Project Time-Lapse

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ABSTRACT: The goal of this project is to set up an organized method of recording the construction of the Frank and Maria Stata Center. This paper describes the current 3-stage system of retrieving data from the site: 1) cameras, 2) server, and 3) web page. The recording process is planned to span from 1998-2003 for the entire duration of the project.

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1 Introduction

Over the past year, MIT has begun a new wave of construction throughout the campus in order to foster growth and embrace new technologies. One of the buildings MIT has been assembling is the Ray and Maria Stata Center. MIT desired to record this building's progress from the ground up and the Computer Graphics Group, in conjunction with the MIT physical plant, opted to lead this project. In order to accomplish this task, several components were needed: cameras to capture and record the construction each day, a server to deposit the captured data and dispense the images, and a web page to present the data in a clear, concise form.

1.1 Building 20

Building 20 was constructed during the Second World War, and initially served as the home of the Radiation Laboratory. "The building was constructed in 1943 as a war building and is of a temporary nature," reads an architect's memo. "The life of said building to be for the duration of the war and six months thereafter." It has been the home to many activities and projects over the course of its 55-year lifetime. This building has inspired creativity and thought in those that worked in it.

Figure 1. Building 20

1.2 The Stata Center

In 1998, Building 20 was torn down in order to construct of a new building, the Ray and Maria Stata Center. The center is named after the co-founder and chairman of Analog Devices, Inc. Designed by Frank Gehry and Associates of Santa Monica, CA, it is a culmination of two buildings: 1) the William H. Gates building which will house the Laboratory for Computer Science and 2) the Alexander Dreyfoos building which will house the Artificial Intelligence Laboratory, the Laboratory for Information Decision Systems, and the Department of Linguistics and Philosophy.

Figure 2. The Ray and Maria Stata Center

2 The Process

The process of recording this information is broken up into three sections: the cameras, the servers, and the presentation.

2.1 The Cameras

2.1.1 Camera Specifications
The Computer Graphics Group uses an Axis Communications camera model AXIS 200+ to take pictures of the site. It is the world's first self-contained web server and network camera. This camera is very simple to install, requiring only a network drop and a place to plug in. It is controlled remotely via a web page that is pushed from its internal server, which stores its settings and configurations. To access the camera, an administrator only requires a standard

web browser, which enables the camera to be controlled from any computer regardless of the platform.

Figure 3: Axis 200+ Web Camera

2.1.2 Locations
Eleven of these web cameras surround the Stata Center construction site: four on Building 26, four on Building 48, and one each in Building 54, Building 68, and the Whitehead Institute. Every three minutes they take snapshots of the construction and FTP these images to MONITOR, the server that stores the images. They remind themselves FTP the images through an internal CRON script. Each camera has a user account and password and is placed in their home directory upon log in, where they may then choose the directory they wish to store the pictures based on the date.

2.1.3 Troubleshooting
One major problem has emerged with this camera model. There have been instances where a camera FTP's a "green image" to the server. In order to remedy this problem, the administrator must manually reset the camera by unplugging and re-plugging its power source. This seems to be the only solution to this problem, as internal software resets have not successfully restarted the camera properly.

2.2 The MONITOR Server

2.2.1 Picture Database
The MONITOR server is the intermediary between the cameras and the web page. This server stores the images sent from the web cameras, updates web page images, creates time-lapse movies of the construction, and serves the project's web page. Each camera has a home directory in which it is placed when it first logs on to the system. The directory structure for each camera is as follows:

/webcam-bldg/year/month/day/

e.g. /webcam-bldg54/2000/12/22/

Each picture stored is approximately 33Kb and a day's directory holds about 9Mb worth of data. There are eleven cameras send these images to MONITOR every day for two years. This will amass to approximately 80Gb of data. Since MONITOR will store pictures in its hard disk till the construction's completion in 2003, the current 60Gb hard disk will need an upgrade in a year or so. The hard disk currently is partitioned into three sections. Nine of the cameras (B54, B26, and B48) are on one partition at the moment because B26 and B48 were put on the system late in the process. This partition will be the first that requires an upgrade.

