IPRO 317 Project Plan

Summer 2008

Design & Build Chicago Scale Model for Dynamic Disaster Simulation

Advisor: Dr. Ahmed Megri

Sponsor: Chicago Fire Department

Team: Graham Balkany
        Matt Claxton
        Jessica Correa
        Emmanuel Flores
        Yvonne Hernandez
        Jichul Kim
        Chance Lebron
        Erick Leong
        Daniel O'Brien
        Oscar Martinez
        Ruben Robledo
        Bogdan Rus
        Diyanna Russeva
        Andrew Seo
        Meng Sun

1. Abstract

This is the second phase of this project as a continuation of Spring 2008 IPRO 317 and will have a focus for Summer 2008 on the computer program, the user interface, as well as completion of the first geographic area of the scale model.

The objective of this project is to design and construct a 3-D scale model for the first portion of downtown Chicago (downtown Chicago has been subdivided into 6 portions). The model will be used to simulate and test the effectiveness of fire defense strategies to address fire or other catastrophes related to public health and safety. This model will include streets, buildings and detailed information that help the Chicago Fire Department in planning interventions, considering various scenarios and case studies.

The model is being built in phases, with the overall design incorporating a sophisticated, computer-driven illumination scheme built within the model base. The model thus will be able to display animated scenarios of virtually any depth and focus, by means of time-varying color and brightness. CAD Computer-generated images and laser-cutting methods are the main techniques used to design and build the model, but hand craftsmanship is also necessary.

The completed model will be fully modular, designed to transport easily to various facilities. The usefulness of the model thus will extend to many needs of the Chicago Fire Department and City of Chicago, as an educational tool within the department and for community outreach. Possible additional uses for the model will be wind tunnel measurement of pressure distributions to inform building design and City infrastructure needs, as well as the study of urban microclimates and the impact on building energy demand. There is also the potential for this model and its design approach to inform the development of scale models to depict the venues associated with the proposed 2016 Olympics along the Chicago lakefront.

This project will include: (1) Identification of the scale, materials, technologies, and strategies for construction; (2) Physical mapping and computer modeling of the downtown built environment; (3) Design of the physical model and computer/electronic components; and (4) Construction of a reduced-area mock-up for final review and approval by the City of Chicago.

2. Background

   A. The project will be advised by Dr. Ahmed Megri of the IIT CAEE Department. The project will be sponsored by the Fire Department of the City of Chicago, under the approval of the Chicago Fire Department Commissioner.
   B. This is a continuing IPRO which will focus on refining the model from the Spring 2008 semester. Specifically, researching a way for the model to be lighted by a projector with the use of mirrors and lenses built into the base structure, which

will illuminate the various acrylic features of the model based on input from a computer interface. Completion of the model also entails the completion of the remaining building models that were left unfinished due to time constraints.

C. Manipulation of the base material acrylic plays an important production role in the project and will consume a large portion of energy in completing the first model. Light manipulation and computer technology will have to be researched in order to convey information with clear resolution on the model.

D. The previous semester was unable to complete the acrylic model and the computer interface due to manpower and costs. This semester will focus on using existing resources and new technologies to finish the model in a more efficient manner.

E. The team will face many technological obstacles in order to identify the cost effective interactive physical model.

3. Objectives

A. Completion of the remaining acrylic building models from the Spring 2008 semester
   a. Fabrication of the remaining detailed models
   b. Experimentation on bonding methods for larger models
   c. Determine a method for creating models with greater detail

B. Experimentation with a liquid acrylic – model cast method
   a. Creation of a model using this method
   b. Determine the degree of possible details
   c. Measure the speed of this manufacturing process

C. Integrate a computer interface into the acrylic model
   a. Obtain a high resolution from the computer onto the model
   b. High illumination so that ambient light does not block information
   c. Ease of interface between the model and a computer
   d. Serviceability of the system due to roughness of use
   e. Maintain a low cost for reproducibility

4. Methodology

A. Work Breakdown Structure

   <See Attached>

B. Gantt Chart

   <See Attached>

5. Project Budget

< See Attached>

6. Team Structure and Assignments

   A. Individual Chart

Name	Major, Year	Skills and Strengths	Experience and Academic Interest	Team
Matt Claxton	Mechanical Engineering, 4th Year	Computers	Diverse technology experience	Projection
Jessica Correa	Political Science, 5th Year	Integrating new ideas	Interested in the dynamic information of the model	Projection
Emmanuel Flores	Material Engineering, 4th Year	Experimenting with models	Interested in application	Molding
Yvonne Hernandez	Architecture, 4th Year	Model making Research	Experience in model Creation/laser cutter	Milling
Jichul Kim	Mechanical Engineering, 4th Year	Research	Research in robotics	Projection
Chance Lebron	Architecture, 5th Year	Organization Model making	Experience in model Creation/laser cutter	Milling
Erick Leong	Mechanical Engineering, 5th Year	Planning	Enjoys the intricacies of models	Projection
Oscar Martinez	Architecture, 5th Year	Knowledgeable about milling	Worked in milling the Spring 2008 models	Milling
Ruben Robledo	Architecture, 4th Year	Rhino Program	Worked in milling the Spring 2008 models	Milling
Bogdan Rus	Civil Engineering, 5th Year	Enjoys playing with his hands	Interested in the model creation	Molding
Diyanna Russeva	Civil Engineering, 4th Year	Architectural Processes	Interested in the street dynamics	Milling
Andrew Seo	Mechanical Engineering, 4th Year	Computers	Experience in molding and electronic technology	Molding
Meng Sun	Electrical Engineering, 3rd Year	Designing Electrical Circuits	Understanding the circuitry application	Milling

