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Low Complexity DCT Based Video Compression

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Abstract- The objective of video coding in most video applications is to reduce the amount of video data for storing or transmission purposes without affecting the visual quality. The desired video performances depend on applications requirements, in terms of quality, disks capacity and bandwidth. For portable digital video applications, highly-integrated real-time video compression and decompression solutions are more and more required. Actually, motion estimation based encoders are the most widely used in video compression. Such encoders exploits inter frame correlation to provide more efficient compression. However, Motion estimation process is computationally intensive; its real time implementation is difficult and costly. This is why motion-based video coding standard MPEG was primarily developed for stored video applications, where the encoding process is typically carried out off-line on powerful computers. So it is less appropriate to be implemented as a real-time compression process for a portable recording or communication device (video surveillance camera and fully digital video cameras). In these applications, efficient low cost/complexity implementation is the most critical issue.

Index Terms- MPEG, ACC, DCT, IRLE

I. INTRODUCTION

The 3d transform based video compression methods treat the redundancies in the 3D video signal in the same way, which can reduce the efficiency of these methods as pixel's values variation in spatial or temporal dimensions is not uniform and so, redundancy has not the same pertinence. Often the temporal redundancies are more relevant than spatial one. It is possible to achieve more efficient compression by exploiting more and more the redundancies in the temporal domain; this is the basic purpose of the proposed method. The proposed method consists on projecting temporal redundancy of each group of pictures into spatial domain to becombined with spatial redundancy in one representation with high spatial correlation. The obtained representation will be compressed as still image with JPEG coder.Wavelet compression is a form of data compression well suited for image compression (sometimes also video compression and audio compression). Notable implementations are JPEG 2000 for still images, and REDCODE, the BBC's Dirac, and OggTarkin for video. The goal is to store image data in as little space as possible in a file. Wavelet compression can be either lossless or lossy.[1] Using a wavelet transform, the wavelet compression methods are adequate for representing transients, such as percussion sounds in audio, or high-frequency components in two-dimensional images, for example an image of stars on a night sky. This means that the transient elements of a data signal can be represented by a smaller amount of information than would be the case if some other transform, such as the more widespread discrete cosine transform, had been used. Wavelet compression is not good for all kinds of data: transient signal characteristics mean good wavelet compression, while smooth, periodic signals are better compressed by other methods,particularly traditional harmonic compression (frequency domain, as by Fourier transforms and related). Data statistically indistinguishable from random noise is not compressible by any means. See Diary Of An x264 Developer: The problems with wavelets (2010) for discussion of practical issues of using wavelets for video compression. First a wavelet transform is applied. This produces as many coefficients as there are pixels in the image (i.e. there is no compression yet since it is only a transform). These coefficients can then be compressed more easily because the information is statistically concentrated in just a few coefficients. This principle is called transform coding. After that, the coefficients are quantized and the quantized values are entropy encoded and/or run length encoded. A few 1D and 2D applications of wavelet compression use a technique called "wavelet footprints".

The scale factor a either dilates or compresses a signal. When the scale factor is relatively low, the signal is more contracted which in turn results in a more detailed resulting graph. However, the drawback is that low scale factor does not last for the entire duration of the signal. On the other hand, when the scale factor is high, the signal is stretched out which means that the resulting graph will be presented in less detail. Nevertheless, it usually lasts the entire duration of the signal. In definition, the continuous wavelet transform is a convolution of the input data sequence with a set of functions generated by the mother wavelet. The convolution can be computed by using the Fast Fourier Transform (FFT). Normally, the output Xw(a,b) is a real valued function except when the mother wavelet is complex. A complex mother wavelet will convert the continuous wavelet transform to a complex valued function. The power spectrum of the continuous wavelet transform can be represented by | Xw(a,b) | 2 . One of the most popular applications of wavelet transform is image compression. The advantage of using wavelet-based coding in image compression is that it provides significant improvements in picture quality at higher compression ratios over conventional techniques. Since wavelettransform has the ability to decompose complex information and patterns into elementary forms, it is commonly used in acoustics processing and pattern recognition. Moreover, wavelet transforms can be applied to the following scientific research areas: edge and corner detection, partial differential equation solving, transient detection, filter design, Electrocardiogram (ECG) analysis, texture analysis and business information analysis.

