# Jitters

COMP 471 / CART 498c
Team Project Proposal – rev 1.2.1

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## Introduction

Jitters is a responsive installation, designed from ideas learned through the joint COMP 471 / CART 498c course given by Dr. Sha Xin Wei, at Concordia University, fall 2006. It will be a wall projection installed in the EV Building, showing a live feed of the people passing through the FOFA gallery corridor.

## Interests

There are many technical and conceptual issues encountered when doing any installation project.

### *Attention Span*

Jitters' primary goal is to be a responsive, augmented environment. As such, the attention span required from the average person is next to none because it is assumed is that people will generally be oblivious to the installation. Most people will become actors in the system, providing a variety of actions for Jitters to react to. It is expected, however, that some people will actually notice the setup and become viewers to the installation.

To entertain the viewers, Jitters will respond to a variety of stimuli:

- Passers-by walking through the corridor, tracked using a camera.
- Passers-by ascending or descending the stairs, detected by their footsteps (using accelerometers or microphones).

The responses will be through dynamic visuals and sounds, generated in Max/MSP+Jitter.

A particular challenge with our setup would be: how to grab the attention of somebody randomly passing-by?

***Location***

The FOFA gallery corridor on the 1st floor of the EV building is the targeted location for Jitters. This space was chosen because it features many of the qualities needed for an audio/visual installation.

- High traffic.
- White wall for projection, above.
- Good lighting conditions.
- Good support infrastructures (to install projector, speakers, etc).
- The stairs vibrate to movement, an interesting quality to use.

***Learning Curve***

The learning curve is mysterious. Why do we say mysterious? It is because the main visual aspect is very easy to learn. Walking through the corridor naturally creates a response. However, the installation does not only cover the corridor. The stairs are also a stimulus for the project, and chances are that less people will use them. This means that we have the following scenarios:

- No people.
- People exclusively in the corridor (moving or not moving).
- People exclusively on the stairs (moving or not moving).
- People using both the corridor and the stairs (moving or not moving).

It will be a feat to develop Jitters into a system that is both natural to learn, yet interesting to explore for more than just an instant.

## *Technical Aspects*

### *Vibration Detection*

Our project uses the stairs' vibration as a means to change the projected video. There exist two ways of detecting the vibration: using an accelerometer or using a microphone. Both methods have their advantages and disadvantages.

The use of a accelerometer to detect the vibration allows us to have a cleaner input, since less ambient noise will affect it. However the use of this sensor is not directly integrated into Max/MSP+Jitter and we will need an external library to read and interpret this kind of data. We will also need to find if we can get such a sensor.

The use of a microphone to detect the vibrations comes from the fact that both sounds and vibrations are waves that propagate through a material. This method would have the advantage of using a normal input for Max/MSP+Jitter since the program is design to work both with video and with sounds. We most also consider that acquiring a microphones is easier than trying to get an accelerometer. The difficulty of this approach is that the ambient noise of the room will contaminate our input; which will make us need more aggressive filtering techniques.

*» Vibration, http://www.ndt-ed.org/EducationResources/HighSchool/Sound/vibration.htm*
*» From Vibration to Sound, http://www.iit.edu/~smile/ph8813.html*
*» A Beginner's Guide to Accelerometers, http://www.dimensionengineering.com/accelerometers.htm*
*» Physique Ondes, optique et physique moderne, ERPI, 1999, Harris Benson and colleagues*

### *OpenGL*

OpenGL will be use in Jitters to create the final output of the video for the installation. It can either be used to create a 3D model of the edge that are distort or to directly distort a 2D frame of the video.

Both paths could be explored for their feasibility (such as finding the CPU power needed), since the rendering of each frame should be almost instantaneous. More research and testing for that part of the project will be needed to determine the most efficient way of accomplish our desired visual output.


» *Obj. Deformation…, http://www.csc.calpoly.edu/~zwood/teaching/csc471/finalproj02/morning/afaruque/*
» *Image Manipulation using OpenGL, http://cg.cs.uni-bonn.de/project-pages/imogl/*
» *Jitter OpenGL Documentation, http://www.cycling74.com*


### *Color Image to Binary Image*

A large part of our project is related to the movement of the people passing in front of the camera. We detect speed and determine size to decide on the output of sound. More importantly, we analyze the contour of the participants in front of the camera to create the final output video of the installation.

