



VideoCompression Techniques: A Review

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ABSTRACT

From past few years, there is an extreme evolution of the internet which leads to significant growth in video innovation and huge video utilization over the web which leads to massive data in general. A good quality video consumes a lot of memory which is a burden for a server or for a user who is a fond of videos over the web, so to reduce this burden compression is done to minimize the memory used by videos. For this purpose, many codecs are there like HEVC/H.265 and VP9 which are capable to compress the video of any resolutions like 8192*4320 including 8k UHD. This paper is giving enough knowledge for both the techniques and also their common points and differences. Also, this paper describes the overall necessity of HEVC and VP9 on playback on the web browser and compression of high definition video for live video streaming, and a proper idea on dividing the frames of the video into a few sections for compression and afterward assembling back for better effectiveness and quality on internet and offline too. At last, it is proved that why HEVC is superior to VP9 in some manners.

INTRODUCTION

With the vast improvement in video compression techniques, Digital video communication is becoming an efficiently growing field. A high definition uncompressed video recorded by a good quality camcorder takes a huge amount of disk, or on the server if it's a live video. An uncompressed video is consuming much memory on the disk, so to save the space we are using compression. Basically, a video is a sequence of images and when these images are in order formed as a video, and these images are known as frames. The human eye is not able to notice any small change in the frame like small change in the color, and

video compression techniques are not able to encode all the information in the video some information might be lost. In real-time video streaming also the video is compressed over the internet then displayed by a user in the real time. With streaming videos an internet user does not have to wait for the whole video to download, instead, he can play that clip as it arrives because it is sent in a continuous stream of data. Compressions are mainly of two types:

Lossless compression: From the name itself it is clear that there is no loss in the quality of images and video while using lossless compression technique, but this technique doesn't save the memory like the video after compression will have almost same size like before. It's examples we can see in Healthcare industries which deal with radiographic pictures and in manufacturing companies which use machine drawing images, and images of circuit diagrams etc..this pictures and charts request zero information loss in quality hence lossless compression strategy is best appropriate for this sort of pictures.

Lossy compression: Applications which do not require high accuracy in the quality of videos and images can be done easily by lossy compression techniques. A good example for this technique can be videos or images taken by mobile phone or digital camera, in this current gadget information from the picture sensor is prepared to a compressed format of GIF or JPEG of wanted quality. Lossy compression techniques can minimize the size or memory of the video from 5% to 95% depends on the requirements. It saves memory but with much data loss, that's why it is called as a Lossy compression.

HEVC/H.265 codec: High-efficiency video codec (HEVC) or H.265 is a video compression technique, which is a successor of the broadly used H.264 standard. As the contrast with H.264, HEVC permits about twofold the information pressure proportion at a similar level of video quality or better quality at a similar piece rate. The best piece of H.265 is that it supports resolutions up to 8192*4320, including 8K Ultra HD. In many ways, the working principle is same for both H.265 and H.264 standards. Both work by looking at partitioned parts of a frame of video to discover zones which are repetitive, that too under a single frame and as well as consequent frames. Then these repetitive areas are changed by a short description in place of original pixels. The main modifications in HEVC/H.265 are development in difference-coding areas from size 16*16 pixels to 64*64 pixels. The effectiveness of this enhancement needs much more flag handling capacities for compressing the video. HEVC is the latest technique which is widely used in video applications.