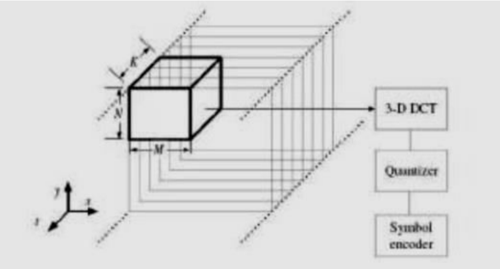
Discrete wavelet transforms: In numerical analysis and functional analysis, a discrete wavelet transform (DWT) is any wavelet transform for which the wavelets are discretely sampled. As with other wavelet transforms, a key advantage it has over Fourier transforms is temporal resolution: it captures both frequency and location information (location in time). The first DWT was invented by the Hungarian mathematician AlfrédHaar. For an input represented by a list of 2n numbers, the Haar wavelet transform may be considered to simply pair up input values, storing the difference and passing the sum. This process is repeated recursively, pairing up the sums to provide the next scale: finally resulting in 2n − 1 differences and one final sum. The most commonly used set of discrete wavelet transforms was formulated by the Belgian mathematician Ingrid Daubechies in 1988. This formulation is based on the use of recurrence relations to generate progressively finer discrete samplings of an implicit mother wavelet function; each resolution is twice that of the previous scale. In her seminal paper, Daubechies derives a family of wavelets, the first of which is the Haar wavelet. Interest in this field has exploded since then, and many variations of Daubechies' original wavelets were developed. Other forms of discrete wavelet transform include the non- or undecimated wavelet transform (where downsampling is omitted), the Newland transform (where an orthonormal basis of wavelets is formed from appropriately constructed top-hat filters in frequency space). Wavelet packet transforms are also related to the discrete wavelet transform. Complex wavelet transform is another form. The Haar DWT illustrates the desirable properties of wavelets in general. First, it can be performed in O(n) operations; second, it captures not only a notion of the frequency content of the input, by examining it at different scales, but also temporal content, i.e. the timesat which these frequencies occur. Combined, these two properties make the Fast wavelet transform (FWT) an alternative to the conventional Fast Fourier Transform (FFT).

Integer Wavelet Transform The Discrete Wavelet Transform (DWT) is a versatile signal processing tool that finds many engineering and scientific applications. One area in which the DWT has been particularly successful is in image compression and it has been adopted in the upcoming JPEG2000 image compression standard. Recently the concept of lifting has thrown net insight and ideas on wavelets and has served to enhance the power and versatility of wavelet transforms. Lifting provides an efficient way to implement the DWT and the computational efficiency of the lifting implementation can be up to 100% higher than the traditional direct convolution based implementation. The lifting approach is adopted in JPEG2000 the lifting scheme has also provided an easy way to construct new types of wavelet transforms which can be nonlinear. The Integer Wavelet Transforms (IWT) maps integers to integers and allows for perfect invertibility with finite precision arithmetic. A simple and effective way to construct IWT is to first factor the traditional DWT into lifting steps and then to apply a rounding operation at each step. The IWT can thus be used for lossless compression of medical images. One of the main advantages of using the wavelet transform for compression is that it provides a multiresolution representation of the image which other techniques like spatial-domain prediction cannot offer. The multiresolution representation allows the transmission of the lower resolution version of the image first, followed by transmission of successive. This mode of transmission is useful when the bandwidth is limited and the image sizes are large, e.g. 2D and 3D medical images for telemedicine applications. The transmission can be stopped at the client end if it is deemed that the received image at the current resolution is sufficient or the image is not of interest at the user end.

However a full resolution lossless version of the image can be received if so desired. Note that the IWT can also be used for lossy compression and it has certain advantages over the traditional DWT. The IWT can be used in a unified lossy and lossless codec and a seamless transition between virtually lossless and strictly lossless can be achieved. The IWT also have the potential for simpler implementation as many of the operands are integer and hence widely used in compression systems in industries.

