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# Spatial Scalable Video Compression Using H.264

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***Abstract:*** *H.264 is a standard was jointly developed by ITU-T and ISO/IEC Moving Picture Expert Group. The main goal of H.264 is to achieve spatial scalability and to improve the compression performance compared to other standards. The H.264 is used to encode the video in a spatial manner, so that the number of the frames is reduced and its size is being reduce thus it achieve scalability. The compression techniques in H.264 will compress the video from its original size and produce an efficient output. The video format used in this software is QCIF video and it is encoded and decoded using the H.264 design.*
***Keywords:*** *Advanced Video Coding(AVC),H.264,High Efficiency Video Coding(HEVC),Joint Collaborative Team-Video Coding(JCT-VC),Moving Pictures Expert Group(MPEG).*

## I. Introduction

In electronics engineering, video processing is a particular case of signal processing, which often employs video filters and where the input and output signals are video files or video streams. Video compression algorithms ("codecs") manipulate video signals to dramatically reduce the storage and bandwidth required while maximizing perceived video quality. The standardization techniques has become higher priority because only a standard can reduce the cost of video compression codecs. The major problem in high compression video coding is the operational control of the encoder. This can be compounded by varying the content and motion found in typical video sequences.H.264 is a method and format for video compression process of converting digital video into a format that takes up less capacity when it is stored or transmitted.

## II. H.261 System

H..261 is a compression has been specifically designed for video telecommunication application. It was developed by CCITT in 1988-1990. It is meant for video conferencing, video telephone application over ISDN telephone lines. The base lines of ISDN is 64 kbps and integral multiple of (P×64).It is a ITU video compression standard . It supports only two video frame sizes CIF(352×288 luma with 176×144 chroma) and QCIF(176×144 luma with 88×72 chroma) using 4:2:0 sampling scheme.

H.261 encoder model

H.261 defines two types of coding. Intra coding where blocks of 8x8 pixels each are encoded only with reference to themselves and they are sent directly to the block transformation process. A prediction error is calculated between a 16x16 pixel region (macroblock) and the (recovered) correspondent macroblock in the previous frame. Prediction error of transmitted blocks (criteria of transmission is not standardized) are then sent to the block transformation process. H.261 supports motion compensation in the encoder in which a search area is constructed in the previous (recovered) frame to determine the best reference macroblock . In block transformation, intra coded frames as well as prediction errors will be composed into 8x8 blocks. Each block will be processed by a two-dimensional FDCT function. If this sounds expensive, there are fast table driven algorithms and can be done in software quite easily, as well as very easily in hardware.

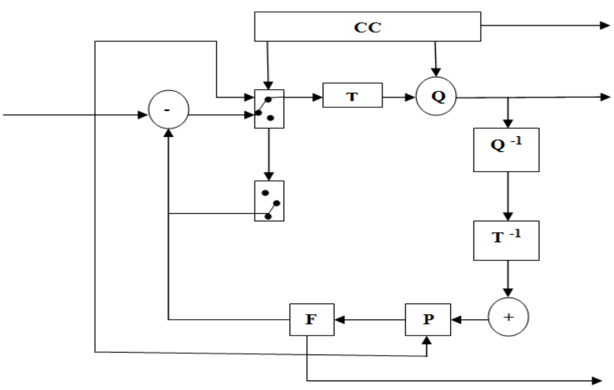



**Fig.1.** Block Diagram of H.261 Encoder System.

The advantage in H.261 is the maximum frame rate is 30 frames per second but it can be reduced depending on the application and bandwidth. It supports both temporal and spatial redundancy of video sequences to achieve high compression ratio. The disadvantage in H.261 is that it does not have good quality as H.263 and it cannot support for lower end machines.

## III. H. 263 System

### A. Encoder

Video coding aims at providing a compact representation of the information in the video frames by removing spatial redundancies that exist within the frames, and also temporal redundancies that exist between successive frames. As in the case of the H.261 standard, the H.263 standard is based on using the discrete cosine transform (DCT) to remove spatial redundancies, and motion estimation and compensation to remove temporal redundancies. When a source frame is coded using the DCT, the encoder is said to be operating in the intra coding mode, and the corresponding encoded frame is called an I-picture. In the case where temporal prediction is used, the encoder is said to be operating in the inter coding mode, and the corresponding encoded frame is called a P-picture. A block diagram for a typical encoder is given in Fig 2.

