under Windows 7 operating system.

Kayword: CBR, VBR, Matlab (Ver 8.1).

1. INTRODUCTION

Video compression, which is a necessary process for video communication over networks, removes spatial and temporal redundancies contained in a video sequences. Transporting MPEG-4 video over the broadband wireless network is expected to be an important component of many emerging multimedia applications. Wireless networks are at the epicenter of this trend. At its broadest, a wireless network refers to any network not connected by cables, which is what enables the desired convenience and mobility for the user. Not surprisingly, given the myriad different use cases and applications, we should also expect to see dozens of different wireless technologies to meet the needs, each with its own performance characteristics and each optimized for a specific task and context.

1.1 Motivation:

The current trend in wireless network to transmit video with quality of services by using resources efficiently. A rate control mechanism for video transmission is required and to reduce redundant frames to provide quality of services.

1.2**Problem statement:**

The major challenges of multimedia transmission over wireless networks are that wireless links have lower bandwidths, higher transmission error rates (typically time-varying and bursty), in contrast to wired networks.

Three of the most important challenges (or the problems associated with design) of any video transmission algorithm are

1. Improved error control
2. Rate control
3. Higher Coding Efficiency

Rate control mechanism reduces the frame redundancy and The Proposed rate control is compared with the existing rate control algorithms by using performance metrics like BER, PSNR, Compression Ratio and Frame rate with the variable SNR of the channel. The wireless network and rate control algorithms are simulated using the MATLAB environment.

1.3 Objectives:

- The main objective is to propose a rate control mechanism for video transmission.
- Rate-control schemes usually resolve two main problems. The first is how to allocate proper bits to each coding unit according to the buffer status, i.e., rate allocation, and the second is how to adjust the encoder parameters to properly encode each unit with the allocated bits, i.e., quantization parameter adjustment.
- To reduce the frame drop rate and to maximize quality of video transmission.
- The proposed algorithm is evaluated by based on QP(Bit rate,PSNR,delay) parameters and compared exiting method.

1.4 Main contributions

- A rate control mechanism for video transmission is developed which reduces the frame drop rate and to maximize quality.
- Rate control algorithm evaluated by bit rate PSNR and delay) parameters and compared to the exiting methods.

  In second chapter we discuss about Exiting system advantages and disadvantages, third chapter we overcome drawbacks of exiting nothing but proposed system, fourth chapter discuss about video transmission, fifth chapter briefly discuss about video compression using rate control in this frame dropping scheme and constant bit rate control scheme and then comparative analysis of results and graphs, and last chapter has conclusion.

2. EXISTING SYSTEM

We addressed the problem of efficient bit allocation in a fixated on coding environment. While optimal bit allocation for independently coded signal blocks has been studied in the blurb, we extend these techniques to the more general temporally and spatially dependent coding scenarios, of particular interest are the topical MPEG video coder and multiresolution coders. Our approach uses an operational rate-distortion (RD) framework for arbitrary quantizer sets.

2.1 Disadvantages of Existing System

1. Low PSNR
2. Current frames are discarded

3. PROPOSED SYSTEM

This paper proposed a technique of bit-rate control for video streaming over constant bit-rate communication channel, where the MPEG-2, standard variable bit-rate (VBR), is adapted to be used as a constant bit rate (CBR). Feedback based on the buffer level controls the target image quality and output rate of the video encoder. A CBR transport over networks, result is a good performance compared with that of VBR. These rate control schemes are usually resolve two main problems. First is how to allocate proper bits to each coding unit according to the buffer status, i.e., rate allocation, and the second is how to adjust the encoder parameters to properly encode each unit with the allocated bits i.e., quantization parameter adjustment. PSNR is relatively easy to calculate and provides a rough approximation to the visual quality of the video frame. a high PSNR indicates a high-quality frame.

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3.1 Proposed System Advantages

1. These rate-control schemes usually objective of two main problems. First is rate allocation and the second is quantization, parameter adjustment.
2. High PSNR

4. VIDEO TRANSMISSION

Video transmission, which is a necessary process for video communication over networks, removes spatial and temporal redundancies contained in video sequences.