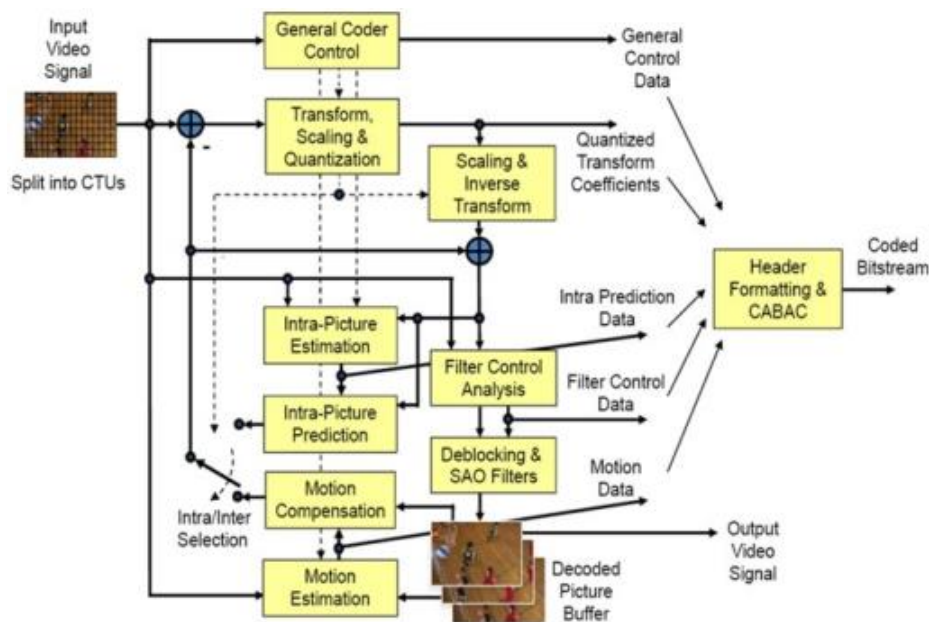


Fig.1 Core Architecture of HEVC/H.265

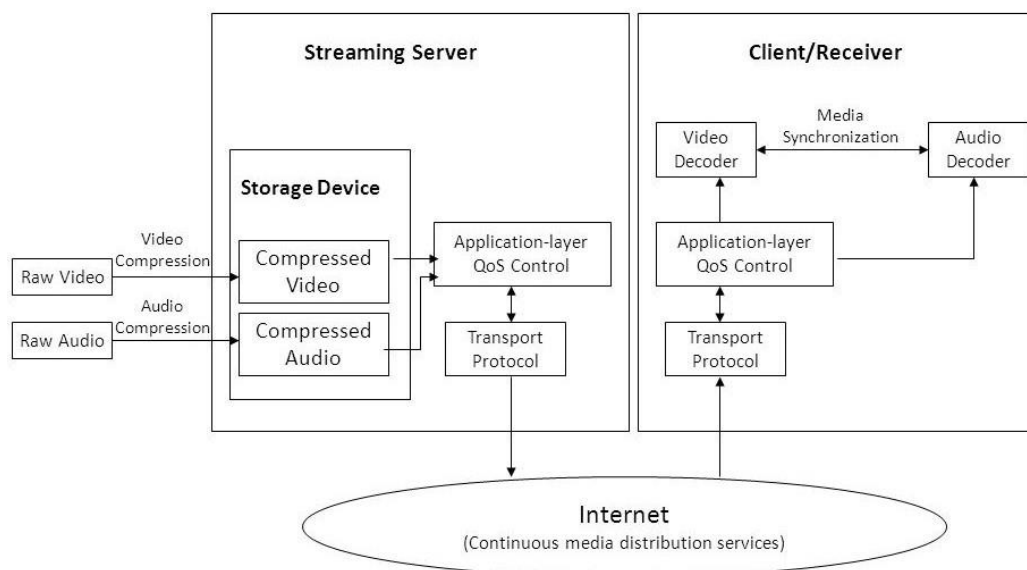


Fig.2 Video Streaming Architecture

VP9 codec: VP9 is another compressions technique which is widely used by many applications, and VP9 is a competitor of HEVC/H.265. VP9 is an open and eminence free video codec created by Google. VP9 is an upgraded version of VP8 and contender of H.265. It is first used on Google's video platform which is YouTube. As compare to HEVC, VP9 supports common among web browsers.

VP9 is skilled at taking care of resolutions more than 1080p and furthermore, it empowers lossless pressure. VP9 has many improvements compared to VP8. Just like H.265, VP9 also supports compression of resolutions up to 8192*4320, including 8K UHD, that's why it is a competitor for HEVC. Another improvement in VP9 is that it supports the use of the coding unit of 64*64 pixels, which is helpful for high-resolution videos. Compared to VP8, the prediction of motion vectors also improved in VP9. If we talk about ultra HD videos then we know that it takes much space and memory because it contains much information so it's a challenging task to send these bigger files on the server, but with VP9 it is easy to send those big video files without losing the actual quality of the video. It is anything but easy to stream a 1080p video to a channel which already dealing with the streaming up to 720p. VP9 using 64*64 block that is further divided into the shorter block for compression. VP9 codes each and every frame into 3 parts. The use of VP9 has done in many technology firms like Sony, Panasonic, LG, ARM, Samsung, and many more. The main competitor of VP9 is HEVC, but the HEVC codec is not an open source codec, so it's a victory point for VP9 which is provided by many vendors.

