THE PROJECT REPORTER: MULTIMEDIA PROGRESS REPORTING FOR CONSTRUCTION PROJECTS

The project reporter: multimedia reporting

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Abstract

The A/E/C industry is the largest US industry. It forms about ten percent of the dollar value of the US GNP, with a total annual volume for new construction exceeding $500 billion. Many of these projects are plagued with delays, over-expenditures, design changes, and other unexpected conditions jeopardizing the smooth and timely completion of the project. Regular and accurate reporting on project progress offers a continuous vital diagnosis of the project status, enabling different project team-members to make proper decisions on any necessary corrective actions to safeguard the project and ensure its completion. This paper discusses a new interactive multimedia system that can be used by different project team-members to document and report progress in construction projects, as well as a tool to analyze this progress and help predict the final project outcome. The interactive multimedia approach was selected to minimize the paperwork, provide timely update, and ensure a safe and easy method for document storage and retrieval. This research aimed at developing a practical and applicable tool to serve as a model of the interaction between academia and industry in the field of construction research and practice.

Keywords: Project management, internet, multimedia

1   Introduction

Project progress monitoring and control is one of the most important tasks of construction project management. Every team-member needs to know, in a timely and accurate manner, how is the project progressing, where they are currently in comparison to the initially set plans, whether deadlines are met, budgets are respected, required quality is achieved, modifications are kept to the minimum, and safety measures are followed. It is mainly the responsibility of the general contractor (GC) to update the Architect/ Engineer (A/E), who, in turn, updates the owner. Under a construction management contract, this responsibility shifts to the construction manager (CM), who has to ensure that all project criteria are met, if not exceeded. This updating process usually takes the form of a periodic printed progress report (issued in most of the cases on a monthly basis), discussing the current versus planned status for the schedule, the budget, constructability problems, quality issues including test results, contract changes including modifications in design and increase/decrease in quantities, pending issues from progress meetings, as well as some pictures showing the current construction activities. Additional components like value engineering updates, safety matters, and weather conditions might also appear on these reports.

However accurate this report might be, the textual description in addition to the still photographic pictures cannot fully convey an exact image of what takes place on site, or show a dynamic and lively view of the construction activities. Once the project is over, the chance for using these progress reports decreases considerably. This may be partly due to the fact that storing and retrieving these reports, as well as sorting them and finding the required information is a tedious task in itself. Making use of the reports might be even more complicated by the deterioration in the condition of the original print of the report, together with changes in the company personnel and its organizational structure. These drawbacks of the printed report can be summarized in the following points:

1. By the time the report is prepared, reviewed, approved and submitted to the owner, it does not reflect the exact project status, as this process could take up to one reporting period (1 month).
2. Many of the problems faced on site can not be efficiently presented by textual or verbal descriptions alone.
3. The accuracy of recording and the timeliness of distribution of the minutes of meetings, with subsequent decisions depending thereupon, are usually disputed by different parties involved in these meetings, with each party trying to interpret any ambiguities for his or her benefit.
4. Photographic pictures can be altered to change their content or taken to conceal facts, which makes them an undependable source of information.
5. Problems faced in any particular project are normally not properly recorded or documented for future usage as lessons learned. Therefore, they might be repeated.

Therefore, there is a need for a different method of reporting progress, adding to the value of the printed report. Recent leaps in information technology and multimedia in particular offered a practical alternative for the printed reports. The purpose of this paper is to illustrate one effort to convert the text-oriented paper-printed static report into an audio-visual, interactive multimedia report that can be stored and distributed on a compact disk (CD) or on the Internet.