A decreasing in distortion leads to an increasing in rate and vice versa. So the fundamental problem in rate control can be stated that min D,

$$s.t. R \leq R_{max} \quad 4.1$$

Where Rmax denotes the maximum bit rate. In other words, rate control is to achieve the maximum picture quality (minimum distortion) without exceeding the maximum permitted bit rate where quality is typically represented by peak signal noise ratio (PSNR). Raw video must be compressed before transmission because to achieve efficiency. Video compression schemes are classified into two categories: scalable and nonscalable video coding. Since scalable video is capable of fitly coping with the bandwidth fluctuations in the Internet, we are primarily concerned with scalable video coding techniques. We can also discuss the requirements imposed by streaming applications on the video encoder and decoder.

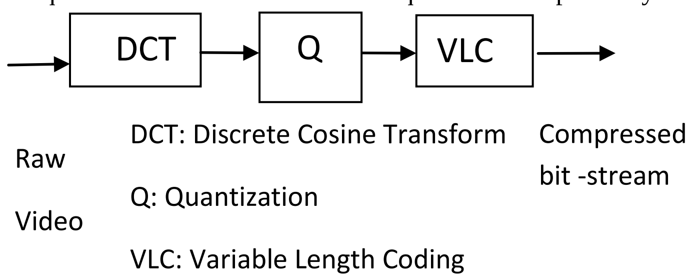

Fig 4.1: Nonscalable video encoder

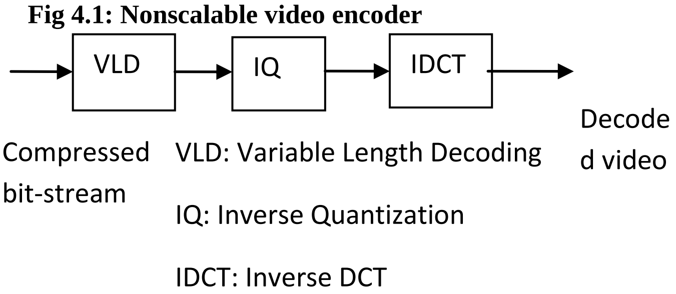

Fig 4.2: Nonscalable video decoder

5. VIDEO COMPRESSION USING RATE CONTROL

5.1 Rate Control Constrained Quality

Rate control always evolves into constrained problems in practical applications. Since the amount of information in compressed video sequences is inherently variable, a buffer is placed between the video encoder and the transmission channel to smooth out the rate variation. The proposed rate control algorithm is designed for bit-rate control includes the requirements of MPEG-2 video coding standard. The TM5 rate control algorithm is designed for bit-rate control in MPEG-2 video coding standard. It consists of the following steps:

(1) Target bit allocation: Target number of bits for the next picture depends on the picture-type and universal weighting factors.

(2) Rate control: The reference value of the QP for each macro block (MB) (Qj) is set as follows:

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$Q_j = (B_i * 31)/r$ 5.1

Where r =2 × R/*f*, **R** denotes the bit rate (bps), *f* denotes the frame rate (fps), for a constant quantization step size of 31, and Bj is the fullness of the buffer.

(1) Adaptive quantization: Finally, the QP for MB *j* is mquantj = Qj× N_actj and is clipped to the range, where N_actj is the normalized spatial activity measure for the MB *j*.

5.2 Mode Selection and Size Selection

In video coding, there are different frame types I, P, and B frames with different Macro Block (MB) modes.

5.3. Frame Dropping Filter: Rate Shaping

The frame dropping filter is used to reduce the data rate of a video stream by discarding a number of frames and transmitting the remaining frames at a lower rate. Before removing the temporal redundancy from the current Inter-frame, it's compared with the previous frame and the difference is measured between them. If the difference is very small, the current frame will be discarded, and the next frame is used as the current frame. But in the receiver side, the discarded frame will be displayed by repeating the previous frame, (i.e. if we transmit 30 fps, and for example in the encoder side we discard two frames, then in the receiver side the number of frames that will be displayed are 32 frame, because the system was design to transmit 30 fps). But if there are no frames to discard, the number of frames displayed equals to the number of frames transmitted. The procedure of frame dropping is as follows:

Step 1: Determine the similarity between the frames.

Step 2: If the current frame is very similar to the pervious frame, then it s drop.

Step 3: The step 1 and 2 repeated for all frame in video sequence.

The encoder transmits the encoded frame with its number and it would be used in decoder side to find the dropped frame. Fig. of The frame dropping sequence shows the frame dropping sequence.

