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Evolution Of Offshore Technology A Case Of Strategic Interaction In Oil Industry
Agustinus Denny Unggul Raharjo

Pendeteksian Malaria dalam Citra Mikroskopis Sel Darah Menggunakan Segmentasi Citra
Julius P. P. Naibaho

An Introduction to Mpeg-4
Yanty Rumengan

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Yulius B. Sirwutubun, Bambang Triyanto, Juanita R. Horman

Aplikasi Metode Geolistrik untuk Menentukan Akuifer Air Tanah di Kampung Horna Baru dan Kampung Muturi Distrik Manimeri Kabupaten Teluk Bintuni Provinsi Papua Barat
Karmila Laitupa, Yulius G. Pangkung, Jance M. Supit

Analisis Resiko Penambangan Sirtu Guna Memenuhi Kebutuhanproyek Jalan Warmare-Prafi Eib 17 Kabupaten Manokwari
Juanita R. Horman

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Alex De Kweldju

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Agnes Dyah Novitasari Lestari

Pembelajaran Materi Lingkaran Menggunakan Metode Commeth
Andi Fajeriani Wyrasti

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DAFTAR ISI

Evolution Of Offshore Technology A Case Of Strategic Interaction In Oil Industry	1 - 7
Pendeteksian Malaria dalam Citra Mikroskopis Sel Darah Menggunakan Segmentasi Citra	8 - 15
An Introduction to Mpeg-4	16 - 20
Evaluasi Dampak Kegiatan Peledakan Vertical Benching Terhadap Ground Support PT. Freeport Indonesia	21 - 27
Aplikasi Metode Geolistrik untuk Menentukan Akuifer Air Tanah di Kampung Horna Baru dan Kampung Muturi Distrik Manimeri Kabupaten Teluk Bintuni Provinsi Papua Barat	28 - 35
Analisis Resiko Penambangan Sirtu Guna Memenuhi Kebutuhanproyek Jalan Warmare-Prafi Eib 17 Kabupaten Manokwari	36 - 41
Analisa Pemanfaatan Aplikasi Clearsea untuk Kuliah Umum di Universitas Negeri Papua	42 - 46
Potensi Pengembagan dye sensitized solar cell (dssc) dengan Sensitizer Zat Warna Alami dari Tumbuhan Asal Papua Sebagai Alternatif Solusi Krisis Energi dan Pemanasan Global	47 - 50
Pembelajaran Materi Lingkaran Menggunakan Metode Commeth	51 – 56
Survei Geolistrik untuk Mengetahui Potensi Air Tanah di Kepulauan Ayau, Kabupaten Raja Ampat, Provinsi Papua Barat	57 - 62

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AN INTRODUCTION TO MPEG-4

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Abstract

In 2005 MPEG-4 is the latest generation in multimedia codec. MPEG-4 was initially discovered in the year 1998 to overcome the obstacles of MPEG-1 and MPEG-2. However MPEG-4 was not officially recognized until the year 2002. The MPEG-4 standard can be applied to many applications because it contains the ability of scene-based presentation, natural and synthetic object coding, power script, java-language support and network transparent integration [1]. MPEG-4 is the extended version from the final one MPEG-1 and MPEG-2 which means also part of the working group of ISO/IEC developed by Motion Picture Experts Group in charge of the development of international standards for compression, decompression, processing and coded representation of moving picture, audio and both of the combination.

Keywords: MPEG-4, ISO/IEC, Multimedia Codec

Abstrak

Pada tahun 2005 MPEG-4 adalah generasi terbaru dari kodek multimedia. MPEG-4 pertama kali dikembangkan pada tahun 1998 untuk mengatasi hambatan yang ada pada MPEG-1 dan MPEG-2. Namun demikian MPEG-4 baru secara resmi dikenal pada tahun 2002. Standar MPEG-4 dapat diterapkan pada banyakaplikasi karena MPEG-4 mengandung kemampuan tampilan berbasis tayangan, pengkodean obyek alami dan sintetis, power script, dukungan terhadap bahasa java, dan integrasi jaringan yang transparan [1]. MPEG-4 adalah versi perpanjangan dari MPEG-1 dan MPEG-2 yang juga tergabung dalam kelompok kerja ISO/IEC yang dikembangkan oleh Motion Picture Experts Group. Kelompok ini bertanggungjawab dalam pengembangan standar internasional untuk kompresi, dekompresi, prosesing dan tampilan terkode dari gambar bergerak, audia, maupun kombinasi keduanya.

