

Multimedia Mail for the Digital Study Hall

Archer L. Batcheller

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Introduction

Basic education has been listed as a priority of development efforts in poor regions around the world [1]. Distance learning has significant potential for enhancing basic education, and the benefits of information and computer technology can provide an efficient means for deploying a distance learning system. Such a system, dubbed the “Digital StudyHall,” is proposed by Wang, et. al. for deployment to Dr. Urvashi Sahni’s private schools in the state of Uttar Pradesh, India [2]. This system is scheduled for deployment in the summer of 2005, and will initially include a computer at the private school in each village, which will be connected regularly through a delay tolerant network to a server at the principle school in Lucknow. The deployment of this system provides an opportunity to try out a number of ideas to enhance the life of people in rural villages, particularly vis-à-vis their educational experience.

This project seeks to extend the functionality of the Digital StudyHall to include the “voice mail” system proposed by the authors. The Digital StudyHall relies on a delay tolerant network derived from the Postmanet architecture developed by Lai, et. al [3]. Such a system would provide users in remote, undeveloped locations with the opportunity to communicate with each other, and with people around the world. Facilitating easy communication will enhance the distance learning process, allowing better coordination of resources and ideas. Furthermore, communication tools offer both the ability to connect with resources and opportunities, and help meet a basic human need to relate. In Bangladesh and Uganda, the Grameen Foundation’s village phone initiative has been very successful in stimulating and utilizing local desire for communication. The multimedia mail system seeks to capitalize on similar demand by providing cheap, simple, and effective tools for new sets of users to communicate. In particular, this messaging will support messaging and interaction for the Digital Study Hall, helping to meet the objectives of the education initiative.

A multimedia mail system allows message content to be included as images, audio, or video, allowing users with little education to communicate effectively. While technological systems often rely on English – an unfamiliar language – multimedia content accommodates any language. Literacy and typing skills are not required in order to create or receive multimedia content. The multimedia mail system offers two benefits over existing systems for emailing or exchanging files. First, it is tailored to fit the niche of messaging within a Postmanet network architecture. The messaging program makes information exchange between users easier, and streamlines a theoretically possible, but complicated, file transfer process. Easy messaging is a sufficient goal, bringing people in developing nations nearer to the communication levels available in developed areas of the world. However, due to the great bandwidth available over a Postmanet network, we can offer capabilities that are not common even in developed nations. The second main benefit of the mail system is the multimedia aspect of the communication. Delivering messages as audio or video allows more direct communication between the two parties, adding a personal touch of the author's character beyond the text alone of a message. This "personal touch" could be used to validate the identity of the sender. Teacher absenteeism is a large problem for the rural schools that the Digital StudyHall will be serving. To help fight this, teachers could be required to send a daily (dated) video message from the village computer. In addition to the relational benefits of multimedia messaging, it can help generate interest in acquiring and using technology while providing a service that is more easily used by those that are illiterate, speak a different language from that used on the computer, or have poor typing skills. As the network is extended in the future, its utility will increase as individuals are connected to more people and resources.

Design overview

Processes for moving data between computers are already in place as part of the general Digital StudyHall design. By leveraging this content delivery system, the multimedia mail system has its messages automatically delivered to the appropriate computer among the small network of private schools. A single program, the "Multimedia Mailbox," provides a simple user interface to ease the process of managing, sending, and receiving messages. Each computer is allowed multiple users, each with their own mailbox. It will use a simple addressing scheme, specifying a target user and computer ("user.computer"). Messages are stored in a directory hierarchy, and

all message content is stored as files. These directory-messages are then transmitted through the Digital StudyHall's repository system to the destination computer.

Implementation

The multimedia mailbox program, "prjMailbox.exe," was written in Visual Basic 6. It requires several additional files in order to run on a standard Windows 2000/XP installation. These files are all included in the final setup program. Several standard objects are used to create most of the controls. Multimedia controls consist of an embedded Windows Media Player object (for playing back audio and video), the Microsoft Multimedia Control (for recording audio), and the ezVidCap control (for capturing video from a webcam) [5]. The system was tested with a standard microphone, and the "PC Camera" webcam, the same components that will be included with the Digital StudyHall installations. Python and Apache are needed for the repository system. The multimedia mail system also relies on a Python interpreter setup in the path.

Files used by prjMailbox.exe

Several files are used to store settings for the multimedia mail system. If these files do not exist, they are created (with default values) as the program initializes. A description of each file follows:

settings.ini

computer – specifies the name of the local computer, for addressing purposes
messagedir – specifies the root directory for storing messages, use a trailing "/"
endexecpy – specifies the Python script that is to be executed upon exit of the mailbox program

user.dat

Each line contains a username and password for the local computer. Messages are stored in the format: "username, sha1(password)" The user "admin" is the only user given rights to the "Edit Users" button in the mailbox program.

end.py

This is the default Python script created; it is executed each time the mailbox program exits. Once inter-village communication is implemented, we need only change this script to synchronize the multimedia mail system over the Postmanet-based repository. Its default action is a test script that adds a new line "Testing..." to a file dummy.txt.