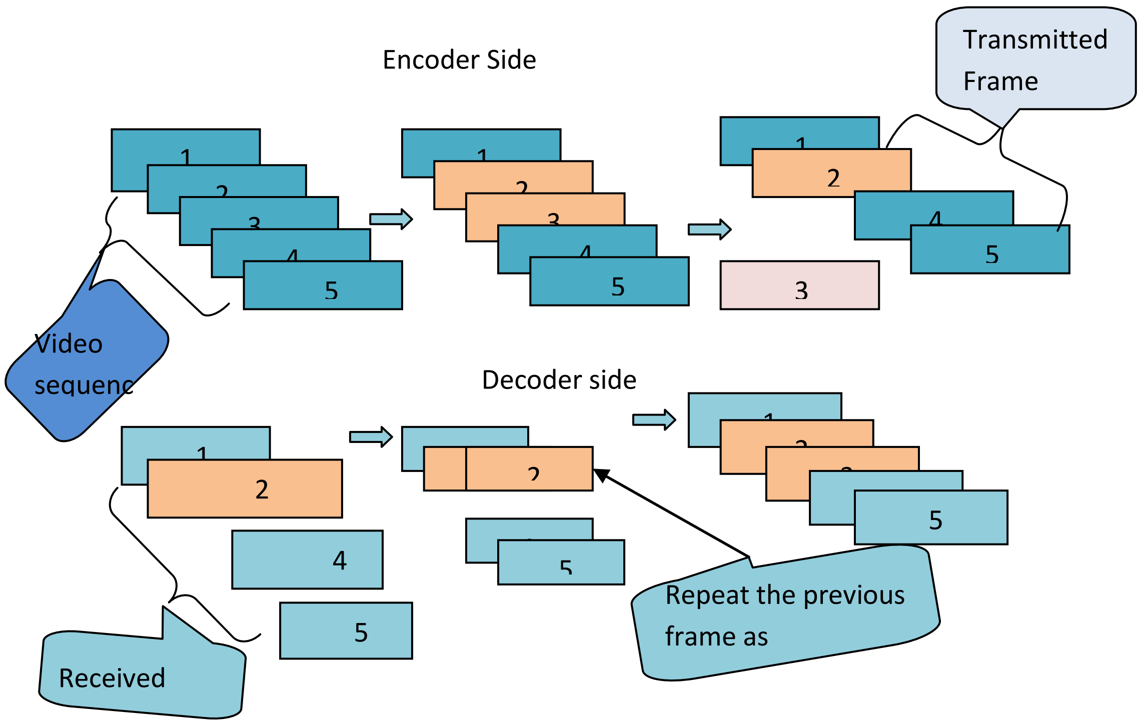

Figure 5.1: The frame dropping sequence

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5.4. Rate Control Scheme:

It can be classified into two major categories: CBR control is used for the constant channel bandwidth video tx and VBR control for the variable channel bandwidth Transmission. These schemes are usually resolve two main problems. First is how to allocate proper bits to each coding unit according to the buffer status, i.e., rate allocation, and then second is how to adjust the encoder parameters to properly encode each unit with the allocated bits, i.e., quantization parameter adjustment. When the output bit rates not match with target bit estimation the rate control provide new quantization step size to encode the data with new quality to be match with target bit rate.