Other Compression Techniques:

H.261: H.261 was developed in the year 1990. It is developed for information rates which are multiples of 64 Kbps. The writing calculations was supposed to possess the capability to figure at video bit rates between 40 kbits/sec and a couple of Mbits/s. H.261 supports only 2 resolutions which are Common Interface Format (CIF) and quarter CIF. It is an outdated compression technique. It is not much-advanced technique as compared to others. Obstruction antiquities area unit presumably a commonplace marvel to almost everyone UN agency has viewed processed video. Deblocking separating has since become an essential piece of the later principles H.264 and HEVC.

H.263: It was developed in the year 1996. H.263 may be a video compression commonplace at first composed as a low piece rate compacted organize for video conferencing. H.263 uses a method which is called as a Test model and is having similarities to H.261 but with improving efficiency and error recovery is highly efficient. It gives a similar quality like H.261 but with almost half the quantity of bits. With the addition of this, H.263 supports 3 more resolutions which are SQCIF, 4CIF, and 16CIF. In digital video coding, both H.261 and H.263 are not suitable.

MPEG-4: It was developed in the year 1988. It empowers multimedia in a low piece rate system and it enables the client to cooperate with objects. An object

can be anything like visual or audio-visual content like in digital television. The main use of MPEG-4 is in a mapping of 2-D and 3-D networks, images, and video. It is a successor of both MPEG-1 and MPEG-2.

RELATED WORKS

A live video service on the internet in an appropriated way is a major task as it impacts on current internet structure and as well as future web advancement also. In this paper [1] the author Ramzan, N., Park, H., & Izquierdo, E explains Peer-to-Peer networks are having important role in online video streaming. Current video coding trends and efficient data sharing mechanism in peer-to-peer networks are discussed in detail. Some video streaming methods on P2P with respect to tree-based and mesh-based system are explained. There are some technical challenges which needs more attention.

In multimedia services the use of HTTP adapting streaming has widely spread because it allows service providers to enhance client's Quality of experience and network resource utilization. In this paper impact of few adaptation technical factors is discussed and investigated. As a result this paper [2] the author Tavakoli, S., Brunnström, K. presents an effective step to optimize the quality in video streaming services. With respect to the assessment methodology there is a need of further investigation.

From past years there is a trend with increased in resolution and dimension in video streaming like SD, HD, 3D and 4kUHD, even for portable devices also there is an important role for playing quality videos. This paper [3] the authors Adeyemi-Ejeye A.O., Alreshoodi concentrates on two experiments, first one is at a Variable Bitrate (VBR) and other is at a Constant Bitrate (CBR), which shows different aspects of the interpretation. The later experiments also focused on comparison and contrast encoding with either a High efficiency video coding (HEVC) codec or an H.264 and after that all results recorded as objective Mean Opinion Score. It is found that packet loss has less impact on HD video than on SD video. The better way of protecting content is to select HTTP Adapting Streaming (HAS) in which no error can occur because of retransmitting of lost packets.

In peer-to-peer network a peer hub serves a receiver and a provider both that empowers transferring transmission capacity of peer devices to be used effectively while alleviating weight of the server hub. This will solve the versatility issue which is experienced in the conventional client-server model. As compared to layered coded video streaming, MD coded video streaming having effective robustness with no requirement of special provision in peer-to-peer system outline at a modest expense of compression productivity. In this paper [4] the author Xu, Y., Zhu, C., Zeng found that SVC may provide a better solution for video streaming and also in low packet loss rate and on the other

hand MDC is much better for dynamic peer-to-peer network with a high packet loss rate.

