

MinuteAid: Multimedia Note-Taking in an Intelligent Meeting Room

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Abstract

A multimedia note taking system called MinuteAid is described that lets users of laptops include multimedia objects in notes they write during a presentation. The multimedia data is provided by devices that capture slide images, whiteboard images, audio and video clips. The MinuteAid system includes a software interface between these devices and a commonly available word processing application (Microsoft Word) and lets the user either insert copies of multimedia objects while they're captured or references to multimedia objects that are automatically retrieved and inserted in the document later. We describe the architecture, implementation and user experience with this system.

1. Introduction

Meeting capture systems are becoming commonly available [1][7]. Typically, they record audio and video of a presentation, capture still images of slides shown on a projector, and save images of whiteboards. This multimedia data is usually retrieved from a networked server later on, whenever a user discovers a need for it.

People who attend presentations often bring laptops to take notes. However, there is no easy way for them to obtain their own personal copies of the multimedia data on the spot and incorporate it in notes that are made while a presentation occurs.

The MinuteAid system overcomes these limitations by allowing a user to incorporate captured multimedia data in a Word file that is composed while a presentation is given. We provide a software interface between MS Word and the multimedia capture devices in the conference room that lets the user insert relevant multimedia data (e.g., the current slide and 5 minute audio clip) in a document that can be formatted any way he likes. Since the multimedia object is embedded within the document (i.e., no external network references are required), it can be freely shared with anyone,

without the need to provide network access to the multimedia data server.

An additional useful feature of the MinuteAid system is that the user can insert references to multimedia objects that can be automatically retrieved and inserted in the notes later. This avoids the need to set up a live network connection or transfer large multimedia objects (e.g., video clip showing the last 10 minutes of a demonstration) during the presentation.

2. Related Work

Conference rooms and lecture halls with automated capture systems provide fertile ground for exploring new methods for multimedia note-taking. MinuteAid is unique in several ways compared to the prior art. In one class of method users compose handwritten notes on PDA's that are uploaded to a server and cross-indexed with the recorded lecture [8][6]. Other work lets users type notes from a web page into a personal or shared space associated with other captured multimedia data [4][2]. Another system provides a special-purpose client application on a tablet PC that lets a user annotate a meeting and create a web page that includes links to multimedia objects accessible by post-hoc network access [5].

These systems contrast sharply with our emphasis on giving the user a personal copy of relevant multimedia objects that can be used independently of any network connection, which we believe will significantly enhance the utility of the data. Our focus is on letting the user compose notes with an application they know already (Microsoft Word in our case) which lets them freely format a document that contains multimedia objects that can be e-mailed to anyone and reused in any way.

MinuteAid lets a user take notes that can be shared with people who might have little patience with the passwords, firewall permissions, and so on that must be overcome to provide reliable network access for embedded links to what could be highly sensitive data. Our

system minimizes the barrier to entry for both the person taking the notes and the person reading the notes with a novel combination of a well-known word processing application and an easy-to-use method for incorporating multimedia data within the document it produces.

3. System Description

The following usage scenario is enabled by our system. A salesperson attends an important marketing research meeting at the company headquarters. He pulls out his laptop and starts typing notes in Word as the presentation is delivered. When a key slide full of sales figures and marketing statistics appears, he inserts a placeholder where he would like to have the actual slide image, and perhaps the audio, appear inside his report. A day later when he returns to his office, he connects his laptop to the Internet and opens up his report, the slide full of numbers is automatically inserted where he intended, along with a 5-minute audio clip. After putting on finishing touches, he attaches the report in an email to his coworkers.

3.1 Capture Environment

We developed a meeting capture infrastructure called the Intelligent Meeting Room, shown in Fig. 1 that serves as an integration platform for captured media and a common interface for client development. During a presentation, several capture devices are used including a Presentation Recorder that captures an image of every projected slide as well as an audio track, a Meeting Recorder that saves an omni-directional mpeg2 video of the conference room, and a digital camera that can save whiteboard images [7].

During a presentation, information about the captured media streams is sent to a server and

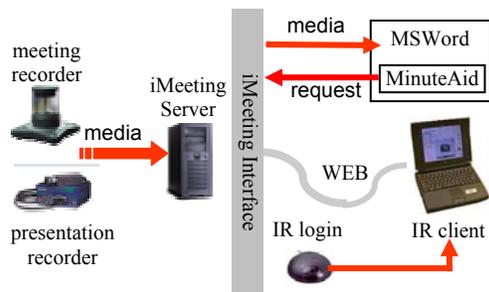


Figure 1 The MinuteAid system consists of a client module running inside MS Word that communicates with the meeting room capture infrastructure to allow users to insert captured multimedia into a Word file.

made available to client applications through an http-based interface. The interface includes a query language for referencing captured media objects by session ID, media type, media time or index number. For example, a query like “Slide #5 from session 12345” returns the slide image. “Audio for current slide (in current session)” returns an audio clip that starts at the beginning of the current slide until the time of the request. The interface also supports queries for notes made by other users, meta information such as meeting title and location, authorization procedure, as well as a synchronization mechanism for clock-skew correction.

