IPRO 317 Midterm Report

Summer 2008

Design & Build Chicago Scale Model for Dynamic Disaster Simulation

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Sponsor: Chicago Fire Department

Team: Graham Balkany
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1. Revised Objectives

   (A, B, & C are the initial objectives noted in the Project Plan)

   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 the cast method
      b. Determine the degree of possible details
      c. Determine the rapidity of this manufacturing process
   C. Integrate a computer interface into the acrylic model
      a. Obtain a high resolution graphic 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
   D. Initial Experimentation
      a. Data displays including LED illumination and projection surfaces
      b. Implementation and design process (after the arrival of materials)

2. Accomplished Work

   A. Continuing the development of a dynamic, scalable model of the city of Chicago, the main challenge that we must face is the linking of our model, which is currently in production, and a computer interface, which will add many more uses of the model, such as dynamic simulation, disaster planning, and interactive methods of training.

      Research has been done regarding methods of displaying information on a large scale. Several of these technologies were initially considered. In our research, and continuing from the previous work done on this project, we feel that the display of information should be implemented on the underside of the model, which, being constructed out of transparent acrylic, would allow for a more professional overall appearance.

      Organic Light Emitting Diodes (OLED) were considered for the display of information on the model buildings. These diodes are available in single or multicolor and do not require backlighting. They also consume approximately one half the power needed to illuminate a traditional light emitting diode (LED). Their flexible nature also proved to be useful when applying them to unique shapes or curves on the underside of the model.

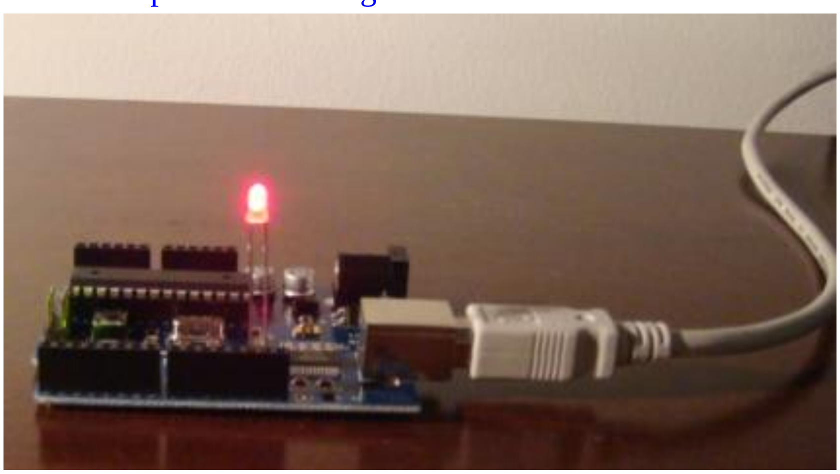
The downside to this technology lays solely on the cost. The price point of implementing these OLEDs on a large scale is in the range of several hundreds of thousands of dollars. Aside from the cost, the usage of OLEDs would require far too much research and design to cover an area of 120 sq. ft.

Our team also considered modular liquid crystal displays (LCD) to be attached to the underside of the model. While this solution generated the level of detail we had expected, the scale of its implementation caused the cost of materials to exceed our budget.

Due to the large scale of this model, the most efficient and cost effective method of displaying data on the model itself is to use a computer projection on the underside of the model. This will be able to show information is far greater detail that a standard LED, and is also more cost-effective than assembling an array of LCD panels on the underside of the model.

Traditional LEDs (Light Emitting Diode) are currently being considered for the illumination of individual city blocks. We have found that using standard LEDs would be the most cost-effective, while still contributing to the overall dynamic nature of the model.

This is the picture of testing on the traditional LEDs and the controller (Arduino).



The goal of the Molding team is to help finish last semester's project. This means processing intricate buildings from acrylic using the casting technique. This would save hours upon hours of work by the Milling Team.

The first problem we encountered was that we were unsure which machine could be properly utilized for this project. The CNC machine from the MMAE department and the CNC machine in the Architecture College were reviewed. The MMAE machine is only limited to the use of a wax block and the size limitations of the machine are 6X12X4 inches. The Architecture CNC machine is only limited to a number of materials such as wood, wax, foam, etc. The dimensions are far greater than the one used in the MMAE department. The Architecture department has a much larger CNC bed which can hold a sheet of material up to 4'x8'. The MMAE department is for smaller sized materials. Therefore, due to the size and stature of some of the models, the CNC machine in the Architecture department is the best option because the building designs are intricate and detailed, it is more appropriate to cast the mold using the bigger CNC machine. We interviewed the foreman in charge of the CNC machine and gathered information on the requirements needed to properly work the machine. We chose to use MDF (medium density fiberboard) wood board as the base and clear casting resin as the polymer used to cast the small scaled building models. After doing numerous hours of research, calling companies and referring to materials professors in the MMAE department, we considered the clear casting resin to be the best option for this project.

