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Implementation of Transcoding Algorithms in the Multimedia Digital Library Transaction

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Abstract—**In the current scenario of technical achievements more emphasis is given to the information captured in the form of Images, Video and Audio. These huge collections of Images, Audio and Video form the Multimedia Information Store best known as Multimedia Digital Library (MDL). An open distributed architecture is needed, to construct a Digital Library Architecture that is in many ways similar to the web. This paper is an approach to e-learning process as to build a bridge between the concept of transcoding and the Multimedia Digital Library. As an experimental setup a MDL transaction is proposed where implementation of a proper transcoding algorithm plays a key role. The parameter like quality factor has its own contribution before the completion of this transaction.**

Keywords- Transcoding, e-learning process, MDL transaction, Quality factor.

I. INTRODUCTION

Computer scientists use the term 'multimedia' to refer to anything that is not conventional alphanumerical data. Sometimes, the term is made more explicit by an enumeration of data types, appealing to an intuitive notion of multimedia: image, audio, video, and text. People interact with multimedia every day: reading books, watching television, listening to music. We organize and structure this multimedia, such that we can easily access it again. Since the multimedia has been introduced in personal computers, it has become more common every day to digitize part of the multimedia data around us. The information conveyed by multimedia data may represent anything from the real-world, while the information conveyed by traditional data is a symbolic representation of facts restricted to the database's (limited) universe of discourse. The huge collections of Images, Audio and Video form the Multimedia Information Store best known as Multimedia Digital Library (MDL).

A. Multimedia Digital Library :

Digital libraries are an emerging concept, as today's libraries routinely provide information and services in digital form. Digital libraries support a wide variety of applications, ranging from educational and research activities to government and private sector applications. Digital library research focuses mainly on digital library design and efficient data manipulation for providing library services, with minimal or no consideration of data security. While a fundamental aspect of digital library design is ensuring open access, the increased dependence of a variety of applications on digital libraries, and privacy and copyright requirements raise the need to develop security models.

The objectives of building a Multimedia Digital Library are:

- To create a large, permanent, indexed multimedia archive as a relevant and effective resource for e-learning process.
- Extend the functionality of underlying multimedia database technology to advance the accessibility and usability of multimedia databases, including complex multi-feature query processing, advanced stream handling, and extended storage hierarchies.
- Expand the capabilities of required query and retrieval system to incorporate agent-based components for intelligent processing of high-level user "concept" queries and secure data access of distributed multimedia data.

The preliminary requirement for Multimedia Digital Library are :

- *Complex multi-feature multimedia query operators:* To support image similarity search for complex multi-feature queries, new query operators can introduced that handle optimal aggregate ranking for any number and combination of image features, ensuring that the operators are practical for real-world databases and can easily be integrated into query pipelines to support a hierarchy of join operations, nested views and a wider range of query execution plans.
- *Advanced stream handling:* Efficient presentation of media streams in a search and discovery database environment requires stream management policies that consider the inherent connection between query results and user stream requests. a new policy can be thought that processes "expected streams" to reduce initial latency and disk I/O and address the query processing of stream data.. We will develop query operators that are capable of joining multiple infinite data streams and combined streamed/stored data input. It can be planned to address access control of streaming video, where video data is altered to protect privacy or ownership while streaming from the database to the user.
- *Extended storage hierarchies:* New database components are needed to handle extended storage hierarchies that support real-time access to buffer, disk and tertiary storage. The large-scale storage for video data requires efficient access and management of tertiary resident data.
- *Expanded capability for e-learning system:*A system that delivers unified access to distributed multimedia data

requires the development of a number of related web-based components. The focus is on building agent-based components that support 1) processing for high-level user queries directed to a collection of heterogeneous systems containing a combination of multiple data types, 2) secure data access for the sensitive shared any type of information, and 3) processing of retrieved multimedia results for presentation.