Kata Kunci: MPEG-4, ISO/IEC, Kodek Multimedia

1. INTRODUCTION

Motion Picture Experts Group (MPEG) is series of international standard organization for compressing video and audio refer to the variety of uses and data rates. MPEG utilizes million of DVD disks, satellite receivers and streaming media processors.

Currently it use the MPEG-2 standard. However as the standard progressed we found that there were certain drawbacks that came into light. Low bit-rate implementation and drifting image quality when encoder and decoder lose correlation are just some of the drawbacks.

Despite the continual demand in efficiency, the basic algorithms in MPEG-2 are reaching their limits in terms of compression efficiency. MPEG-4 designed to improve these drawbacks.

MPEG-4 allows each media type to be handled in independently for maximum in order to define a set of tools that can be used to encode and transmit multimedia content that can include video, text, sound, and animals as independent objects.

Meanwhile, consider to all the object oriented analysis allows the media to be combined as overlays and video windows of different sizes, shapes and transparency without any compromising of object's data.

Furthermore, MPEG-4 also provides scaleable image quality, digital rights management, and interactivity through a mechanism for incorporating new encoder/decoder image compression scheme as technology improves.

2. MPEG-4 COMPRESSION FEATURES

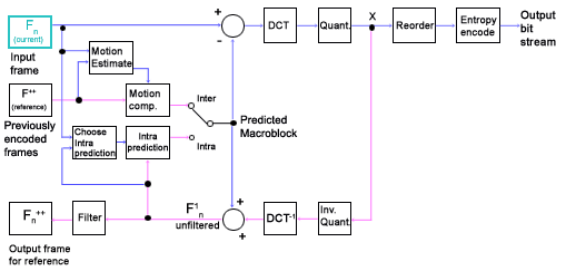

Figure 1 MPEG-4 Processing Steps

Figure 1 (http://www.techonline.com/comunity/ed_resource/feature_article/37054) represents the processing steps of advance video coding used in MPEG-4.

As can be seen in the MPEG-4 block diagram above, there some additional compression efficiency e.g. spatial compression at the pixel level which is equal with the frequency domain.

The first step is the mode selection process. Here the AVC scheme (advance video coding) will use infra-frame or inter frame compression along with other MPEG techniques. The AVC approach uses information from previous encoded blocks that lie nearby in the image frame instead of encoding each macro block in isolation.

The second step is the inter-frame operation where AVC can use maximum of five frames in its search for motion estimation. The advance video encoding scheme uses the sub-blocks of the 16x16 main blocks. That means that the coding scheme can use any of the following blocks like the 8x16, 16x8, 8x8, 8x4, 4x8, and 4x4. If we compare this coding scheme to the coding scheme of the MPEG-2 player then we find that this player uses only the 16x16 macro block with ½ pixel accuracy. In the intra-frame compression scheme, the prediction technique is used where the result of the block is predicted in advance and is then displayed on the output side rather than the actual block value.

The prediction technique which is used by the block is an important distinguishing feature in a AVC profile. In the AVC method, the scheme subtracts the value that has been predicted from the actual output value before going through the transformation to spatial frequency. With only the error term being under observation, fewer frequency components will pass the quantization step. After the quantization step has been undergone, the frequency components of all the zero-value words would be together for run-length coding process.

Finally the infra-frame prediction must use the same macroblocks as its reference in order to ensure that the decoder is able to reconstruct the frame based on the prediction values provided. The motion estimation step helps remove compression artifacts from the image. The feedback way performs the same steps used in the decoder to reproduce the image for display.

3. THE MPEG-4 ARCHITECTURE

MPEG-4 contained three main components that can communicate among each other through DAI and DNI interfaces as represented in figure 2 (Tung Y. S and Wu J. L, p.38). The three components that mentioned before are streaming server, DMIF server and player.

