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AN EFFICIENT COMPRESSION OF ENDOSCOPIC VIDEOS USING DPCM ENCODING

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Abstract: Full-length endoscopic operations are increasingly being stored. Endoscopic videos are used for further diagnosis and research, and they must be combined with patient-level data in the electronic health record (EHR). The health-based cloud centre is a large-scale private cloud that requires a lot of storage capacity. Using a HEVC-based method, this research provides a revolutionary video compression technique based on DPCM. Effective compression Technique is explored in our proposed study. Our goal is to demonstrate a method for lossless compression of endoscopic video while maintaining quality as a part of our research work. Our implementation measures performance in terms of PSNR, SSI, and other metrics.
Discussion: The proposed method is implemented in MATLAB, the testing results revealed its use in terms of compression ratio, PSNR, SSI, and bit rate.
Keywords: HEVC, PSNR, SSI, Bitrate, Compression Ratio, Intra Frame prediction and Inter Frame Prediction.

Introduction

Technology and services in the realms of e-Health and telemedicine, such as Video Cloud Services for Hospitals, have expanded rapidly in recent years. National health care legislation is gradually recognising telemedicine services, which use videoconferencing or other ICT systems to enable distant treatment and consultations, as viable treatment options. In some European countries, including Germany, France, and Poland, the requirement for a face-to-face meeting between the doctor and patient has been lifted as of 2018[1]. These services have been around for a while in the United States, but European companies that want a piece of the market here need to provide options that comply with European regulations and account for the varied nature of healthcare systems across the continent. The telemedicine industry is growing [2].
There are three main applications for telemedicine services: 1) improving the patient-doctor relationship, 2) facilitating remote collaboration between medical specialists, and 3) bolstering medical education. These three groups use a wide range of people and technologies, but they all rely heavily on video conferencing, which means they need a safe way to record and store their footage. When it comes to medical equipment, the vast majority only stores video on local storage media like hard drives, DVDs, or USB drives. This is extremely unmanageable, and managing and storing the recordings is a major problem for the IT department. Many hospitals cannot afford the expensive equipment needed to store the recordings, especially over long

periods of time, even if they have an integrated video system. The quantity of space required to store medical video is growing rapidly in tandem with the proliferation of video technologies, with Full High Definition systems being the norm now and 4k or even 8k resolution systems on the horizon. CT, MRI, and PET-scan images, for instance, can take up several hundred megabytes per examination, while high-definition surgical stereoscopic video is based on two streams of 1.5 Gbits/s each. In 2009, 2.5 PBytes were needed to store mammograms in the United States, and by 2010, 30% of all images stored globally were medical images [3]. Also, the preservation time for medical records is relatively considerable in many nations.Medical photographs related to a patient must be retained for 20 years following their final visit in nations like France and Poland. Useful resource for the preservation of photos and videos. In 2015, France generated 55 TBytes of picture data.A Full HD endoscopic camera, which is frequently used in endoscopic surgery, can produce 2.6 TBytes of data in just two hours. These numbers highlight the archiving capacity difficulty that must be overcome. Therefore, for regular usage by medical practitioners, medical image/video should be encoded (i.e. compressed), provided that the encoding does not degrade the therapeutic quality of the data. It is crucial to make sure that the compression phase doesn't result in any major loss (degradation) (or additional processing, like for instance watermarking) at the encoder stage, regardless of whether the data needs to be sent or stored.For healthcare practitioners, maintaining an acceptable visual quality of the video stream is critical.

Choosing a set of codes that is both efficient in terms of storage requirements and compliant with medical standards is crucial. As a result, data compression is currently very important in the healthcare sector. Let's evaluate the storage requirements of the hospital. Hospitals typically have eight operating rooms, and each room performs 32 procedures per day, with an average of three endoscopies per day. [5]. This suggests that a hospital that keeps a record of all surgical procedures generates about 189.8 GBytes of video data per day, or 67.7 TBytes per year, and about 7.8 Tbytes of endoscopic data per day, or 949 Tbytes per year. Poland uses a total of 62.9 PBytes of data each year. If these tapes are being used to document the patient's medical history, they must be stored for 20 years after the patient's last appointment.

This volume poses serious difficulties for hospital IT systems. The preceding estimates are based on the idea that only one Full HD video will be recorded. However, there are currently available medical devices (such as endoscopes) that offer 4K or even 8K resolutions. The amount of information generated due to the use of these tools will increase by a factor of 4 or 16. As a result, we require more compact video encoding methods while maintaining a sufficiently high standard for use in the healthcare industry.

At the moment, there are two main types of video compression systems:

1) Lossy Compression
2) Lossless Compression

In most cases, the last stage of video distribution makes use of lossy compression, which gives compression ratios of 10x to more than 100x. High compression by lossy compression is possible, but it usually requires a lot of processing power from the encoder. Yet, in modern video codecs, the encoder is able to control the compression ratio and, by extension, the resulting video quality. For telemedicine applications, we can deliver video of such high quality that its origin can't be visually determined.