1.1 What is interactive multimedia?

Multimedia can be loosely defined as the use of information technologies as a controller of a variety of external media devices such as cameras, microphones, video recorders, compact disk and audio tape players and recorders for input and /or output. The computer serves as an integrator combining different media ranging from text, animation, video, audio, and still pictures or graphics, weaving them together into a consistent fabric. Multimedia in itself can be divided into two distinctive types: passive, also called linear, and interactive, also called non-linear. Passive multimedia does not allow for user interaction, while allowing only for one straight or linear path. A clear example for linear presentations is computer slide shows. Interactive multimedia (IM), on the other hand, allows for user interaction and feedback, and allows movement along several paths through links (also called hyperlinks) and buttons that trigger different actions (playing sound or video clips, moving to another part of the application, getting input from the user, etc.). It can be used for computer-based training (CBT), information kiosks, and educational applications.

The application discussed through this paper is based on the interactive multimedia type, to produce a paperless project progress report, the "Project Reporter".

2 Reporter development methodology

The development of the Project Reporter followed the steps listed below:

- Defining the structure of a progress report to reflect actual project status at any period.
- Selecting appropriate project management software packages to document project information including schedule, cost, quality, and contract administration.
- Designing the report including different media to be used.
- Data collection from real-life projects including progress meetings and review of various correspondences and project documents.
- Recording the project data in various media including editing and processing of different file formats (Audio, Video, and Virtual Reality).
- Compiling the final application and testing it in a real project to ensure its usability and applicability.
- Receiving feedback from users and performing needed modifications to the system based on the evaluation and feedback.
- Producing the final report including the findings and the results of this research.

2.1   Tools used to develop the project reporter
       Several software and hardware tools were used to develop the technical content, as well as the presentation content of the Project Reporter. Among the tools used were:

2.1.1 Hardware tools and peripherals

- A camcorder for shooting live video (Construction activities and minutes of meetings)
- A digital still camera (To record project progress) and a tripod to stabilize the camera during shooting
- A video capture board (To digitize, i.e. convert from analog to digital, captured video)
- A recording microphone (To record overlay sound)
- A PC (Pentium 200 with MMX, 64 MB RAM, 5.1 GB HD, 17" monitor, sound card and speakers, and a modem)
- A CD recorder (to copy the compiled application for distribution)
- A Zip drive and Zip disks (For temporary storage of multimedia files)
- A color scanner (To scan documents and correspondence samples)

2.1.2 Software tools

- Multimedia authoring tool
- Video editing software
- Still picture editing software
- Still screen capturing software
- Screen sequence capturing software
- Image stitching software
- Sound editing software
- Scheduling software
- Contract administration software
- CAD software
- Animation software
- Web browser
- Microsoft office suite

2.2 Report structure

The report was structured to mimic the traditional text-based report in its main components:

- General information about the project and the different project parties
- Progress information including:
    - A summary of the current status of the schedule, budget, and expected completion date
    - Report on the current progress this period (since last update to date)
    - Report on the cumulative progress to date (Since the start of the project)
    - Report on the end forecast (Expected time and cost at completion)
- Technical details related to:
    - Constructibility issues
    - Design modifications
    - Unexpected site conditions
    - Quality measures
- Contractual measures including change orders and contract modifications
- Media section including:
    - Progress video clips reflecting different work items that took place during the report period
    - Edited recorded clips of the minutes of meetings
    - Panoramic (360 degree) pictures of construction activities with the ability of panning and zooming in and out
    - Sound files providing commentaries or descriptions of the work in progress.