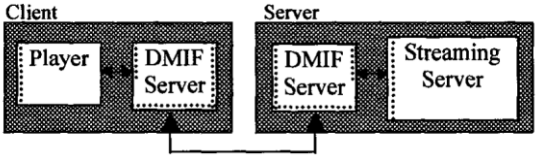

Figure 2 DAI and DNI on MPEG-4

Player is client component which process the incoming content and displays the result. For the user interaction this component contains two different ways, which are programmers and end-users. There are two sub components inside the player which are decoding process and controlling process. The decoding process use for the processing the incoming data and the controlling process creates decoding graphs and look after its behavior.

DMIF connects to different site of protocol therefore it may have delivering service for streaming server and client application through DAI.

Streaming server has three elements namely the request handler, the scheduler, and the script processing unit. The request handler looks into the need of the client, the scheduler accesses the contents which are in the MPEG-4 file format and sends the data to the server designer. The script processing unit reads the instruction on the input side and executes them accordingly.

4. MPEG-4 APPLICATION

The attractive feature integrated in MPEG-4 enable benefit its application. MPEG-4 provides two types of scene structure that composed of all kinds of multimedia objects. They are 2D coordinated system and 3D coordinate content (Tung Y. S and Wu J. L, p.38). Each of these scenes enables to apply in many applications. MPEG-4 application can found at:

(http://www.electronicstalk.com/news/kan/kan115.html):

multimedia applications
internet appliances
video security
videophone
consumer equipment

video server

The example below are also some of the MPEG-4 applications along with the explanation.

News Report / Video On Demand (figure 3)

MPEG-4 is predicted as the only technology that provides VoD (Video on Demand) service on the next generation TV. With the script language feature, MPEG-4 can obtain higher user interaction. Future interactive TV will become real as MPEG-4 with content provider give the latest news for user selection or simultaneously give additional instant financial information. On the other hand the customers may use the layout or its presentation style. The layout regularly could be change by triggering the sensors provided by VRML. MPEG-4 with integrated multiple scene will control elements to be centralized on the display in order to separate the control and the display. MPEG-4 technology can also simulate virtual reporter when main display switches to prerecorded tapes.

Figure 3 New Report (Video on demand)

Virtual Art Gallery (figure 4 & 5)

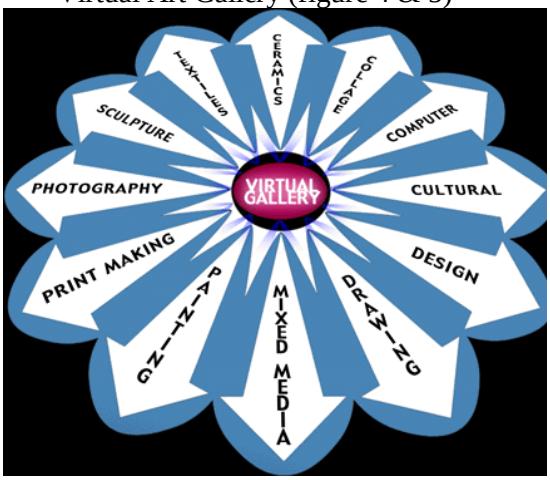

Figure 4 Virtual Art Gallery A

Virtual gallery means the gallery displays all the painting in the world and can be accessed through internet. MPEG-4 wavelet coding, scene based representation along with multi-resolution can display the object in an effective way. All those features is needed in the virtual gallery. Digital library as the additional feature enable the server to filter user's selections according to their interest.

a

b

c

d

Figure 5 Virtual Art Gallery B

Figure 4 and 5 represent the example of virtual gallery on the internet. Figure 4 provides the option for the users to choose the criteria of their interest. Figure 5a and b are the example of painting which is held on may 2004, figure 5c shown the example of textiles and figure 5d shown the example of cultural (http://web1.ibo.org.uk/gallery/index.cfm).