In our current implementation, slide images can be accessed in real-time. Arbitrary audio segments can be requested with a 15 second delay. Since postprocessing is required on the video, video requests cannot be processed until the end of meetings. The specification and data size of these media objects are shown below. Meeting header information is currently entered manually. However, this can be automated by applying OCR on the title slide and face detection on the video.

image	audio	video
640x480jpg	16kbps mp3	320x240wmv
30KB/img	120KB/min	1.80MB/min

3.2 MinuteAid Client

The MinuteAid client is implemented in the Visual Basic for Applications (VBA) supported by the standard Microsoft Office Suite. It has been used on PC’s running both English and Japanese Windows and can be run on laptops used in our Intelligent Meeting Room. The code modules and forms, along with other layout and formatting guidelines, are distributed as a Word template (.dot) file.

When a user opens MSWord with this template, the MinuteAid module is started and a toolbar is created, as shown in Fig.2. Users can edit their meeting minutes in the same way they would any Word document. They can also request multimedia objects from the live presentation they are attending using the MinuteAid toolbar. When a *request* is made, a bookmark is placed at the cursor position where the multimedia objects will be inserted, and the context of the referenced multimedia objects is cached in the document.

Before the data corresponding to a request can be inserted in the document, MinuteAid must know the IP address of the server and have access to the session. In addition to manual

entry in a dialog box, we also provide an automatic authorization mechanism with infrared (IR). When the laptop comes in range of an IR login receiver, it obtains an IP address, session ID and password. This sign-in process must take place some time during the presentation to prove physical presence in the meeting room.

Another requirement for retrieving the data corresponding to a request is having a network connection to the server. To reduce the amount of user effort required, users do not have to configure a live server connection at every presentation they attend (a sign-in process is still needed). Instead, MinuteAid caches requests and places bookmarks where multimedia objects are to be inserted. When the document is opened later, MinuteAid checks for a server connection and automatically processes cached requests.

After a request is processed, it is removed from the document and the requested data is formatted as a table and inserted at the bookmark location, as illustrated in Fig.2. The inserted image or audio can be manipulated or played just like a regular picture or a sound clip. This document can be copied and emailed to other people as a regular Word document.

Whenever a request is processed, meta data for the associated session is stored on the user's laptop. This provides a permanent record of the presentations a user attends and populates a calendar interface that can be used to request data from previously attended meetings.

4. Discussion

The Intelligent Meeting Room infrastructure has been in regular use in our lab for more than two years. In that time, we've recorded more than 200 meetings that consume over 600 GB and include 150 hours of audio and video as well as 35,000 slide images. We provided several web interfaces to this data and made it easy for people to access it.

We observed many cases when this infrastructure was useful for analyzing brainstorming meetings in which conclusions were reached after long discussions. Also, users frequently accessed structured presentations based on PowerPoint slides. In both cases, people attended those meetings who were required to create a summary that could be shared with other people outside our lab. The MinuteAid system directly addresses this need.

One of the early design issues we considered was the choice of client application for note composition and data access. The most intuitive

and common solution is to build special software. However, this often restricts users to a feature-limited composer and a template-based browsing interface. The proprietary data format and application prevents sharing with people outside the target environment. Another approach provides generic access to captured media through a web interface where slide images, text notes and url's can be dragged-and-dropped into a note editing application. However, it is difficult to extend this approach to support flexible access to audio and video objects. It also requires a constant connection to the server while taking notes. Our approach leverages the multimedia support and wide adoption of MSWord to provide the same interface for composition and access, and facilitate easy distribution and reuse of the data.

In a survey of users in our lab, we found four people who are required to produce summaries of meetings they attend. Based on their familiarity with our meeting capture system, they all saw cases where MinuteAid would be extremely useful. Obviously, this is because it is often more effective to see someone say what they mean than it is to paraphrase what they intended in written form. This is particularly true in an international environment in which the recipient of a message might not be completely fluent in the original language and would prefer to see a multimedia explanation (e.g., a video clip of a demo) to reading a written explanation.

Furthermore, based on interviews with our Japanese colleagues, we found that it is common practice for someone to be designated as the minutes taker for a meeting. Their reports often include related material as attachments and are distributed to others. The MinuteAid should also be useful in this environment.