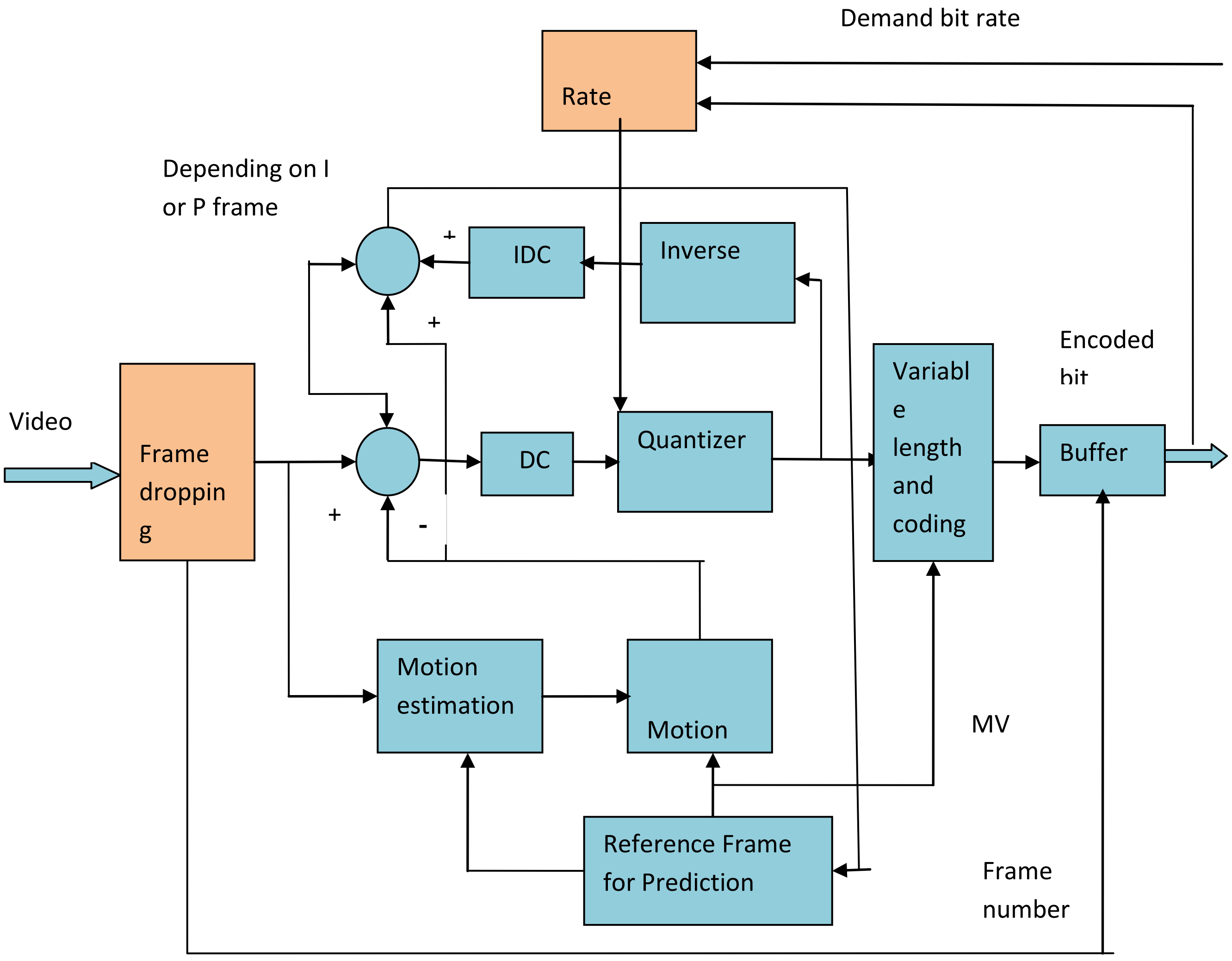


Figure 5.2 the proposed rate control scheme

5.5. **Proposed Bit-Rate Control Requirements:**

Complexity Estimation

The MAD used as the prediction error which is a convenient surrogate for this purpose as follows:

$MAD = \sum_{ij} \left| source_{i,j} - prediction_{i,j} \right|$ (5.2) This MAD is an inverse measure of predictor's accuracy and the temporal similarity of adjacent pictures.

Virtual Buffer Model

Change in the fullness of the virtual buffer is difference between the total bits encoded into the stream, it assumes less a constant removal rate to equal the bandwidth.

GOP Bit Allocation

Based on the demanded bit rate and the current fullness of the virtual buffer, a target bit rate for the entire group of pictures (GoP) are determined, and QP for the GoP's
I-frame and before P-frame is determined. The GoP Target is fed into the next block for detailed bit allocation to smaller basic units or to pictures.

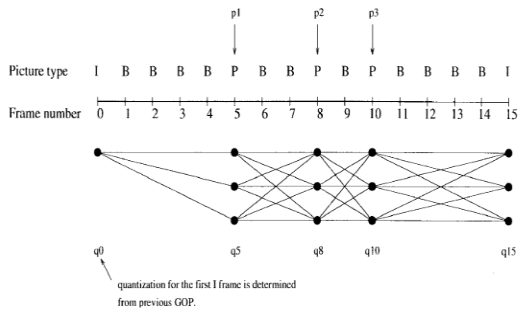


Figure 5.3: An example of GOP structure with corresponding quantization trellis diagram for the case of three quantization values.