H.264/AVC and H.265/HEVC are two examples of video encoding formats that fit this description. The term "lossless compression" refers to a method of data compression that maintains as near to the original quality as possible while also lowering the file size for transmission or storage (lossless or visually lossless compression). Compression ratios between 2 and 6 are common, and encoding and decoding using far fewer computational resources than severe compression.

Formats supported herein include the JPEG-2000, JPEG-XS, and VC-2 codecs. When it comes to high-quality video compression, the 2013-approved H.265/HEVC standard is unrivalled. When compared to H.264/AVC, it can cut the required bandwidth in half without sacrificing quality. HEVC can compress video by a factor of 250x to 500x compared to uncompressed video, depending on the bitrate and video resolution used. At 30 fps and 3 MBit/s, Full HD (1920 x 1080) is magnified 249 times and 4K is magnified 478 times. (8K, 3840 by 2160) x (398) = 60 fps, 25 Mbits/s; (4K, 7680 by 4320) x (60 fps, 120 mbps). While H.264 Main Profile (MP) only allows 8 bits, HEVC MP may use up to 10, meaning better colour accuracy and less banding artefacts in scenes with consistent tonal and luminance transitions. A new generation of video codecs is being created to fulfil the demands of growing applications like UHD TV in 4K and 8K resolutions, 360° video, and new quality formats like High Dynamic Range (HDR), High Frame Rate (HFR), and Wide Color Gamut (WCG).

AV1 is a cutting-edge video codec made specifically for use in streaming services like VoD [16]. As its name suggests, the AV1 codec is meant to be accessible to all. Research done in 2017 indicates that AV1 can reduce bitrate by 17%-22% compared to H.265/HEVC. It appears that the AOM's reference implementation of AV1 is computationally very heavy, and to the best of our knowledge, no efficient AV1 encoder implementation is available. Thus, AV1 should not be implemented and optimised for usage in the context of medical video storage because it cannot compete with HEVC in terms of compression gain relative to encoding performance. To determine if there is a need for a new codec with compression capabilities beyond HEVC, the ITU-T VCEG and the ISO/IEC MPEG created the Joint Video Exploration Team on Future Video Coding (JVET) in October 2015.

Using a unified platform, test cases for high-definition, ultra-high-definition, high-dynamic-range, and 360-degree video have been defined, and cutting-edge compression technologies have been explored [14]. To that purpose, JVET plans to finalise a new codec standard by 2020. (The International Telecommunication Union-Telecom (ITU-T) will likely designate this codec as H.265). The open-source x265 encoder [17] (x265 has inherited its core techniques from its predecessor x264 H.264/AVC) and commercial encoders given by businesses both offer efficient HEVC/H.265 software encoding. 265 has been proved to be superior to competing industrial encoders in terms of compression quality and speed, especially for Full HD video, in a number of independent testing. The performance of competing video codecs is often compared to x265 in the name of benchmarking. When faced with the enormous data volumes that would result from recording medical procedures, we believe that only tight compression should be considered. That's why it's crucial to standardise cutting-edge compression codecs for medical uses in a way that takes into consideration the specific requirements of the field. Compressing medical movies for archival storage has been the subject of numerous academic articles. Nonetheless, it's worth noting that most research into multimedia data compression in medicine is done in quite niche settings.

Related Work

The growing dimensions of data volumes provided by different medical imaging modalities and the increasing popularity of medical imaging in clinical practice necessitate data compression for the distribution, storage, and management of digital medical image data sets. Thus, data compression is now essential in PACS (Picture Archiving and Communication System), DICOM, and cloud-based health care centres. As a result, there is a pressing need to reduce image file sizes while maintaining diagnostic accuracy. With the use of lossy and lossless compression algorithms, medical image compression is a method that can reduce the overall cost of sending and storing images. Let's have a look at the many compression methods that have been devised and examined by scientists recently.

According to S. Ponlatha et al. [2013], the rapid growth of picture data has been accelerated by developments in medical imaging technologies. Positron emission tomography, magnetic resonance imaging, computed tomography (CT), and single-photon emission tomography are just a few examples of the many medical imaging modalities that generate massive amounts of data, necessitating the development of robust and efficient storage systems. Compression has become a crucial part of medical imaging due to the requirement to improve transmission times for large image studies, such as high-resolution three-dimensional CT datasets, and minimise data storage costs. Nevertheless, unlike the video compression methods typically used, the current DICOM (Digital Imaging and Communication in Medicine) standards for image compression do not make use of inter-frame redundancies. With the help of the DICOM working group-4 compression, JPEG2000 was developed as an enhancement of JPEG to address this limitation. The compression of medical images necessitates the use of an effective compression approach in order to maximise storage space, decrease the file size, and increase the frame rate while maintaining image quality. Here, genetic programming is used by JPEG2000 to create an improved quantization matrix known as GQM. Quantization differs for each input block and the resulting matrix is a feature-based matrix. The compression in this case relies heavily on the specific use case being examined. Thus, the condition can be used as the fitness function. Visual perception is emphasised similarly to the medical application [6].
Video compression has the potential to improve the compression ratio by minimising duplication in huge volumetric data, which is something that current DICOM does not do. Because of this, a new era of diagnosis has emerged, one that relies on video codecs to enhance transmission for massive datasets and is thus called video-based remote diagnosis and telemedicine application. Using 3D medical CT scan datasets, we evaluate the efficiency of the lossless video codecs H.264, H.265, Lagarith, MSU, and MLC with the still-image codecs JPEG, JPEG2000, and JPEG-LS. Evidence from a comparison to JPEG-LS reveals that both

JPEG and JPEG2000 benefit from the performance evaluation of video codecs, resulting in a higher compression ratio. The results show that video codecs have great potential for lossless compression of large volumetric medical images like computed tomography datasets. Telemedicine solutions based on video codecs and video-based remote diagnosis should benefit from this advancement in the compression and transmission of very large multidimensional picture datasets [7].