A flexible navigation pattern was developed, enabling the user to move between the different components of the report with a minimum number of mouse clicks. This navigation pattern, shown in Figures 1 and 2, followed a main hub approach, represented by the main menu, with sub-hubs serving as the main access points for the other components of the report.
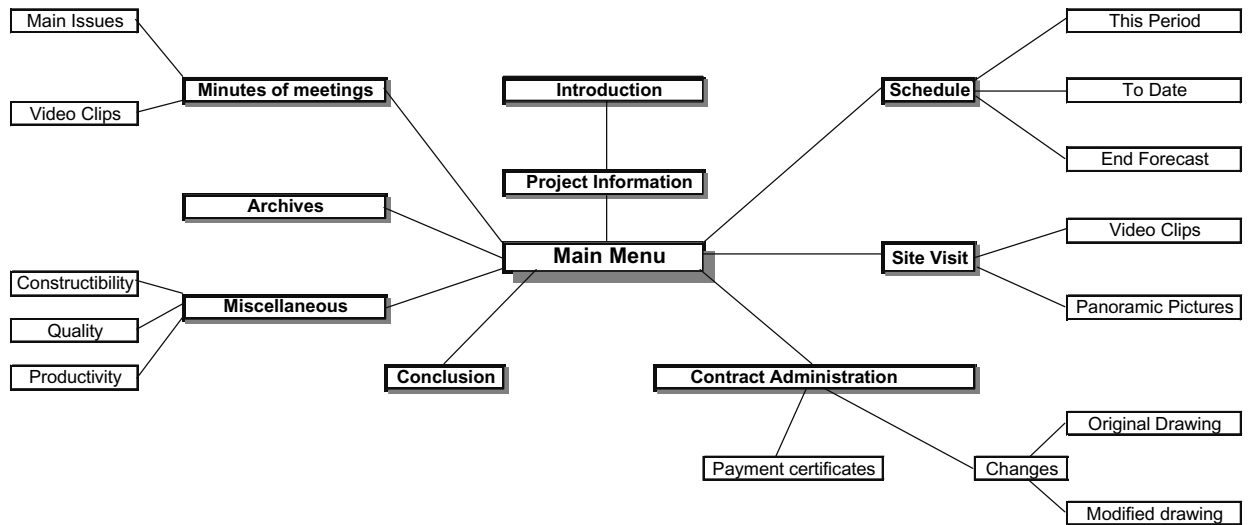
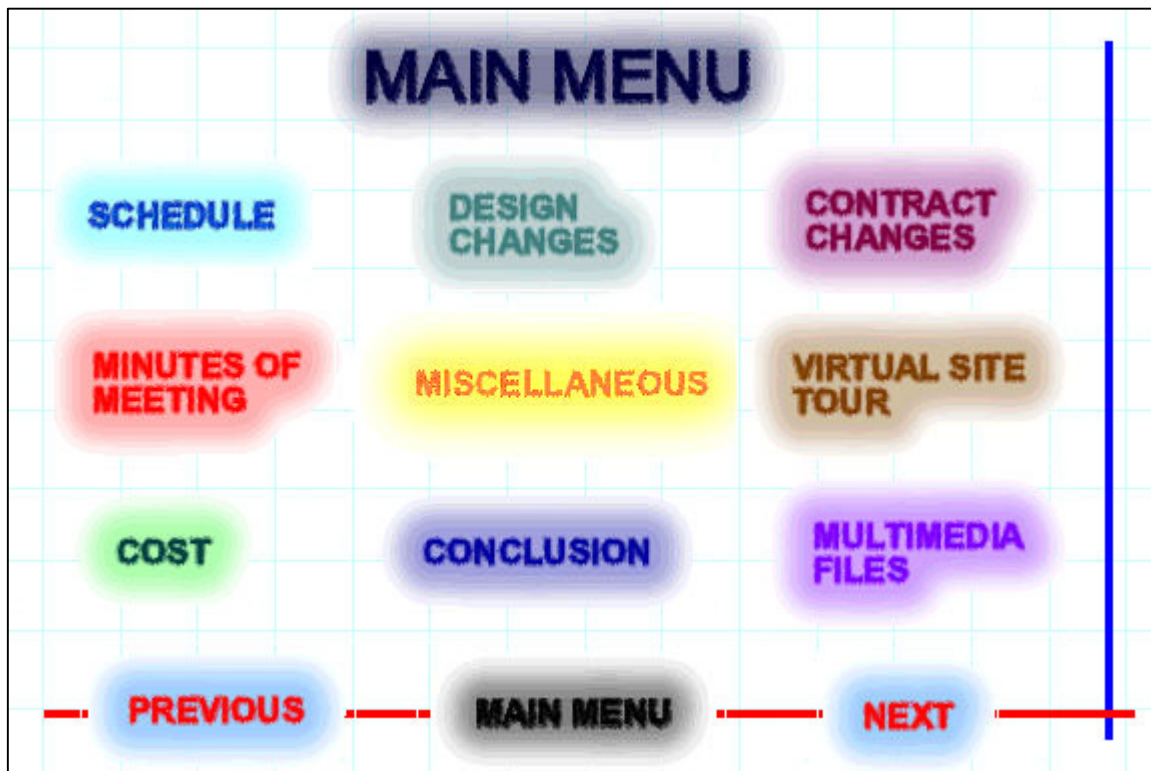**Fig. 1: Project reporter's navigation pattern**