   B. Team Structure

      a. Milling sub team
         Sub team leader Chance Lebron

Team Responsibilities:

Oscar, Ruben: Completion of the previous Spring 2008 models

Diyanna, Yvonne: Research in proper bonding methods to ensure clarity, strength, and speed of models

Chance: Setup of the model/Organize milling rotation

b. Molding sub team

Sub team leader Andrew Seo

Team Responsibilities:

Bogdan, Emmanuel: Research different materials for the molding cast in order to meet temperature requirements, be cost effective, and ease of manipulation

Andrew: Create computer models for use in the molding machine

c. Projection sub team

Sub team leader Matt Claxton

Team Responsibilities:

Meng, Jessica, Jichul: Research possible candidate LED controllers and lamp implementations, while considering scalability, practical application, and prospective computer control methods.
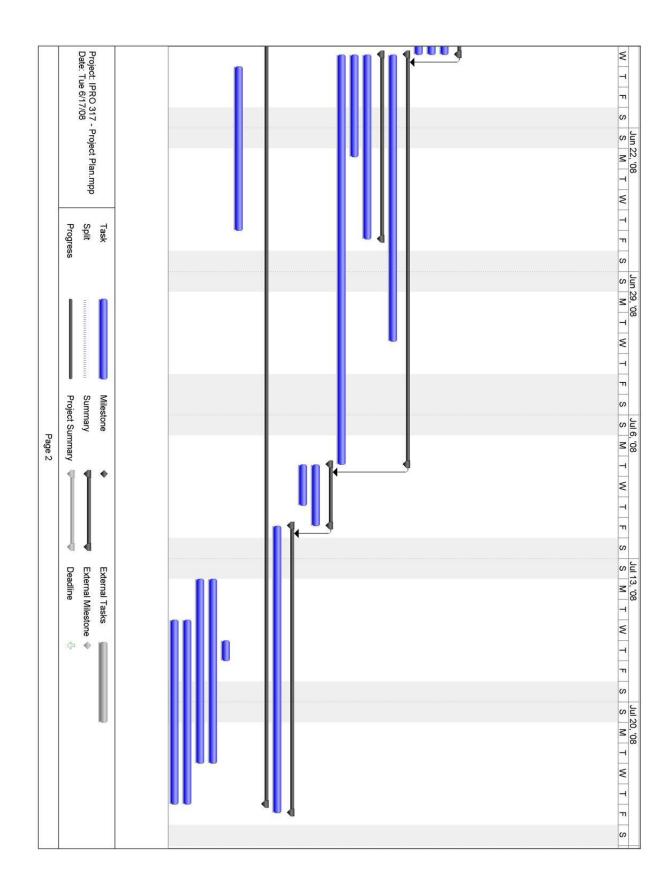
Erick, Matt: Consider applicable projector models in regards to overall practicality and revise existing base design for optimal rear projection performance and durability.

C. Project Monitoring Roles

Meeting Minutes – Erick

Timesheets – Erick

Weekly Task List – Erick

iGroups Management – Erick

Work Breakout Structure

Name	Duration
Defining the Problem	**2.5 days**
Evaluate Previous Work	20 hrs
Remaining Problems	20 hrs
Gathering Research	**3.75 days**
Computer Model Integration	**3.75 days**
Existing Solution	30 hrs
Mirror Solution	30 hrs
TFT / LCD / LED	30 hrs
Windows Tabletop	30 hrs
Model Improvements	**3.75 days**
Existing Solution	30 hrs
Mold Injection in Reverse Negatives	30 hrs
Identifying Possible Solutions	**5 days**
Projection	40 hrs
Milling	40 hrs
Molding	40 hrs
Testing	**13 days**
Location	80 hrs
Device or Documents	**7 days**
Purchasing Components	56 hrs
Constructing Molds / Models	24 hrs
Analyzing and Selecting	104 hrs
Designing and Modifying	**3 days**
Connecting Visual to Model	24 hrs
Finishing the Model	16 hrs
Preparing for IPRO Day	**10 days**
Prototype	80 hrs
IPRO Deliverables	**30 days**
Project Plan	32 hrs
Midterm Report	48 hrs
IPRO Day Preparation	8 hrs
Poster	56 hrs
Brochure	56 hrs
Presentation	56 hrs
Final Report	56 hrs