II. EXISTING WORK OR LITERATURE SURVEY

DCT BASED CODING METHODS The transform coding developed more than two decades ago, has proven to be a very effective video coding method, especially in spatial domain. Today, it forms the basis of almost all video coding standards. The most common transform based intraframe video coders use the DCT which is very close to JPEG. The video version is called M-JPEG, wherein the .M. can be thought of as standing for .motion.. The input frame is first segmented into N N blocks. A unitary space-frequency transform is applied to each block to produce an N X N block of transform (spectral) coefficients that are then suitably quantized and coded. The main goal of the transform is to decorrelate the pixels of the input block. This is achieved by redistributing the energy of the pixels and concentrating most of it in a small set of transform coefficients. This is known as Energy compaction. Compression comes about from two main mechanisms. First, low-energy coefficients can be discarded with minimum impact on the reconstruction quality. Second, the HVS 1 has differing sensitivity to different frequencies. Thus, the retained coefficients can be quantized according to their visual importance. Actually, the DCT, witch will be used in our video compression approach, is widely used in most modern image/video compression algorithms in the spatial domain (MJPEG, MPEG). Although its efficiency, it produces some undesirable effects; in fact, when compression factors are pushed to the limit, three types of artifacts start to occur: .graininess. due to coarse quantization of some coefficients, .blurring. due to the truncation of high-frequency coefficients, and .blocking artifacts,. which refer to artificial discontinuities appearing at the borders of neighboring blocks due to independent processing of each block.[7] Moreover, the DCT can be also used in the temporal domain: In fact, the simplest way to extend intraframe image coding methods to interframe video coding is to consider 3- D waveform coding. The 2D-DCT has the potential of easy extension into the third dimension, i.e. 3D-DCT. It includes the time as third dimension into the transformation and energy compaction process [3][4][5][6]. In 3-D transform coding based on the DCT, the video is first divided into blocks of M N K pixels (M; N; K denote the horizontal, vertical, and temporal dimensions, respectively). A 3-D DCT is then applied to each block, followed by quantization and symbol encoding.



A 3-D coding method has the advantage that it does not require the computationally intensive process of motion estimation. However, it presents some disadvantages; it requires K frame memories both at the encoder and decoder to buffer the frames. In addition to this storage requirement, the buffering process limits the use of this method in real-time applications because encoding=decoding cannot begin until all of the next K frames are available. Moreover, the 3D DCT based video compression method produce some side effects in low bit rates, for example the effect of transparency produced by the DCT 3D [8]. This artifact is illustrated by figure 2. The technics of transformed 3Ds was revealed since the 90s, but the research in video compression was oriented towards the coding based on motion estimation. The design tendency of new coding diagrams led some researchers restarting the exploitation of transformed 3Ds in video compression. The coders based on this type of transformation produce high compression ratio with lower complexity compared to motion compensated coding. 3D DCT based video compression methods treat video as a succession of 3D blocks or video cubes, in order to exploit the DCT properties in both spatial and temporal dimensions. The proposed coding method will be based on the same vision. The main difference is how to exploit temporal and spatial redundancies. Indeed, the proposed method puts in priority the exploitation of temporal redundancy, which is more important than the spatial one. The latter assumption will be exploited to make a new representation of original video samples with very high correlation. The new representation should be more appropriate for compression.