We have purchased a sample of clear casting resin to use as a beta test to begin our casting process. Another machine that we took into consideration was the SLS machine which would have provided the intricacy and detail we would like in our buildings but due to the limitations of the material powder needed and the project scope of the models, the SLS machine was rejected. The SLS machine is currently calibrated to take in plastic resin or metal powder, and nothing else.

B. Our team feels that a combination of both LED for the buildings and projection technologies for the streets is the correct solution. Our team is currently investigating the possibilities regarding a computer-controlled interface, which will be able to dynamically manipulate both projector and LED methods seamlessly.

To date, we have completed the research into possible candidates regarding a display solution and are now beginning on the experimentation phase of the project. Following our original work breakout structure, as stated in the Project Plan, we are on pace with our original time estimations.

C. Using both projection and LED displays, we are able to display detailed amounts of data dynamically on a scale model, which aligns with the requests of the Chicago Fire Department. A working demonstration of these methods is projected to be complete by the end of this summer 2008 term.

D. From our research we are on a clear path to what our sponsor/customer is looking for. We are attempting to complete a portion of a large scale model of the city of Chicago that will incorporate several technologies that are easy to manage by an average educated person.

E. With the research we have done, we will run tests of the proposed solutions to see if we can have better results than those obtained in the previous semester.