As such, since color is not necessary for our project and potentially detrimental to our analysis, our first step once a frame is captured is to binarize it using a carefully chosen threshold value.

As we have observed, the hallway is not always very well lit. Even when it is sunny outside the hallway remains dark, illuminated only by artificial lights. Therefore, multiple tests comparing histograms should be performed to determine the best threshold value at which we can get the full contour of the participants with least amount of noise as possible.


» *Asif, Conversion of a Color Image to a Binary Image, Coder Source.NET, April 18 2005*
*http://www.codersource.net/csharp_color_image_to_binary.aspx*
» *MIL 8.0 Guide, Jan 2006, http://www.matrox.com/imaging/products/mil/milguide.pdf*

***Filtering and Convolution***

Despite our best efforts with finding the "best" threshold value, it is inevitable that noise mar our video capture. Since aesthetics is an integral part of this project and clean lines are a must, filtering becomes a necessity.

The amount of filtering necessary is determined on the edge detection operator we choose later on.

If we choose a "Canny" filter, the image is, in theory, automatically convolved with a Gaussian mask. At that point, all we have to do is choose the Gaussian mask size (small mask for small, sharp lines vs. big mask for large, smooth edges) and two threshold values.

If, however, we choose a "Sobel" or any other filter, it is preferable to remove unwanted artifacts before performing edge detection. Filter operations to be use will most likely be open and close operations as well as various convolve operations.

*» Canny, Wikipedia, October 2006, http://en.wikipedia.org/wiki/Canny*

***Blob Analysis***

For our project, blob analysis will primarily be used to determine the size of the participants in front of the camera. This value will be used to control the sound emitted.

To determine the area occupied by participants in front of the camera, we will mostly take advantage of the existing packages of cv.jit.mass, cv.jit.blobs.elongation or cv.jit.blobs.bounds.

*» Untitled, Cv.Jit Computer Vision for Jitters, October 2006, <http://www.iamas.ac.jp/~jovan02/cv/objects.html>*

***Edge Detection***

Once the image is sufficiently cleaned, we will use an edge detection filter to find the smooth contour of the participants. This operation will enable the OpenGL component to create the final video of this installation.

Since the Sobel and Canny filters come with Jitter or cv.jit, we will most likely use one or a combination of both filters to perform the edge detection. From what we understand, a Canny filter is more adaptable to various situations, but slower to process. In contrast, a Sobel filter is less precise, but faster to process.

Depending on the laptop used for our installation as well as the results from the filtering, we will determine the filter used.

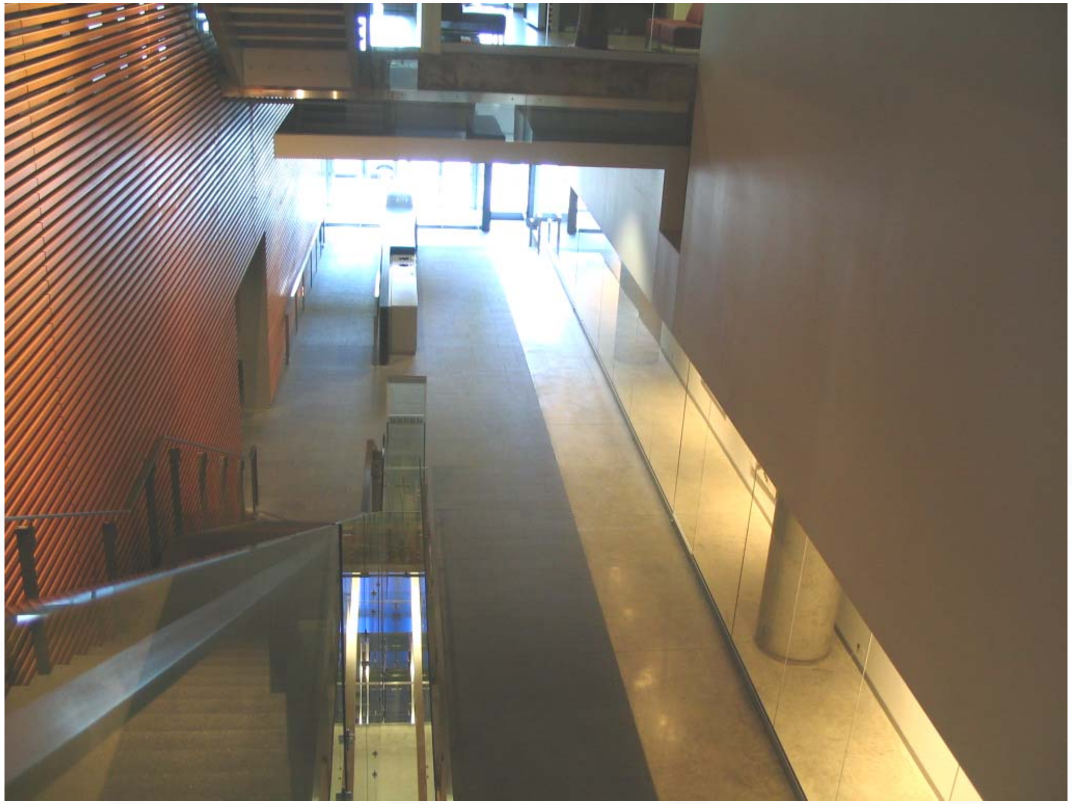
*» Edge Detection, Wikipedia, September 2006, <http://en.wikipedia.org/wiki/Edge_detection>*