In all studied sequences, the ACCfiJPEG outperforms the MJPEG in low and high bit rates, it outperforms MJPEG 2000 in high bit rates (from 750 kbs) and it starts reaching the MPEG 4 performance in bit rates higher than 2000 Kb/s. Among the studied sequences, we have got worst compression performance with .Foreman. sequence. The .Foreman.sequence contains more motion than the other studied sequences. This sequence contains non-uniform and fast motion which are caused by the camera as well as the man's face movement. The ACCfiJPEG efficiency decreases, measured PSNR is relatively low with an alternate character, especially in low bit rate. In fact, such results are expected as ACC JPEG eliminate "IACC" frame's high frequency data which actually represent the high temporal frequency produced by the fast motion in the Foreman sequence. .Hall monitor.sequence seems to involve less motion compared to the Foreman sequence; the motion takes place only in a very concentrated area. Due to the little amount of motion taking place on the overall image, we observed that our method get better results. Results of PSNR based comparative study between ACCfiJPEG and different existing video compression standards relative to .hall monitor. sequence. The best results were given with .Miss America. sequence; .Miss America. is a low motion sequence. The motion is confined to the person's lips and head. Since motion is low, temporal redundancy is high and it is expected that ACCfiJPEG. In the proposed method, the DCT is exploited in temporal domain. Some artifacts produced by 3D DCT based compression methods [9][10] persists in ACCfiJPEG. Actually, the application of the DCT on IACC allows the transformation from the spatial domain to the frequency domain. After quantification process, we will eliminate the high spatial frequencies of "IACC" frame which actually present the high temporal frequencies of the 3D signal source. Thus, a strong quantification will not affect the quality of image but will rather affect the fiuidity of the video. The change in the value of a particular pixel from one frame to another can be interpreted as a high frequency in the time domain. Once some of the coefficients have been quantized (set to zero) the signal is smoothed out. Thus some fast changes over time is somewhat distorted which explain the alternate character of the ACCJPEG PSNR waveform shown in figure 10. However, some sudden pixels change will be eliminated. This willoffer a useful functionality such as the noise removal; Indeed, the very high temporal frequency (sudden change of a pixels value over time) is generally interpreted as a noise. Moreover, some artifacts existing in DCT based compression methods such as spatial distortions generated through the massive elimination of the high spatial frequencies (macroblocking) does not exist in the proposed method as shown in figure 11. The PSNR Curve relative to the ACC JPEG coding is in continuous alternation from one frame to another with a variation between 31.4 dB and 33.8 dB unlike MPEG PSNR which is almost stable. In one hand, ACCJPEG affects the quality of some frames of a GOP, but on the other hand, it provides relevant quality frames in the same GOP, while MPEG produces frames practically of the same quality. In video compression, such feature could be useful for video surveillance field; Generally, we just need some good quality frames in a GOP to identify the objects (i. e. person recognition) rather than medium quality for all the frames.

ACC JPEG artifacts & ACC JPEG FEATURE ANALYSIS The proposed method presents several advantages: -Symmetry: On the contrary of coding schemes based on motion estimation and compensation whose coding is more complex than decoding, the proposed encoder and decoder are symmetric with almost identical structure and complexity, which facilitates their joint implementation. -Simplicity: The proposed method transform the 3D features to 2D ones, which enormously reduce the processing complexity. Moreover, The complexity is independent of the compression ratio and motions. -Objectivity: Unlike 3D methods that treat temporal and spatial redundancies in the same way, the proposed method is rather .selective., it exploits the temporal redundancies more than the space redundancies; what is more objective and more efficient. -Flexibility: The parameters of the ACC JPEG offer a fiexibility that makes it possible to be adapted to different requirements of video applications: The latency time, the compression ratio and the size of required memory depend on the value of the NR parameter. Indeed, by increasing the value of NR, the compression ratio, the latency time and the reserved memory increase. This parameter allows to optimize the Compression/Quality compromise while taking in consideration memory and latency constraints. -Random Access: 3D transform and motion estimation based video compression methods require all the frames of the GOP to allow the random access to different frames. However, the proposed method allows the random frame access the ACC formula makes it possible to code and/or decode a well defined zone of the GOP (Partial coding). As conclusion, we can state that the ACC JPEG is very efficient for scenes with a translator character [9], or with slow motion, especially without change of video plan. However, it loses much of its efficiency in scenes with extremely fast moving objects and very fast change ofvideo plan. The ACC JPEC produces images whose details are clearer and without macro-blocking. it seems that ACC JPEG can be very suitable to video surveillance applications. In fact, in such applications, we find usually video with uniform motion because used cameras are always fixed on specific supports. With such given video, ACC JPEG becomes very efficient, it gives good visual quality with clear image details and identifiable moving objects by exploiting the high quality of some frames in the GOP for further recognizing operations. Furthermore, ACC JPEG seems to be well adapted to embedded or portable video devices such as the IP cameras thanks to its fiexibility and its operating simplicity.