B. *Need of Distributed Architecture:*

Digital libraries, whether distributed across the globe or across a small campus, provide a quick and cost effective means to distribute learning resources to students, employees etc. The challenge for administrators is to facilitate the indexing, searching, and retrieval of material to prevent users from becoming overwhelmed by the task of finding the proper data. Two methods to manage a digital library are: *monolithic and distributed.*

The monolithic systems used a single point to store and deliver all the course material for the organization. While this simplifies the maintenance and indexing of the digital library, user access and information maintenance can present a problem. The monolithic method may be best suited for organizations with small, highly specialized information bases.

A distributed model also has the advantage of eliminating a single point of failure. A mirror plan can be implemented where is one server is down, another server with a copy of the information can still provide access to users. With information stored locally, the authors retain ownership of the documents and multimedia stored on their server. The distributed model also can reduce access time for certain users, especially if highly utilized information is mirrored to different geographical locations. The distributed model would provide space for development and distribution needs. Approved material would be placed in a specific directory structure where the master index would search, catalog, and retrieve it. Users contact the system through the closest machine, which uses a distributed index to find the material requested by the user. The distributed system does, however, increase the maintenance complexity since index updates and material transfers can significantly impact system performance. However, digital libraries have an advantage over the www with more control of content and information organization. As such, digital libraries can take advantage of automated indexing, agreed upon set of keywords, and meta-data to describe documents. These techniques can improve retrieval of relevant information and improve the services that a digital library offers its users.

C. *Transcoding Concept:*

The transcoding process changes the bit stream format of one file to another file without any other encoding and decoding processes. This is generally effective only if the source and destination formats are alike. The data file is decoded to an uncompressed format and further encoded into a target format. There are 4 type of object that needs transcoding process: document (text, html, pdf, ppt, doc), image, audio video. There are three types of transcoding:

1. Lossy to Lossy
2. Lossless to Lossless
3. Lossless to Lossy

Transcoding with a lossy encoder decreases quality. The drawback of this process is that the resultant quality is never regained. However, this method is still used to lower bit rate in portable players, where the listener is less concerned about sound quality than saving storage space. Lossless to lossless transcoding is recommended to avoid quality disruption. Transcoding from a lossless source to a lossy target requires keeping the lossless source files. This allows for re-encoding if the lossy result is not adequate.

Various mechanisms exist for Transcoding web pages. In general, these mechanisms can be divided three categories:

1. Client-based
2. Proxy-based
3. Server- based

In client-based techniques, gadgets receive the whole page from HTTP server and transform the content to the required format on the user gadget e.g. mobile device as shown in Figure 1. The main advantage of this technique is that nothing needs to change in web server. Client-based Transcoding is not very common, as this method needs to use the device itself for transcoding web pages and the mobile devices need to be powerful enough to handle transcoding. Moreover, this method does not reduce network bandwidth usage, as the whole web objects need to be transferred to the mobile device in order for the transcoding process to be done. Cascading Style Sheet (CSS) is a common technique used for client-based transcoding.

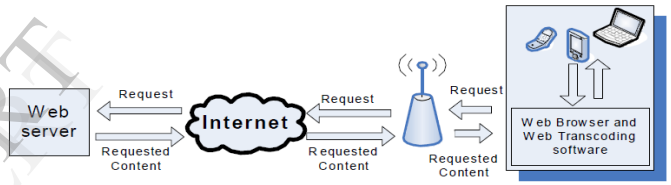

Figure 1: Client-based Transcoding

Transcoding is implemented using a proxy server, which receives a file and uses any particular format to change it according to the client. In proxy-based techniques (which are nowadays used by many commercial web sites) Transcoding process is done by a transparent node called a proxy server. A proxy server is located between client and web server (as shown in Figure 2). The web server transfers web objects to the proxy server and then the proxy server transcodes the content according to type of the device which is mentioned in the user request. The resulted content is then transferred to the user.