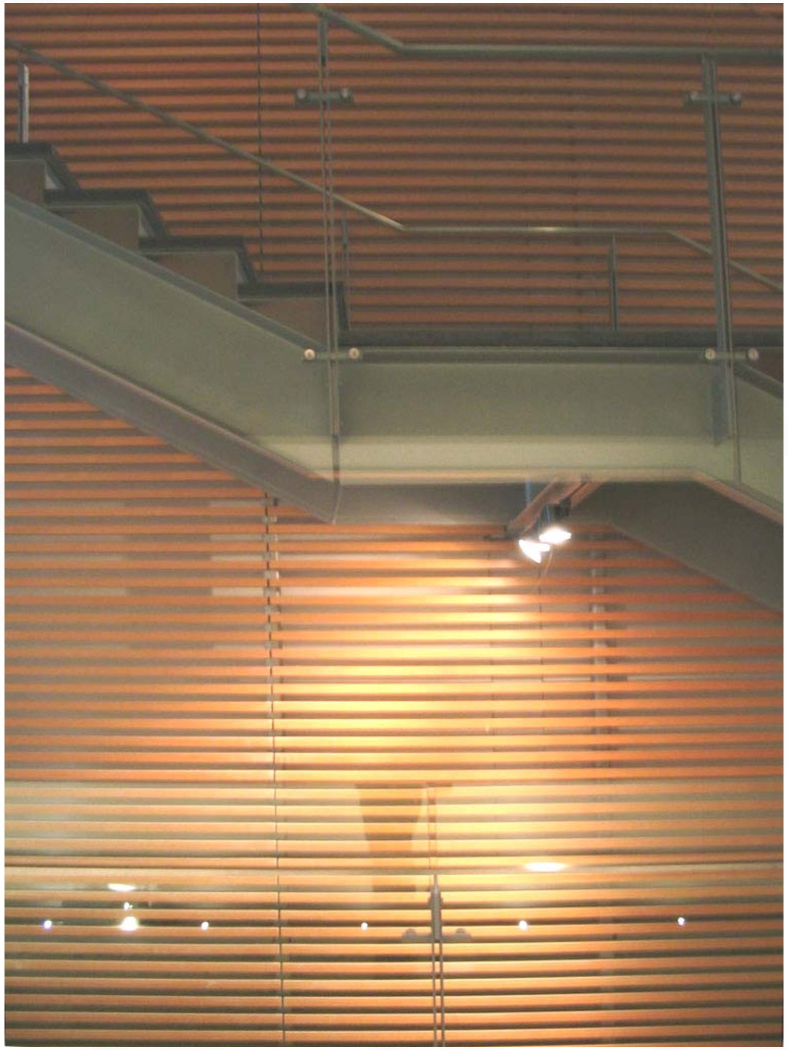
## Design

### *Overview Diagrams*

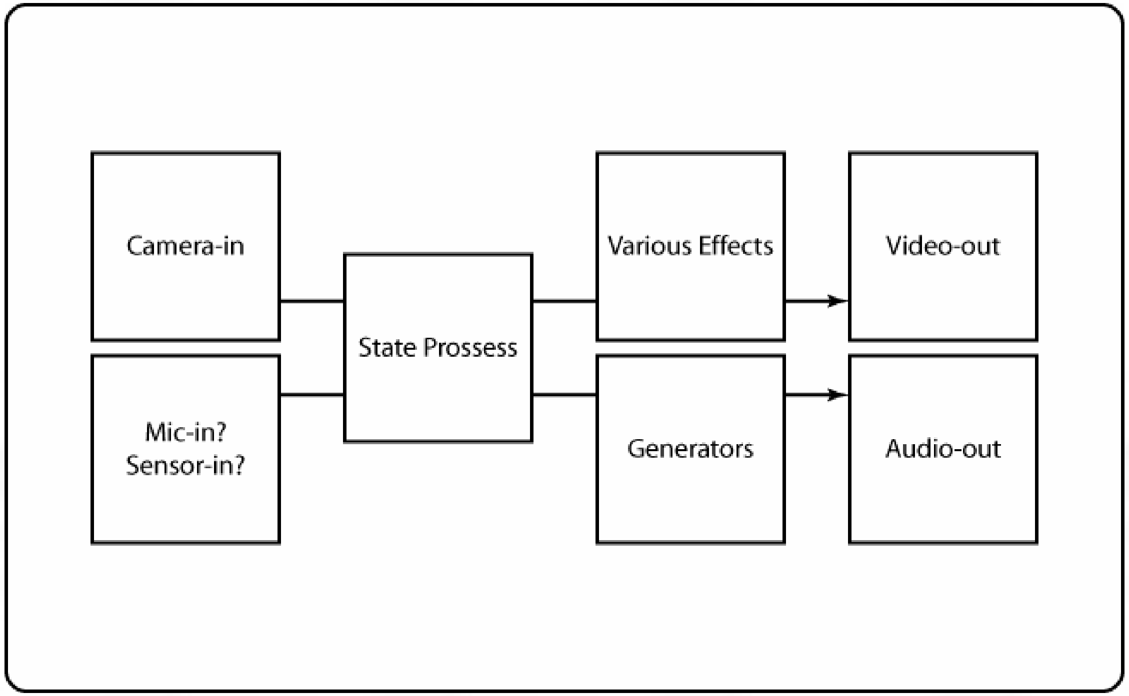
#### *Location Photos*

Ground-level


From the Top

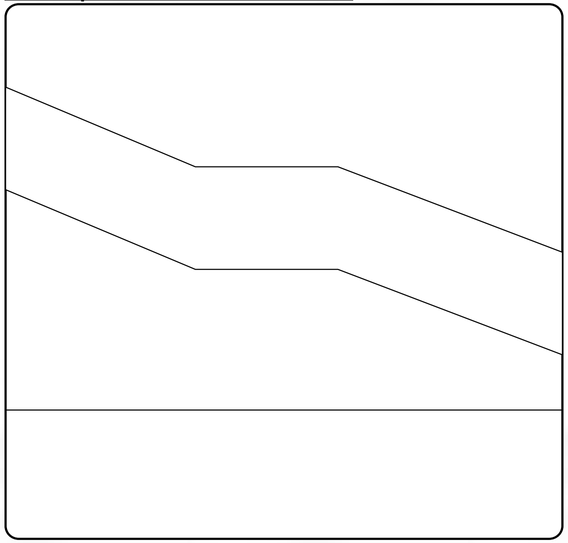

Wall Deco as Support Railings