Basic Unit Bit Allocation

The "Basic Unit of this approach, rate control may be pursued to different levels of granularity, such as picture, slice, MB row or any contiguous set of MBs. That level is referred to as a "basic unit" at which rate control is resolved, and for which distinct values of QPs are calculated.

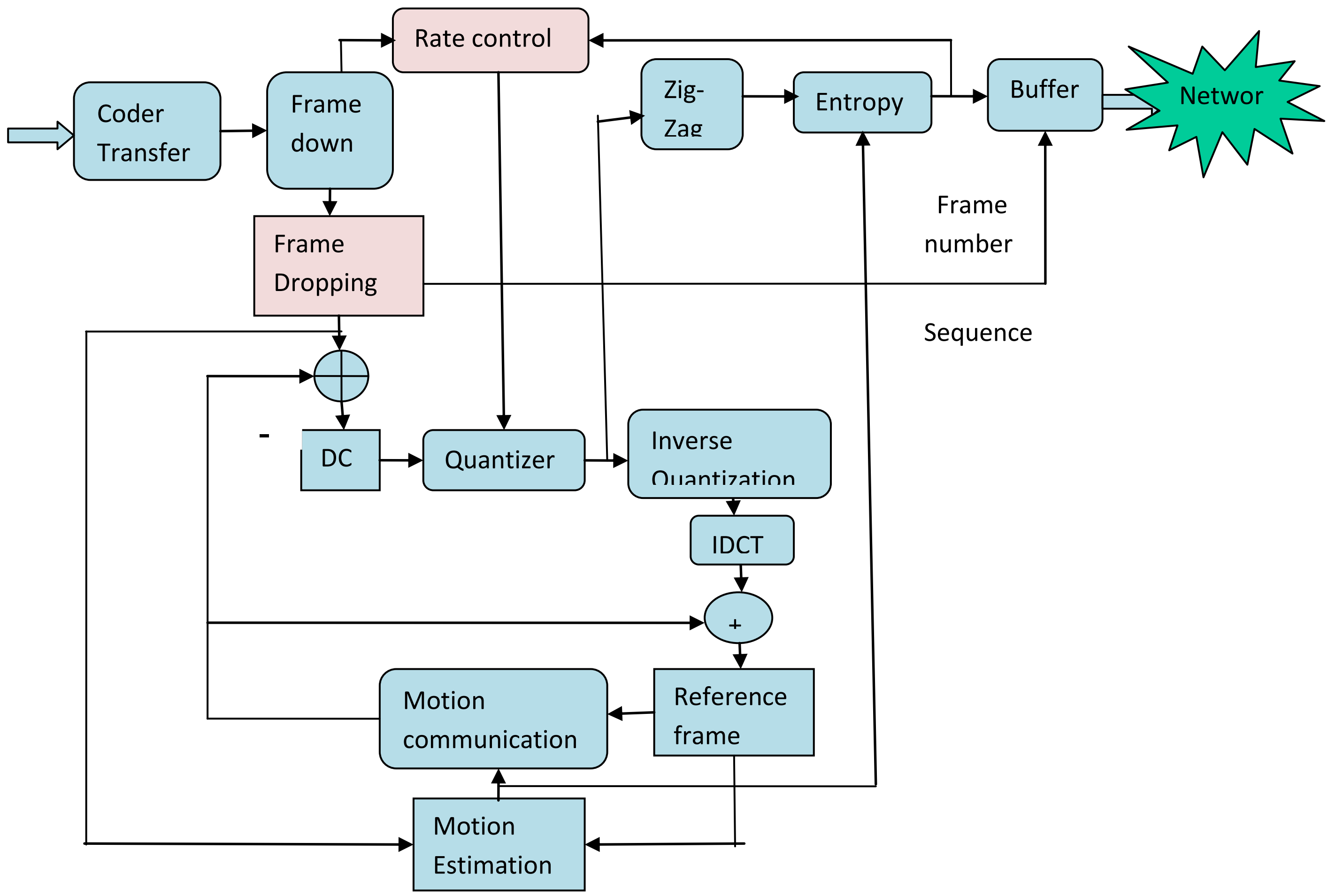
Motion Estimation and Compensation

The uncompressed video sequence input undergoes temporal redundancy reduction by exploiting similarities between neighboring video frames as used Temporal redundancy arises since the differences between two successive frames are usually similar, especially for high frame rates, because the objects in the scene can only make small displacements. With motion estimation, the difference between successive frames can be made smaller since they are more similar. Compression is achieved by predicting the next frame relative to the original frame.