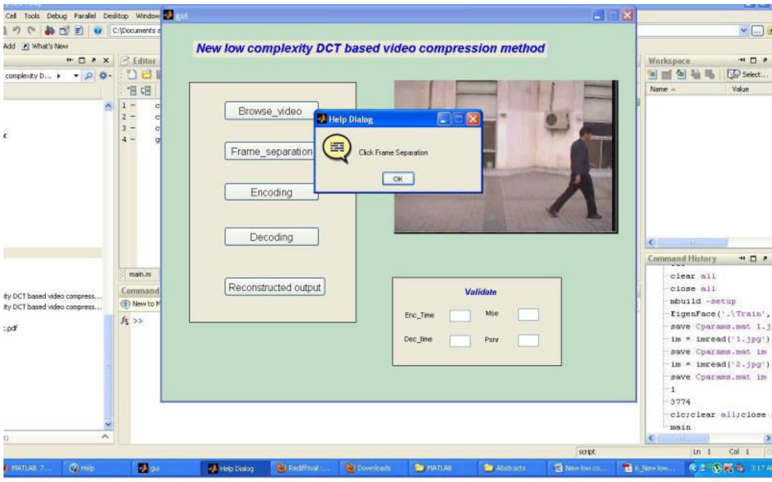
MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation.

III. WRITE DOWN YOUR STUDIES AND FINDINGS

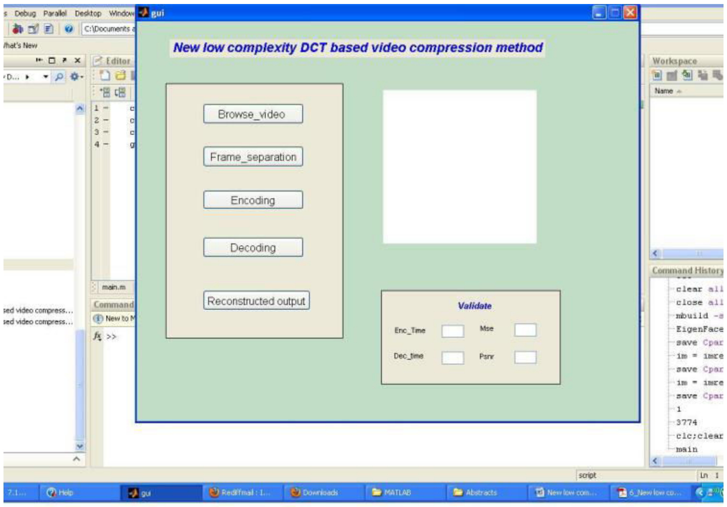
Model-Based Design with MathWorks tools provides a proven technique for creating embedded control systems. It is used today for satellites, aircraft, and many other aerospace applications, in the automotive industry, and for process control, computer peripherals and industrial machinery. Through Model-Based Design, embedded control system design teams can begin evaluating software designs without using prototype products and real-time targets. The MathWorks environment for Model-Based Design allows engineers to mathematically model the behavior of the physical system, design the software and model its behavior, and then simulate the entire system model to accurately predict and optimize performance. The system model becomes a specification from which you can automatically generate real-time software for testing, prototyping, and embedded implementation, thus avoiding manual effort and reducing the potential for errors. The MathWorks products for Model-Based Design provide a visual, interactive environment in which to build, manage, and simulate the model. The graphical, hierarchical nature of this environment lets embedded control system software design teams functionally model, accurately document, and effectively communicate their designs, reducing the risk of misinterpretation ormisunderstanding. Changes or corrections to the system requirements and specifications are easily incorporated into the model, fully evaluated by simulation, and automatically reflected in the final real-time embedded software. Modeling and Simulation To effectively design an embedded control system and accurately predict its performance, designers must understand the behavior of the entire system in which the control system will reside. MATLAB and Simulink form the core environment for Model-Based Design for creating accurate, mathematical models of physical system behavior. The graphical, block-diagram paradigm of the MathWorks environment lets you drag-and-drop predefined modeling elements, connect them together, and create models of dynamic systems. These dynamic systems can be continuous-time, multi-rate discrete-time, or virtually any combination of the three. You can create custom model elements or reuse legacy code-based models by incorporating C, Fortran, or Ada code directly into the modeling environment.The modeling environment is hierarchical and self-documenting. System structure and function can be clearly expressed by grouping model elements in virtually any combination, allowing large teams to work concurrently on the design. Libraries of hierarchical elements can be quickly created, allowing those elements to be reused easily by other members of the design team or on subsequent designs. Fully integrated into the environment is the capability to graphically model event-driven systems using state charts, truth tables, and flow diagrams. Specialized capability for mechanical and electrical power systems allows models of these systems to be constructed using modeling elements that correspond directly to the structure of the physical system, avoiding the need to express them as mathematical equations. If prototype or actual physical systems are available and input/output data can be acquired from them, mathematical models can also be created using system identification techniques. As soon as a hierarchical element of the model is constructed, that element can be simulated. Simulation allows specification, requirements, and modeling errors to be found immediately, rather than waiting until later in the design effort. As the model becomes larger, through the addition of hierarchical elements or by increasing the complexity of existing ones, the designercan continue to find and correct errors during simulation by using the model coverage, performance profiling, and interactive debugging features. When the physical system model is specified to the required level of detail and simulation has shown the model to be accurate, the control system can be designed. Control System Software Design With the behavioral model of the physical system available, the designer can begin the embedded control system software design. The MathWorks environment for Model-Based Design supports many types of control system design techniques and requirements that range from the simple to the most complex and large-scale. For example, some product designs may require using linear control design methods to determine the correct algorithms and parameters for the control system software. Using MATLAB and Simulink, the designer can automatically create the linear physical system models needed by this design technique, calculate the parameters, and then visualize the results using Bode plots and root locus diagrams. Other applications may require less sophisticated techniques to determine the correct control system design. Regardless of the control system design method used, the MathWorks environment for Model-Based Design helps the designer use interactive simulation to quickly evaluate each control system design model in conjunction with the physical system model and avoid the risk, expense, or need for prototypes or actual physical systems.