***Software Architecture***

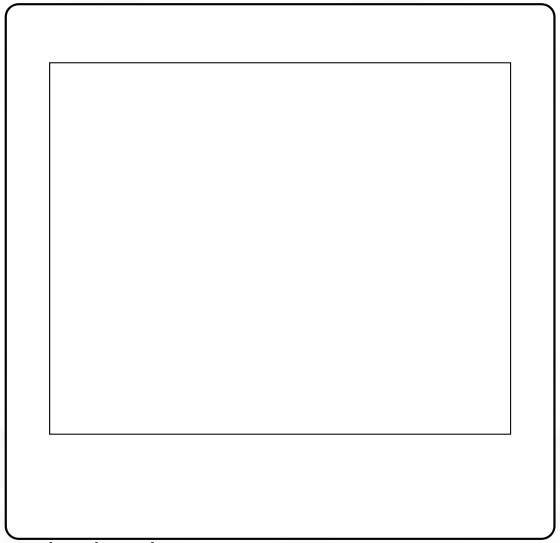


***Use Case Scenarios***

Example Case A. Minimal



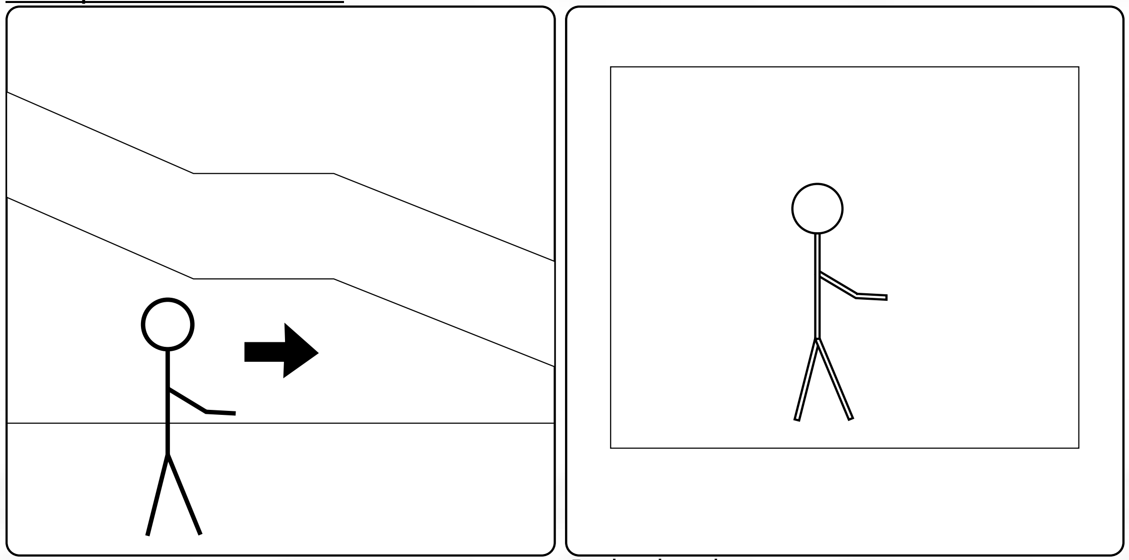
Installation view



Projection view

- No activity is detected in the corridor or in the stairs.