Fig. 2: The project reporter's main menu

2.2.1 Site Visit

Site visit is divided into two visual representations of the current work being done on site: (see Figures 3, 4 and 5)

- Digitized video clips: Which summarize the completed or under progress activities within the reporting period. These clips are sorted by location, trade, activity, and/or date.
- Panoramic pictures: also called vistas, which are 360 degree pictures, composed of several digital images stitched together to give the panoramic view. These vistas allow for panning and zoom-in and out. Several vistas were linked together through "hot spots", which are embedded hyperlinks enabling the user to move from one vista to another, showing a different view of the project from a different vintage point. Special windows were inserted inside each of the vistas, allowing the user to have a look at live video embedded inside the vista as he/she zooms in.

The combination of panoramic still pictures and live video allows for maximum interactivity and gives the feeling of "being there".
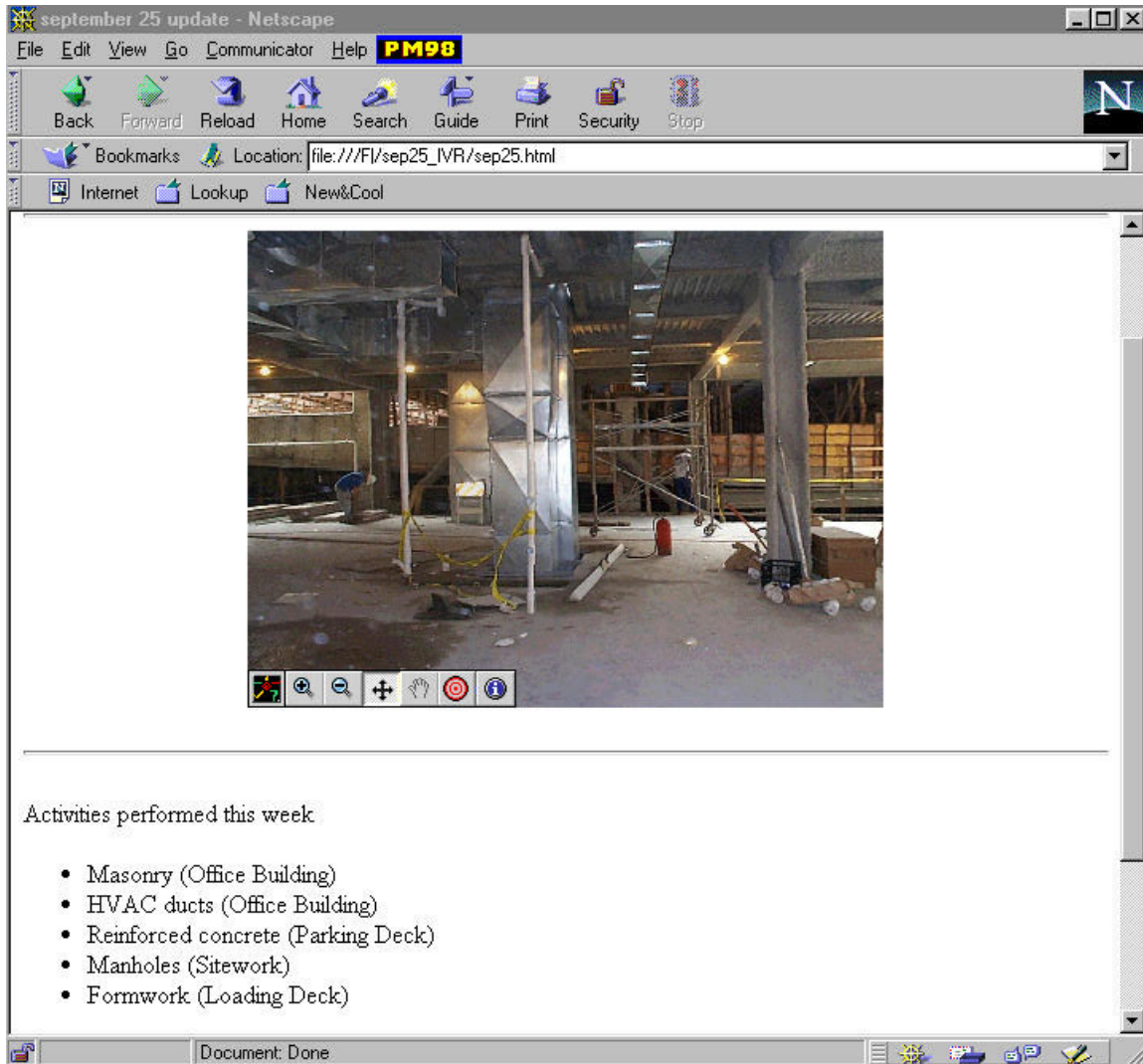