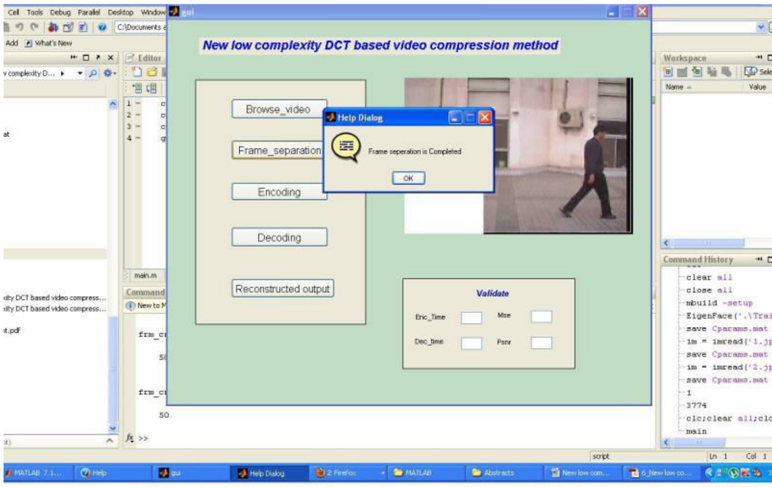
As the control system functional design is completed and the target environment needs to be considered, the designer can specify implementation details for the software directly in the modeling environment. The MathWorks environment supports all aspects of control system software design, including processor, interface, or standards issues. For example, you may need scaled integer or fixed-point data types for target processors that have no floating-point math capability. The effects of fixed-point mathematics can be evaluated by simulation, to see if the proper data sizes and scale factors have been selected. Data structures that are needed to meet software standards or target environment interface requirements can be defined as part of the system model and then realized when the embedded control system software is automatically generated.