2.2.2 Scripts
All processes within MONITOR are automated with the use of Cron, Perl, and c-shell scripts.   The time-triggered Cron script tells the computer to run one of the Perl or C-shell scripts. There are currently five scripts utilized in this process: dailymovie.pl, weeklymovie.pl, monthlymovie.pl, live-update.csh, and movie-stream.csh (See Appendix 5.2).

The first three each create time-lapse movie by creating parameter files that store the settings and image paths to be used for a given movie. They then produce movies with the Berkeley mpeg encoder and dump then in the proper web directory.

Live-update.csh grabs the most current images from each camera and posts them in the web page directory every ten minutes. This enables the user to get a glimpse of what a camera sees at a given time.

The movie-stream.csh script grabs movies, transforms the mpeg movies to quicktime format, and dumps then back in their original directory. It does this with the help of dmconvert, a converter program available for IRIX systems.

All scripts except the latter are stored in /www/httpd/cgi-bin/. Movie-stream is kept on a separate SGI machine because there, currently, is not a converter available for Linux that will accomplish this task.

2.2.3 Streaming server
The Darwin Streaming Server, developed by Apple, is used to stream movies to users. Streaming media allows the users to view a movie as it is being downloaded to them without waiting.   This program is located in /usr/sbin/DarwinStreamingServer and is configured to stream movies stored in /www/httpd/html/Movies/.   All other configurations (/etc/streamingserver.conf)

were left at their default values.   For more information on how to configure this server, go to:

http://www.publicsource.apple.com/projects/streaming/StreamingServerHelp/

2.3 The Project Time-Lapse Web Page

2.3.1 Front-end Graphics
The front-end display and graphics are done with the use of Macromedia Flash 4. Flash 4 is web development tool used to design and deliver distinctive, low-bandwidth web sites with a high impact experience. It was used to develop the interactive graphic components of the web site.

The web page is broken up into six sections to display all the given information: Home, Time-lapse Sequences, Stata Center, Building 20, Technical Information, and Feedback. Each of these sections has a navigation bar at the top for easy movement throughout the site.   All pages are stored in the /www/httpd/html/ directory of MONITOR and all movies are stored in /www/httpd/html/Movies/ directory.

3 Future Developments

The Computer Graphics Group is currently considering several innovative ways to use the data from the site. One idea is to create a 3D model of the Stata Center and render it on top of the pictures to create a skeleton of the center. As more progress is made, the skeleton fills up with the actual picture of the center.

4 Conclusion

The Computer Graphics Group will continue to monitor the construction of the site until its completion in 2003.

5 Appendix

5.1 Technical Info for Cameras

No.	Location	Website
1	26 Rooftop	http://webcam-bldg26-north0.mit.edu/
2	26 Rooftop	http://webcam-bldg26-north1.mit.edu/
3	26 Rooftop	http://webcam-bldg26-south0.mit.edu/
4	26 Rooftop	http://webcam-bldg26-south1.mit.edu/
5	48 Rooftop	http://webcam-bldg48-west0.mit.edu/
6	48 Rooftop	http://webcam-bldg48-west1.mit.edu/
7	48 Rooftop	http://webcam-bldg48-east0.mit.edu/
8	48 Rooftop	http://webcam-bldg48-east1.mit.edu/
9	54-1615	http://webcam-bldg54.mit.edu/
10	68-620	http://webcam-bldg68.mit.edu/
11	Whitehead 5th Floor	http://webcam-bldgwi.wi.mit.edu/

