Digital Multimedia

Neil C. Rowe
U.S. Naval Postgraduate School, USA

INTRODUCTION

Multimedia data can be important assets of government computer systems. Multimedia data can be documents, statistics, photographs and graphics, presentations, video and audio of events, and software. Examples include maps, video of meetings, slide presentations by consultants and vendors, graphs of budgets, and text of regulations. Video of meetings of legislatures and other government organizations is particularly valuable as it makes government processes more visible to citizens and can encourage trust in government. Multimedia is also particularly valuable in presenting geographical information (Greene, 2001), a concern of all governments. Added multimedia can also be used to more effectively deliver information to people, as with films, animations, sound effects, and motivational materials.

Multimedia information is important for digital government because it is often a more natural communication mode for people than text. It is thus important that government be responsive to the needs and desires of citizens by providing it. Much of the world is illiterate, and the ubiquity of television means even the literate often prefer watching video to reading text. Some citizens have special needs: Blind people need audio, and deaf people need images. Video and audio also convey information beyond text: A video of a legislature meeting contains subtleties not apparent from its transcript. Research has shown that multimedia is especially good at conveying explanatory information about functional relationships in organizations (Lim & Benbasat, 2002). Research has also shown that people learn better from multimedia presentations than from conventional classroom instruction, and the multimedia provides a consistent experience available at any time unlike human instructors (Wright, 1993).

BACKGROUND

The management of multimedia data entails considerations not encountered with data that is solely text (Vaughan, 2003). The main problem is data volume: A typical report can be stored in 20,000 bytes, but a typical 20-centimeter square image requires 500,000 bytes to represent adequately, an audio clip that is 1 minute long requires around 1,000,000 bytes, and a typical 3-centimeter square video clip that is 1 minute long requires around 50,000,000 bytes. Compression techniques can reduce storage requirements somewhat; however, media that can be compressed significantly tend to be merely decorative and not very useful for digital government. Multimedia size is especially a problem when transferring media between computers, especially with the limited data rates of conventional telephone lines and modems (Rao, Bojkovic, & Milovanovic, 2002). So, since digital government cannot be sure what technology its citizens have, it must be conservative in its use of multimedia.

Distributed database technology (Grosky, 1997) can help manage multimedia data efficiently. However, the human side of multimedia management requires a different set of skills than those of most computer support staff. One needs media specialists familiar with the problems of the technology, including some staff with art training to address the aesthetic issues that arise. Much multimedia management is time consuming, so adequate personnel must be available. Government can also choose to actively encourage the development of a multimedia-supporting infrastructure by its industries (Mohan, Omar, & Aziz, 2002).

INDEXING AND RETRIEVAL OF MULTIMEDIA

A first issue in using multimedia data is finding it. Citizens often want to retrieve quite specific multimedia objects to meet their needs, and they can do this with a browser or a search engine (Kherfi, Ziou, & Bernardi, 2004). This requires metadata describing the media objects such as size, date, source, format, and descriptive keywords. A browser can provide a hierarchy of media objects that users can navigate. This works best when media objects can be described in just a few words, or are characterized along a single dimension like date or place. Otherwise, a keyword-based search engine is necessary, such as that provided by commercial services like Google but adapted to search only government data. Accommodating a broad range of citizens means keeping extensive synonym lists for keyword lookup so that many possible ways of specifying the same thing will work. In some cases, a graphical

specification may be a good way for the public to specify what they are looking for, such as a visual timeline or geographical display on which they click on the location they want.

Unfortunately, it is difficult to index and search nontext media for its contents. Segmentation by identifying shapes within images can be tried, but it is time consuming and often unreliable. So captions on media objects (text that describes them) are valuable (Rowe, 2005). They can be directly attached to a media object or located near it in a document. Captions directly attached include the name of the media file, descriptive keywords, annotations describing the object like the *alt* string associated with Web media, the text of clickable links on the Web that retrieve the object, text directly embedded in the media like characters drawn on an image, and data in different channels of the media like narration or closed captions for video. Captions indirectly attached include text centered or in a special font above or below the media, titles and section headings of the document containing the media, special linguistic structures like "The photo shows …," and paragraphs above or below the media. Caption text can be indexed for a more precise keyword search than that obtained by just indexing all the words of the enclosing document (Arms, 1999). This is what the media search engines such as the image searchers of Google and AltaVista do, though their success rate at finding images is not as good as their success rate at text search. Media retrieval is, however, an active area of research, and new developments are appearing frequently.

DELIVERY OF MULTIMEDIA

Multimedia can enhance documents in many ways. It can enliven information, and this is helpful for the often-unexciting information provided by governments. But the primary concern of government must be for media that convey important information of their own. Mostly, this means the delivery of multimedia information from the government to its citizens, though there are also issues in the collection of information by government (Cheng, Chou, Golubchik, Khuller, & Samet, 2001) and communications within government.

Broadcast technology is the traditional method for a government to disseminate media through newspapers, radio, and television. Broadcast is a one-way technology. This is fine for announcements and authoritarian governments, but interactivity is very important to a responsive and effective government. So, the Internet and especially the World Wide Web are increasingly preferred to deliver user-selected information and permit the completion of forms. The Web is well suited for multimedia. It permits the embedding of pointers to multimedia content in documents with much the same ease as text. Web multimedia can range from informal illustrations to media retrieved from structured databases in response to queries entered on dynamic Web pages. Media is particularly helpful for the illiterate as graphical interfaces can enable access to the full power of computers without the necessity of words.

A key issue for digital government is the choice of media formats. Government information systems intended for only internal use can follow very few mandated formats for interoperability. But much multimedia is for the public, and the public uses a diversity of computers, software, and networking services, and accessibility to all citizens is important. So copies of important multimedia in different formats are essential. Web images are currently mostly in JPEG and GIF formats, with some in PNG format. Audio and video are more diverse: Currently popular audio formats are WAV, RAM, MID, and ASX, and currently popular video formats are MPEG, SWF, MOV, FLI, AVI, and MP3. Multimedia can also be software in various formats. Not all these formats are supported by all Web browsers, so it is important for government to provide free viewer software for downloading so citizens can view any of its multimedia. This generally restricts governments to using formats that have free open-source software for reading or viewing them.

Multimedia software of particular interest to government organizations is groupware, supporting collaborative activities of groups. It can be used to run meetings of people at widely scattered locations so participants can see, hear, and read comments by other participants. Groupware requires transmission of video, audio, and graphics between sites (Klockner, Mambrey, Printz, & Schlenkamp, 1997).

STREAMING MULTIMEDIA

Because of its bulkiness, multimedia is often best stored at a few centralized sites and retrieved from there. That can entail logistical problems since video and audio in particular need to be delivered at a certain minimum speed to be viewable or listenable (Smith, Mohan, & Li, 1999). Video or audio can be fully downloaded in advance of playing, but this entails a time delay and most citizens prefer real-time delivery (streaming). Important applications with streaming are being accomplished including video meetings, video medicine, distance learning, multimedia mail, and interactive television. Streaming is simplified if it is delivered by one-way broadcast, and this works well for standardized content such as training materials. Traditional technology like television can also be effective in