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Graphics in Electronics Printing and Publishing

I-MEDIA: AN INTEGRATED MEDIA SERVER AND MEDIA DATABASE AS A BASIC COMPONENT OF A CROSS MEDIA PUBLISHING SYSTEM

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Abstract—The publication of the same information on different media, the so-called Cross Media Publishing (CMP), is becoming one of the central aspects in today's publishing industry. CMP centers on a media independent document definition and an efficient integrated publishing on different media: *e.g.* as a paper document, as an online document in the World Wide Web, and as an offline (CD-ROM based) multimedia presentation. The aim of CMP is to get these different media at the same stage, while—and that is important—spending an acceptable amount of additional effort (in time and money) for production. In this paper we present a solution for a key problem of Cross Media Publishing, the handling of media data (images, audio, video, *etc.*) by using a combined approach of server and database systems functionality. The integrated multimedia server and database i-Media and its role in a complete CMP solution will be presented. © 1997 Elsevier Science Ltd. All rights reserved

1. INTRODUCTION AND BASIC REFLECTIONS

In these days the publishing industry is affected by enormous changes regarding structures and contents. Since the completely electronic production of printed documents is becoming more and more common and new technologies and media such as the World Wide Web (WWW) and CD-ROM based multimedia presentations show an overwhelming success, the traditional workflow in the publishing world is no longer timely. Moreover, the publishing world has become complex, since several different platforms, applications, and media must be supported in an open architecture.

Now that a reader has the possibility to choose from different types of media he also expects to get the same information irrespective of what he chose. He can then decide depending on his situation which media platform fits best.

In this paper we will present a solution for a key problem of Cross Media Publishing, the handling of media data. A media management system will be presented, which offers an added value by a combined approach of an object-oriented database management system (OODBMS) configured to the purposes of an CMP system and expanded with additional server functionality, *e.g.* regarding format conversion in an automated, configurable way.

Conceptually all media types—text, image (both raster and vector images), audio, video, and animation—are supported and the special technical publishing requirements, *e.g.* OPI server functionality or DTP/multimedia authoring tool support are taken into account.

In this section we will shortly explain the requirements of Cross Media Publishing (see Section 1.2). We will take a look at the variety of formats and standards (Section 1.3) and the media dependent advantages, disadvantages and technical restrictions (Section 1.4).

1.1. *Naming*

The term *media* is used for a variety of things. To avoid confusion, we will use in this paper the following naming:

- Images, audio, video, and animations are called *Media Data* or *Document Resources* or shortly *Resources*. Media data is often saved in special media and platform dependent formats.
- Documents are published on paper (*Print Media*) or as electronic documents (*New Media* or *Electronic Media*). Electronic documents could be made available either online or offline. Offline documents are usually published on storage media such as CD-ROM. Documents are published on so-called *Target Media* or *Media Platforms*.

1.2. *Cross Media Publishing*

In Fig. 1, an example of a cross-media produced and published article is shown. It was printed on an offset press as a color brochure. Then it was converted to an HTML document with embedded GIF and JPEG images, to a PDF document with

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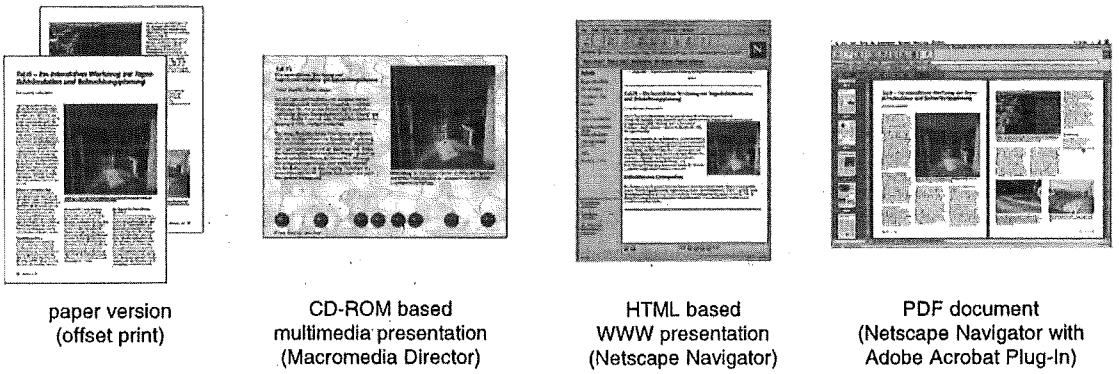

Fig. 1. CMP example.

integrated "weblinks", as well as to a CD-ROM based multimedia presentation with PICT images and additional sound and video clips. A stripped version of the multimedia document is also accessable as a Shockwave document via Internet.

See http://www.igd.fhg.de/www/igd-a1/crossmedia/index_e.html for the electronic documents.

The basis of CMP is a media independent document description. Media independent means that you can convert a document (automatically) to any media platform.

To achieve a high quality, the technical requirements of a media independent format are given by the media platform with the highest demands. Therefore a media independent document contains among other things:

- high resolution raster images (necessary for print, although not necessary for screen presentation),
- audio, video, and animations (although not supported by print media), and
- hypertext functionality (although again not supported by print media).