The performance of the proposed compression system was evaluated by using a popular quantitative measure of image quality known as the peak signal-to-noise ratio (PSNR), which is defined as: $PSNR(dB) = 10log_{10}\frac{(2^n-1)^2}{MSN}$ (5.3)
Where n is the number of bits per image sample and MSE is the Mean Squared Error between the distorted frame and the original frame.

$$MSE = \frac{1}{W\times H}\sum_{r=0}^{H-1}\sum_{c=0}^{W-1}(I(r,c)-I^\wedge(r,c))^2 \quad (5.4)$$

This ratio represents the size of the original uncompressed video to the size of compressed video.

$$CR = \frac{\text{Uncompressed file size}}{\text{Compressed file size}} \quad (5.5)$$


Rate control
Coder Transfer
Frame down
Zig-Zag
Entropy
Buffer
Networ
Frame Dropping
Frame number
Sequence
-
DC
Quantizer
Inverse Quantization
IDCT
+
Motion communication
Reference frame
Motion Estimation

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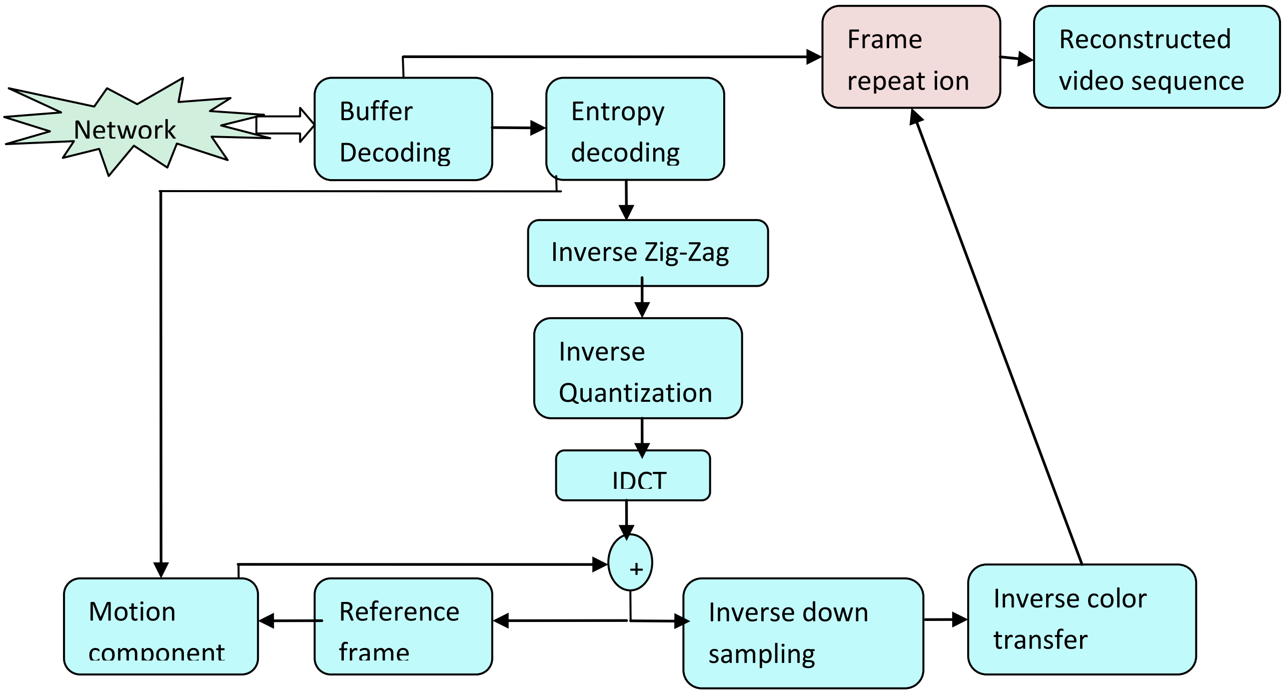