Many lossless compression approaches for high-efficiency video coding have been proposed by Yao-Jen Chang et al (HEVC). First, a generalised intra block copy (GIBC) is created to identify the coding unit from a reference block whose samples may be fully or partially recreated. It is also recommended that a cyclic block padding approach be used to predict the unreconstructed samples in the reference block by geometrically co-located blocks. Using the results of feature distribution studies for palette coding, we present a HEVC-based medical video coder (HMC) that can integrate the GIBC, line-coded palette coding, and intra palette predictor without causing any conflicts. It has been demonstrated experimentally that the proposed GIBC and HMC can reduce bit rates for medical videos by up to 13.9% and 22.3%, respectively, when compared to the lossless HEVC.

N. Senthil kumaran et al. [2011] describe an enhanced backpropagation neural network method for lossless image compression. Using X-ray images, the system also demonstrates that the improved Backpropagation Neural Network Method achieves better results than the standard Huffman Coding Algorithm for lossless image compression across all three metrics. The results of the experiments are described and compared [7].

In the context of medical videos, Moustafa M. Nasralla et al. [2018] compared the performance of HEVC with its predecessor, H.264/AVC. The evaluation results are based on the JCT-VC team's provision of three configuration modes: random access, low delay, and intra. For a level playing field, H.264/AVC is also configured to closely resemble the specifications of HEVC. By transmitting encoded videos over a simulated 4G network, we can compare the resource demands of different encoding methods, such as HEVC and H.264, in light of issues such user authentication, message privacy, data compression, and network latency[8].

Because of the massive amounts of space that multimedia data consumes, S P Raja et al. [2019] have called attention to the importance of multimedia compression and authentication. Compressing data is crucial in the multimedia industry since large files can quickly become unwieldy. Compression strategies offer trustworthy benefits, especially for businesses managing meta-size data in the cloud. The primary goal of DICOM is to provide a new framework that is amenable to encoding methods and that enables multiscale transforms. With the combination of public-key cryptography and cloud-based medical image compression, we now have a significantly higher level of security. Among of the available transforms are the bandelet, curvelet, contourlet, wavelet, and ridgelet. Other examples of embedded approaches include Wavelet Difference Reduction (WDR), Adaptively Scanned Wavelet Difference Reduction (AS-WDR), Tree zerotree ation (TzTree), and transmission efficiency (TE), as well as the Rivest-Shamir-Adleman (RSA) and Set Partitioning in Hierarchical (SPIHT) algorithms (TE). Test results show that compared to H.264/AVC, HEVC's compression effectiveness is higher, meaning a lower bandwidth is sufficient for transmitting high-quality video across LTE/LTE-networks [9].

Using the HEVC standard for telemedicine increases the efficiency of compression and the transmission performance via communication channels while decreasing the total transmission size. The HEVC standard reduces the required bandwidth for encoding medical videos while increasing compression efficiency and transmission performance via communication channels. the minimum bitrate required for encoding healthcare videos. The results of the tests show that compared to the compression efficiency of H.264/AVC, the HEVC standard is capable of saving anywhere from 40 to 65 percent in terms of bitrate. H.264, a more advanced compression method, has recently been proposed for use in the medical video compression industry. As a first step, we provide an overview of H.264 and its application in the field of medical video compression. In the second stage, we propose a novel motion complexity (MC) for determining the complexity of a video frame's motion content and use that to inform a perceptual bit allocation for medical video compression. H.264 is used to compress medical video and 3D medical datasets. H.264's superior performance in this regard is attributable to a number of factors, including a recently proposed MC measure to represent the complexity of a frame's motion content and a new perceptual mode decision algorithm that updates the Lagrangian multiplier, which is set according to the perceptual characteristics of the video, to allocate bits to the edge pattern.

As Mohamed Uvaze Ahamed Ayoobkhan et al. [2018] point out, the ever-increasing output of medical images necessitates a highly efficient compression strategy able to deal with the related storage and transmission issues. It is also crucial in medical imaging that image and video quality not be compromised during compression. Predictive picture coding is offered as a means to protect the quality of medical images. Predictive picture coding is a technique for restoring compressed images to their original quality by shielding the key diagnostic area (DIR). Graph-based segmentation is used to divide the image into DIR and non-DIR areas. To perform the prediction process, [10] researchers use a pair of feed-forward neural networks (FF-NNs) as one for compression and another for decompression.