This paper clarifies a procedure which plans to achieve an effective balance between video pressure by utilizing H.265 convention and maintenance of 8K determination. By using H.265 they implemented multi-level of improvement in the encoding procedure. In this paper [5] Murthy, S. V. N., & Sujatha shows that there is a good balance between the video compression and maintenance of better data quality. They used H.265 for multiple video compression.

In computer science video streaming techniques have evolved consequently over the years. Currently, the most helpful method for live video and video-on-demand is the adaptive HTTP streaming which is acknowledged by numerous business merchants. In this paper [6], an approx. investigative model for live adaptable streaming over HTTP has cleared up. Tanwir, S., & Perros, H proposed a new rate control algorithm which makes the rate transition less frequent and increase the quality of experience. The model is divided into three parts and they are, client video model, video server model, and model of the IP network.

A multi-tile display has developed as an empowering instrument for appropriated representation work and high-resolution show conditions are based on the network. This paper [7] the author Kimball, J., Wypych, T clarified a higher quality video stream procedure which permits remotely produced content spilled to multi-tile display situations over a heterogeneous wide zone network. To reduce the entropy this technique uses video compression and therefore it required a transmission capacity of the video stream. As a result, the introduced system can convey 1080p resolution, a media-rich substance with data transmission necessities less than 10 Mbps and adequately low latency for content interactivity.

Nowadays logical and business applications operates tens of cloud data centers around the world. Jetstream is proposed in this paper which is a superior batch based stream middleware for proficient transfer of event between cloud server farms. Jetstream is efficient to self-adapt to the streaming conditions by modelling a set of context parameters. In this paper [8] Tudoran, R., Costan, A., Nano shows that, when contrasted with state of the art solution there is a 3 times increment in the exchange rate utilizing the versatile multi-course streaming. Jetstream is a framework which builds the exchange rates up to 250 times when contrasted with individual event transfer.

Cloud mobile media (CMM) is referred as the adoption of smartphones, increased access to mobile broadband systems and accessibility of open cloud infrastructure. The goal of this paper [9] Garcia-Pineda, M., Segura-Garcia, is to estimate and predict this subjective metric using different estimation techniques like artificial neural networks, factor analysis and multinomial linear regression. Factor analysis shows simpler and faster models to estimate the subjective video quality of the delivered video in real time.

Video streaming over TCP has become popular because TCP's congestion control provides stability to the internet. In this paper, an adaptive video streaming course of action is proposed to improve the nature of the experience of the customers by applying TCP factors. In this paper [10] Douga, Y., Bourenanethe simulation results have shown a good quality of experience performance and a better user satisfaction.

Video streaming applications are progressively being conveyed in remote work systems. In this paper [11] the author Hassan, M. M., & Farooq presents an interactive video streaming scheme for scalable video coding based over wireless mesh network is explained. The outcome demonstrates that the proposed streaming methodology can respond to changing channel conditions with less corruption in video quality.

The broad usage of mobiles and high-quality video gadgets are changing web traffic with an expansion in multi-media content. This paper [12] the author Maia, O. B., Yehia, H. C demonstrates current strategies used to grow the nature of involvement in a video streaming service. In this a video assessment diagram is described, and examination of the subjective, target and mixture approaches are presented. This paper reviewed the quality appraisal process currently used to acquire the quality of experience input with respect to video streaming services. It also gives the definition for both quality of service and quality of experience. At last, the paper identified some challenges which still require attention to create quality video sets.

Just-noticeable-difference (JND) is a methodology to measure coded video quality. In this paper [13] the author Wang, H., Katsavounidis, I presents a large scale JND based coded video dataset is tried to build. The dataset comprises of 220 5-s arrangements in four determination and for each of the 880 video cuts encoding is finished with H.264/AVC codec with QP=1,... ..,51 then measure the initial three JND focuses with 30+ subjects. At last the suggestions and hugeness of the video set to future video coding examination and institutionalization endeavors are brought up. It indicates out a reasonable way information-driven perceptual coding.

This paper [14] with author Naik, P. K., Tigadi, A is all about handling the live video got from the portable robot and design constraints of a PC vision-based mobile robot. The primary focus of this paper is on applying DWT calculations on the live video so memory size required for capacity is reduced. There is a low quality in live streaming of video which fees by mobile robots. The memory controller is utilized as an interface amongst memory and the handling component. As a result, it is discovered that portable robot has a speed of 10 inches per second.