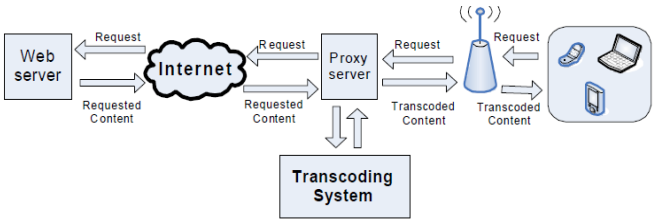

Figure 2: Proxy-based Transcoding

In server-based techniques (shown in Figure 3), the content is transformed by the web server and clients receive the transcoded content on their mobile device. This technique does not have the limitations of client-based technique, e.g., limitation on processing power of the clients' device. There are

two mechanisms widely used in such techniques. The content can be either chosen based on the characteristics of the device from a set of different versions that have already been generated, or it can dynamically generated . Different systems might produce different content with different layout and with the browsing capabilities. There are a number of Java-based technologies that are commonly used in server-based techniques. Java Serverlets, Java server Pages (JSP), JSP Tag Libraries, Java Beans and Enterprise Java Beans (EJB) are the most common ones.

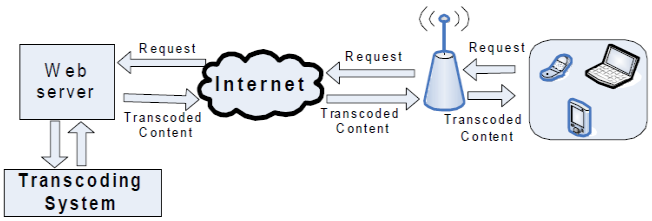

Figure 3: Server-based Transcoding

II. PROPOSED TRANSCODING ALGORITHMS

The developments in various types of gadgets like mobile communication technologies and rapid adoption of mobile devices with internet capabilities make learners to access the e-learning content "anytime anywhere" with mobile devices. Many universities develop their e-learning web page to provide online learning materials but mainly for viewing on desktop computer, that is why those e-learning content are not accessible through mobile handled device such us mobile phone, PDA, Smartphone or iPhone. The problem is that those learning contents may not be supported by various types of gadgets, for example the mobile device may run different operation systems (Symbian, Windows Mobile, iOS, Android) and support different markup language, such as WML, cHTML, or XHTML. Hence, there is a desire to transcode the e-learning content to an adaptive format that is more suitable to be presented on the mobile devices.

The system should be able to transform the video & audio and image separately based on constrained features from request. To Standard Documents (PPT, DOC, PDF etc), we have developed an agent to extract contents (Image + Text) for mobile learners. The transcoding algorithm is shown in Table 1.

```
get the constrained V features from XML
if ( V of Item existed in pre-cached database )
pointer = XML file of pre-cached content;
else
switch(type of media)
case image: transform based on V;
case text :  transform based on V;
case audio: transform based on V;
case video: transform based on V;
case document: transform based on V;
end switch
pointer = XML file of transformed content;
end if
```

Table 1: Transcoding Method

Table 2 and Table 3 show example rules for video and image transcoding. For example in rules number 2 of video transcoding rules, system will transform video files into audio files if user device has no video support but only audio support.

1. convert_video_type(V, T):-
   (video(V))video_type(W),
   user_video_support(X),
   W != X, T is X
2. convert_video2audio(V, R):-
   (video(V)video_type(W),
   user_video_type(none),
   user_audio_support(A), R is A

Table 2: Rules for Video Transcoding

In rule number 1 of image transcoding, system will convert image width (X) into user screen height size (Z) if user screen size is lower than image size (X>Z) and user device has dual orientation capability (like iPhone). Otherwise, system will rotate image in 90 degree in clockwise direction and convert image width into the size of user screen height size (Z) for device with height size larger that width size.