Kilobyte to Terabyte In their paper, Thomas M. Deserno et al. [201l] discuss the difficulties associated with four different types of medical imaging: 1) medical image management and image data mining; 2) bioimaging; 3) virtual reality in medical visualisations; and 4) neuroimaging. Image processing and visualisation methods need to be updated to accommodate the ever-increasing volume of data. Graphics processing units have enabled the development of scalable algorithms and cutting-edge parallelization approaches. In their paper, they provide a summary. As these methods tackle the difficulty of managing data at the terabyte to petabyte scale, the next level up, at the petabyte, is already in sight. This is why study of medical image processing is still so important. Telemedicine is currently receiving a lot of attention because it offers a promising way to connect patients in far-flung areas with doctors located anywhere in the world. Medical images must be transferred over the network in order for telemedicine to function, which results in a significant rise in network traffic and the

requirement for large amounts of storage space. In light of this, medical picture compression has emerged as a necessity for both long-term storage and transfer [11].
Taking advantage of the geometrical regularity of image structure, S. Juliet et al.[2015] suggest a new method of medical image compression utilising a sparse representation approach. The geometric flow characterises the pattern of variation in grayscale values across the image. There are fewer meaningful coefficients in the wavelet decomposition of geometrically regularised data. While compressing medical photos, it's important to keep in mind that the data inside the image, as well as the context in which the image was taken, must be protected and unaltered in any way during the processing phase. Many metrics, including maximum absolute error (MAE), universal image quality (UIQ), and peak signal-to-noise ratio (PSNR), are utilised to accomplish this goal[12].

According to research by N. Senthilkumaran et al.[2011], picture compression reduces the size of an image file while maintaining a high level of image quality. The time it takes for an image to be uploaded to or downloaded from a website is cut down as a result, too. In order to achieve lossless picture compression, the authors of this research propose an enhanced version of the backpropagation neural network method. Taking into account compression ratio, transmission time, and compression performance, the system demonstrates that the enhanced Backpropagation Neural Network Method provides superior lossless image compression compared to the current Huffman Coding Technique. The authors present and compare their experimental findings [13].

Implementation DPCM for Endoscopic videos

Video compression is the process of reducing the size of a video file by removing redundant or unnecessary information while preserving as much video quality as possible. Video compression is beneficial because it reduces the amount of data required to store or transmit a video, making it easier to store, share, and stream videos over the internet. We have also discussed about the importance of video compression in medical field earlier. Now let us look at the HEVC. HEVC (High Efficiency Video Coding), also known as H.265, is a video compression standard that was developed to provide improved compression efficiency compared to its predecessor, H.264/AVC. HEVC works by employing a number of advanced techniques to reduce the amount of data required to represent a video sequence while maintaining a high level of visual quality. Recent developments include a new video compression standard known as High Efficiency Video Coding (HEVC), developed by the Joint Working Committee on Video Coding (JCT-VC). To achieve such high coding efficiency with DPCM, we make use of the blueprint for the HEVC standard shown in figure 1. The capacity to encode video at the lowest possible bit rate while retaining a goal quality is what is meant by "calculating reliability in video coding and filtering for quality" [14]. Nevertheless, HEVC intra coding [15] increases compression efficiency, albeit at the cost of greater processing time. Each video frame is divided into smaller sections using Coding Tree Units (CTUs) or macro blocks. In order to function, HEVC uses both Intra- and Inter-Prediction. Intra-slice prediction, as contrast to inter-slice prediction, makes only localised spatial predictions. Nevertheless, Inter-Prediction makes use of both temporal redundancy (in the form of previously encoded frames) and spatial redundancy (in the form of similar frames). CTUs, or Common Transaction Units, are analogous to macro blocks in earlier standards. In terms of pixel size, CTUs can be either 64x64, 32x32, or 16x16. Inside CTUs are smaller square parts called Coding Units (CUs), whose sizes go from 64 by 64 pixels to 32 by 32 pixels to 16 by 16 pixels to 8 by 8 pixels [11, 2]. In this case, we will be using endoscopic videos for professional reasons. The AVI file format is based on the 64x64 macro block structure of a raw video direct sample format used for compression studies. The peak signal-to-noise ratio (PSNR), the Structural Similarity Index, the compression ratio, and the bitrate are all taken into account to determine the quality of a video coding scheme. We will examine the common understandings of these principles below. Image resolution (p and q), input pictures (f (x,y)), and the reconstructed image (g(x,y)) are all part of the PSNR formula. Decibels are used to quantify the PSNR.

$$\mathrm{PSN} = 10\log_{10}\left[\frac{\frac{1}{\mathrm{pxq}}\sum_{i=1}^{p}\sum_{j=1}^{q}(f(x,y))^2}{\frac{1}{\mathrm{pxq}}\sum_{i=1}^{p}\sum_{j=1}^{q}(f(x,y)-g(x,y))^2}\right]$$

Compression Ratio is the ratio of original and compressed images.

$$\text{Compression Ration}=\frac{\mathrm{Uncompressed_{image}(Bytes)}}{\mathrm{Compressed_{image}(Bytes)}}$$