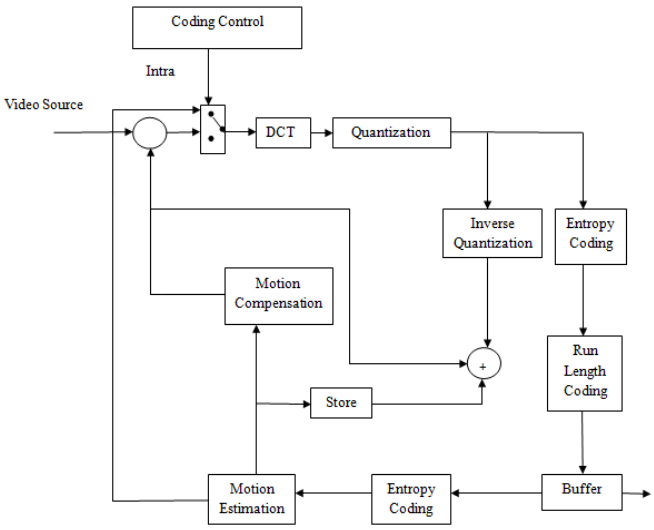



**Fig.2.** block diagram of H.263 Encoder.

### B. Decoder

A block diagram of a typical decoder is shown in Figure 3. In the case of an intracoded macroblock, the encoder performs only the inverse quantization and inverse DCT operations to reconstruct the original macroblock. The reconstructed macroblock is then used in the reconstructed frame.

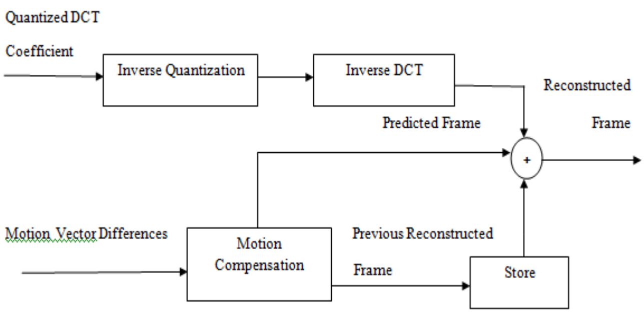



**Fig.3.** Block diagram of typical decoder.

## IV. H.264 System

H.264 is a video compression format that is currently one of the most commonly used formats for recording ,compression and distribution of video content.

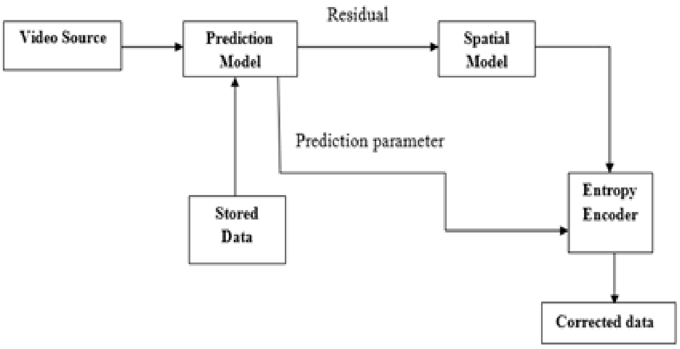
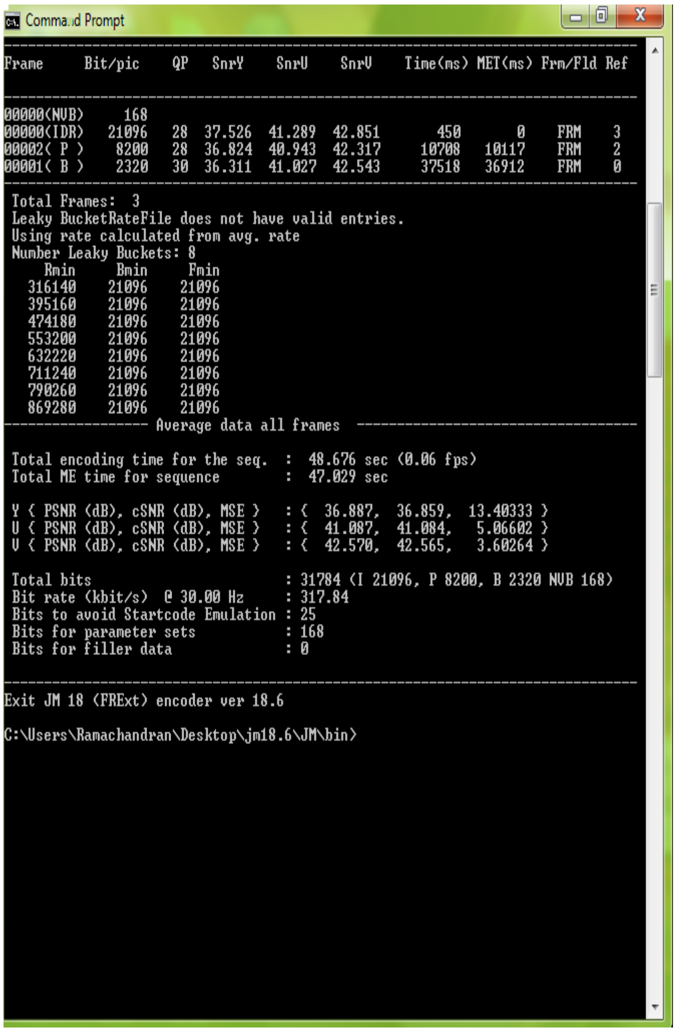