IV. RESULTS AND DISCUSSION



Click Frame Separation





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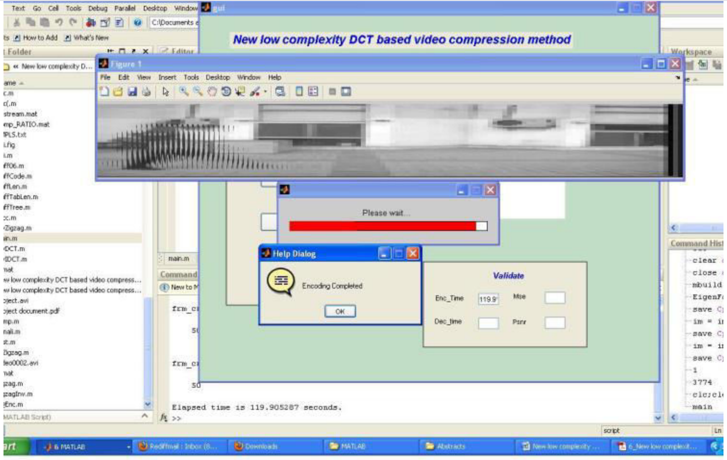

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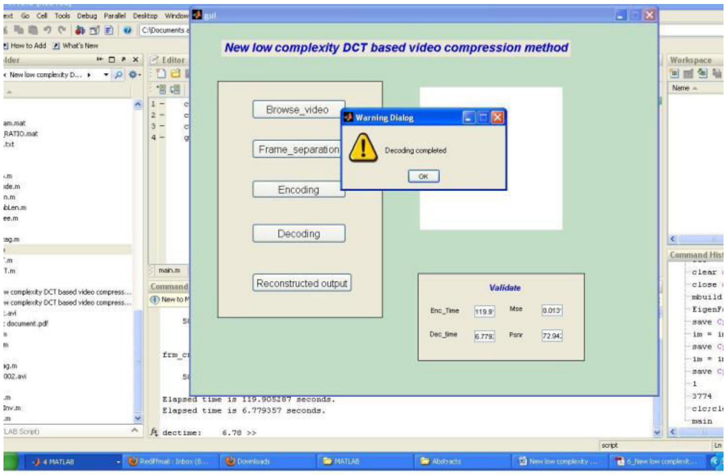

Decoding completed

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V. CONCLUSION

The video signal has high temporal redundancies between a number of frames and this redundancy has not been exploited enough by current video compression technics. In this research, we suggest a new video compression method which exploits objectively the temporal redundancy. With the apparent gains in compression efficiency we foresee that the proposed method could open new horizons in video compression domain; it strongly exploits temporal redundancy with the minimum of processing complexity which facilitates its implementation in video embedded systems. It presents some useful functions and features which can be exploited in some domains as video surveillance. In high bit rate, it gives the best compromise between quality and complexity. It provides better performance than MJPEG and MJPEG2000 almost in different bit rate values. Over .2000kb/s. bit rate values our compression method performance becomes comparable to the MPEG 4 especially for low motion sequences. There are various directions for future investigations. First of all, we would like to explore others possibilities of video representation.

REFERENCES

[1] E. Q. L. X. Zhou and Y. Chen, .Implementation of h.264 decoder on general purpose processors with media instructions,. in SPIE Conf. on Image and Video Communications and Processing, (Santa Clara, CA),pp. 224.235, Jan 2003.

[2] M. B. T. Q. N. A. Molino, F. Vacca, .Low complexity video codec for mobile video conferencing,. in Eur. Signal Processing Conf. (EUSIPCO),(Vienna, Austria), pp. 665.668, Sept 2004.

[3] S. B. Gokturk and A. M. Aaron, .Applying 3d methods to video for compression,. in Digital Video Processing (EE392J) Projects Winter Quarter, 2002.

[4] T. Fryza, Compression of Video Signals by 3D-DCT Transform. Diploma thesis, Institute of Radio Electronics, FEKT Brno University of Technology, Czech Republic, 2002.

[5] G. M.P. Servais, .Video compression using the three dimensional discrete cosine transform,. in Proc.COMSIG, pp. 27.32, 1997.

[6] R. A.Burg, .A 3d-dct real-time video compression system for low complexity singlechip vlsi implementation,. in the Mobile Multimedia Conf. (MoMuC), 2000.

[7] A. N. N. T. R. K.R., .Discrete cosine transforms,. in IEEE transactions on computing, pp. 90.93, 1974.

[8] T.Fryza and S.Hanus, .Video signals transparency in consequence of 3d-dct transform,. in Radioelektronika 2003 Conference Proceedings, (Brno,Czech Republic), pp. 127.130, 2003.