The SSI is a superior metric for measuring image quality because it is objective. Compared to more used measurements like peak signal-to-noise ratio and mean square error, the SSIM index has been found to provide more accurate and dependable assessments of image quality (PSNR). Common uses include image and video compression, denoising, augmentation, and other processes where evaluating image quality is crucial.

$$SSI = [l(x,y)]\alpha\,[c(x,y)]\beta\,[s(x,y)]\gamma$$

Where **α** >0, **β**>0 and **γ** >0 and l, c, s are

$$l(x,y) = \frac{2\mu_x\mu_y + c1}{\mu_x^2\mu_y^2 + c2}$$

$$c(x,y) = \frac{2\sigma_x\sigma_{y+}\,c2}{\sigma_x^2 + \sigma_y^2 + c2}$$

$$S(x,y) = \frac{\sigma_{xy} + c3}{\sigma_x\sigma_y + c3}$$

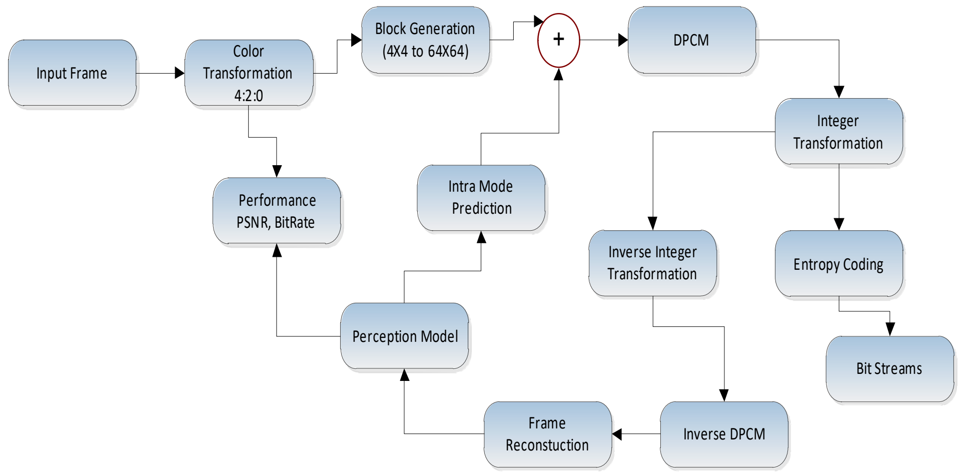


Figure 1: HEVC Encoding Architecture

Flow Chart and Algorithm

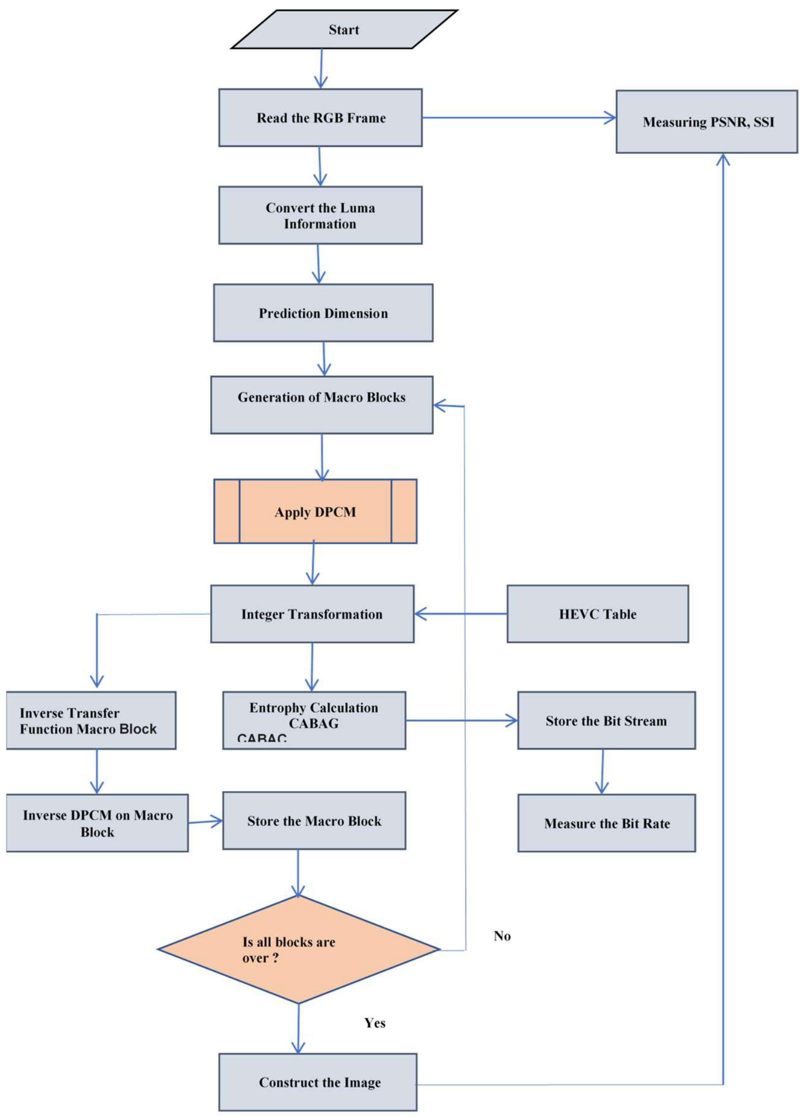


Figure 2: Flow chart for the compression of Endoscopic Videos Using DPCM Encoding.
There are additional stages required for the actual implementation of the algorithm, beyond the fundamental processing processes stated above. Process steps are represented by rectangles. Solid lines depict the movement of volumetric and other data.