Video quality appraisal (VQA) assumes a noteworthy part in video and picture preparing on the grounds that it can anticipate the effect of bending on the video in the Quality of experience of the client. In this paper [15] another strategy is

proposed for video quality appraisal by utilizing an artificial neural system to predict the assessment of the video as though it were seen by a client. Therefore the proposed technique makes a phenomenal relationship with the subjective scores over a similar database. This technique is tried in VQEG stage 1 database, which produces incredible evaluations of video quality.

Delivering real-time video is a challenging and an essential part of some web multimedia applications and transmission of the live video has its data transmission, delay and loss requirements. But, our present web does not offer Quality of service assurance to video transmission over the web. In this paper [16] the author Wu, D., Hou, Y. T presents a comprehensive approach which is taken for these difficulties and present arrangements from transport and compression viewpoint. With this technique, a system is designed for transporting real-time video over the web with two components which are congestion control and error control.

The continuously progressing in the field on digital video communication has enabled the high quality video and live video streaming over internet. Compression technologies has made possible for a user to watch this videos easily. In this paper [17] the author Sun, H., Vetro, A presents a detailed information about scalable video streaming methods which are developed in past years. Techniques like scalable video coding, and network related issues are discussed in this paper.

With the increase in technology now we are able to watch videos on mobile phones but the traffic in video mobile networks is an issue, and because of this the quality of service is poor for mobile video streaming. In this paper [18] the author Wang, X., Chen, M presents a new technology is discussed which is AMES-Cloud which has two sections that are, adaptive portable video streaming and effective social video sharing and based on the social network analysis operators in the cloud can successfully give the adaptive streaming, and perform video sharing.

Live video streaming is a challenging task for many applications. In this paper [19] the use of Priority progress streaming is done for real-time video streaming. In general Priority progress streaming is a procedure for the delivery of media over factor bit-rate channels. When utilizing PPS for real-time video streaming the time delay presented by reordering is always a concern. This paper the author Huang, J., Krasic, C gives proper explanation on how PPS can be extend for real-time video streaming.

With the great success of peer-to-peer (P2P) system for the purpose of file sharing have set the way for another application on the internet that is peer-to-peer video streaming. In this paper [20] Sentinelli, A., Marfia presents a proper analysis is done to check what is available to end user with respect to P2P video streaming products. The result shows that such systems are adequate for on-demand viewing of delay tolerant content.

This paper [21] the author Conklin, G. J., Greenbaumis providing an overall architecture of current web streaming media delivery systems and a brief explanation with regard to video coding. It is easy to rectify some models of communication which may require different operation from both source and channel coding points of view. In this paper there is a clear explanation for some of the existing mechanism in RealSystem 8 which supports adaptive transmission of pre-encoded information, and also the overall architecture of its RealVideo 8 codec.

In this paper [22] there is a detail dialog about the significance of misusing between picture likenesses in multi-see video pressure and a few approaches to deal with multi-view video pressure. When multiple cameras are acquired many viewpoints of the scene then the resulting output is known as multi-view video. In this paper the author Flierl, M., & Girod, B finish up the article by clarifying some relative focal points and burdens of these compression approaches when looked with extra limitation that emerge in down to earth framework.

This paper [23] is all about H.264/AVC codec for wireless video application, including its efficiency, advantages, telephony, video broadcasting. AVC is an effective component in planting wireless video applications all because of its network friendly design and good compression efficiency. In this paper the author Stockhammer, T., & Hannuksela also talks about bit rate adaptation, integration in to packet networks, buffering consideration and interoperability.

As of late change in video correspondence and figuring innovation, multi-view video is one of the patterns which is fascinating because of its upgraded seeing knowledge. This paper [24] the author Lou, J. G., Cai, H introduces a framework design for continuous catching, handling and productive conveyance of multi-view video with high level of intelligence progressively. With the proposed system, a user can enjoy their visual experience by selecting their desired viewing directions in real time.