Personal Karaoke Room

In some countries in Asia karaoke believed is the best way to fade away of stress especially in Japan as the inventor country of karaoke. MPEG-4 can provide many amazing of virtual karaoke room style. The users can choose which type of the room the same as their interest while the provider can charge the fee when requests are made. This is one of interactive and scripting features of MPEG-4 that connect the program to a music database and intelligently list of songs. Figure 6

represent the example of personal karaoke room.

Figure 6 Personal Karaoke Room

Live Sports Report

Live sport report is a challenging representation because it is not easy to represent quick movement and heavy body deformation of the athletes. The technology shows how to represent the athletes behaviors live synthetically. MPEG-4 predicted to provide this technology. Figure 7 shows the example of live sport report.

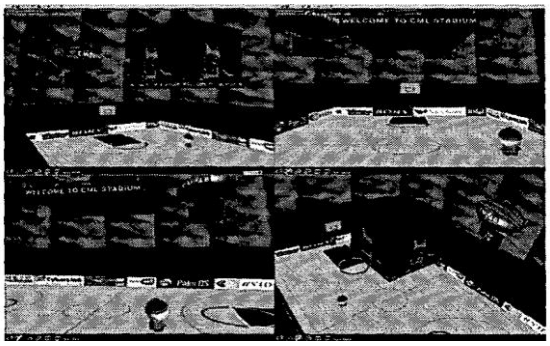

Figure 7 Live Sports Report

5. COMPARISON OF MPEG-4 WITH OTHER TECHNOLOGIES

There are some systems predicted will have the same function with MPEG-4. DivX, XVid, WMV9, and WME are those technologies.

DivX is the technology format for digital video where some people called it the imitation of MPEG-4. There is no wonder on that because DivX uses MPEG-4 standard technology such as compressing video files at the highest compression rate, making them small enough to be easily transferred through internet (http://www.gocyberlink.com/english/dv-entertainment/articles/divx2.jsp). This type of codec enables transmission of signals with low bandwidth requirements. Due to this feature, there would be no wastage of the chanel space in the devise. The DivX is highly reliable with speed and efficiency factors. An example of DivX codec feature can be seen on a CD. This is to say that a full land DVD movie can be compressed and fitted in to a Compact disk. Even though the DivX gives high quality movies the time for encoding the signal in the CD is negligible (http://www.divxmovies.com/info/). With DivX user can download full screen easily, full motion video from internet where the sound and the picture are almost the same with DVD player.

XVid is a part of MPEG-4 compatible codec, which normally produces good video quality. (http://www.afterdawn.com/software/video_software/codecs_and_filters/xvid.cfm).

The XVid technique is not used as much as the DivX technique. However the XVid plays movies in DVD players that support the DivX technique. When users install the XV id systems it increases the features of the players as add-on and explain how compression and decompression of video is done in XVid format. Once the XVid system is install in the player, the movies can be played either by using the windows media player or any other XVid device.

As can be seen from the explanation approach, we find that the MPEG-4 technology is a step ahead when compared to other technologies like DivX and XVid because of the fact that the MPEG standards nowadays are being marketed as defacto standards. Defacto standard means that the standard which is not yet published by an organization like IEEE.

The MPEG group has now collaborated with JVT and AVC. This has helped MPEG4 to improve its performance over time.

6. MPEG-4 FUTURE APPLICATION SCOPE

Due to the presence of many technologies at the moment the user might feel tempted to test all the products. By doing this, there would be high level of competition in providing compression performance features with good quality. In a few years from now, the digital media will come across a new technology called object based compression which provides much more flexibility and interactive experiences for many application fields.

7. CONCLUSION

In this paper we have seen how the MPEG-4 technology came into force from its predecessors such as MPEG-1 and MPEG-2. According to the working principle of MPEG-4 we found that the coding scheme is given the highest priority for the display of output. In the succeeding section we explain the basic architecture of MPEG-4 which consisted of three functional blocks for maximum performance of the system. Later on by taking some example of image processing system we saw how the digital image is captured and decoded into suitable form which the user understands. The MPEG-4 standard has a lot of competition in the market and hence we have compared it with system like DivX and XVid. On that comparison basis we found that mpeg-4 is still a step forward compared to them. We also have explained the application areas of MPEG-4 in detail. The future application areas have also been mentioned in this paper.

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