Fig. 3: Virtual site tour (Video)

Fig. 4: Link to an Internet browser to show project Vistas and current activities

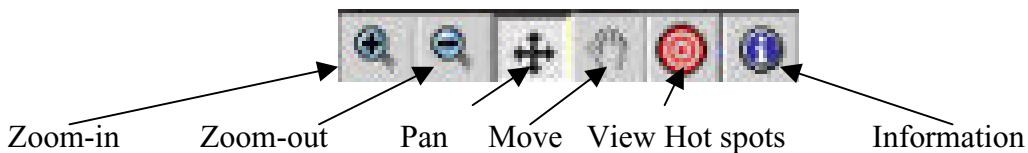Zoom-in   Zoom-out   Pan   Move   View Hot spots   Information

Fig. 5: Navigation panel within Vistas

2.2.2 Schedule

Through a textual description of the current status, a schedule shows percentage of completion, expected completion date, and comments on the progress in general (e.g. Concrete activities are 2 weeks behind schedule). A direct connection to the scheduling application is provided through using the OLE (Object Linking and

Embedding) properties linking (P3, Suretrak, Microsoft Project, etc). For example, OLE enables the user to view actual schedule data, as well as compare between actual and target schedules, in the form of a Gantt chart or a precedence network. This schedule module is divided into three main parts:

- This period: reflecting the progress achieved since the last progress update
- To date: reflecting the cumulative progress achieved from the start of the project to the date of the report
- End forecast: reflecting the expected project completion date, if the following performance trends are maintained. Any change in the expected completion date should not be construed as a change in contract conditions, but rather as a warning, in case of delay, that some corrective measure should be taken to restore the contracted completion date.

2.2.3 Contact Administration

Contract Administration: Shows any modifications to the contract documents, particularly the drawings in an electronic format (CAD files), and reflects any design changes and the potential impact of the change on the project schedule and cost. The original drawing is shown on one side of the screen, whereas the modified drawing is shown next to it, reflecting the design changes. This module also shows a copy of the latest payment certificate reflecting the value of the completed portion of the works, and the remaining balance till the end of the project, including past modifications to the project price through previously approved change orders. One of the concerns about releasing CAD drawings electronically is the issue of security and authenticity of the engineer's seal. Recent progress in encryption and electronic signature technology makes the release of these drawings safer. Additionally, it should be understood to all project parties that the electronic document is only a supplement to the printed one, not a substitute to it.