Pseudo Code

Start:
Input: An endoscopic video
Step 1: Generation of RGB frames.
Step 2: Conversion of the frames into the luma values.
Step 3: Creating the macro block 16x16 from the luma values.
Step 4: Applying the DPCM technique to macro block.
Step 5: Integer transformation take place by referencing the HEVC table information.
5.1. Calculation of Entropy CABAC
5.1.1. Bit stream is generated and stored.
5.1.2 Bit rate is measured from the stored bit stream.
5.2 Inverse Transformation of the macro block.
5.3 Inverse DPCM of the macro block 1st to nth block.
5.3.1 The generated macro blocks is stored.
5.3.2 If all the block from 1st to nth is converted goto step 6.
5.3.3 Else go to step 3.
Step 6: Reconstruction of the image take place.
Step 7: Measurement of PSNR and SSI.
End.

Video	Memory(MB)	Time	Bytes	Frame Height	Frame Width	Frame Rate/Sec	Bitrate
1	77.5	19:15	8,12,81,024	320	240	30	445kbps
2	65.8	09:30	6,90,25,792	320	240	30	831kbps
3	65.4	25:49:00	6,86,22,848	320	240	30	295kbps
4	40.6	6.52	4,25,86,112	320	240	30	688kbps
5	35.9	05:52	3,77,28,256	320	240	30	713kbps
6	26.5	04:24	2,76,35,712	320	240	30	697kbps
7	25.7	04:22	2,69,72,160	320	240	30	687kbps
8	25.6	06:30	2,68,65,664	320	240	30	492kbps
9	20	03:18	2,09,96,096	320	240	30	705kbps
10	18.4	03:02	1,93,98,656	320	240	30	692kbps
11	15.9	05:36	1,67,11,680	320	240	30	337kbps
12	14.8	05:03	1,55,23,840	320	240	30	569kbps
13	13.3	04:13	1,39,67,360	320	240	30	367kbps
14	11.7	02:00	1,23,24,864	320	240	30	684kbps
15	6.44	01:30	67,62,496	320	240	30	500kbps
16	5.86	01:01	61,48,096	320	240	30	673kbps
17	4.59	00:53	48,16,896	320	240	30	611kbps

18	**4.47**	**01:47**	**46,89,920**	**320**	**240**	**30**	**307kbps**
19	**3.12**	**00:52**	**32,76,800**	**320**	**240**	**30**	**415knps**
20	**2.97**	**00:37**	**31,17,056**	**320**	**240**	**30**	**566kbps**

Database creation for the compression of endoscopic Video

In the database creation of endoscopic videos, let us deal with its definition, type and technical details. To perform an endoscopic examination of an internal organ or tissue, a long, thin tube is inserted into the body. It has a wide range of applications, from imaging to minor surgical procedures. The term "endoscopy" can refer to a number of different procedures. Esophagogastroduodenoscopy (EGD), also known as upper endoscopy; gastroscopy; endoscopy; endoscopic ultrasound (EUS); endoscopic retrograde cholangiopancreatography (ERCP); colonoscopy; and sigmoidoscopy are all endoscopic procedures that utilise natural bodily apertures. Gastric endoscopy is being used for this research. The main function of a database is to store and order endoscopic videos that can be used for the compression and can then be analysed during performance analysis. The table 1 contain 20 endoscopic videos which are stored on disk are in raw AVI videos prior to the compression, which shows the different parameters memory size before compression, duration of the video in term of time as measuring unit and memory details in terms of storage as size and frame details such as frame height, width and bit rate.

Table 1: Database of endoscopic video before compression

RESULTS

The following table contains the information about the values obtained during implementation.

Table1 Meta data information about the endoscopic video.

Name	**en val**
Type	Endoscopic Video
Format	'RGB24'
Size	52-60 MB
Width	320
Height	240
BitsPerPixel	24
FrameRate	30
Number of Frames:	5613

Table 2: Meta Data Information of Endoscopic Video

Intra Prediction Encoding Information

Parameters	Value Obtained
Original Bitrate	43.945313 Mbps
Intra Prediction Encoded Bitrate	35.931396 Mbps
PSNR Value	52.622910 dB
SSI Value	0.887023
Compression Ratio	0.40

Inter Prediction Encoding Information

Parameters	Value Obtained
Original Bitrate	43.945313 Mbps
Inter Prediction Encoded Bitrate	30.682373 Mbps
PSNR Value	46.518277
SSI Value	0.852431
Compression Ratio	.045