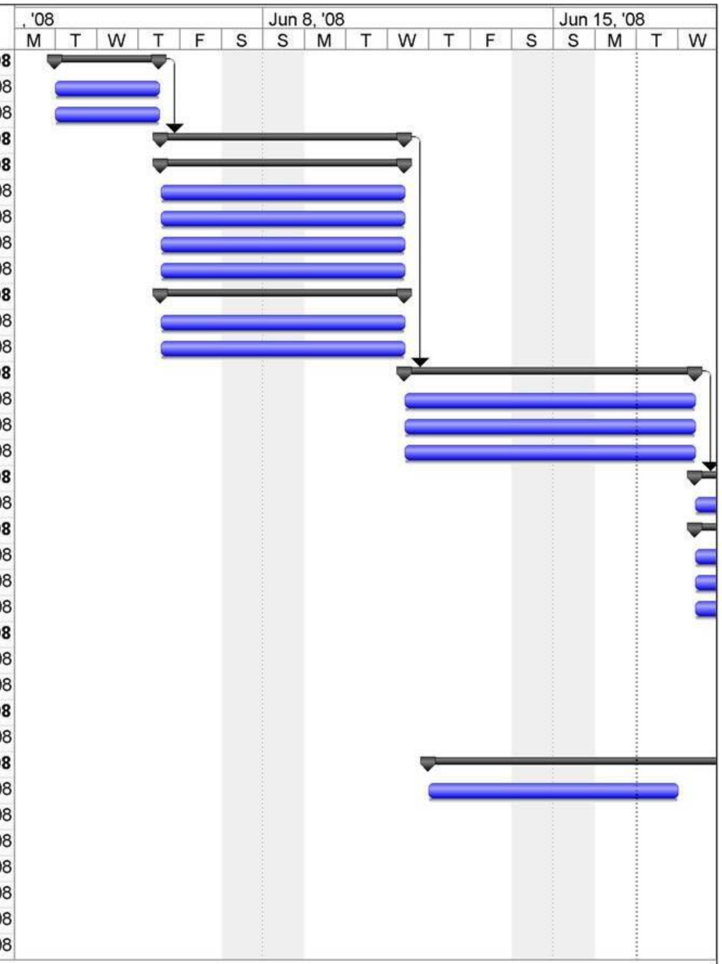
3. Revised Task/Event Schedules

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

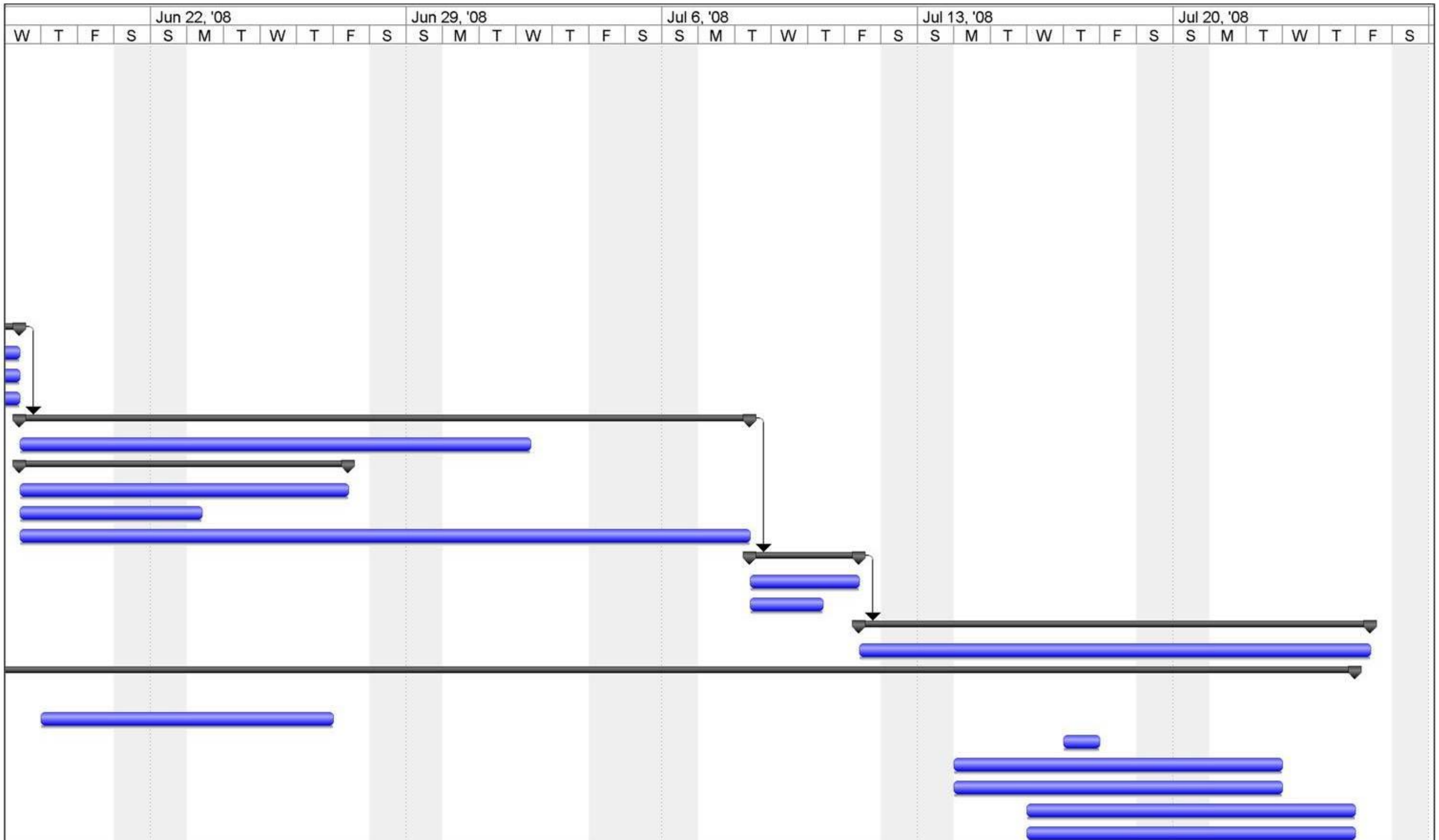
Constructing Molds / Models	24 hrs
Analyzing and Selecting	104 hrs
Designing and Modifying	**3 days**
Connecting Visual to Model	24 hrs
Finishing the Model	16 hrs
Preparing for IPRO Day	**10 days**
Prototype	80 hrs
IPRO Deliverables	**30 days**
Project Plan	32 hrs
Midterm Report	48 hrs
IPRO Day Preparation	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	**Identifiying 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



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

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		External Tasks	
	Split		Summary		External Milestone	
	Progress		Project Summary		Deadline	

4. Changes in Task Assignments and Designation of Roles and Team Organization

A. Team Structure

a. Milling sub team – Leader Chance Lebron
Team Responsibilities:
Oscar: Coordinate Milling Schedule/Sanding/ Completion of the previous Spring 2008 models
Ruben: Completion of the previous Spring 2008 models/Milling/Sanding
Diyanna: Milling/Sanding
Yvonne: Research in proper bonding methods to ensure clarity, strength, and speed of models/ Technology Report/Editing Mid-term Report/Sanding
Chance: Setup of the model/Organize milling rotation/ Milling /Sanding/Test Bonding Acrylic/Purchase Material/Task Organizer
Bogdan: Milling/Sanding

b. Molding 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 – 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.

B. Project Monitoring Roles
Meeting Minutes – Erick
Timesheets – Erick
Weekly Task List – Erick
iGroups Management – Erick

5. Barriers and Obstacles

    A. Obtaining the clear casting resin in mass quantities for the modeling sub team

    B. Our biggest barrier has been finding a workspace on the IIT campus so that we are able to freely experiment with components of the model so that results can be observed and improvements can be implemented. Currently, we are still awaiting approval in order to gain access to a space in which we are able to set-up the model and experiment. Professor Megri is currently in contact with several administrators and department heads on the IIT campus in search of a location where we may continue to expand our work. Thanks to Tom Jacobuis and Brenda Stewart for working hard to allow us to use an empty room in the basement of 3424.

    C. An obstacle that we have identified is the computer interface communication. We have a few options on how to communicate with the LED arrays under the model using computer software. We plan on experimenting with all options upon receipt of purchased components and materials.

6. Midterm Presentation Slides

   < attatched >