Figure 5.4: Block diagram of constant Bit Rate control

GOPs	Quality	Bit rate (Mb/sec)	Compression Ratio	Encoding Time(sec)	Decoding Time(sec)	PSNR (db)
60	90	2.2012	42.6759	92.8958	66.7894	42.05
	70	1.2520	55.586	91.4845	65.5226	38.56
	50	1.0501	60.1819	90.5184	64.5444	35.85
	30	0.9937	65.2800	88.8284	63.5354	33.12
	10	0.4636	68.9810	87.1280	62.8193	28.16
40	90	2.3061	40.5859	79.1013	78.5404	43.67
	70	1.6085	52.1819	84.2013	76.6332	40.89
	50	1.2010	56.2680	87.1933	75.4766	36.60
	30	1.1205	62.5850	89.4337	75.3637	34.15
	10	1.0810	64.7354	92.4668	75.0104	29.18
30	90	2.74	38.15	95.52	78.54	45.53

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		56	17	15	63	
	70	1.8245	50.0809	94.3349	77.8816	42.18
	50	1.5983	55.8910	94.0619	77.0816	38.89
	30	1.3217	58.1980	92.6858	76.3637	36.81
	10	1.1971	62.2340	91.7493	75.0104	31.45
10	90	3.0610	35.5658	94.2030	83.0957	46.67
	70	2.8910	48.2850	93.8852	81.9677	44.26
	50	1.8650	50.1890	92.5802	80.5538	41.75
	30	1.5610	54.6680	91.7052	79.6462	38.16
	10	1.3230	59.1769	88.7043	78.3899	33.15

Table 5.1: comparative analysis

5.5 Comparison of proposed with exiting methods :

The testing table (table 1) video compression system (CBR system) consists of 7 parts; the first is total bit rate of uncompressed video and number of frames per second GOP. The second part is quality, the third is bit rate, the fourth is compression ratio, the fifth is encoding time, the sixth is the decoding time and final part is PSNR.

1. Table 5.1 shows the relationship between the quality and bit rate, when the quality increases, the bit rate increases as shown in figure 5.5.
2. Table 5.1 shows the effect of quality on the compression ratio (CR).By increasing the quality, the compression ratio decreases. With quality=90, the CR= 42.6759, and with quality=10, the CR=68.9810 as shown in figure 5.6.
3. Table 5.1 shows also the relation between the number of frames per GOP and compression ratio, when the number of frames per GOP is maximum (60) the compression ratio is high (68.9810), and when the number of frames per GOP is minimum (10) compression ratio is lower (35.5658) as shown in figure 5.6.
4. Table 5.1 shows the effect of number of GOPs on bit rate, when the number of frames per GOP is maximum (60), the bit rate is small (2.2012) as Mbps and when the number of frames per GOP is minimum (10), the bit rate is larger (3.0610) Mbps as shown in figure 5.5.
5. Table 5.1 shows the effect of quality on the compression ratio (CR).By increasing the quality, the PSNR increases. With quality=90, the PSNR= 42.05 db, and with quality=10, the PSNR=28.16 db as shown in figure 5.7.
6. Table 5.1 shows the effect of quality on the compression ratio (CR).By increasing the quality, the encoding time increases. With quality=90, the ET=92.8958, and with quality=10, ET=87.1280 as shown in figure 5.8.
7. Table 5.1 shows the effect of quality on the compression ratio (CR).By increasing the quality, the encoding time increases. With quality=90, the ET=92.8958, and with quality=10, the ET=87.1280 as shown in figure 5.9.