- Audio and Video are inviting, but brief.

Example Case B. Median

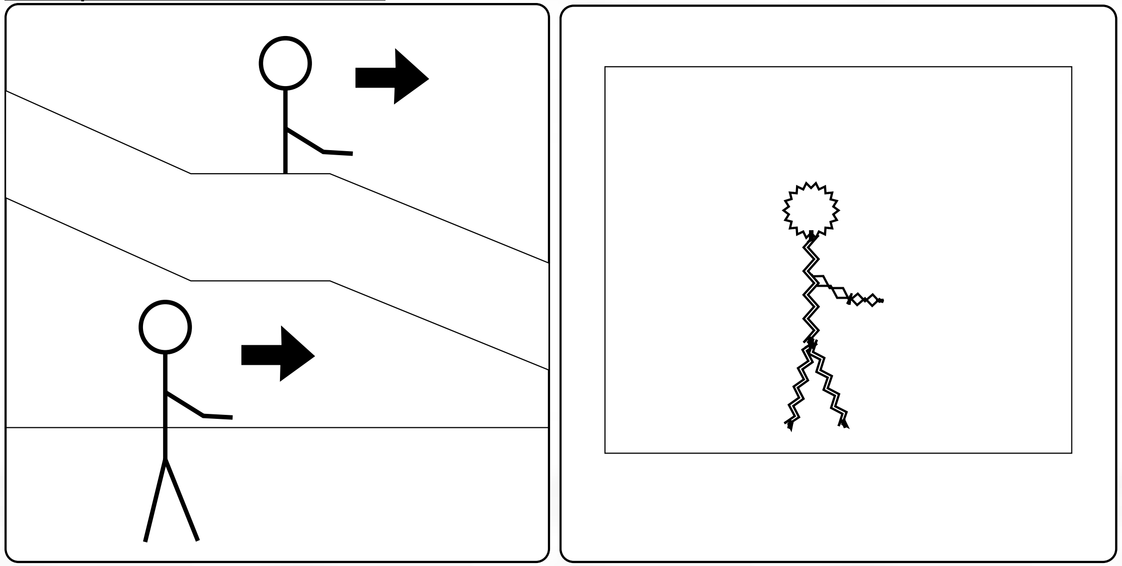


Installation view

Projection view

- Activity is detected in the corridor.
- The projection change to an outline of the activity.
- Audio changes but keeps playing.