Because of the continuing high acceptance of paper documents, Cross Media Publishing is seen especially from the print publishing's point of view. Advanced and commonly used publishing systems like Adobe FrameMaker, Adobe PageMaker, or Quark XPress have to fit into an integrated CMP system architecture, as well as sophisticated authoring tools.

1.3. *Formats of the publishing industry*

In the publishing industry a variety of standardized as well as proprietary data formats have been established. Formats like PostScript, EPS, and TIFF for print media or HTML, JPEG, and GIF for the Web have to be taken into account when setting up a Cross Media Publishing solution.

In the following we will shortly mention some of the most important formats used. A more detailed discussion can be found in [1].

1.3.1. *Formats of the prepress world.* The prepress world is coined by the de-facto industry standard Adobe PostScript [2] used for document encoding, as well as the derived formats EPS (Encapsulated PostScript [3]) and AI (Adobe Illustrator), which are widely used for interchange of illustrations.

Raster images are usually encoded in TIFF (Tagged Image File Format [4]), which can handle bitmaps, gray level images, as well as RGB, CMYK or even device independently (CIE Lab) encoded images in arbitrary resolutions.

Because of the high resolution of raster images there are tremendous requirements due to storage capacity in the prepress world. A typical letter format four color image requires about 30 MByte, when encoded as an uncompressed CMYK TIFF. To reduce the load on the network and the DTP computers Aldus has specified OPI (Open Prepress Interface [5]), which has become a widely used standard. A so-called OPI server manages the high resolution images and calculates a low resolution sample, which is used for positioning on the DTP computer. When sending a document with embedded OPI images to a printer, the OPI server substitutes transparently for the user the samples by the high resolution originals. Using an OPI server can boost up productivity during printing easily by a factor of 100!

More and more Adobe's Portable Document Format (PDF) [6, 7] is becoming used as a page description language suitable for both displaying on screen as well as for printing on b/w or color printing devices. Currently PDF is mostly generated by "distilling" PostScript (using Adobe's Acrobat technology). Automatic generation of hypertext elements (especially links) and integration of document information in PDF format is possible by using "pdfmark" commands encoded in PostScript.

1.3.2. *Formats of the World Wide Web (WWW).* The standard document format for the Web is HTML [8], which is not a page description language such as PostScript or PDF, but a document markup language. The layout is not fixed in the document.

Based upon markups enclosed in the document the appearance of the document is defined by the WWW client, depending on the current windows size, as well as the adjusted fonts.

Raster images are encoded in GIF (Graphic Interchange File format) for bitmap or color lookup table (LUT) images, and JPEG is used for contone RGB color images.

Animations are supported, *e.g.* as animated GIF or Java-Applets. Extensions via WWW client plug-ins are widely used. Adobe is for example pushing its PDF format by offering plug-ins for several WWW clients for free. Because of its good printability (see Section 1.4) PDF is becoming common on the Web also.

1.3.3. *Formats of multimedia authoring software.* Multimedia authoring systems such as Macromedia Director and Asymetrix Toolbook typically uses platform specific formats, such as PICT for images on Apple Macintosh computers and BMP for images on Microsoft Windows computers, to give just an example.

Moreover, there are several additional image formats as well as audio and video formats supported by the authoring systems. A complete list would be too extensive to be discussed here.

1.4. *Media platforms: advantages, disadvantages, and technical restrictions*

Media platforms differ in several aspects: they are either electronically available or not, either online or offline accessable, and so on. A typical advantage of one media platform is often a disadvantage on the other platform. The aspects are listed below in detail.

Advantages:

- print document: excellent presentation quality and readability; no computer required for reading; no bandwidth problems; easy markup; social aspects (*i.e.* people are used to read paper documents); layout under control of the publisher,
- electronic online document based on HTML: up-to-date information; hypertext functionality; search functionality; compact format; (information when you need it),
- electronic (online or offline) document based on PDF: hypertext functionality; search functionality; up-to-date information when online accessable; good printability; well suited for archiving purposes; layout under control of publisher,
- electronic offline document based on multimedia authoring systems, usually on CD-ROM: excellent presentation quality on screen; support of audio, video, and animation (no problems with network bandwidth); hypertext and search functionality; layout under control of publisher.

Disadvantages:

- print document: information often not up-to-date; no hypertext functionality; audio, video, and animation not supported;
- electronic online document based on HTML: often bad presentation quality (publisher has little control over layout); bad printability; computer with network connection necessary; usually small network bandwidth; often one logical document is divided into several HTML files, which makes archiving or printing disadvantageous;
- electronic document based on PDF: not well suited for reading on computer display; computer necessary; usually more memory intensive than, *e.g.* HTML-based documents;
- electronic CD-ROM based offline presentations: information often not up-to-date; computer necessary; often bad printability.