1. convert_image_width(Im, R) :-
   (image(Im))object_size(X,Y),
   user_screen_width(W, Z),
   user_dual_orientation(true), X>Z,
   R is Z
2. rotate_image(Im, 90),
   convert_image_width(Im,R) :-
   (image(Im))object_size(X,Y),
   user_screen_width(W,Z),
   user_dual_orientation(false),
   Y>W, Z>W,R is W
3. convert_image_type(Im, T) :-
   (image(Im))image_type(G),
   user_image_format(W), W != G,
   T is W

Table 3: Rules for Image Transcoding

III. EXPRIMENTAL SETUP

The scope of the work is to the e-learning process as to build a bridge between the concept of transcoding and the Multimedia Digital Library. As an experimental setup a MDL transaction is proposed where implementation of a proper transcoding algorithm plays a key role. The following Figure 4 shows (i) the on-line Client request for the Transaction using the gadget and (ii) the offline MDL Mechanism for the retrial process.

The authenticated user request is first stored in the Digital library environment. Then the request is then send to the Multimedia database. If the data is met with the user request, then the transcoding method start their process. The major role of the Transcoding methods is to identify the necessity of the transcoding of the data as per the gadget requirement. For example the images reflected on the computer monitor is of very high resolution , but on the other side the gadget used by the user is of low resolution then the transcoding method get activated and converts the resolution factor. The converted data

is stored in the offline environment of the MDL before it is transferred to the user gadget. The quality factors the play the important role as to adjust the size and resolution of the data as per the user gadget.

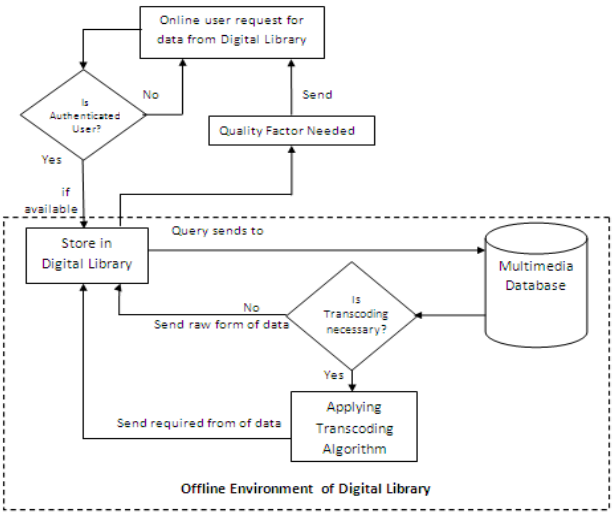

Figure 4: Implementation of Transcoding Algorithm in Digital library

Transcoding is used by the origin server or a server proxy to customise the size of image object and hence manage the available network I/O bandwidth at the server. The primary performance metric is the image quality factor. Transcoding provides graceful degradation of image quality factors so that the preferred clients are served at quality factors closely follow the original images and non – preferred client are served at the lower image quality factor.

Transcoding depends on some terms like bitrate, quality factor, format, codecs. Format extensions like .mkv, .avi or .ogg determine in which container and format are video and audio saved. They encapsulate streams, one or multiple so that video and audio can play synchronized and smooth. Information that tells you how much you can lower your bitrate is called quality factor and it's different for different encoders. We can calculate the quality factor (QF) as:

$$QF = bitrate/(framerate*width*height) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

IV. FUTURE SCOPE

Due to rapid growth in digital media and network technology, development of multimedia digital libraries has been an interesting research focus. Many research works have set a path of success like Informedia II which provides a high visualization quality for videos, MDLTR and ASIS MDL are the other research works, that provides indexing, searching using keywords in Videos. On the other hand transcoding standard like MPEG_2 to H.264 can be adopted as the content of the proposed system. The latest video coding standard H.264 has been recently approved and has already been adopted for numerous applications including HD-DVD and satellite broadcast. The latest transcoder between G.279A and EVRC provides sound quality corresponding to the quality of tandem coding.