Performance Evaluation

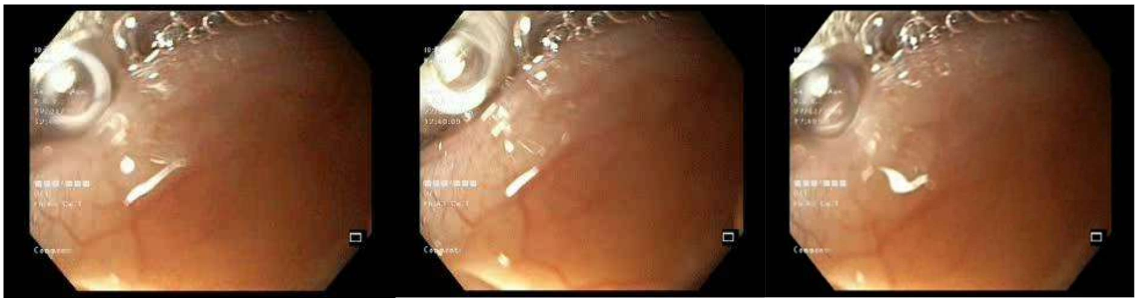
Frame Type	BitRate (Original)	Bitrate (Mbps)	PSNR (dB)	SSIM
Intra	43.945313	35.931396	52.622910	0.887023
Inter	43.945313	30.682373	46.518277	0.852431
Inter	43.945313	31.909180	45.917132	0.848263

Average Savings Bits per Pixel at each Encoding Level

Frame Type	Bitsper Pixel (Original)	Encoded	Saving
Intra	8	6.541111	1.458889
Inter	8	5.585556	2.414444

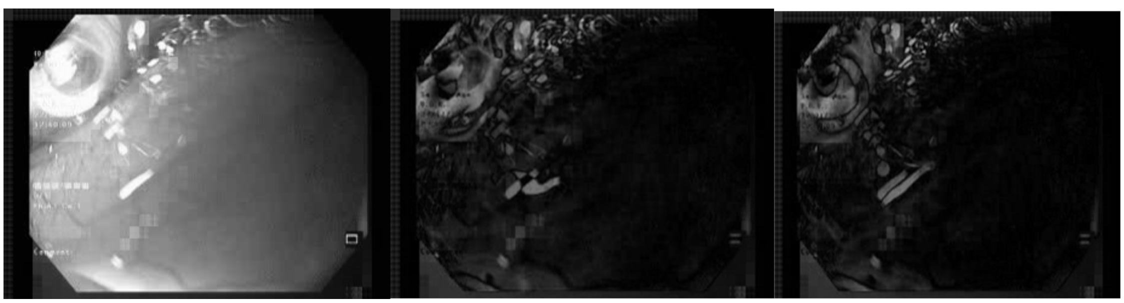
Inter	8	5.808889	2.191111

Here we demonstrate how well DPCM works for compressing endoscopic video. The primary goal of our proposed method is to successfully compress the provided endoscopic footage while avoiding the usual pitfalls of such an endeavour. Figure 2 demonstrates the initial three consecutive frames of the endoscopic video being encoded using Intra Prediction, followed by Inter Prediction encoding.



Frames (1) Frames(2) Frames(3)

Figure 2: Original Endoscopy Frame

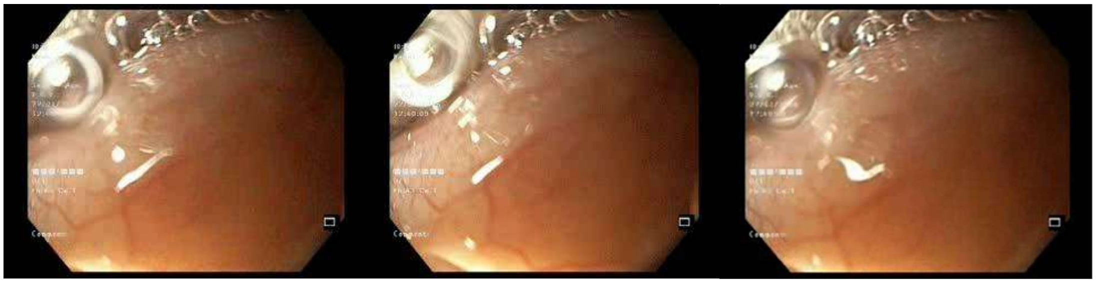


Intra Prediction Frames(1) Inter Predicted Frame (2) Inter Predicted Frame (3)

Figure 3: Intra & Inter prediction Frame during encoding

Reconstructed Intra Frame (1) Reconstructed Inter Frame (2) Reconstructed Inter Frame (3)

Figure 4: Intra & Inter prediction Frame during Reconstruction



Reconstructed Frame (1) Reconstructed Frame (2) Reconstructed Frame (3)

Figure 5: Intra & Inter Frame After Decoding

Average Savings Bits per Pixel at each Encoding Level

Frame Type	Bits per Pi (Original)	Encoded	Saving
Original	8	6.541111	1.458889
Intra	8	5.585556	2.414444
Inter	8	5.808889	2.191111

Performance result for the proposed approach

The following graph shows the results of our proposed approach via the parameters such as PSNR,(Figures 6-12).