Due to massive improvement in internet and high demand in multimedia over the web, video streaming is taking so much attention because of its popularity. Live video over web also plays a crucial role. But present internet does not give any Quality of service experience for video streaming. This paper [25] the author Wu, D., Hou, Y. T covers some crucial area of video streaming with complete detail and discussion and they are video compression, application-layer control and many more.

This paper [26] gives all the information and comparison of different codecs like VP9, HEVC and H.264. In addition with this, commercial HEVC technique and the open source encoder x265 were used. An examine were performed in which they give similar configuration to all the respective codecs and they found that HEVC/H.265 codec provides critical normal piece rate reserve saving of 38.4% and 32.8% as compare to H.264 and AV1 respectively. In the experimental result

the author Grois, D., Nguyen shown that the working efficiency of VP9 is inferior to all test encoders.

This paper [27] the author Rěrábek, M., Hanhart presents detail information and comparison in many ways for HEVC and VP9 codecs. Both are high efficient and widely used compression techniques. One can get a dilemma that which one is better in terms of rate-distortion VP9 or HEVC because both are competitors. In the experiment they had taken 10 video sequences with various spatial and transient qualities, frame rates and resolution, from which 8 video sequence were utilized for subjective tests and 2 video sequence were utilized for training purpose. The experiment results show that HEVC is better than VP9 in terms of compression performance. The test shows that HEVC accomplishes normal bitrate saving of 57.3% and VP9 saves 33.6%.

This paper [28][29] the author Feamster, N., & Balakrishnan explains the recovery of packet loss in the compressed video in which error may contain across many frames. They explained the impact of packet loss on the nature of the MPEG-4 video. They developed a logical model to clarify these impact. They introduce a system which effectively convey MPEG-4 video in the face of a packet loss and variable web conditions and other possible conditions. By recovery of most imperative information in the bit-stream, huge execution can be pick up with no penalty. This streaming system can deliver high quality and highly-interactive videos.

RESULT AND DISCUSSION

This presents all the information and comparison of different codecs like VP9, HEVC, and H.264. In addition to this, commercial HEVC technique and the open source encoder x265 were used. An examine were performed in which they give similar configuration to all the respective codecs and they found that HEVC/H.265 codec provides critical normal piece rate reserve saving of 38.4% and 32.8% as compared to H.264 and AV1 respectively. In the experimental result, it is shown that the working efficiency of VP9 is inferior to all test encoders. In most of the cases, the efficiency of H.265/HEVC is found to be greater than all other codecs.

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This paper clarifies a procedure which plans to achieve an effective balance between video pressure by utilizing H.265 convention and maintenance of 8K determination. By using H.265 they implemented multi-level of improvement in the encoding procedure. The results show that there is a good balance between the video compression and maintenance of better data quality. They used H.265 for multiple video compression. It has better compression performance and better resolutions. HEVC is proved as a latest and efficient technique.

To check the efficiency of HEVC we have compressed a 720p resolution video by HEVC/H.265 and as a result we have found that by HEVC we can save much data and that too with better quality as compared to other compression technique. In online streaming also HEVC has proved as a better solution for high quality videos. By using HEVC/H.265 codec over online video streaming there will be less delay in playing videos and less consumption of data which is very useful for users.



Original video snapshot 720p Resolution



HEVC Compressed Video Snapshot 720p Resolution

CONCLUSION

In this paper we propose all the information in two phases, firstly this paper gives all the knowledge regarding video compression, video streaming and live video and secondly, the main part of this paper gives the common points and differences between the two main compression techniques which are High-Efficiency Video Coding (HEVC) and VP9. We found that in many aspects the working principle is same in both codecs H.265 and VP9 but with a fact that HEVC/H.265 is much faster than VP9. VP9 is also a good option for video compression but a little slower than H.265. On the other hand, HEVC/H.265 compression efficiency is 58% which includes compression of Ultra High Definition video up to 8k UHD. As compare to H.265, the compression efficiency of VP9 is 56% and it divides the image into a matrix which can increase the performance. By HEVC we can get a better quality video with less memory. By using HEVC/H.265 codec over online video streaming there will be less delay in playing videos and less consumption of data which is very useful for users.

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