ID	Task Name	Duration	Start	Finish
1	**Defining the Problem**	**2.5 days**	**Tue 6/3/08**	**Thu 6/5/08**
2	Evaluate Previous Work	20 hrs	Tue 6/3/08	Thu 6/5/08
3	Remaining Problems	20 hrs	Tue 6/3/08	Thu 6/5/08
4	**Gathering Research**	**3.75 days**	**Thu 6/5/08**	**Wed 6/11/08**
5	**Computer Model Integration**	**3.75 days**	**Thu 6/5/08**	**Wed 6/11/08**
6	Existing Solution	30 hrs	Thu 6/5/08	Wed 6/11/08
7	Mirror Solution	30 hrs	Thu 6/5/08	Wed 6/11/08
8	TFT / LCD / LED	30 hrs	Thu 6/5/08	Wed 6/11/08
9	Windows Tabletop	30 hrs	Thu 6/5/08	Wed 6/11/08
10	**Model Improvements**	**3.75 days**	**Thu 6/5/08**	**Wed 6/11/08**
11	Existing Solution	30 hrs	Thu 6/5/08	Wed 6/11/08
12	Mold Injection in Reverse Negatives	30 hrs	Thu 6/5/08	Wed 6/11/08
13	**Identifying Possible Solutions**	**5 days**	**Wed 6/11/08**	**Wed 6/18/08**
14	Projection	40 hrs	Wed 6/11/08	Wed 6/18/08
15	Milling	40 hrs	Wed 6/11/08	Wed 6/18/08
16	Molding	40 hrs	Wed 6/11/08	Wed 6/18/08
17	**Testing**	**13 days**	**Wed 6/18/08**	**Tue 7/8/08**
18	Location	80 hrs	Wed 6/18/08	Wed 7/2/08
19	**Device or Documents**	**7 days**	**Wed 6/18/08**	**Fri 6/27/08**
20	Purchasing Components	56 hrs	Wed 6/18/08	Fri 6/27/08
21	Constructing Molds / Models	24 hrs	Wed 6/18/08	Mon 6/23/08
22	Analyzing and Selecting	104 hrs	Wed 6/18/08	Tue 7/8/08
23	**Designing and Modifying**	**3 days**	**Tue 7/8/08**	**Fri 7/11/08**
24	Connecting Visual to Model	24 hrs	Tue 7/8/08	Fri 7/11/08
25	Finishing the Model	16 hrs	Tue 7/8/08	Thu 7/10/08
26	**Preparing for IPRO Day**	**10 days**	**Fri 7/11/08**	**Fri 7/25/08**
27	Prototype	80 hrs	Fri 7/11/08	Fri 7/25/08
28	**IPRO Deliverables**	**30 days**	**Thu 6/12/08**	**Thu 7/24/08**
29	Project Plan	32 hrs	Thu 6/12/08	Tue 6/17/08
30	Midterm Report	48 hrs	Thu 6/19/08	Thu 6/26/08
31	IPRO Day Preparation	8 hrs	Thu 7/17/08	Thu 7/17/08
32	Poster	56 hrs	Mon 7/14/08	Tue 7/22/08
33	Brochure	56 hrs	Mon 7/14/08	Tue 7/22/08
34	Presentation	56 hrs	Wed 7/16/08	Thu 7/24/08
35	Final Report	56 hrs	Wed 7/16/08	Thu 7/24/08

Task		Milestone	◆	External Tasks	
Split		Summary		External Milestone	◆
Progress		Project Summary		Deadline	⇩

Project: IPRO 317 - Project Plan.mpp
Date: Tue 6/17/08

Task	Milestone
Split	Summary
Progress	Project Summary
External Tasks	
External Milestone	
Deadline	

Jun 22, '08   Jun 29, '08   Jul 6, '08   Jul 13, '08   Jul 20, '08

Submitted Budget

Using IIT facilities to fabricate objects.
$300 - Dental acrylic, tape, and other materials needed to finish the Spring 2008 models
$1000 - LED Controller for the models
$50 - LEDs, wires, and other electronic components
$50 - Biconcave lens for testing with shipping for the existing projector.
$40 - Acrylic mirror for the existing projector with shipping.
$2000 - Molding materials for experimentation with a reverse negative method that may expedite the molding process.
$3000 - Contingency for molding materials due to limitations in availability of expertise.
$700 - Metal framework to hold the model up.
$4000 - Two teaching assistants for the summer semester.
Meal for a planned trip to visit the Chicago Fire Department in order to put into detail the crisis scenarios and for sponsor feedback.
N/A

Category	Requested	Approved	Actual/Forecast	Explanation	Status
Supplies	$ 0	$ 0	$ 0	Using IIT facilities to fabricate objects.	Pending
Equipment	$ 7140	$ 0	$ 0	$300 - Dental acrylic, tape, and other materials n...	Pending
Services	$ 4000	$ 0	$ 0	$4000 - Two teaching assistants for the summer sem...	Pending
Travel	$ 50	$ 0	$ 0	Meal for a planned trip to visit the Chicago Fire ...	Pending
Participant Support	$ 0	$ 0	$ 0	N/A	Pending
TOTAL	$ 11190	$ 0	$ 0		