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Enhanced Scalable Video Coding Technique with an Adaptive Dual Tree Complex Wavelet Transform

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Abstract

The scalable Video is the most suitable video format for the current day scenario where there are different varieties of electronic gadgets used to communicate and play back. As the device resolution varies, the codec designed for Scalable video (H.264/AVC) is the only solution for its support. But the challenge is in its transmission due to the limited network resources in wireless networks viz; bandwidth. This introduces jitter during video playback. This needs an effective Compression technique to reduce the possible transmission time. The paper presents a novel Adaptive Dual Tree Complex wavelet Transoform (ADT-CWT) using the efficient Motion Block Estimation (MBE), Diamond search with Large Diamond Search Path (LDSP) and a Small Diamond Search Path (SDSP). This technique effectively improves the performance of Scalable Video in wireless transmission. The PSNR and the Compression Ratio (CR) are considered for the comparison.

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Keywords:Compresion Ratio (CR); Dual Tree Complex Wavelet Transform; PSNR; Scalable Video Coding

1. Introduction

In past few decades, Compression of video has been developed as an integral part of the total communication[1]. The applications of Digital video communication in the present day are Broadcast services, storage of video, wire and wireless network services, and in the terrestrial channels. The solution is video compression[2,3,4]. All video coding standards make use of the redundancy inherent within digital video information in order to reduce its bit rate[5]. The different scenarios of Digital video applications of are; i) Broadcasting, Pay on view service, terrestrial and cable transmission channels, ii) Interactive video communication over wired and wireless in the Internet and Local network, and iii) Various storage formats[7,8]. The classification of video compression methods are;

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i) Prediction, ii) Transformation, iii) Quantization, iv) Entropy coding[6]. A video has sequence of frames or images, in general, in the order of time. This hints that compression of video can be performed by prediction over the previous frame. Compression can be done by the subtraction of present and previous frame and to code only the residual part of error[9]. This can even be done by searching the right part of image subtracted from the previous frame. The reason is that the video contains much spatial and temporal redundancy. In a single frame, nearby pixels are often correlated with each other. This is called spatial redundancy, or the intra frame correlation. Another one is temporal redundancy, which means adjacent frames are highly correlated, or called the inter frame correlation[10,11].

Scalable Video Coding (SVC) is a technique that has been in the signal processing community for already sometime[12]. SVC has designed to cater the video of lower resolutions, lower rate of frame transmission and also reduced quality, to the heterogeneous devices having lower resolution displays and reduced computational capabilities[13]. Lagrangian technique helps to produce an optimal bit allocation to an encoder, having bit rate constraint. In contrast to conventional non layered video coding, SVC is able to serve all users by single bit stream of transmissio[14]. Modern video transmission system challenges are effectively solved by the SVC. This paper refers the term 'Scalability' as preparing a frame with reduced bits to suit the video for various devices in the network[15,16,17].

SVC is a bitstream which is encoded by sampled bits of the original video. The encoder is a complex one and it produces many sets of lower resolutions. SVC encoder has a compression technique involved in it to support the transmission to the direct end users on the broadcast system. In the research, different SVC methods were utilized for performing video coding process. Among them, wavelet based SVC is the most widely used technique to encode and decode the video frames. In this wavelet-based SVC technique, initially the frames are encoded in the base layer with low resolution and then these encoded frames are decoded by applying inverse process. The differences between the original and the decoded frames are calculated. This difference is then given as input to the wavelet process. The sub bands obtained from the wavelets are given as input to the coding techniques to acquire the high resolution bit streams. The most commonly used wavelet techniques like DCT and DWT have major drawbacks in their process. The disadvantage of DCT is that its vulnerability to block noise and restricted scalability, whereas DWT compress the image with less quality. Such drawbacks in the wavelet technique make the image blurred and provide low PSNR value due to the presence of small amount of noise. Also, the application of wavelet decomposition degrades the SVC performance. Moreover, there is no standardization exists for selecting the suitable techniques to solve those drawbacks. If all the aforesaid drawbacks in the literary works are solved, then the image quality is improved to better PSNR value. As there are no solutions for such issues, it is motivated to do research work in this direction.

The main aim of this research is to provide a better SVC (Scalable Video Coding) technique for video by solving the drawbacks that currently exist in the literary works. Hence, we intended to propose an enhanced SVC technique using wavelet decomposition. In the proposed technique, the frame's bit streams will be processed in two layers. Initially an enhanced zero coding model will be used at the base layer to make less memory storage of the low resolution bit streams. The variation between the low resolution decoded frame and the original frame will be computed. The difference value will be then given to the wavelet technique; here we will exploit a novel wavelet technique as adaptive complex wavelets transform (ACWT). The ACWT will be used to overcome the drawbacks of other wavelet methods and also it is a complex-valued extension of the standard discrete wavelet transform (DWT). The wavelet adaption is fashioned to select the wavelet coefficients based on the nature of the video. The selected wavelet coefficients by ACWT will be given to the quantization and coding techniques to acquire high resolution bit streams at the enhancement layer. Thus, the image can be coded more effectively by achieving higher PSNR ratio with high quality. The technique will be implemented in the working platform of MATLAB and the results will be analyzed to demonstrate the performance of the proposed wavelet-based SVC technique.