One open issue in our system is the handling of concurrent sessions. One scenario is that a user moves between parallel tracks in a conference before a session ends. Since a media object can no longer be uniquely identified based on time stamps, we could require either an explicit sign-in process or an implicit location reference using a wireless protocol, for example.

5. Conclusions

We described the design and implementation of the MinuteAid system for facilitating multimedia note-taking in an automated meeting capture environment. Based on over two years of experience with an Intelligent Meeting Room that captured audio, video, and slide images, we

determined that people need an easy-to-use method for creating notes that include multimedia data captured in such a room. The MinuteAid does this and makes the multimedia data accessible from Microsoft Word, allowing users to create self-contained Word documents that can be easily distributed and reused. This novel combination of technologies makes it easy for users to incorporate multimedia data in their everyday work practice. We expect that this will increase the demand for multimedia capture systems and significantly improve the efficiency of people who take notes during meetings.

6. References

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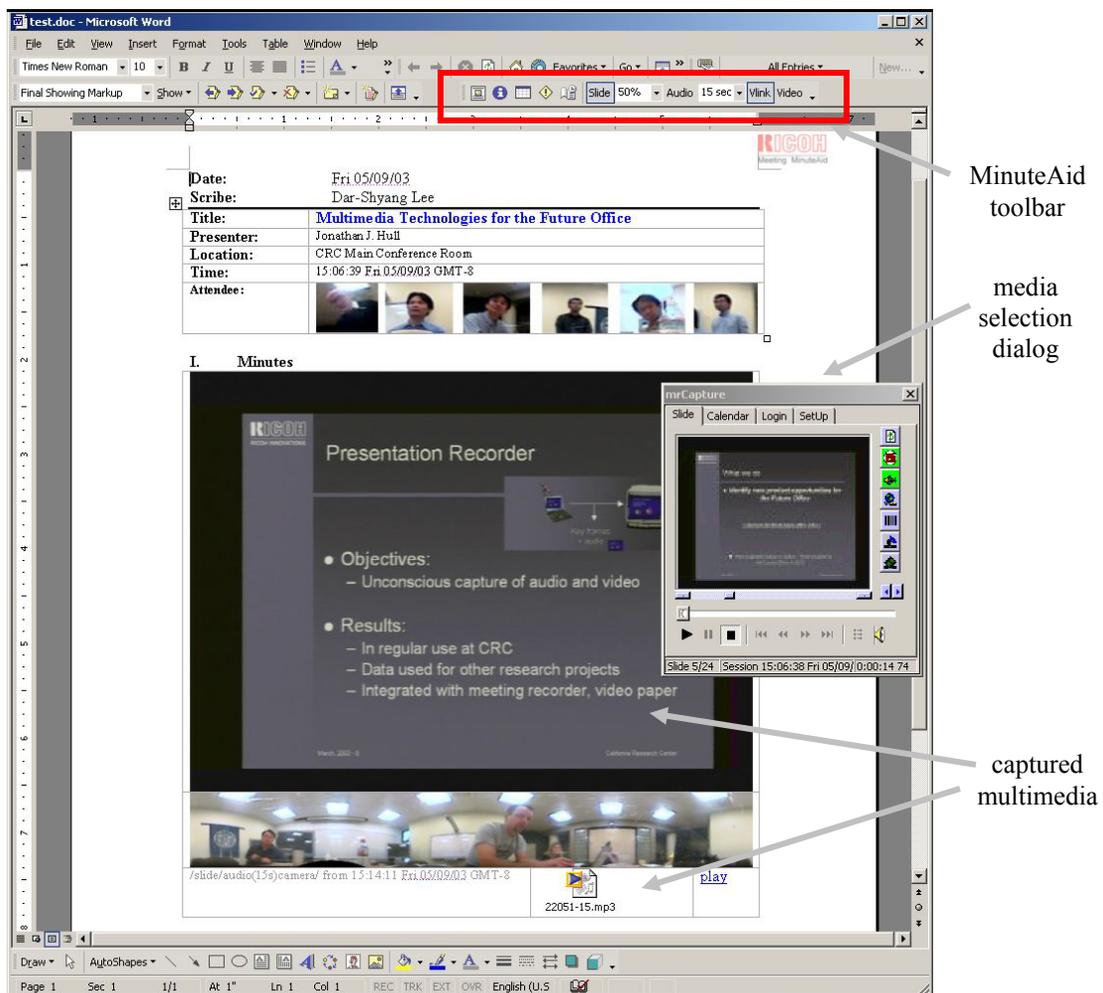


Figure 2 – An example a Word document created by MinuteAid. The meeting header table and slide table are inserted as a result of multimedia data requests.