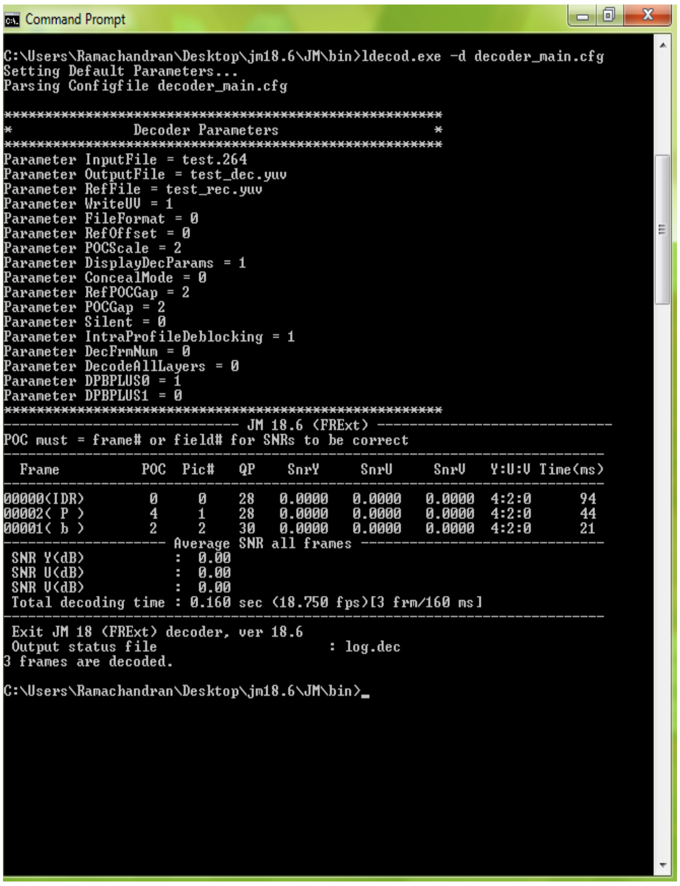

**Fig.4** H.264 Encoder module.

A video CODEC Fig.4 encodes a source image or video sequence into a compressed form and decodes this to produce a copy or approximation of the source sequence. A video encoder Fig.4 consists of three main functional units: a prediction model, a spatial model and an entropy encoder. The input to the prediction model is an uncompressed 'raw' video sequence. The prediction model attempts to reduce redundancy by exploiting the similarities between neighboring video frames and neighboring image samples, typically by constructing a prediction of the current video frame or block of video data. The output of the prediction model is a residual frame, created by subtracting the prediction from the actual current frame, and a set of model parameters indicating the intra prediction type or describing how the motion was compensated. The residual frame forms the input to the spatial model which makes use of similarities between local samples in the residual frame to reduce spatial redundancy.