-Sample Cron Script for Cameras
This is the Cron script located on each camera. It tells the camera to FTP an image to MONITOR every three minutes (line 3 and 4). It also resets the cameras everyday to avoid the camera from freezing.

```
1  # CRON Script Header
2  #  Work.
3  0,3,6,9,12,15,18,21,24,27,30,33,36,39,42,45,48,51,54,57 0-23 1-31 1-12 0-6 * :
4  ftp -host monitor.lcs.mit.edu -user webcam-bldg54 -pass webcam -src fullsize.jpg -dest
5  $Y/$n/$d/w54-full-$Y.$n.$d-$h.$m.$s.jpg;
6  %
7  0 0 1-31 1-12 0-6 * :
8  reset -hard;
9  %
10 # reset
11 0 0 1-31 1-12 0-6 * :
12 reset -soft;
13 %
```

-Image Settings
These are the settings specific to this project's requirements that are stored for each camera. They set what type of picture the camera takes.

Rotation | Normal ▼

90 and 270 deg rotation is available in fullsize and halfsize images.

Mirror | Off ▼

Color | Color Level 5 ▼

Compression | Low ▼

White balance | Automatic Fast ▼

Brightness | 9

(0-9) default value 5

Image Cache time | 0

(Cache time in seconds, 0 = no cache.)

Front panel LED | Off ▼

Image Text | | Position x | 0 | Position y | 0

Autoadapt period | 5

5.2 Server scripts

-dailymovie.pl for Building 54

```perl
#!/usr/bin/perl
use CGI;

($sec,$min,$hour,$mday,$mon, $year, $wday, $yday, $isdst)= localtime(time);
$mon=$mon+1;
$year=$year+1900;
$mday=$mday-1;
if ($mday < 10){
   $mday= "0$mday";
}
if ($mon < 10){
   $mon= "0$mon";
}


#-------------------------------------------------------------------
#building 54 movie

open(MOVIE, ">/www/httpd/cgi-bin/daily54movie.param");
print MOVIE "
PATTERN IBB
OUTPUT /www/httpd/html/Movies/b54daily.mpg
INPUT_DIR  /webcam-bldg54/$year/$mon/$mday
BASE_FILE_FORMAT JPEG
INPUT_CONVERT *
GOP_SIZE 30
SLICES_PER_FRAME 1
PIXEL FULL
RANGE 10
PSEARCH_ALG LOGARITHMIC
BSEARCH_ALG SIMPLE
IQSCALE 8
PQSCALE 10
BQSCALE 25
REFERENCE_FRAME ORIGINAL
INPUT
";

opendir(PIC, "/webcam-bldg54/$year/$mon/$mday/") || die "no ~54/$year/$mon/$mda
y?: $!";
@docs= (sort readdir (PIC));
@front= splice (@docs,0,3 );
foreach $name (@docs){ #list context, sorted
  # unless (($name == ".") or ($name == "..")){
      print MOVIE "$name\n"; #prints listing
  # }
}
closedir(PIC);
print MOVIE "END_INPUT\n";
close MOVIE;

system "/www/httpd/cgi-bin/mpeg_encode /www/httpd/cgi-bin/daily54movie.param";
```

-live-update.csh for Building 54

```csh
#!/bin/csh -f
# this identifies and returns the URL of
# the second-most recent webcam image
# expects argument $1 to be webcam id
# example from csh:  % ./webcam-live 54
# from web: http://monitor.lcs.mit.edu/cgi-bin/webcam-live.csh?54

# construct the directory name
set dir54 = /webcam-bldg54`date +"/%Y/%m/%d"`
# go there
cd $dir54
# find the second-newest file
set iname = `ls -1t | head -2 | tail -1`
cp -f $dir54/$iname /www/httpd/html/live-54.jpg
# construct the directory name
set dir68 = /webcam-bldg68`date +"/%Y/%m/%d/"`
# go there
cd $dir68
# find the second-newest file
set iname = `ls -1t | head -2 | tail -1`
cp -f $dir68/$iname /www/httpd/html/live-68.jpg
```

6 Bibliography

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Darwin Streaming Server.   Apple
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