2.2.4 Minutes of meetings

Minutes of meeting show a textual description of the meeting agenda, discussed topics, and pending decisions. Video excerpts of the progress meetings for the reporting period can complement this textual description. The advantage of using video is the undisputed documentation of what has been discussed as well as what has been decided. It is worth mentioning that some of the project parties may show discomfort with the video-taping of the meetings, however, it should be brought to their attention that this is for documentation purposes, and that edited versions of the meeting can be sent to different parties for approval before being released.

2.2.5 Miscellaneous

This is a flexible module reflecting any issues related to project productivity, quality, or any Constructibility issues or problems. Value engineering change proposals (VECP) may be included in this module, reflecting any contractor-submitted changes to improve the project value.

2.2.6 Archives

This module reflects pending issues from previous reporting periods, as well as video clips and vistas from previous periods to reflect the gradual progress of the project. This module serves as the as-built chronological documentation of he project.

2.2.7 Conclusion

Including a final comment on the current progress report, any anticipated measures to improve performance, and any corrective measures to be implemented to remedy existing problems. This module serves as summary of the current period report, and a starting point for the next period's report. Graphical representations of different project trends were used to summarize the project status, especially for top management review.

3   Case study

A specific project was selected as a case study for the development and testing of the Project Reporter. This project was the construction of an office building in downtown Peoria, Illinois, together with an adjacent parking deck. The office building is a seven-story steel structure, whereas the parking deck consisted of a five-floor reinforced, cast in-situ, post-tensioned, pre-stressed, concrete structure. The project was partnered between the main owner (Peoria City), the A/E (Clark Engineers), and the general contractor (River City Construction) who where all stakeholders in the project. The project was part of a larger project for restoring the riverfront of Peoria City to attract more tourists.

The first author was involved in the project as an observer, and attended the weekly coordination meetings between the A/E and the contractors, as well as the coordination meetings between the different owners.

4   Packaging and distribution

Due to the large size of multimedia files, video files in particular, the selected method for distribution was the compact disk (Read only Memory CD-ROM), which can contain up to 650 MB of data. Another method of distribution is the Internet, through Shareware or free plug-ins the user can download from the Internet, enabling review of most of the report (excluding video files) over the Internet; thus allowing timely distribution and sharing of the report. One of the advantages of the Internet over the CD is being independent of the platform (PC or Mac.). Another advantage was the ease and higher frequency of performing the updates and making them concurrently available (daily, semi-weekly, or weekly). Feedback about the report can be obtained through e-mail or IRC, completing the paperless cycle of the progress reporting.

A special web page was developed by the author for this case study, which was updated on a weekly basis, enabling the different project parties, particularly the top