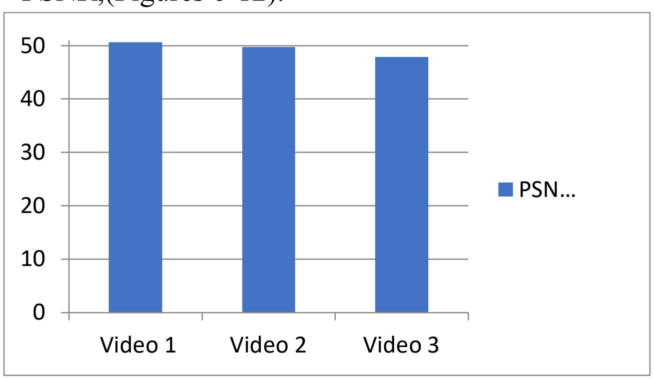


Figure 6: PSNR of three endoscopic Video

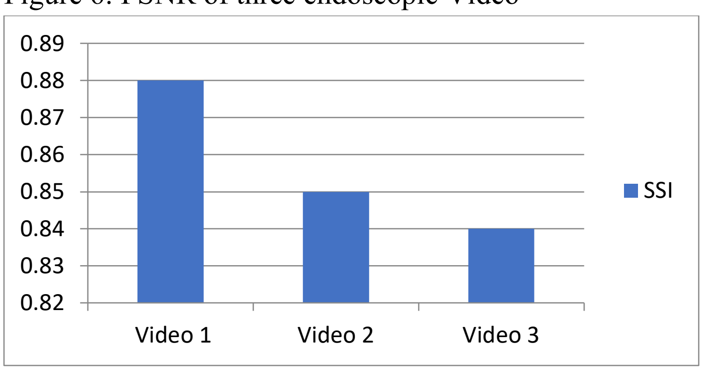


Figure 7: SSI of three endoscopic video

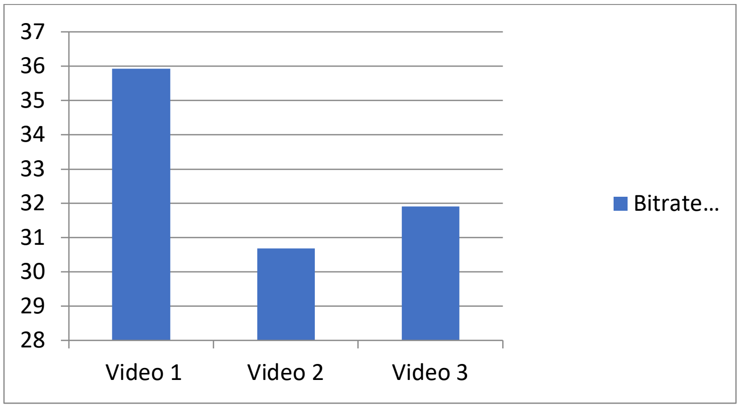


Figure 8: Bitrate of three endoscopic video.

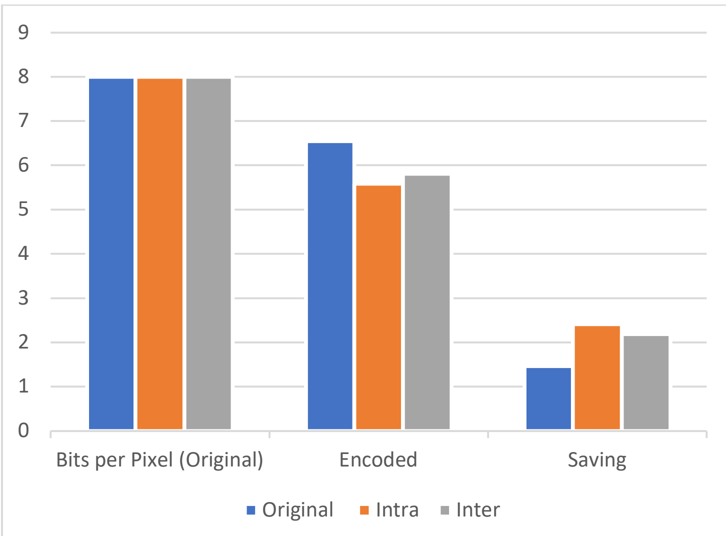


Figure 9: Performance evaluation of original vs three compressed endoscopic video frame

Conclusion

There are still many unanswered questions in the fields of telemedicine and video-based cloud health centres, despite the many studies conducted on compression techniques. Medical video transmission is crucial for the widespread implementation of telemedicine and video-based cloud health centres. Compression is the essential notion behind the success of video-based cloud health centres, which rely on the storage and transmission of data that can be in massive volume. In this research, a DCPM-based image compression strategy is offered as a means to address and overcome these challenges. Bitrate, compression ratio, SSI, and PSNR comparative findings are obtained as effective parameter. The effectiveness of the proposed strategy was illustrated by comparison tables and graphs. Because of this, the difficulties of current picture compression are mitigated to a far greater degree with the help of the proposed method.

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