## V. Stimulation Parameter



```
Command Prompt
-------------------------------------------------------------------------------
Frame     Bit/pic    QP   SnrY    SnrU    SnrV    Time(ms) MET(ms) Frm/Fld Ref

-------------------------------------------------------------------------------
00000(NVB)     168
00000(IDR)   21096   28  37.526  41.289  42.851       450       0    FRM    3
00002( P )    8200   28  36.824  40.943  42.317     10708   10117    FRM    2
00001( B )    2320   30  36.311  41.027  42.543     37518   36912    FRM    0
-------------------------------------------------------------------------------
 Total Frames:  3
 Leaky BucketRateFile does not have valid entries.
 Using rate calculated from avg. rate
 Number Leaky Buckets: 8
     Rmin     Bmin     Fmin
   316140    21096    21096
   395160    21096    21096
   474180    21096    21096
   553200    21096    21096
   632220    21096    21096
   711240    21096    21096
   790260    21096    21096
   869280    21096    21096
------------------ Average data all frames  -----------------------------------

 Total encoding time for the seq.  :  48.676 sec (0.06 fps)
 Total ME time for sequence        :  47.029 sec

 Y { PSNR (dB), cSNR (dB), MSE }   : {  36.887,  36.859,  13.40333 }
 U { PSNR (dB), cSNR (dB), MSE }   : {  41.087,  41.084,   5.06602 }
 V { PSNR (dB), cSNR (dB), MSE }   : {  42.570,  42.565,   3.60264 }

 Total bits                        : 31784 (I 21096, P 8200, B 2320 NVB 168)
 Bit rate (kbit/s)  @ 30.00 Hz     : 317.84
 Bits to avoid Startcode Emulation : 25
 Bits for parameter sets           : 168
 Bits for filler data              : 0

-------------------------------------------------------------------------------
Exit JM 18 (FRExt) encoder ver 18.6

C:\Users\Ramachandran\Desktop\jm18.6\JM\bin>
```




In this paper we use JM (Joint Model) Software to stimulate the output of H.264. The output is genertated by giving a QCIF format of video sequence as input and the output will be H.264 format video data. Here the encoded and decoded output values of the given sequence is compared using various parameters. The video sequence consist of mainly three frames namely Y-frame, U-frame, and V-frame. At the decoder part of H.264 the input format of video is H.264 and the output is the QCIF form of video. The display parameters of the YUV frames or fields and their decoding time of each frames were given.
The following table 1 and table 2 shows the parameter comparison in encoder and decoder of H.264.

**Table 1 Comparison of SNR, CSNsR, MSE**

| | PSNR | CSNR | MSE |
|---|---|---|---|
| **Y** | 36.887 | 36.859 | 13.40333 |
| **U** | 41.087 | 41.084 | 5.06602 |
| **V** | 42.570 | 42.565 | 3.6024 |

The table 1 shows the signal to noise ratio and channel signal to noise ratio of YUV frames and its Mean Square Error rate.

| FRAME | BIT/ PIC | QP | SNR Y | SNR U | SNR V | TIME |
|---|---|---|---|---|---|---|
| NVB | 168 | - | - | - | - | - |
| IDR | 2109 | 28 | 37.5 | 41.2 | 42.8 | 450 |
| P | 8200 | 28 | 36.8 | 40.9 | 42.3 | 10708 |

**Table 2 Comparison of various parameters.**

The table 2 shows the bit/pic rate, QP and SNR values for various parameters in the video sequences.

## VI. Comparison Of Pervious Standards

The H.261 coding algorithm was designed to operate at video bitrates between 40kpbs and 2mbps. H.261 supports two video sizes CIF and QCIF using 4:2:0 sampling scheme. H.263 is a video compression standard originally designed as a low bit rate compressed format for video conferencing. The next enhanced video codec developed by ITU-T VCEG after H.263 is the H.264 standard, also known as AVC and MPEG 4 it provides a significant improvement in capability beyond H.263.

**Table 3 Comparison of H.261,H.263&H.264**

| **Application** | **Data Rate** | **Video Standard** |
|---|---|---|
| Digital television broadcasting | 2-5 mbps<br>10-20 mbps for HD | MPEG-2 H.264/AVC |
| DVD video,HD-DVD,Blue ray disk | 4 to 8 mbps<br>10 to 20 mbps | MPEG-2 H.264/AVC, VC-1 |
| Internet video streaming | 20 to 600 kbps | Proprietary similar to H.263, MPEG-4 of H.264/AVC,<br>VC-1 |
| Video conferencing, telephony | 20 to 320 kbps | H.261,H.263,<br>H.264/AVC |
| Video over 3G wireless | 20 to 200 kbps | H.263, MPEG-4,H.264/AVC, VC-1 |

## VII. Conclusion

The result of this paper indicate that the H.264 standard can provide a significant amount of increased coding efficiency. The reduction is achieved by the video coding design H.264 using JM Software. . The video sequence we use in this is quarter video with 176×144 size. This is achieved by removing the similar neighboring frames and compress the space and improve scalability of the video sequence It provides 31 to 35% of efficiency and bit rate reduction when compared to the previous standards.

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