Until the end.py script is adjusted to properly synchronize with the Digital StudyHall, messaging only functions within the users on one computer. The Python synchronization script will have a simple role: it just needs to upload all directory structures that are bound for other computers. Upon arrival, these directory structures just need to be placed in the root message directory on the destination computer. Depending on the exact functionality of the repository system, a “begin.py” script may be needed to receive new messages from the repository as the mailbox program loads.

Message storage

Messages are stored in a directory structure, as illustrated in Figure 1. The hierarchy starts with the root message directory, and then descends to computer, user, inbox/sent, and individual messages. Individual messages are stored as folders of the form: “userto.computerto-userfrom.computerfrom-timestamp.” Within each message’s directory, a header file is used to keep track of bookkeeping for the message. The file body.txt is also included for each message. A message may include one media file (either audio or video), and any number of additional “other” files that can be attached.

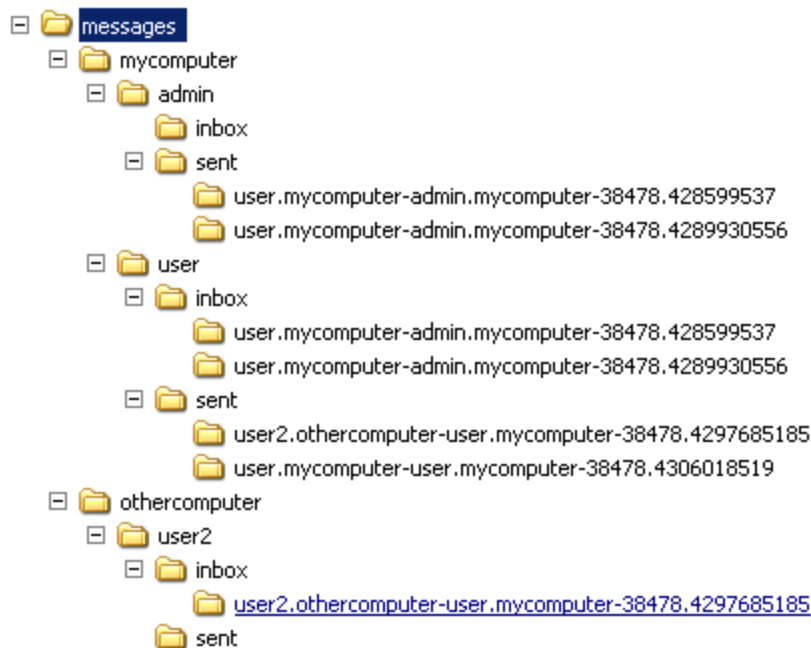


Figure 1: An example of the message directory structure.

Future Work

There are several stages of future work that should be continued to bring this project to usable completion. These are outlined below. Some stages may exchange order, but they are generally prioritized, starting with the most important steps.

Stage 1: Coding “TODOs”

There are a variety of locations in the code labeled “TODO.” These are the next logical steps to add useful functionality and implement the program more cleanly. One of the larger TODOs is an address book system for the entire Digital StudyHall network. With these, it would be nice to implement the webcam capture with native Visual Basic code, rather than relying on a third party ActiveX object.

Stage 2: Multimedia compression, previewing

Although we have a large bandwidth available, multimedia should still be compressed in a reasonable format (e.g., MPEG-4 for video and MPEG-3 for audio). Also, users should be allowed to preview their multimedia content before sending.

Stage 3: Testing/debugging

Thorough testing *must* be conducted, to ensure that the program is robust. Technical support will be limited once deployed.

Stage 4: Usability

The current version focuses on features and functionality. The program needs to be adapted to a design that will be simple to use for people of low education, little experience with technology, and who may not even know English. Voice recognition APIs should be investigated as part of this stage.

Stage 5: Synchronize with the Digital StudyHall

Once the Postmanet-based repository is complete, a few small scripts must be written to synchronize the multimedia mail system with the entire Digital StudyHall network.

Stage 6: Get feedback from end users and improve

Input from users in India will be vital to continue improving the program, and developing it to meet people's needs. People from another culture and setting in the West have difficulty predicting the way users in a developing nation will interact with a technological product like this one. Observation and interviews should be conducted, with the goal of handing over development of the product to those in India that are skilled to use it.

Stage 7: Gateway to the Internet and phone system

The central server in Lucknow is connected to the Internet, and has good phone connectivity. It could serve as a mail gateway, such that messages from the multimedia mail system could be passed back and forth with the global Internet (perhaps omitting costly multimedia content). Separately, while the public phone system in India is good enough to provide people with a means for making calls, it is difficult to receive calls. The gateway could provide a voice mailbox system, so that people can call one central number and leave messages in an appropriate mailbox. These messages could then be delivered as audio content to the appropriate user on the multimedia mail system.

Conclusion

The multimedia mail system provides exciting opportunities for enhancing the use of an Information and Communication Technology system – the Digital StudyHall network. As the project is being implemented in the summer of 2005, the rapid feedback from an actual deployment will help provide a faster development loop. Within a short period, this system could be helping students, teachers, friends, and villagers to communicate.

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