Based on the different purposes many different formats are used for the encoding of text, images, audio, video, and animation. Moreover, the technical surrounding conditions are of importance:

- different color spaces: RGB for displaying on screen and CMYK for printing device independent color (CIE Lab) not yet widely used;
- different color depth: color tables are famous for displaying on screen because of its compactness and because of technical limitations of typical PCs graphic hardware;
- different required resolutions: usually low resolution (approximate 72 dpi) for displaying on computer screens, but resolutions of about 300 dpi (gray and color images) and of up to 3000 or 4000 dpi (bitmaps) for printing purposes;
- different document concepts used in the publishing world (page description languages (PDL) like PostScript or PDF as well as document markup languages, such as HTML).

Following these technical restrictions, *e.g.* for every single image used in a document one easily gets eight or more different variations in format and size! This is one reason why Cross Media Publishing nowadays is expensive, because converting images (or any other document resource) from one format to another is done as a manual step, which is time consuming and labour respectively cost intensive as well as error prone. Data consistency is in danger when no automatic mechanisms are available (imagine what happens, if an image has to be changed when you have eight different variations of this image!).

Here you need a sophisticated media management system, which does both the administration of media (storage, access control, versioning, data consistency) and automated conversions regarding format, size, color space or color depth.

Although multimedia databases are available even as products, they are lacking support of the requirements of Cross Media Publishing. In the following we will propose a concept and an implementation for an "intelligent" media management system, suitable for CMP purposes.

2. i-MEDIA: INTEGRATED MEDIA SERVER AND DATABASE

In this section we will explain the basic concepts and functions of the i-Media server and database (see Section 2.1) as well as its role in the context of a Cross Media Publishing system (see Section 2.2).

2.1. *i-Media server and database*

To handle the different formats mentioned above, a multimedia database system is well suited. For the special purposes of Cross Media Publishing additional support for the user (publisher) is necessary. For example conversion of an image from one format to another is a task, which could be done on an automated way, configured by the special needs of the publisher.

The general idea of *i-Media* is the integration of multimedia database functionality and additional functionality like automatic format conversion and OPI server functionality. It consists of two parts: the database itself and the server, which allows a prescribed access to the database.

The database system part of i-Media handles the resources (media data of any kind), especially:

- native format files (such as Aldus/Macromedia FreeHand, Quark XPress or Adobe Photoshop files),
- links to resources used in the generic files (*e.g.* embedded TIFF or EPS images),
- interchange files,
- variations of the above mentioned regarding

  —versions,
  —formats, and
  —languages used in text.

The server contains:

- a user and group management which is used to grant and restrict access rights to media data (see below);
- a version management which allows to create new version and to remove old versions;
- check-in/check-out functionality which allows a user to change media data and to lock access during changes;
- a configurable and extensible set of filters, which allow for automatic format conversion as well as OPI server functionality.

Media data (resources) are stored in an object-oriented manner, using an object oriented database management system (see Section 3).

2.1.1. *Native format files and generic representations.* The media data which is stored in the database come from a variety of input channels. Raster images for example are often scanned on drum or flatbed scanning devices. Illustrations are usually generated by some high level illustration software such as Aldus/Macromedia FreeHand or Adobe Illustrator, video clips are edited by Adobe Premiere or other video editing systems.

There are many different application specific formats used for these input channels. In the context of this paper, application specific files are named as *Native Format Files*. These files are not particularly suitable for interchange, therefore standard interchange file formats are needed for further processing, usually generated by an export module of the above mentioned tools and systems. The interchange files are called *Generic Representation* or *Source Files*. The format must be suitable to generate further variations needed for the different media platforms automatically, *e.g.* for an image resource EPS illustrations or high resolution TIFF images can be used.

2.1.2. *Integrated "intelligence" of media data.* An important added value in our approach is the integrated "intelligence" of media data, which gives also the name of the system (i-Media = "intelligent media").

A media object keeps a log of every conversion from one format or size to another (which filter was used, which parameters were expected). Therefore, it is possible that the user checks in a corrected version of an image and the object itself starts to do the necessary conversion to all used formats, sizes, color spaces, color depths and so on.

In the example shown in Fig. 2, an image resource (iImageObject) is illustrated partly. It consists of an English and a German (language) variation of an image which is created by using Macromedia FreeHand 5 (FH5). Every version of this image is available as an EPS file (generated by the illustration software) and as format variations, which were automatically calculated using internal and external filters. After calculation the following image files are accessible by the CMP system for every version of the iImageObject:

- an EPS image used for print publishing: this serves as a generic representation, too (*i.e.* it is used as a basis for the calculation of all further variations in format and size);
- a TIFF image used for internal reasons only (it is easier to convert the raster image format TIFF than EPS, which consists of text, raster and vector images);
- two BMP images (a thumbnail version for previewing and a full screen version for best quality displaying) used for Microsoft Windows based multimedia presentations;
- a small GIF image (again a thumbnail version) and a JPEG image for use in a HTML document.

In the example of Fig. 2 the user has checked out the English version 1.0e to correct a mistake. After correction he checks in a new version (1.1e). He puts the application specific file (native format file) as well as a generic representation of the image (source file, in this case the EPS encoded image) into the database.

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