Example State C. Maximum



Installation view | Projection view

- Activity is detected both in the corridor and on the stairs.
- The projection change to display a jitter contour of the activity detected in the corridor.
- Audio changes again but keeps playing.

### *Requirements*

- Apple computer with Max/MSP+Jitter
- iSight
- Projector
- Speakers
- Platform for projector
- Ladder
- Extension cables (power, audio, video)
- Power bar
- Lights

### *Specifications (to be developed)*

- Laptop, with Firewire.
- Max/MSP 4.5.7 +Jitter 1.5.
- iSight auto-adjustments must be disabled.
- Projector capable of 640x480 without distortion.
- 5.1 channel sound is more than adequate (must have a subwoofer).

### *Standards (to be developed)*

- Dimensions of video output: 640x360 pixels (padded letterbox: 640x480 pixels)
- Canned audio? Generated audio?
- MIDI output? WAV output?

## Use Case Scenarios

***Common activity…***

| Corridor | Idle Response | Active Response |
|---|---|---|
| Absence | Audio & Video: inviting | |
| Presence | Audio & Video: T.B.A. | Audio & Video: T.B.A. |

***Uncommon activity…***

| Stairs | Idle Response | Active Response |
|---|---|---|
| Absence | Audio & Video: T.B.A. | |
| Presence | | Audio & Video: T.B.A. |

***Cross-reference of minimum and maximum activity…***

| Corridor & Stairs | Idle Response | Active Response |
|---|---|---|
| Absence | Audio & Video: inviting | |
| Presence | | Audio & Video: creative, explorative, deep, intriguing |

## Milestones

Week 1 - Draft Design Basis
- Proposal Writing

Week 2 - Secure Location
- Secure Standard Equipment
- Secure Construction Materials

Week 4 - Complete Design Basis
- Complete Code Sections
    - Sound
    - Images
    - Response

Week 5 - Prototype Construction
- Prototype Test Demo

Week 6 - Revisions and Additions
    - Revised / Extra Features
    - Final Design Documentation; based from Proposal

Week 7 - Presentation Construction
    - Presentation Demo

## Member Roles

***Shared Tasks***

- Design
- Programming
- Construction
- Copy-text

***Victor Yap***

- Chairperson / Editor

***Olivia Tang***

- Research

***Geneviève Thérien***

- Aesthetics

## Timesheets

***Victor Yap***

| Task | Date | Hours |
|---|---|---|
| Draft Design Basis | Oct-16-2006 | 1 |
| Proposal Writing | Oct-19-2006 | 3 |
| Proposal Writing | Oct-20-2006 | 1 |
| Proposal Writing | Oct-21-2006 | 1 |
| Proposal Meeting | Oct-21-2006 | 2 |
| 3D Plan | Oct-23-2006 | 1 |
| Proposal Writing | Oct-23-2006 | 1.5 |
| | **Total Time:** | 10.5 |

***Olivia Tang***

| Task | Date | Hours |
|---|---|---|
| Draft Design Basis | Oct-16-2006 | 1 |
| Proposal Writing | Oct-20-2006 | 1 |
| Location Photography | Oct-21-2006 | 0.5 |
| Proposal Meeting | Oct-21-2006 | 1 |
| Proposal Writing | Oct-21-2006 | 1 |
| Proposal Writing | Oct-22-2006 | 2.5 |
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| | **Total Time:** | 7 |

***Geneviève Thérien***

| Task | Date | Hours |
|---|---|---|
| Draft Design Basis | Oct-16-2006 | 1 |
| Proposal Writing | Oct-20-2006 | 1 |
| Proposal Meeting | Oct-21-2006 | 2 |
| Proposal Writing | Oct-22-2006 | 2 |
| | **Total Time:** | 6 |