management of their different organizations, to view a panoramic picture of the latest progress status within the project. The web page contains 4 to 5 consecutive updates at a time, enabling the viewer to compare the progress from one week to the following one, and giving a brief idea about what activities took place on site during that week. The CM for this project (CMPI) linked this page to his own web site, as did the A/E (Clark Engineers), giving their different clients an idea about the project as a model on how communication and reporting could be done in a visual way on the Internet. The project web page includes short clips of video showing a morphing view of the ancient building that used to exist on this site, to its gradual transformation into the new building. Figure 6 shows a partial view of the project web page.
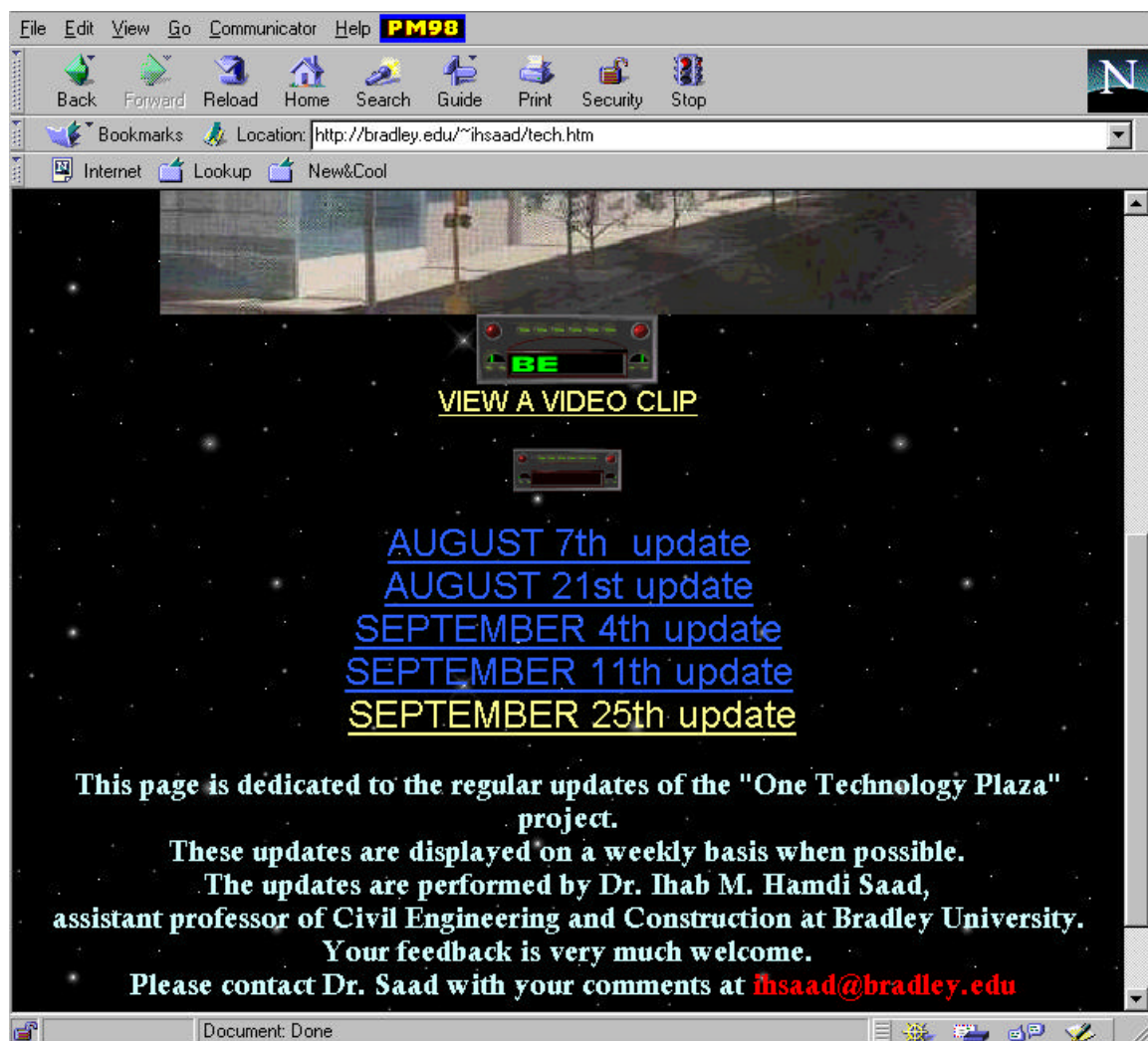

Fig. 6: Project web page for regular Vista updates

5   Discussion

Multimedia is a very flexible and promising tool for application in various fields, including construction project management. Timely sharing and exchange of information about project progress is of ultimate importance, especially in case of deviation from the initial plans, or any modification thereto, allowing for proper corrective measures to be implemented, as well as reassessment of the project budget, schedule, and contractual arrangements. Multimedia documentation of the project progress allows for increased perception of the actual project status, and allows for a safe and dependable way of storing historical project data for future reference and comparisons. Progress reporting is a multi-layered process, with different levels of details about the project status corresponding to different managerial levels of the stakeholders' organizations; brief and global view for top management, and detailed view for project management.

A web page was created to enable the project team members monitor the project progress remotely on a regular basis, allowing for comments and discussions. The web page was also used to post agendas for future meetings. A view of the web page dedicated to the vistas for progress updates can be accessed at:
http://bradley.edu/~ihsaad/tech.htm