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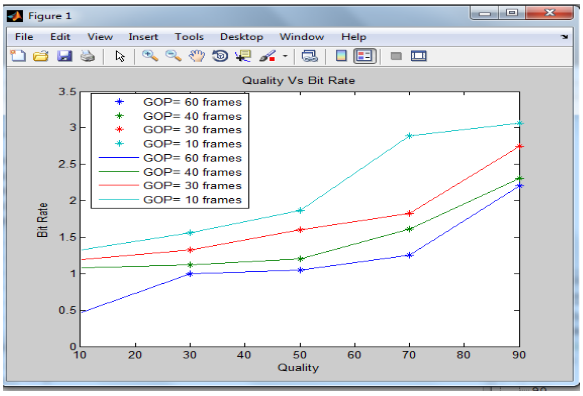

Figure 5.5: Quality Vs Bit Rate

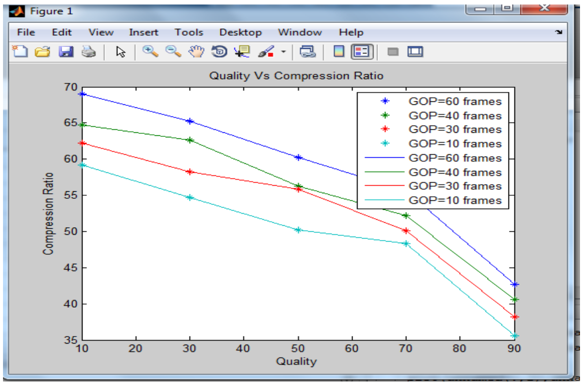

Figure 5.6: Quality Vs Compression Ratio

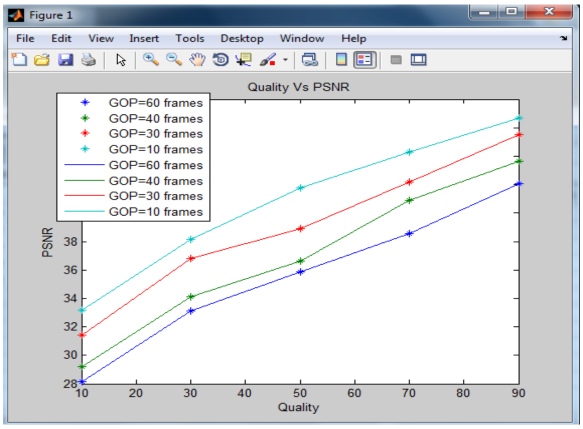

Figure 5.7: Quality Vs PSNR

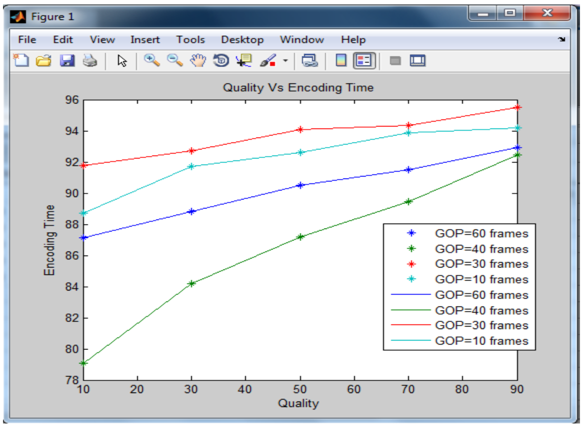

Figure 5.8: Quality Vs Encoding Time

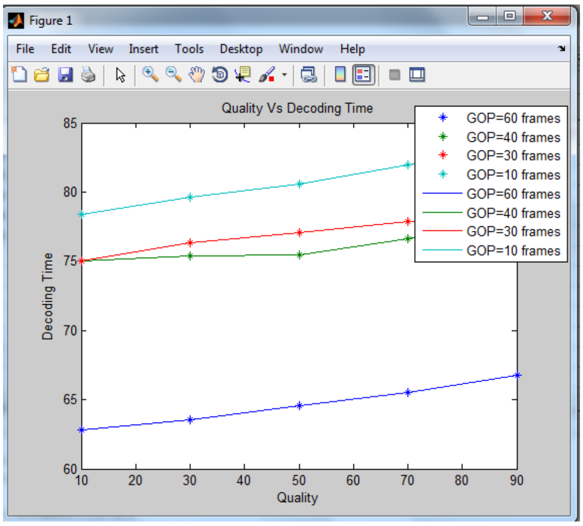

Figure 5.9: Quality Vs Decoding Time

6. CONCLUSION

In this we have to observed GOP on video, in this GOP increases PSNR decreases and bit rate minted ,in the GOP we take some Qualities (90,70,50,30,10) in this bit rate is constant it is main advantage.

7. FUTURE SCOPE

In this we have developed up to 60 GOP without data losses, improve more GOP without data losses in real time.

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