All these above tools and techniques concentrate on the visualization, summarization and database technologies but the performance, resolution and scalability issues are not considered as the primary area of attention. Also, new items are also recommended based on clustering technology and Top-K technologies. Last, adaptive contents are created for learners based on learners' experience and device capabilities. In future, we plan to run the system on real e-learning system to evaluate the features in ubiquitous learning environment.

V. CONCLUSION

In order to resolve the diversity of learning contents and various gadgets like mobile device, this paper proposed adaptive and personalized system architecture for ubiquitous learning environment. We have analyzed the technology that best fits the Multimedia Digital Library and proposed an architectural solution framework. Our approach is to build a bridge between the concept of transcoding and the Multimedia Digital Library environment. This framework can be implemented for a web-based Multimedia Digital Library using open source technologies and applications. Lastly the parameter of quality factor related to the transcoding is studied as to satisfy the user gadget requirement.

References:

[1] Long Xu, Sam Kwong, , Hanli Wang, , Yun Zhang, Debin Zhao, and Wen Gao.: A Universal Rate Control Scheme for Video Transcoding in IEEE Transactions On Circuits And Systems For Video Technology, Vol. 22, No. 4, April 2012.

[2] Coulombe, S. , Chandra, U. : Quality Prediction-Based Dynamic Content Adaptation Framework Applied to Collaborative Mobile Presentations, in Mobile Computing, IEEE Transaction Digital Object Identifier: 10.1109/TMC.2012.173 Publication Year: 2012

[3] Martin, A.; Leon, C. : An intelligent e-learning scenario for knowledge retrieval in Global Engineering Education Conference (EDUCON), IEEE Transaction 2012.

[4] Kohei Arai and Herman Tolle: Based Content Adaptation of Composite E-Learning Content for Delivering to Mobile Learners in International Journal of Computer Theory and Engineering, Vol. 3, No. 3, June 2011.

[5] Zhenyu Wu, Hongyang Yu, Bin Tang, and Chang Wen Chen: Adaptive Initial Quantization Parameter Determination for H.264/AVC Video Transcoding in IEEE Transactions On Broadcasting, 2011.

[6] L. Xu, D. B. Zhao, X. Y. Ji, L. Deng, S. Kwong, and W. Gao, "Window-level rate control for smooth picture quality and smooth buffer occupancy," IEEE Trans. Image Process., vol. 20, no. 3, pp. 723–734, Mar. 2011.

[7] Naren Kodali, Csilla Farkas and Duminda Wijesekera: An Authorization Model for Multimedia Digital Libraries International Journal on Digital Libraries, 2010.

[8] Mehregan Mahdavi, Hamid Khordadi and Mohammad-Hassan Khoobkar :Web Transcoding for Mobile Devices Using a Tag-Based Technique in World Applied Sciences Journal 10 (Special Issue of Computer & Electrical Engineering): 49-58, 2010.

[9] Yui-Lam Chan, , Hoi-Kin Cheung, and Wan-Chi Siu, Compressed-Domain Techniques for Error-Resilient Video Transcoding Using RPS IEEE Transactions On Image Processing, Vol. 18, No. 2, February 2009.

[10] Mehdi Jafari Shohreh Kasaei: An Efficient Video Transcoding Algorithm Between H.263 and MPEG-4 for Inter-Network Communications, 2008.

[11] Gerardo Fernández-Escribano, Jens Bialkowski, Jose A. Gámez, Hari Kalva, , Pedro Cuenca, Luis Orozco-Barbosa, and André Kaup: Low-Complexity Heterogeneous Video Transcoding Using Data Mining,in IEEE Transactions On Multimedia, Vol. 10, No. 2, February 2008.

[12] Gerardo Fernández-Escribano, Hari Kalva, Pedro CuencaLuis Orozco-Barbosa, and Antonio Garrido A Fast MB Mode Decision Algorithm for MPEG-2 to H.264 P-Frame Transcoding in IEEE Transactions On Circuits And Systems For Video Technology, Vol. 18, No. 2, February 2008.